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Extent of bottom contact by commercial trawling and dredging in New Zealand waters, 1989–90 to 2018–19

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The spatial analysis of bottom-contacting trawl effort by commercial trawlers within the New Zealand Territorial Sea and 200 n. mile Exclusive Economic Zone (TS+EEZ), in waters open to trawling down to 1600 m depths, is presented in this report, for different time periods, based on available data.

The All Stocks (deepwater and inshore fishstocks) analysis was completed for 1989–90 (1990) to 2018–19 (2019) fishing years, but the most comparable time period covers fishing years 2008–2019. During this latter period, the All Stocks footprint contacted between about 81 000 and 95 500 km^2 each year, decreasing over the 12 years, with the lowest value estimated for 2019. These data reflect the decreasing amount of bottom-contacting trawl effort during these years; the numbers of tows in the Trawl Catch Effort Processing Return, Trawl Catch Effort Return, and Electronic Reporting System (ERS) data steadily dropped from 89 236 in 2010 to 66 039 in 2019. The annual aggregate areas for the All Stocks analysis decreased overall from a peak of 164 795 km^2 in 2010 to the nadir of 143 500 km^2 in 2019. Over these years, the intensity of trawling within cells was reasonably steady despite the decrease in aggregate area, implying that the contact was more concentrated. The All Stocks footprint contacted about 2% of the EEZ+TS seafloor annually for 2008–2019 and about 6% of the fishable area each year

In the 30-year time series for deepwater data, there was a steady increase in the footprint from under 50 000 km^2 in 1990 to a sustained period of contact during 1998 to 2003 (range 72 612 to 81 005 km^2), followed by a steady decrease to 43 481 km^2 in 2019, the lowest of the full 30-year time series, with declines seen for most deepwater targets and the swept area data reflecting the drop in effort. The annual aggregate areas have decreased from 150 730–171 901 km^2 during 1997–2003 to under 100 000 km^2 after 2005, with a nadir in 2009 (79 650 km^2), another peak at 97 045 km^2 in 2018, and a drop to 86 777 km^2 in 2019. The deepwater analysis estimated a 30-year total of 3 475 450 km^2 aggregate area and 351 683 km^2 footprint, with this overall deepwater footprint representing 8.6% of the EEZ+TS and 25.3% of the fishable area. Between 1990 and 2007, the annual footprint contacted between 1.2% and 2.0% of the EEZ+TS and 3.4% and 5.8% of the fishable area (peaks in 2002 and 2003); whereas, between 2008 and 2019, the annual footprint contacted 1.1–1.2% and 3.2–3.7% of the fishable area (lowest values in 2019).

The 2008–2019 inshore footprint also decreased, from a peak of about 47 220 km^2 in 2010 to a nadir of 38 131 km^2 in 2019. This contact was equivalent to 0.9–1.1% of the EEZ+TS seafloor area, and 2.7–3.4% of the fishable area, with the lowest values from 2019. The aggregate areas during these years ranged between the low in 2019 (56 611 km^2) and the peak in 2014 (71 053 km^2). As noted above, the decrease in swept areas seen for each group of fishstocks reflects the drop in bottom-contacting effort.

The use of ERS data in 2018 and 2019 has allowed for more precision in locating the start and end positions of tows and thus had an effect in the standard reporting measures: number of contacted cells, aggregate area, and footprint. The magnitude of the effect depended on the target fishery. The greatest effect of the ERS data is in the inshore fishstocks because the ERS data provide both start and finish positions and therefore provide more certainty in the direction of a tow and more comparability with the deepwater data.

These results are further discussed to indicate the intensity of contact, the frequency of contact (comparing annual data), and any areas contacted in one years but not in previous years. Overlap of the footprints with depth zones, the Benthic-optimised Marine Environment Classification, surficial sediment layers, and probability of occurrence of some target species is presented by the broad fishery groups. Data inclusion and the effect of the methodology used is also discussed. The data behind these summaries are stored in a Ministry for Primary Industries Geographic Information System geodatabase at the level of each tow, with the potential to analyse data at regional or smaller scales by target or groups of targets, as well as at a 25-km^2 cell grid level for the broad analysis of the EEZ+TS given here.

Lastly, shellfish dredge data are presented as summaries of the effort by year and specific target fishery, and, for the oyster fishery in Foveaux Strait, swept area per 1-nautical mile grid provides a finer resolution of this fishery based on 2019 ERS data.

1. INTRODUCTION

Understanding the nature and extent of bottom-contacting fishing activity within New Zealand waters is a research area that contributes to Fisheries New Zealand fisheries management objectives: For offshore fisheries —'Manage deepwater and middle-depth fisheries to avoid, remedy or mitigate the impacts of deepwater fisheries on the benthic habitat' (Fisheries New Zealand 2019a) and inshore finfish fisheries — 'Minimise adverse effects of fishing on the aquatic environment, including on biological diversity' (Ministry of Fisheries 2011). The primary bottom-contacting mobile fishing methods are trawling for finfish, squid, and scampi, as well as dredging for shellfish (oysters and scallops).

Bottom-contacting trawling has been conducted mainly in continental shelf waters in depths defined by the distribution of target species, generally in waters shallower than 1600 m (Baird et al. 2011). The primary trawl gear, defined here as including bottom trawl and midwater trawl used within a metre of the seafloor, target inshore and deepwater fishstocks within the 200 n. mile New Zealand Exclusive Economic Zone and the Territorial Sea (EEZ+TS). Skippers of trawl vessels operating these gears have reported this commercial fishing activity on Trawl Catch Effort Processing Return (TCEPR) forms if the vessel is over 28 m in overall length or if the vessel is required by the Director-General of Fisheries to furnish a TCEPR (as required by the Fisheries (Reporting) Regulations 1990). Introduced in October 1989, the TCEPR was primarily used to report data from vessels in the deepwater fleet these vessels mainly operate in waters deeper than 200 m. From October 2017, the Electronic Reporting System (ERS) was introduced for data collection from these vessels, to replace the TCEPR.

Daily trawl effort by vessels operating in inshore waters around New Zealand was primarily reported on Catch Effort Landing Return (CELR) forms from October 1989, although skippers of some small inshore trawl vessels also reported effort on TCEPRs (see Baird et al. 2011). The CELR form for trawl data was replaced in October 2007 by a more comprehensive form, the Trawl Catch Effort Return (TCER). From January 2019, the use of ERS for data collection was gradually implemented throughout other commercial fishing fleets, including the inshore trawl and dredge vessels.

The TCER, TCEPR, and ERS data provide tow-by-tow information that can be used to generate annual trawl footprints that represent the area of the seafloor contacted by trawl gear. Previously, trawl footprints have been determined using, where available, TCEPR and TCER data extracted from the Ministry for Primary Industries (MPI) database *warehou* (see for example, Baird et al. 2011, Black et al. 2013, Baird et al. 2015, and Baird & Wood 2018), generally for fishing years since 1989–90. In 2018, the trawl footprint analysis for deepwater vessels was re-run and updated, using the MPI CatchMapper software tool (Osbourne 2018) and data extracted from the Enterprise Data Warehouse (EDW) – a database that includes the *warehou* form-based data and the ERS data (Baird & Mules 2019).

The overall research objective for the BEN201901 project reported in this document is:
to monitor the extent and intensity of bottom contact by trawl and dredge fishing for all inshore and deepwater target species in the Territorial Sea and Exclusive Economic Zone.

The specific objectives addressed by this report are:

1. To help MPI groom data, develop and compile summary statistics for all deepwater and inshore trawl and dredge fishing by year, depth zone, sediment categories, fishable area, and any other agreed habitat classifications or proxies, and to identify any trends or changes to meet management needs.
2. To assess the effects of footprint estimation methods used in previous footprint assessments where less precise location data were available.
3. To summarise all trends and statistics in an Aquatic Environment and Biodiversity Report.

1.1 Specific Objectives

Objective 1

Trawl swept area

Objective 1 requires analyses of the bottom-contacting trawling for deepwater Tier 1 and Tier 2 fishstocks (as defined by Fisheries New Zealand 2019) and for inshore trawl fisheries with specific analyses of inshore fishstock groups defined by Fishery Management Area (FMA). Trawl footprint summaries are presented relative to the 'fishable' area – waters open to trawling down to 1600 m and to defined 200-m depth zones within the fishable area; the 15-class Benthic-optimised Marine Environment Classification (BOMEC) generated by Leathwick et al. (2012); predicted distribution of likely occurrence for the deepwater Tier 1 target species (Leathwick et al. 2006); and interpolated distribution of surficial sediments for the continental shelf, slope, and deep ocean (Bostock et al. 2019a, 2019b). Additional summaries are provided for some deepwater Tier 1 fishstock groups relative to areas used in analyses of the distribution of finfish bycatch (Anderson & Edwards 2018) or to specific orange roughy fishery areas relevant to Marine Stewardship Certification assessment.

The footprint analyses are presented by fishing year (1 October to 30 September) for the 1989–90 (1990) to 2018–19 (2019) fishing years for bottom-contacting effort based on deepwater and combined deepwater and inshore (total) effort and for 2007–08 (2008) to 2018–19 (2019) for inshore effort. These years cover the time period for which detailed tow-by-tow data have been available since the introduction of the TCEPR in the 1990 fishing year, primarily for the deepwater fleets.

Dredge swept area

The spatial coverage for dredge effort has previously been summarised in earlier projects by the number of tows in a year in each fishery-specific area, as reported by oyster and scallop fishers, because of the lack of fine-scale location data. With the gradual implementation of ERS data collection for these fisheries during 2019, the available dredge ERS data are investigated and a preliminary spatial swept area coverage is presented where data are available. Note: the data, methods, and results for dredge effort are presented in Appendix G, separate from the trawl footprint analyses.

Objective 2

Trawl swept area

The ERS data collection provides a finer-scale set of position data compared with the previous form-based paper logbooks, as input to the swept area estimation. A comparison of methods used to generate trawl footprints from the different data collection methods is presented as a preliminary assessment of the effect on the extent of seafloor area contacted by trawl gear.

Objective 3

This report describes the data sources and treatment, assumptions, methods, and results of the above analyses, with additional summaries and information given in appendices. Annual summary documents from the May and November fishery plenaries provide historical and current background information on the fishstocks analysed in this report (Fisheries New Zealand 2019b, 2020).

2. METHODS

2.1 Trawl fishery analyses

The methods below describe the data exploration and grooming and the preparation for the trawl footprint spatial analysis. The methods used for the dredge spatial analyses are described in section 2.2. These methods build on those developed and described by Baird et al. (2011), Black et al. (2013), and Baird & Wood (2018) for TCEPR data; Baird et al. (2015) and Baird & Wood (2018) for TCER data; and Baird & Mules (2019, in review) using the MPI spatial software CatchMapper.

2.1.1 Fishery data sources

The MPI Spatial Intelligence team accessed all TCEPR, TCER, and ERS trawl and dredge effort data from the Enterprise Data Warehouse for 1990–2019 fishing years. The data extract (replog 12010) included fishing event data and associated vessel data for trawl and shellfish fisheries. The TCEPR data provided information about each fishing operation, with tow-by-tow records of latitude and longitude and date-time for the start and end of each tow, target species, tow duration, tow speed, and gear parameters, amongst others. The TCERs provided similar tow-by-tow data, but with start of the tow position information only which necessitates the generation of an endpoint (see Baird et al. 2015). The ERS collects data similar to the TCEPR; however, the position data are at a finer resolution: TCER and TCEPR data are generally recorded in degrees to one or two decimal places, whereas ERS data are recorded to four decimal places.

2.1.2 Fishery data grooming and treatment

Grooming routines followed those used in previous analyses (see references in section 2.1) and summary data are given in Appendix A. Broad queries on all bottom and midwater trawl data were run using R statistical package (R Core Development Team 2017) to isolate duplicates or missing data. Particular attention in the grooming was given to variables required to characterise the effort: location/area fished, date and time, gear type, target species, number of tows, fishing duration, towing speed, vessel characteristics, effort width (wingspread), and depth.

The deepwater component included the Tier 1 and Tier 2 deepwater fishstocks (Ministry for Primary Industries 2017) listed in Table 1. The main inshore fishstocks were grouped by Fishery Management Areas (FMAs) following discussions with Fisheries New Zealand (Table 2).

Table 1: Tier 1 and Tier 2 deepwater fishstocks with bottom-contacting trawl effort reported during fishing years 1990–2019 (see Fisheries New Zealand 2020 for fishstock boundaries). The only fishstocks with no reported effort in these years (and not in the table) are for pale ghost shark (*Hydrolagus bemisi*).

Code: fishstock	Common name	Scientific name
Tier 1		
HAK: all	Hake	*Merluccius australis*
HOK: all	Hoki	*Macruronus novaezelandiae*
JMA: JMA 3, 7	Jack mackerels	*Trachurus declivis*, *T. murphyi*, *T. novaezealandiae*
LIN: LIN 3, 4, 5, 6, 7	Ling	*Genypterus blacodes*
OEO: all	Oreo species	*Allocyttus niger*, *Neocyttus rhomboidalis, Pseudocyttus*
ORH: all	Orange roughy	*Hoplostethus atlanticus*
SBW: all	Southern blue whiting	*Micromesistius australis*
SCI: all	Scampi	*Metanephrops challengeri*
SQU: all	Arrow squid	*Nototodarus sloanii*, *N. gouldi*
Tier 2		
BAR: BAR 4, 5, 7	Barracouta	*Thyrsites atun*
BYX: all	Alfonsino	*Beryx splendens*, *B. decadactylus*
CDL: all	Black cardinal fish	*Epigonus telescopus*
EMA: EMA 3, 7	English mackerel	*Scomber australasicus*
FRO: FRO 3, 4, 5, 6, 7, 8, 9	Frostfish	*Lepidopus caudatus*
GSH: GSH 4, 5, 6	Dark ghost shark	*Hydrolagus novaezelandiae*
LDO: all	Lookdown dory	*Cyttus traversi*
PRK: all	Prawn killer	*Ibacus alticrenatus*
PTO: all	Patagonian toothfish	*Dissostichus eleginoides*
RBT: all	Redbait	*Emmelichthys nitidus*
RBY: all	Rubyfish	*Plagiogeneion rubiginosum*
RIB: RIB 3, 4, 5, 6, 7, 8	Ribaldo	*Mora moro*
SKI: SKI 3, 7	Gemfish	*Rexea solandri*
SPD: SPD 4, 5	Spiny dogfish	*Squalus acanthias*
SPE: SPE 3, 4, 5, 6, 7	Sea perch	*Helicolenus percoides*
SWA: all	Silver warehou	*Seriolella punctata*
WWA: all	White warehou	*Seriolella caerulea*

Table 2: Inshore fishstocks for which there was trawl effort during fishing years 2008–19 (see Fisheries New Zealand 2020 for fishstock boundaries).

Code: fishstock	Common name	Scientific name
BAR 1	Barracouta	*Thyrsites atun*
ELE 3, 5, 7	Elephant fish	*Callorhinus millii*
FLA 1,2,3,7	Flatfish	*Rhombosolea retiaria, R. plebeia, R. tapirina, Pelotretis flavilatus*
GSH 1, 2, 3, 7, 8, 9	Dark ghost shark	*Hydrolagus novaezealandiae*
GUR 1, 2, 3, 7, 8	Red gurnard	*Chelidonichthys kumu*
JDO 1, 2, 3, 7	John dory	*Zeus faber*
KAH 1, 2, 3, 8	Kahawai	*Arripis trutta*
LEA 1, 2, 3	Leatherjacket	*Parika scaber*
LIN 1, 2, 8, 9	Ling	*Genypterus blacodes*
MOK 1, 3	Moki	*Latridopsis ciliaris*
RCO 2, 3, 7	Red cod	*Pseudophycis bachus*
RSK 7,3	Rough skate	*Zearaja nasuta*
SCH 1, 2, 3, 5, 7, 8	School shark	*Galeorhinus galeus*
SKI 1, 2	Gemfish	*Rexea solandri*
SNA 1, 2, 3, 7,8	Snapper	*Pagrus auratus*
SPD 1, 3, 7	Spiny dogfish	*Squalus acanthias*
SPO 2, 7, 8	Rig	*Mustelus lenticulatus*
SSK 3	Smooth skate	*Dipturus innominatus*
STA 2, 3, 4, 5	Giant stargazer	*Kathetostoma giganteum*
TAR 1, 2, 3, 4, 5, 7,	Tarakihi	*Nemadactylus macropterus*
TRE 1, 2, 3, 7	Trevally	*Pseudocaranx dentex*
WAR 1, 2, 3, 7, 8	Blue warehou	*Seriolella brama*

Fisheries New Zealand provided a list of potential fishstocks to be included in a Fishery Management Area-based collation of inshore fishstocks, based mainly on those fishstocks given in Table 2. The data indicated that some of these have few data (kahawai and smooth skate) and there are some that have data in recent years (ling and dark ghost shark) that have been added to the original list.

2.1.3 GIS layers for estimating the overlap of the bottom-contacting trawl footprint

Spatial data layers were used to determine the extent of coverage of the trawl footprint on 200-m depth zones, the potential 'fishable' area, and modelled environmental classification layers, as required in the project specifications. These are described below. Note that all the spatial overlap and area calculations were made from data in the following projection: Albers Equal Area Projection (central meridian at 175° E, standard parallels at 30° S and 50° S, and the latitude of origin at 40° S). Appendix B provides maps of the spatial distributions of these layers at the resolution they were generated in, and the extent of the seafloor area of each layer (and divisions therein) within their full boundary within the EEZ+TS.

All the spatial layers described below were overlaid on a 5 km x 5 km analysis grid and a data value for each layer was assigned to the midpoint of each cell.

Depth zone

Two depth zone layers were used: one created from the 2016 NIWA 250-m cell bathymetry data (Mitchell et al. 2012) to yield 200-m depth zones out to a depth of 1600 m, the depth that is close to the depth limit of current trawling effort; and a second based on an unpublished but validated 100-m cell bathymetry dataset produced by NIWA (Kevin Mackay, NIWA, pers. comm.) for use in coastal areas to yield a 50-m depth zone GIS layer to describe the fishing depths of effort for inshore fishstocks (to 250 m). The seafloor area (km^2) of each zone was then calculated using tools in ArcGIS. The distribution of these zones is shown in Figure B1 in Appendix B. The depth zones are restricted to waters open to trawling, and thus the area of 0–1600 m depths has the same seafloor area (km^2) as the 'fishable' area.

'Fishable' area

The 'fishable' area is used to display the trawl swept area values and represents waters in 0–1600 m depths that are open to trawling: that is, waters exclusive of Benthic Protection Areas (BPAs) that were introduced in 2007, closed areas to protect underwater features including seamounts (the first of which were closed in

2001), and marine reserves, for example, around the Auckland Islands group (Appendix B). The area covered by the 'fishable' area was calculated as 1 391 680 km^2 using the equal area projection described above. The percent overlap of the footprint and the layers discussed in this section are based on the fishable area; the seafloor areas covered by the full extents of these layers (which vary by layer) are given in Table B1 of Appendix B.

Benthic-optimised marine environment classification (BOMEC)

This layer was created by Leathwick et al. (2012) and contains 15 classes that represent different environments generated from modelling the relationships between the distributions of relevant environmental variables to discriminate the distributions for eight taxonomic groups of benthic fish and invertebrates. The classification broadly describes three inshore classes (A, B, D), three shelf classes (C, E, F), and nine classes in deeper waters down to 3000 m (G–O) (see Figure B1 in Appendix B). Thus, it extends beyond the depths where fishing normally occurs. The area (km^2) of each class was calculated, as above, for the full extent of the predicted layer and the fishable area.

Probability of capture/annual distribution for the Tier 1 target species

For the seven fish target species in the deepwater Tier 1 group of fishstocks, Leathwick et al. (2006) predicted the distribution of the probability of capture during a standardised trawl in waters out to 1950 m within the outer EEZ boundary, based on presence/absence data and relevant modelled environmental variables (Figures B2a–B2b of Appendix B). For scampi and arrow squid, the annual distributions of the populations as mapped by MPI (www.nabis.govt.nz) are used as a proxy for the species distribution (see Figure B2c). The arrow squid and scampi areas match the extent of the EEZ and the Territorial Sea; the areas of unknown presence, hotspot, 90% and 100% annual distribution for arrow squid and scampi were calculated, as above.

Surficial sediment distribution

Sediment analyses and observations from a comprehensive range of sources were collated into a database nzSEABED to characterise and map the surficial sediments of the New Zealand continental shelf, slope, and deep ocean by Bostock et al. (2019a, 2019b). The data were interpolated using kriging in GIS to yield percent mud, sand, and gravel (to total 100%) and carbonate content (% carbonate versus non-carbonate) to provide information about biological content. The distributions of these substrates are shown in Figure B3 in Appendix B).

2.2 Generation of trawl fishery spatial output

The trawl data all have position and operational data that allow spatial analysis and presentation. However, each data type requires different treatment to generate swept area estimates. TCEPR data include both start and end positions (generally to the nearest 1 minute of arc, or about 1.852 km), as do ERS data (to a finer resolution). TCER data have tow start positions only, at the same resolution as TCEPR data. Thus, the groomed data are treated separately before being combined to develop the swept area statistics. The methods described below follow those used and fully described by Baird et al. (2011) and Black et al. (2013) for TCEPR data and Baird et al. (2015) and Baird & Mules (2021) for TCER data.

Where latitude and longitude data were truncated to the nearest minute of arc, and thus many tows appearing to start at the same location because of the lower resolution of the data, the start and finish positions were randomly jittered using an offset of ± 0.5 minute, to better represent the likely start and finish positions. The jittered values were stored as new fields in the dataset. Note that the reported position data represent where the vessel was at the time the net was deemed to have reached (and left) fishing depth rather than the location of the net. However, the use of random jittering does limit the artificial patchiness of effort created by the resolution of the data.

A second set of 2018 and 2019 ERS swept area data was generated by decreasing the resolution of the position data to the same level as that generally seen in TCER and TCEPR data (to the nearest minute of arc), to provide a 'rounded' comparison dataset of the ERS data required for Objective 2 (section 6).

2.2.1 Preparation for estimating swept area from TCER forms

The TCER data lack information that describes the finish location. Although a measure of swept area can be calculated, based on the duration of the tow and tow speed, the swept area cannot be spatially represented, other than as a circle centred on the start position. To create a trawl track, the methods described by Baird et al. (2015) was used, whereby, within a trip, a tow direction was generated from the bearing between the start position of a tow and the start of the following tow. A distance measure (in kilometres) was estimated from tow speed and tow duration data and used with the estimated bearing to generate finish co-ordinates.

TCER data are characterised by a relatively small number of tows per trip (Baird et al. 2015) and thus, a substantial number of tows had no following tow (in a given trip). Thus, the last tows and only tows of a trip are identified, and for each of these tows, a bearing was estimated based on the median estimated bearing values from other tows by the same vessel for the same target species within 1/30th of a degree north/south or east/west, using a minimum number of 2 tows. This was used to generate finish co-ordinates (as above). Where this failed, tow end co-ordinates were generated by using the median estimated bearing values from tows of the same target species within 1/30th of a degree north/south or east/west, using a minimum number of 2 tows.

2.2.2 Spatial allocation of tows

Several new variables were generated on a tow-by-tow basis to provide spatial representation of each tow:

Doorspread. The distance between the two trawl doors provides a measure of the width of the trawl path used to estimate the potential area of the seafloor contacted by the trawl gear, that is, the swept area. This measure is not reported on commercial data forms, so previous footprint studies have applied doorspread values (with agreement from the MPI Aquatic Environment Working group) to each tow, based on vessel size, target species, and known gear parameters, including the number of nets used to reflect differences in the spread of gear depending on vessel size (see for example, Baird & Wood 2018). The estimated doorspread values used in this study were assigned according to vessel size (overall length), target, and the number of nets used (based on the "number of nets" data which were first collected on the TCER and TCEPR forms in the 2008 fishing year). Data from the HOK/HAK/LIN stock assessment projects (Sira Ballara, NIWA, pers. comm.) were used to identify those tows in the effort data that used twin trawls before 2008. Thus, the assigned doorspreads were:

- 70 m for vessels up to 28 m in length, with a single net
- 90 m for vessels 28–46 m, with a single net
- 50 m for scampi tows with two nets and 70 m for scampi tows using three nets
- 150 m for all targets, except HAK/HOK/LIN/SWA, for vessels 46–82 m that used one net
- 200 m for HAK/HOK/LIN/SWA, for vessels 46–82 m that used one net
- 400 m for HAK/HOK/LIN/SWA, for vessels 46–82 m that used two nets
- 200 m for all targets for vessels over 82 m.

Tow distance. A distance for each trawl track (kilometres) was calculated from the finalised start and fishing positions, assuming a straight-line tow.

Speed-time distance. A second distance value was calculated for each tow; this was based on the speed and the tow duration (the difference between the reported tow start and finish times) for use with the TCER data and for some deepwater target TCEPR tows where short tows on hills resulted in the coordinates of the start and finish location being the same.

Each tow was converted into a trackline (distance between the start and finish locations). Scampi, arrow squid, and hake tows were permitted a maximum length of 70 km and a maximum tow distance for other species was set at 55.56 km (after Black & Tilney 2017, Baird & Mules 2019). A median distance (calculated from the straight-line tow distance by target species) was applied to the start points of those tows that exceeded the prescribed maximum lengths, and new end points were generated in GIS by shortening the trackline to the median distance.

The trawl data were imported in GIS and each trackline was buffered by the assigned doorspread to produce polygons to represent the trawl path (as a straight line). In some regions, this resulted in tow tracks going across land (for example, Farewell Spit at the northwestern edge of the South Island). Each trawl polygon was clipped by the 'fishable' area layer, so that no effort remained on land or in any areas closed to fishing and

portions of some tows remained in the data (e.g., for narrow protrusions such as Farewell Spit.) A summary of the data retained, and data excluded, from the fishable analysis is provided in Appendix C.

2.2.3 Assignment of tow data to cells

To aid in the categorisation and analysis of the data, a grid of approximately 25 km^2 cells was created as a database table and joined to the TCER, TCEPR, and ERS effort table. This 5x5 km cell size has been used in previous work and is considered reasonable, by successive Aquatic Environment Working Group meetings, as the unit of analysis for trawl swept areas on a broad scale such as the EEZ+TS. This grid was generated in the Albers Conic Equal Area Projection and re-projected to latitude and longitude degrees to overlay with groomed effort data as a basis for spatial analysis to identify and quantify the amount of effort per cell over time and to generate an indicative "footprint" of trawl effort on the seafloor.

For area-based calculations, the data were re-projected to the Albers Conic Equal Area projection to minimise distortions caused by converging lines of longitude with increasing latitude using degrees as the co-ordinate units.

This study used the estimated swept area for each tow (in square kilometres), hereafter referred to as the *swept area*, as a measure of the fishing intensity.

1. *Swept area* is the area (km^2) derived from the tow distance as measured between start and finish positions and the assigned doorspread. This measure was used to summarise the effort and the total for each fishing year, referred to as the *aggregate swept area* (Figure 1).
2. *Trawl footprint* is the area (km^2) that represents the seafloor area estimated to have been contacted by trawl gear (Figure 1).

For each cell, the sum of the area of all the portions of the estimated doorspread trawl polygons that lie within that cell was calculated. Thus, a cell in any given fishing year may have an aggregate swept area of 0 km^2 (no contact) or 25 km^2 (contacted area is similar to the cell size), or perhaps 100 km^2, suggesting that for that year, the swept contacted area was 4 times the cell area; whereas the maximum trawl footprint in a cell is 25 km^2.

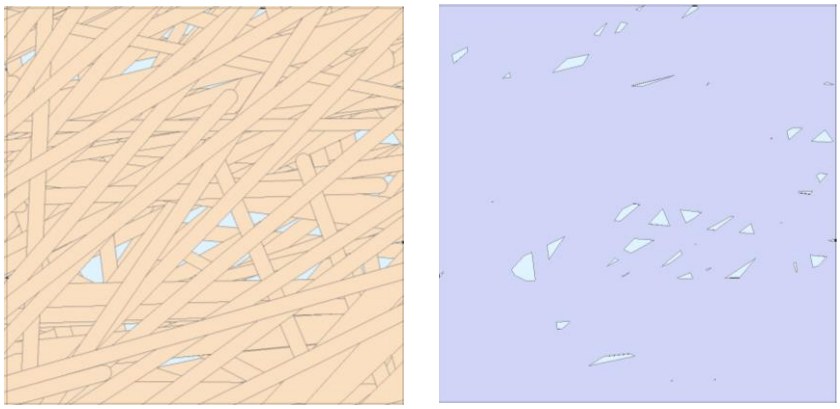


Figure 1: A 25-km2 cell showing the trawl polygons representing the aggregate area (i.e., the sum of the swept areas of the bottom-contacting trawls) shown in the left panel and the footprint that represents the seafloor area estimated to have been contacted by the trawls in the right panel.

2.3 Estimation of newly trawled area using identification of 'new' cells contacted

The extent of the trawl footprint will vary in each annual footprint project analysis because: (i) a full set of data is extracted for each project and includes the most recent fishing year of data, as well as any updates to the underlying previous years of data; (ii) the use of jittering (section 2.2) will produce slight changes in the location of each jittered position in each analysis. To identify areas that are newly contacted by the annual footprint in the most recent year, the footprint of the previous years (e.g., for the combined 1990–2018 fishing years) can be directly compared with the most recent year (e.g., 2019) in GIS. Baird & Mules (2019) showed that this method identified small slivers of footprint from the most recent year in areas of dense contact and concluded that because of the inherent uncertainty in the estimation of the swept area – from the resolution of

the start and finish data, the treatment of the trawl trackline as a straight line, and the use of generic doorspread values – much of this 'new' area may not represent expansion of the footprint extent.

An alternative method to identify areas of expansion/exploration in the most recent year is a cell-based comparison, based on the 25-km^2 cell footprint. Thus, any cells in the most recent analysis year that were not identified as contacted in the combined previous years are identified as 'new' cells (Baird & Mules 2019): that is, cells that had no previous trawl contact (within the time series of analysis) as newly trawled areas that represented an extension of bottom trawling. This method is used in this analysis.

2.4 Underlying assumptions in trawl fishery spatial analysis and representation

The effort data used here represent subsets of the total commercial trawl effort data reported during these years. First, data are for tows that used bottom trawl gear or midwater gear within 1 m of the seafloor, and second, the data are restricted to three data sources (TCER (2008–19), TCEPR (1990–2019), and ERS (2018–19).

Some underlying assumptions need to be stated.

1. Each time series has an artificial start and end. The study treats the first fishing year of data, for example, 1990 or 2008, as the start of fishing in each area, and thus any discussion of trends is relative to the fishing year at the beginning of the time series.
2. It is assumed that the paths (trackline) of all tows follow a straight line between the reported or estimated start and end positions. In reality, tows may follow contours and may include turns, but the trackline data do not allow any determination of actual tow path. The duration-speed distance measure provides some measure of a tow path distance and where this differs from the trackline distance it is assumed to be closer to the 'real' length of a tow.
3. It is assumed that the gear is in contact with the seafloor throughout the tow.
4. It is assumed that gear used by similar sized vessels fishing for the same target species has the same doorspread, and that there are no differences in the way in which skippers operate or rig their gear.
5. The resolution of most of the position data is to the nearest minute (about 1.852 km – assuming no allowance for latitudinal changes).
6. The measure of swept area will be indicative and may well be better estimated for certain target species where fishing effort is carried out by larger vessels with gear parameters that are better understood.
7. The irregular nature of the seafloor is ignored, and it is assumed that, within each cell, the seafloor is homogeneous.
8. The patchy distribution of fishing is in part due to avoidance of areas of the seafloor that are unfishable because of undersea formations or habitats such as sponge gardens that fishers may describe as "foul ground".

2.5 Comparison of the ERS data and TCEPR/TCER data, 2018 and 2019

To address Objective 2, the methods used to generate the tow polygons (as an initial step in the spatial analysis) for the TCER and TCEPR data were applied to the fine scale start and finish position data collected via electronic reporting, to provide an assessment of the difference between the resolution of the source data. For this work, the resolution of the finer-scale position data from ERS data collection was reduced to the nearest nautical mile (the resolution of most of the paper logbook data), then to apply the same rules described above to generate the spatial representation of the tows: that is, round or truncate the ERS position data (which record the vessel position when the net reaches fishing depth – as do the TCERs and TCEPRs) and then apply the jittering script and compare the results with the original ERS position data.

2.6 Shellfish dredge fishery analyses

The scallop and oyster dredge fishery data for 1990–2019 were groomed according to rules used by Baird et al. (2011), based on information from fishers and researchers at the time. The methods used and the analysis results are presented in Appendix G).

3. ALL STOCKS TRAWL FOOTPRINT, 1990–2019

3.1 Number of tows

For the combined 1990–2019 fishing years, 2 044 718 bottom-contacting tows were retained for the spatial analyses; 71% were from TCEPRs, 26% from TCERs, and 3% from ERS data collection (Table A1 in Appendix A). Deepwater fishstocks accounted for about 59% of all tows and inshore fishstocks for about 41%. These forms were introduced in different years over the time series, with the TCEPR providing the first tow-by-tow data collection for vessels over 28 m that generally fished deeper waters within the New Zealand EEZ, with the first data collection year being 1 October 1989 to 30 September 1990 (referred to here as the 1990 fishing year). It is this form that provides the backbone of the All Stocks data, and the deepwater component has been supplemented from the mid-1990s with inshore effort primarily targeting snapper, but also other inshore target species that were likely fished by the snapper vessels. Other inshore effort continued to be recorded on CELRs that collected daily data on a target-Statistical Area basis; the summary data for annual effort recorded on CELRs are given in Table A2, along with the annual TCER, TCEPR, and ERS tows. These data show that before 2008 the amount of overall trawl effort each year could be double what is recorded from the tow-level data; note that these CELR tow numbers are preliminary.

With the introduction of the TCER in October 2007 (2008 fishing year), a new set of data covering an equally sized fishery group (inshore) was available for spatial analysis alongside the TCEPR data. Lastly, the move to ERS data from TCEPR during 2018 for deepwater fishstocks and from TCER in 2019 for inshore fishstocks has provided similar data but at a finer resolution and, for inshore data, an endpoint for each tow. The change of data collection during the time series needs to be considered when interpreting these data. The most comparable time period for annual data is from 2008 to 2019.

3.2 Spatial coverage

The extent of the All Stocks seafloor contact is summarised by year in Table C1 in Appendix C. Overall, the data available for all stocks indicates that at least 41 424 25-km^2 cells were contacted over the 30 years, with a total aggregate area of 4 672 058 km^2, and a footprint of 460 627 km^2. These areas represent the estimated swept areas retained in the fishable area analyses (for the waters open to trawling down to 1600 m), where, for 1990–2019, 98.7% of the aggregate area and 93.9% of the footprint area were retained (see Appendix C, including Tables C2 & C3 and Figure C1 in Appendix C). Any further references to the aggregate and footprint in areas in this document are for the fishable area.

All Stocks footprint. Overall, the trawl footprint of 460 627 km^2 represents 11% of the EEZ+TS seafloor area, and 33.1% of the fishable area (Table C1). The annual footprint shown in Figure 2 shows a steady increase from the start of the data collection in 1990, to a peak in 2002 and 2003 at about 97 000 km^2, followed by a sharp drop to about 68 000 km^2 in 2006 and 2007. The marked rise in the annual footprint from 2008 is a result of the addition of the TCER data from all the bottom-contacting inshore trawl activity. Effectively the footprint has extended from offshore to inshore with these TCER data, and the lack of a large increase in the annual number of cells in subsequent years, despite the addition of the inshore data, indicates a decrease in the extent (as measured by cells contacted) of the offshore component. The annual footprint after 2010 (at 95 500 km^2) shows a slight decrease overall, to a low (since 2008) in 2019 (at 81 000 km^2). The spatial distribution of the All Stocks footprint for all years combined and for 2019 is shown in Figure 3.

All Stocks aggregate area. The aggregate area increased to a peak in 1998, at over 202 000 km^2, then had a relatively steady period (range of 175 235–182 542 km^2) between 1999 and 2003 (Table C1, Figure 2). From 2004 to 2007, the aggregate area declined to levels seen in the early 1990s, to a low of 112 518 km^2. The TCER data increased the aggregate area in 2008 to the level seen in 2004 and over the following years the aggregate area ranged between 150 830 and 157 466 km^2, except for peaks in 2010 (164 795 km^2) and 2018 (160 151 km^2) and lows of just over 148 000 km^2 in 2013 and 2016 and 143 503 km^2 in 2019. The spatial distribution of the All Stocks aggregate area for all years combined and for 2019 is shown in Figure 4.

All Stocks number of cells. Over the 30 years in this dataset, 41 424 cells were contacted by the All Stocks footprint (Table C1). Pre 2008, when the data mainly represented the deepwater fleet effort, the number of

cells increased to a peak of over 20 000 cells in 2002 and then dropped to 15 890 cells in 2007 (similar to the number in 1994). Subsequently, with the addition of the TCER data, 18 606 cells were contacted in 2008, then the number dropped to 16 363 in 2013, followed by a steady period at about 17 300 to 17 600 until 2019 when the number of cells dropped to just over 16 000. During those most recent 12 years, a total of 30 247 cells were contacted and 32% of those cells had contact, at some time, by both deepwater and inshore trawl effort.

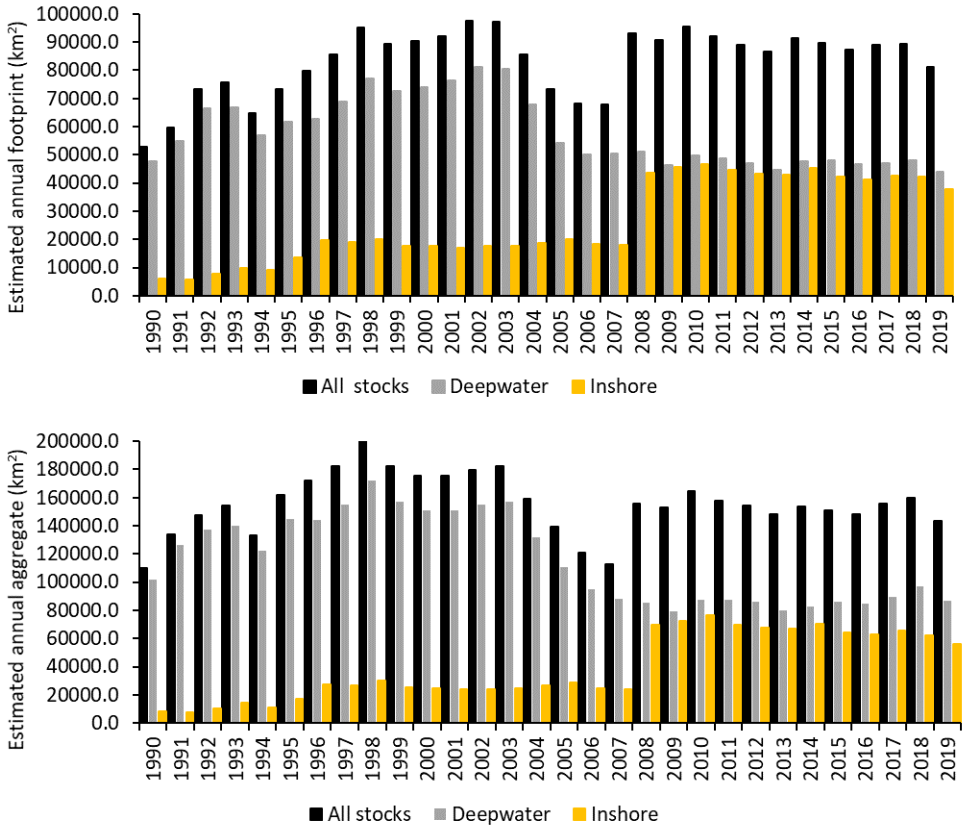


Figure 2: Annual estimated footprint and aggregate area for All Stocks, Deepwater stocks, and Inshore stocks, 1990–2019. The data represent TCEPR (1990–2019), TCER (2008–19), and ERS (2018–19) bottom-contacting effort. Note: TCER data collection was introduced in the 2008 fishing year and ERS data collection started in the 2018 fishing year.

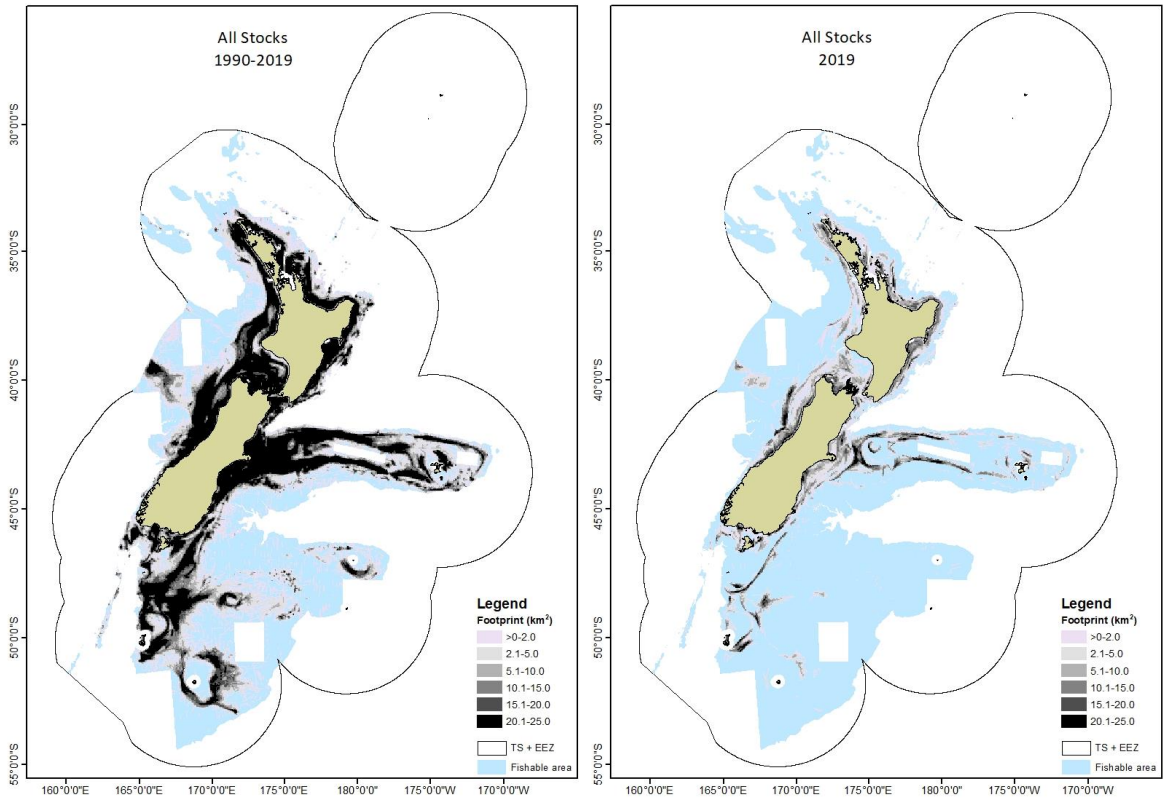


Figure 3: Distribution of the All Stocks footprint represented by 25-km^2 cells, 1990–2019 and 2019.

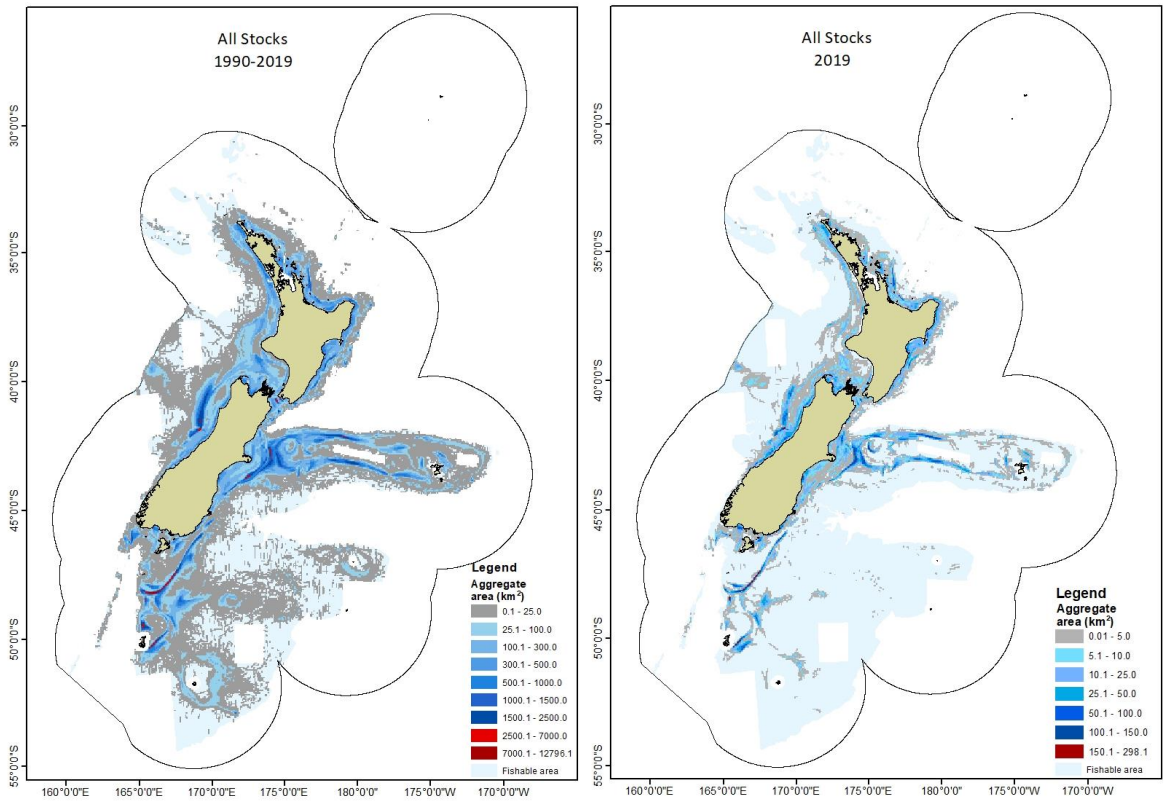


Figure 4: Distribution of the All Stocks aggregate area per 25-km^2 cell, during the combined fishing years 1990–2019 (left) and for 2019 (right).

3.2.1 Extent of new areas contacted across the time series

Overall, 68% of all cells contacted by the footprint were contacted in both 1990–2007 and 2008–2019 time periods, whereas 27% were contacted pre-2008, but not during 2008–2019, and 5% were contacted for the first time during the last 12 fishing years.

A measure of change across all years is the number of cells contacted in a year (for example 1998) that were not contacted in previous years (1990–1997); these cells are referred to as 'new cells'. These cells provide a way in which to isolate new areas that have been contacted, beyond the usual fishing areas. From a total of 27 820 cells contacting during the 1990–1994 fishing years, 1439 cells were contacted for the first time in 1995. In the following years the number of new cells each year ranged between a low of 1147 (in 2000) and a high of 1519 (in 1998) (Table C4). The extent of the aggregate area and footprint for these new cells gives an idea of the amount of spread estimated in these new cells. In most years given in Table C4, there is little difference between the estimated swept area measures and the areas are small and likely represent the edge of the main fishing areas. For 1990–2007, the annual new cell footprint represents between 81 and 96% of the pre-2008 new cell aggregate area, and for 2009–2019 the annual new cell footprint represents between 91 and 100% of the total 2009–2019 aggregate area. This suggests the swept area of the tows is spread out within each cell, without much overlap between tows. However, in 2008 when the complete set of bottom-contacting inshore data were included (resulting in a large number of new cells relative to previous years), the new cell footprint is 68% of the new cell aggregate area suggesting more overlap of tows.

3.2.2 Intensity

For the combined 1990–2019 All Stocks data, the median number of tows that contacted a cell was 28 tows (mean of 277), and 50% of cells had contact by between 4 and 229 tows, with a maximum of 19 483 tows over the total dataset (Table 3). The top 10 cells for total aggregate area are at the southern edge of the Stewart-Snares shelf (between 7277 and 12 796 km^2); nine of these cells were in the top ten cells for the number of tows per cell and the other cell was in Cook Strait.

Over the time series, the median number of tows in a cell in a year was 3–6 tows during 1990–2007 and in 2008–19, the median number of 8–9 tows (Table C5). During the pre-2008 fishing years, the spread of the data was tighter than for the 2008–19 years, but the maximum numbers of tows contacting cells during 1990–2007 was between 2 and 3 times that in most years for the 2008–19 data. The year with the maximum of tows contacting a cell was in 1991 (2427 tows off the southern edge of the Stewart-Snares shelf) and, for 2008–19, the maximum number was in 2018 (828 tows near the Hokitika Canyon off the west coast South Island). This pattern was reflected in the annual summary data for aggregate area (Table C5). Substantially smaller maximum aggregate areas per cell were seen in the last 12 years compared with the earlier years; a reflection of the decrease in deepwater component of aggregate area as well as the inclusion of the inshore data (see Figure 2). The peak years for aggregate area during 2008–2019 were mainly between 2013 and 2019 (with the exception 2017) when between 290 and 403 km^2 maximum per cell – in the Hokitika Canyon for most years and the Stewart-Snares shelf southern and eastern edge). The maximum footprint in a cell in each year was equivalent to the cell area (25 km^2).

Table 3: Summary data for the number of tows that contact a cell, the aggregate area, and the footprint by 25-km^2 cell for the All Stocks data, for the combined fishing years 1990–2019. Annual summaries are given in Table C5.

	Minimum	1st quarter	Median	Mean	3rd quarter	Maximum
No. of tows	1	4	28	277	229	19 483
Aggregate area (km^2)	< 0.1	1.4	10.6	112.8	82.3	12 796.1
Footprint (km^2)	< 0.1	1.4	28.0	11.1	22.7	25.0

3.2.3 Number of years contacted

Of the 41 424 cells contacted by the total All Stocks footprint, 16% (n = 6662) were contacted in one year only, 8% in 2 years, and 6% in 3 years (Figure 5). Just over half the cells (56%) were contacted for up to 12 years (the number of years TCERs were used). In total, 7.2% of cells (n = 2993) were contacted each year. Beyond the 12 years, these data largely reflect the deepwater stocks reported on TCEPRs. This is reflected in the spatial distribution of number of years per cell, as shown in Figure 6.

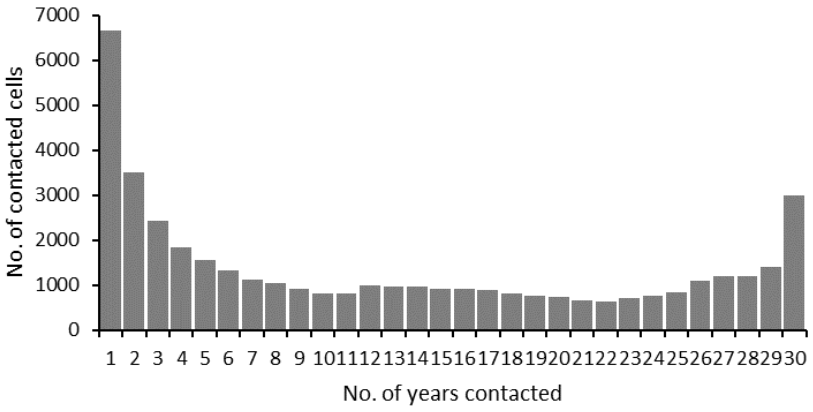


Figure 5: Frequency of the number of years cells were contacted, All Stocks for 1990–2019.

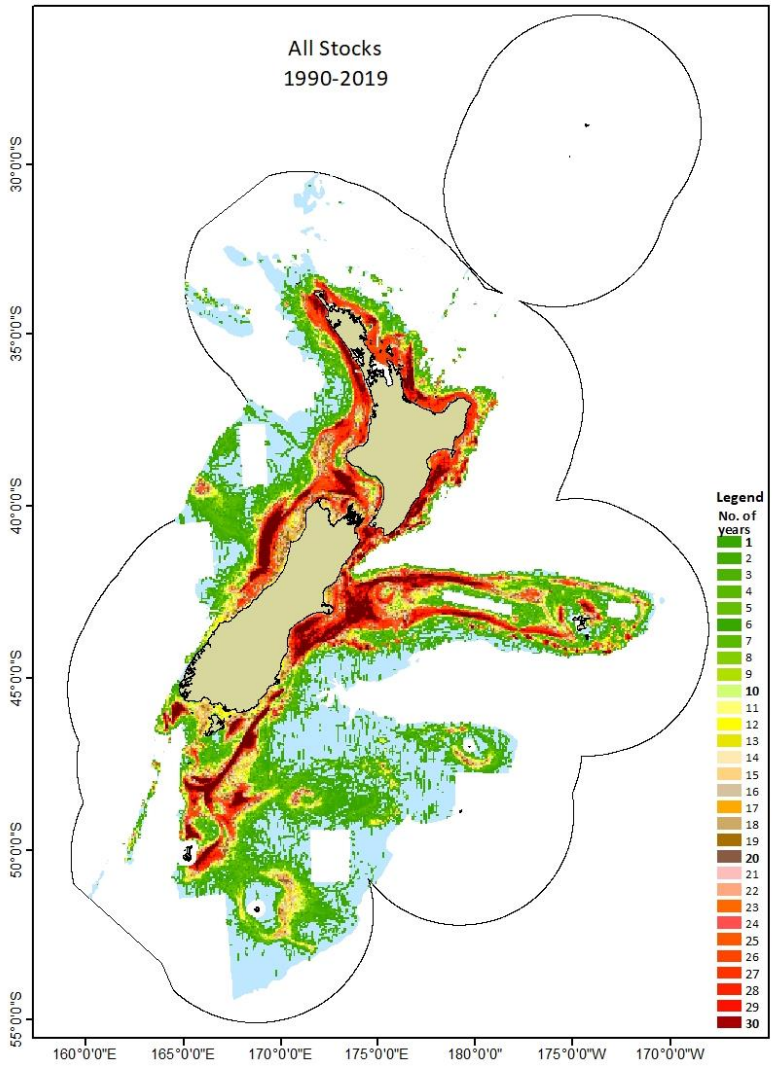


Figure 6: Distribution of the All Stocks cells by the number of years contacted, during 1990–2019.

3.3 Overlap of All Stocks footprint with 200-m depth zones

Tables C6, C7, and C8 in Appendix C give the total and annual extent of the 1990–2019 bottom-contacting measures (number of cells contacted, aggregate area, and footprint), by year. Almost 40% of the 1990–2019 footprint was in the shallowest depth zone (Tables 4 & C6). Another 23% of the total footprint was in 400–600 m, 13% in 600–800 m, and 11% in 200–400 m. In 2019, 53% of the footprint was in under 200 m, 26% in 400–600 m, and 9% in 200–400 m. The percent of the total and 2019 footprints in depths over 1000 m was under 7% and under 2%, respectively. The extent of the distribution of the footprint by depth class for all years and for 2019 is shown in Figure 7.

The footprint overlap was greatest in the shallowest depth zone, which had the second largest seafloor area (72.5% of the < 200 m depth zone for all years combined, and 17% for 2019) (see Table 4). About 50% and 8% of the relatively small seafloor area in 200–400 m, 41% and 8% of 400–600 m zone, and 32% and 3% of the 600–800 m zone was contacted by the 1990–2019 and 2019 footprints, respectively. Although the 1990–2019 overlap in 800–1000 m was about 21% and 13.5% of the 1000–1200 m, the 2019 footprint contacted 1.5% and 0.7% of the seafloor in these deeper zones.

The annual change in the percent of each depth zone contacted by the footprint is shown in Figure 8. The percent of the overlap of the 400–600 m zone increased from 1990 to a peak in 2003, then dropped to under 10% from 2005. The influence of the addition of the TCER data in 2008 is evident in the marked increase in overlap of under 200 m zone, with a peak at 22% in 2010, before dropping to 17% in 2019. For the years

since 2008, the percent overlap of other depth zones by the annual All Stocks footprint has been relatively steady, though many indicate a small decrease in the overlap extent in 2019.

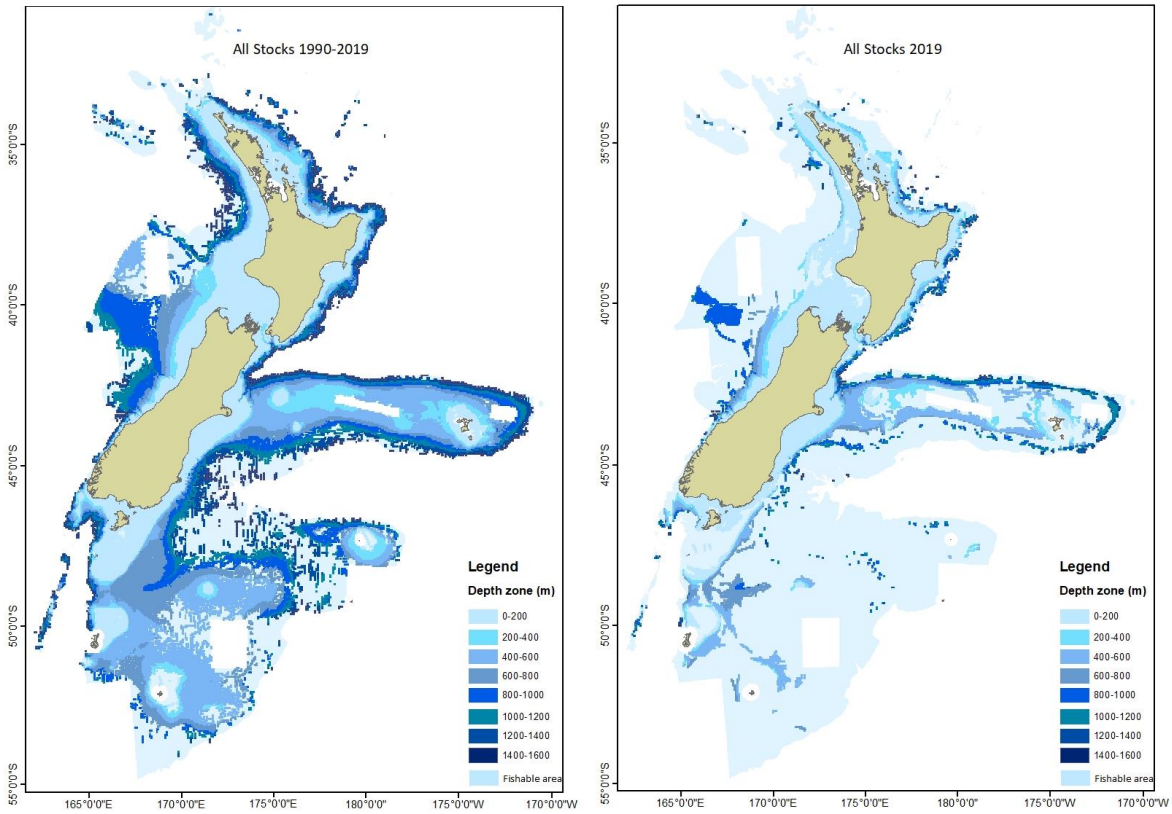


Figure 7: Extent of the All Stocks footprint overlap with 200-m depth zones, represented by 25-km^2 cells, for all years combined(left), and for 2019 (right).

The total aggregate area by depth zone showed a similar pattern to the footprint in the two shallowest depth zones, with 40% of the total aggregate area in under 200 m and 13.5% in 200–400 m, but the higher estimated aggregate area in the 400–600 m zone (32% of the total) indicated more intense contact (Table C7). In contrast, relatively small proportions of the total aggregate area were in deeper waters where the tow swept areas are likely smaller because the effort often consists of short tows on underwater features. The aggregate area in waters over 800 m accounted for under 5% of the total 1990–2019 area. The spread of the 2019 aggregate area showed a similar pattern with 49% in under 200 m, 11% in 200–400 m, 31% in 400–600m, and 6% in 600–800 m. About 3.5% of the 2019 aggregate area was in 800–1600m.

The changes described above are reflected in the numbers of cells contacted (Table C8), particularly with the shift from middle depths to shallow depths as a result of the addition of inshore data in 2008.

Table 4: The total area of the seafloor in each depth zone within 'fishable' waters (all depth zones ≤ 1600 m combined), the All Stocks footprint, the percent of the total footprint in each depth zone, and the percent of each depth zone area contacted by the trawl footprint, for 1990–2019 and the 2019.

Depth zone (m)	Area (km^2)	Footprint (km^2)		Total footprint (%)		Footprint overlap (%)	
		1990–2019	2019	1990–2019	2019	1990–2019	2019
< 200	249 341.9	180 810.8	42 645.1	39.3	52.6	72.5	17.1
200–400	98 295.9	48 651.9	7 490.7	10.6	9.2	49.5	17.6
400–600	253 939.2	104 923.7	21 278.9	22.8	26.3	41.3	8.4
600–800	185 161.6	59 832.3	5 670.5	13.0	7.0	32.3	3.1
800–1000	166 645.0	3 544.4	2 515.4	7.7	3.1	21.3	1.5
1000–1200	144 930.5	19 620.2	1 033.3	4.3	1.3	13.5	0.7
1200–1400	168 376.8	7 875.1	341.2	1.7	0.4	4.7	0.2
1400–1600	124 988.8	3 368.9	79.8	0.7	0.1	2.7	0.1
≤ 1600	1 391 679.7	460 627.2	81 054.9	100.0	100.0	33.1	5.8

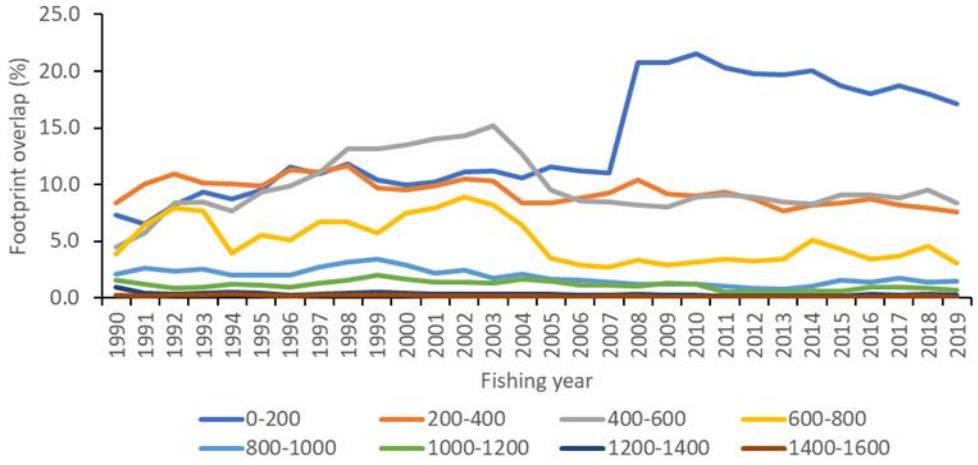


Figure 8: Percent of each 200-m depth zone contacted by the All Stocks footprint each year, for 1990–2019.

3.4 Overlap of All Stocks footprint with BOMEC classes

The extent of the distribution of the footprint by BOMEC class for all years and for 2019 is shown in Figure 9, and Tables C9–C11 in Appendix C provide the annual overlap of the footprint, aggregate area, and number of contacted cells for each class.

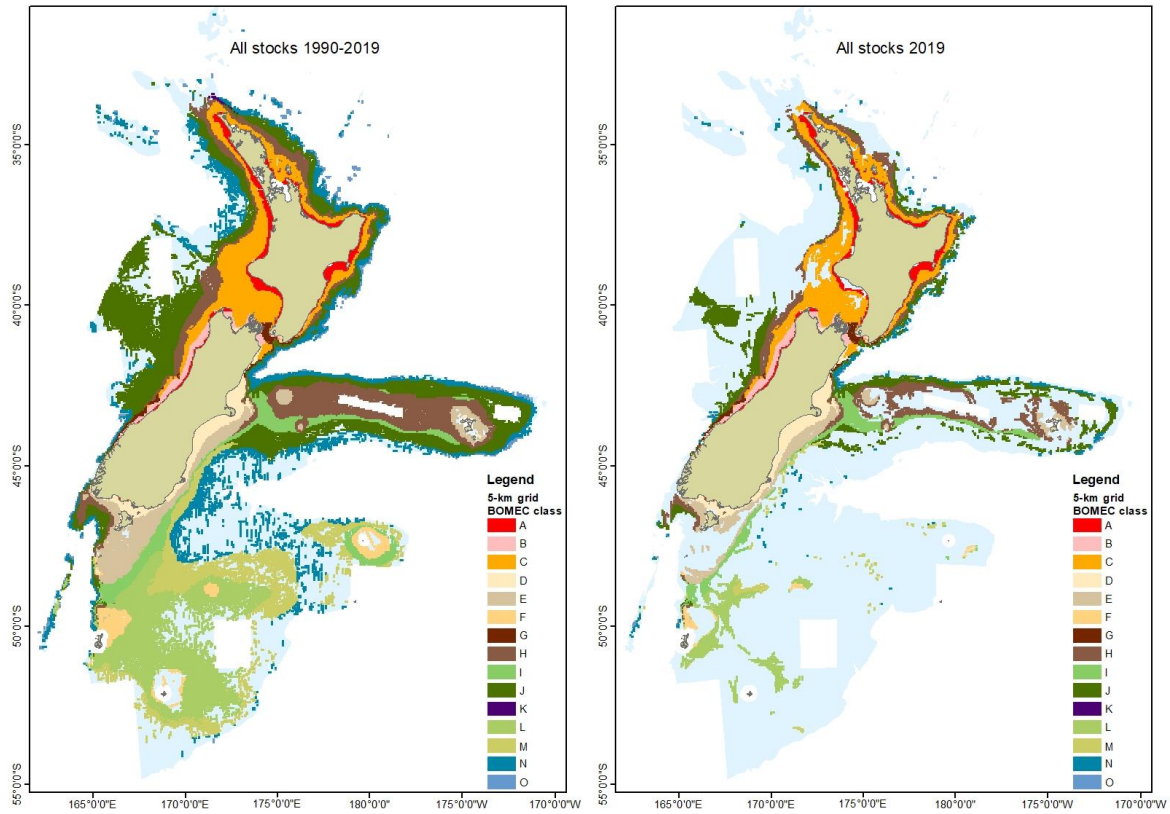


Figure 9: Extent of the All Stocks footprint overlap with BOMEC classes, represented by 25-km^2 cells for all years combined(left), and for 2019 (right).

The 1990–2019 footprint was mainly in classes C, H, J, and L (Table 5); these four classes accounted for 63% of the 30-year dataset. These classes represent four of the five groups discriminated by Leathwick et al. (2012): class C is part of the inshore and shelf group (classes A-E), class H is in the upper slope group (classes F-H), class J is in the northern mid-depths group (classes I-K), and class L is in southern mid-depths group (classes L and M); classes N and O are in the deeper waters group.

The annual footprints for the inshore and shelf areas increase markedly with the addition of TCER data in 2008, whereas the footprints for other groups tend to drop off or remain reasonably steady from 2008, after peaks years in 1998–2004 for classes H-J, for example, and 2001–2004 for class L (Figure 10, Table C9). Comparatively small amounts of footprint were in classes N and O. For 2019, classes C and H-J accounted for 60.5% of the footprint; all classes except class B showed a decrease in 2019.

When the 1990–2019 All Stocks footprint is considered as a percent of the seafloor area of each class, between 56 and 89% of classes in the inshore and shelf group and classes G-I were contacted (see Table 5), and 18–28% of classes F, J, and L seafloor were contacted. For the 2019 data, a similar pattern was seen, though at a smaller scale. The impact of the TCER additional data is evident in the annual percent of each class area that was contacted shown in Figure 11, with higher percent overlap in the inshore and shelf group especially.

The 1990–2019 aggregate area was greatest in classes H-J, with 51% from these classes; 24% was in classes C and E, and 16% in classes A, D, and L (Table C10). For the classes more likely to be comparable across years (deepwater trawling effort), in middle depths and deeper waters, Class J accounted for the greatest spread when measured by the number of contacted cells (Table C11), followed by classes, H, L, and N; these classes are expansive and effort in them is widespread (see Figure 9). In contrast, less than half the cells contacted in class H were contacted in class I, yet the aggregate areas for these two classes, for all years, were similar. Thus, although the footprint in class I is relatively smaller than that in class H, the intensity as measured by the aggregate area is greater because of the limited extent of class I.

Table 5: The total area of the seafloor in each BOMEC class within 'fishable' waters (all depth zones ≤ 1600 m combined), the All Stocks footprint, the percent of the total footprint in each class and the percent of each class area contacted by the trawl footprint, for 1990–2019 and the 2019.

BOMEC class	Area (km^2)	Footprint (km^2)		Total footprint (%)		Footprint overlap (%)	
		1990–2019	2019	1990–2019	2019	1990–2019	2019
A	30 661.0	17 481.6	5 236.8	3.8	6.5	57.0	17.1
B	12 786.1	11 374.4	5 297.1	2.5	6.5	89.0	41.4
C	90 256.5	74 461.7	15 782.4	16.2	19.5	82.5	17.5
D	28 085.7	21 748.7	6 934.7	4.7	8.6	77.4	24.7
E	61 258.0	34 431.6	6 316.9	7.5	7.8	56.2	10.3
F	38 775.8	6 900.9	316.7	1.5	0.4	17.8	0.8
G	6 702.3	5 173.3	1 092.4	1.1	1.3	77.2	16.3
H	138 399.1	78 072.4	12 987.0	16.9	16.0	56.4	9.4
I	52 008.3	38 811.1	9 906.8	8.4	12.2	74.6	19.0
J	312 604.9	81 921.7	10 365.4	17.8	12.8	26.2	3.3
K	1 200.2	41.5	0.4	0.0	0.0	3.5	0.0
L	198 578.4	56 638.2	5 518.0	12.3	6.8	28.5	2.8
M	233 837.4	19 138.8	719.9	4.2	0.9	8.2	0.3
N	495 154.2	13 771.8	555.4	3.0	0.7	2.8	0.1
O	1 006 911.1	614.7	19.7	0.1	0.0	0.1	0.0
Total	2 707 219.0	460 627.2	81 054.9	100.0	100.0	17.0	3.0

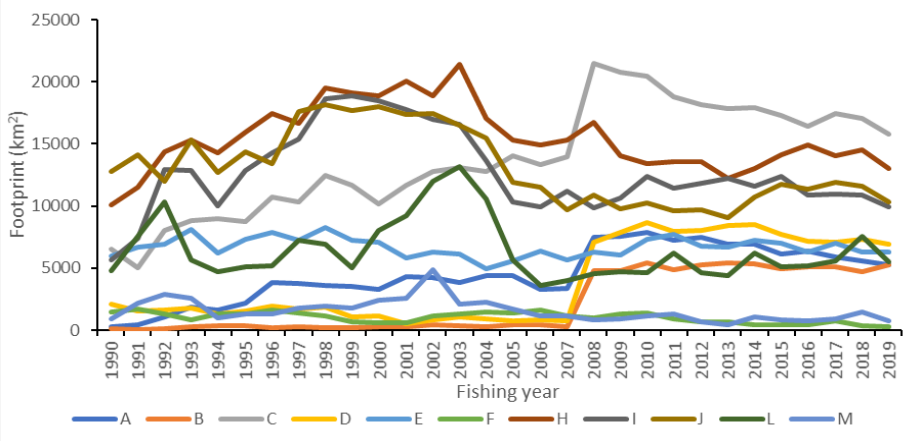


Figure 10: Estimated annual footprint for bottom-contacting trawling for All Stocks, by BOMEC class within the fishable area, for 1990–2019. The full dataset is given in Table C9.

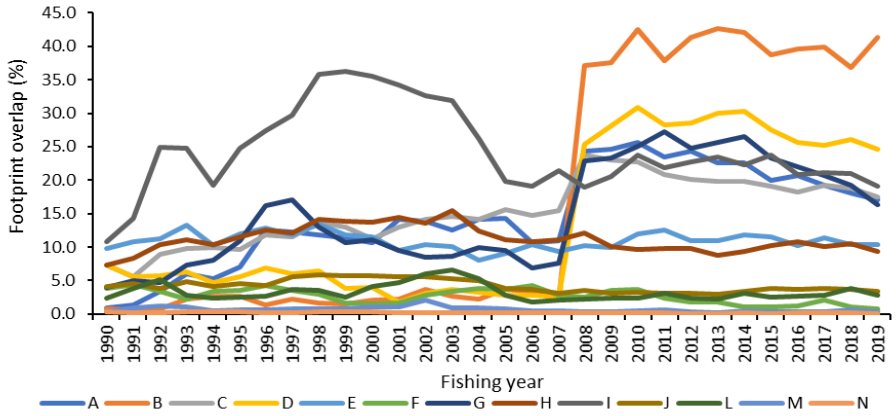


Figure 11: The percent of each BOMEC class contacted by the All Stocks footprint each year, for 1990–2019. Classes K and O are not included (see Table C9 for the footprint areas).

3.5 Overlap of All Stocks footprint with surficial sediment layers

In relation to the interpolated surficial sediments layers available for within the EEZ+TS (Bostock et al. 2019a, 2019b), the overlap of the 1990–2019 and 2019 footprints of the seafloor areas estimated for each sediment layer is summarised in Table C12. There are overlaps between substrate types: for example, 0–20% sand could overlap with 80–100% gravel (compare figures in Figure B3).

The footprint is reasonably well spread throughout the carbonate classes (Table C12), whereas the footprint in the gravel classes is greatest in 0–20%. For mud, most of the footprint is with the 0–20%, 20–40%, and 40–60% classes, and for sand, in the 40–60% and 60–80% classes.

The seafloor areas of these classes can vary greatly within each sediment layer: for example, the class area for carbonate 0–20% is about a third the size of the 80–100% area (Table 6), whereas the seafloor area for gravel 0–20% is almost 8 times the size of the 80–100% class. The greatest overlap of the All Stocks footprint is with the carbonate layer (as percent of the seafloor area in each sediment class): in the 0–20% and 20-40% categories, at 63% and 48%, respectively for the 1990–2019 and 17% and 10% for 2019 (Table 6). For gravel, the footprint contacts at least a third of the vastly different sized areas in the 10–20% and 20–40% classes, and about a third of the 40–60% and 60–80% classes. The footprint overlap with the mud classes range between 26% and 39% of class areas, and, for sand, the overlap varies between 26% and 51%.

The extent of the 1990–2019 All Stocks footprint overlap with each substrate type is shown in Figure 12.

Table 6: Percentage overlap of the seafloor area of the substrate classes by the fishable area 1990–2019 and 2019 All Stocks footprint. For gravel, mud, and sand, the percentage classes total 100%, and for carbonate the percentage represents the proportion that is carbonate versus non-carbonate.

Substrate	Class (%)	Class area (km^2)	1990–2019 overlap (%)	2019 overlap (%)
Carbonate	0–20	138 252.7	63.4	17.0
Carbonate	20–40	282 469.8	47.8	9.4
Carbonate	40–60	275 070.0	33.3	5.2
Carbonate	60–80	288 732.7	22.6	2.9
Carbonate	80–100	369 402.8	20.8	2.1
Gravel	0–20	1 037 250.7	34.6	6.3
Gravel	20–40	188 550.0	36.9	6.2
Gravel	40–60	77 886.4	25.8	3.1
Gravel	60–80	26 682.0	21.6	1.4
Gravel	80–100	14 188.5	11.5	2.7
Mud	0–20	387 549.1	38.7	6.3
Mud	20–40	323 852.0	34.2	5.6
Mud	40–60	299 719.3	34.1	6.8
Mud	60–80	233 123.9	27.5	5.7
Mud	80–100	109 712.9	26.5	4.1
Sand	0–20	142 639.8	28.9	4.6
Sand	20–40	348 482.0	26.2	5.1
Sand	40–60	482 383.1	34.0	5.8
Sand	60–80	303 832.8	39.8	6.7
Sand	80–100	77 166.5	50.6	9.9

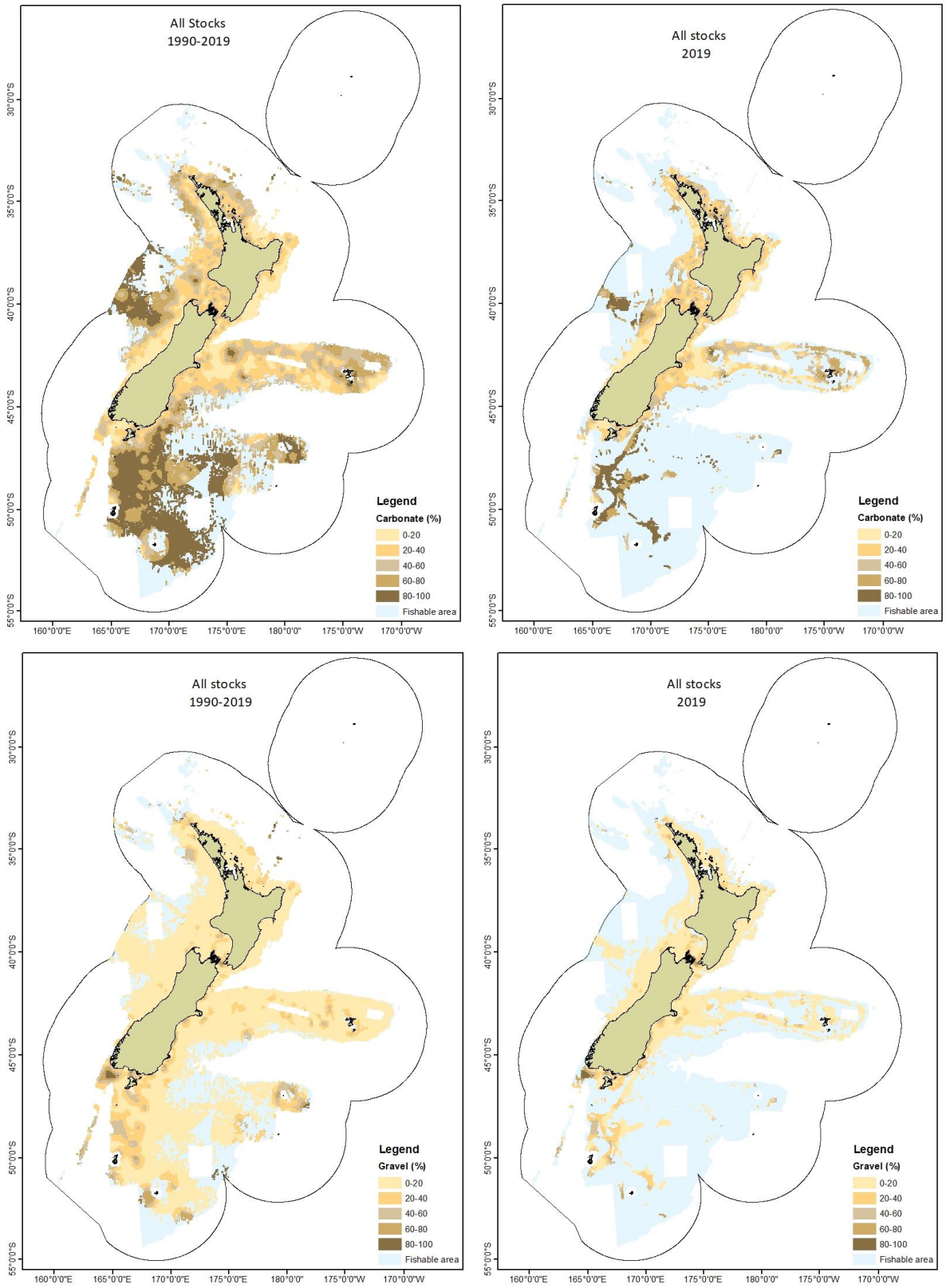


Figure 12: Distribution of the extent of the 25-km^2 cells for the All Stocks 1990–2019 (left) and the 2019 trawl footprints (right) for substrate types, by class: carbonate, gravel, mud, and sand (after Bostock et al. 2019a, 2019b). Carbonate (upper) and gravel (lower).

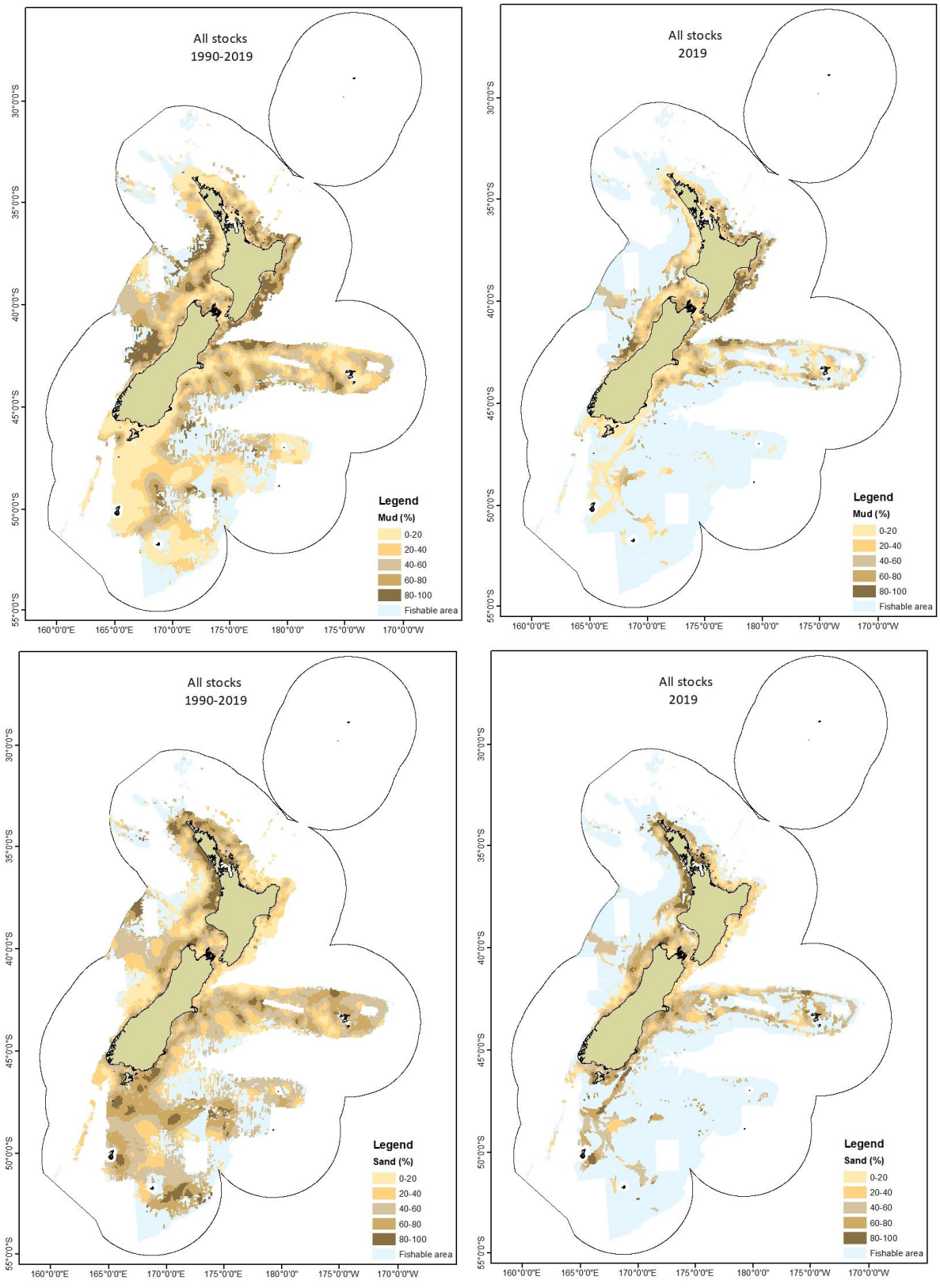


Figure 12: continued. Mud (upper) and sand (lower).

4. DEEPWATER FISHSTOCKS TRAWL FOOTPRINT, 1990–2019

4.1 Deepwater data

During 1990–2019, a total of 570 vessels reported bottom-contacting effort that targeted deepwater Tier 1 and Tier 2 species (Table D1). These vessels represented both foreign and domestic fleets and over time there have been substantial changes in the numbers of vessels and the type and size of vessels in this dataset. The numbers of vessels in most vessel groups have decreased over the years, especially the foreign-owned fleets and this is reflected in the decrease in reported tows by these vessels (Figure 13). Different trawl gear set-ups have been used by these vessel groups to target a variety of deepwater species and, until there is better information on the spread of gear that contacts the seafloor, vessels in each group are considered to have similar bottom contact in these analyses.

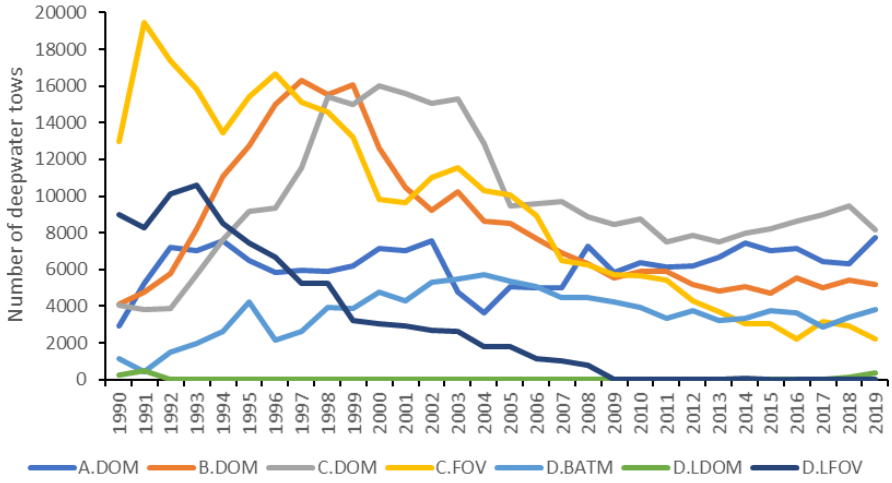


Figure 13: The number of bottom-contacting tows reported by vessels that targeted Tier 1 and Tier 2 deepwater fishstocks during 1990–2019, by year and vessel type. A.DOM is domestic vessel under 28 m in length; B.DOM is domestic vessel between 28 and 46 m; C.DOM is domestic vessel between 46 and 82 m; C.FOV is foreign-owned vessel between 46 and 82 m; D.BATM is foreign-owned vessel of 104 m in length; D.L.DOM is domestic vessel > 82 m; and D.L.FOV is foreign-owned vessel over 82 m long.

The underlying tow data and results of analyses based on the deepwater Tier 1 and Tier 2 fishstocks are presented in Appendix D. The tow data are from TCEPRs throughout the time series, TCERs from 2008 to 2019, and ERS from 2018 to 2019 (Table D1). Over 1.1 million tows in the deepwater dataset targeted Tier 1 fishstocks, primarily hoki (39%), arrow squid (17%), orange roughy (15%), and scampi (12%) (Table D2). Over the time series, the number of Tier 1 bottom-contacting tows increased from about 31 220 in 1990 to nearly 57 600 in 1998, then decreased each year to about 29 400 tows in 2007. A small amount of TCER data was included in subsequent years, but the decrease in numbers of tows continued, with between about 23 000 and 24 000 tows during 2012–2017. In 2018 and 2019, tow numbers increased to about 24 900 a year; and the predominant data collection was by ERS.

In the first year of this dataset, hoki, arrow squid, and orange roughy accounted for about 73% of the annual effort (Table D2). Hoki data accounted for most of the annual tow data, with at least 43% of the annual tows in 1996–2004 from hoki effort; this peaked in 2000 and 2001, at about 51% of annual tows. The impact of decreases in the hoki TACC (Fisheries New Zealand 2020) can be seen in the subsequent drop in the hoki proportion of the annual effort; hoki tows accounted for 27–31% during 2005–2009. As the TACC was increased, the hoki percentage then increased to 38–44% during 2010–2018, then dropped to 35% in 2019, when the relative percentages of arrow squid and scampi increased. The numbers of tows for hoki and orange roughy were similar in the early-mid 1990s, and the numbers for arrow squid and orange roughy were similar in the mid-late 1990s before TACC changes affected the orange roughy fishery. About 12–13% of annual tows targeted orange roughy during most of the 2000s, 7–10% during 2011–2015, then closer to 13% in 2016–2019 (see Table D2). Arrow squid effort accounted for 25% of effort during 2005–2006, when hoki effort dropped off; in the following years, the arrow squid effort relative to hoki decreased to about 8–11% of annual tows, except for 2019 (17%). Annual effort for scampi relative to other main targets was generally under 10%

before 2005. Following introduction to the Quota Management System (QMS) in the 2005 fishing year (1 October 2004), the percentage of annual tows for scampi increased to over 18% from 2013 (peaks of 21.5% in 2016 and 21.6% in 2019).

Of the remaining Tier 1 targets, the percentage of hake, jack mackerel, and ling effort, although low in comparison, increased during the 2000s when the hoki TACC was decreased, but in recent years have accounted for under 2%, about 3.5%, and 4–5%, respectively. Oreo effort accounted for a decreasing amount of the annual tows over the time series, to about 3% in the last four years; the oreo fishstocks have been subject to a decreasing TAC throughout the time series (Fisheries New Zealand 2020). Southern blue whiting bottom-contacting tows accounted for a smaller percentage of the Tier 1 annual tows in the last four years than in the early 1990s.

The Tier 2 fishstock data for 1990–2019 represent about 9% of the total deepwater bottom-contacting tows, with a total of 103 787 tows (Table D3). The number of tows before the introduction of the TCERs was generally between about 3000 and 4000 per year, with peaks over 4000 in 1995, 1996, 2006, and 2007. The peak number for the time series was in 2008, with over 5000 tows; subsequently the effort gradually dropped to about 2600 (in 2018 and 2019). Barracouta accounted for 33% of all tows, with alfonsino, silver warehou, and black cardinalfish contributing 19.5%, 18%, and 15%, respectively; these four species accounted for 86% of all bottom-contacting Tier 2 tows. White warehou, sea perch, and rubyfish accounted for another 10%. For the remaining targets, effort was low and intermittent.

During 1990–2007, barracouta accounted for a decreasing percentage over the years, from over 50% in 1990–1991, to a nadir in 2006, then increased to a second peak at 42% in 2008 and between 33 and 39% during 2012–2019. The percentage of alfonsino tows increased in the late 1990s, with 22–27% of tows in most years between 1997 and 2012, apart from peaks of close to and over 30% (32% in 2006 and 37% in 1999), before a series low in 2013 at 8%. During 2014–2017, alfonsino accounted for 14–16%, with further increases in 2018 and 2019 (18%, 25% respectively). Silver warehou accounted for 18–28% of annual tows during 1990–1996, under 16% in 1997–2006, 17–25% in 2007–2018, then 13% in 2019 when there were small relative increases for the other main target species. Black cardinalfish accounted for about 25% of annual tows during 1996–2007, but since then dropped to under 10% in most years.

4.2 Spatial extent

The annual totals of cells, aggregate area, and footprint for the deepwater fishstocks are given in Table 7 and by tier and target in Appendix D. For all years, the deepwater fishstock effort contacted 38 872 25-km^2 cells, based on the total estimated aggregate area of almost 3.48 million km^2 and a total footprint equivalent to about 10% of the aggregate area (351 683 km^2, Table 7). Overall, the footprint contacted almost 9% of the area of the EEZ+TS and 25% of the fishable area. The greatest annual overlap was during 1992–2004, with peak overlap in 2002 and 2003, but from 2006 the footprint overlap has been 1.1–1.2% of the EEZ+TS and 3.2–3.7% of the fishable area (1.1 and 3.2%, respectively in 2019).

The annual aggregate area increased each year (except 1994) to a peak in 1998 (almost 172 000 km^2), about 151 000–157 212 km^2 during 1999–2003, followed by a sharp drop before levelling out at between almost 80 000 and 97 045 km^2 during 2007–2019 (86 777 km^2 in 2019). The footprint generally followed the trend of the aggregate area in the 1990s, but the peak annual spread as measured by the footprint (at about 81 000 km^2) and numbers of cells (16 000–17 000 cells) was during 2002 and 2003; at this time the footprint was equivalent to 80% of the 30-year footprint (Figure 14). Subsequently, the footprint decreased to about 50 000–51 000 km^2 during 2006–2009, then dropped below this and ranged from 49 886 km^2 (in 2010) to 43 481 km^2 (in 2019), the lowest annual footprint estimated over the 30-year dataset. The numbers of cells steadily decreased after the peak in the early 2000s to a series minimum of 10 352 in 2019.

Table 7: The number of cells contacted by the deepwater bottom-contact trawls, the aggregate area, and the footprint, and the percent of the EEZ+TS (4.1 million km^2) and the fishable area (1.39 million km^2) contacted by the deepwater footprint, for 1990–2019.

Fishing year	No. of cells	Aggregate (km^2)	Footprint (km^2)	%EEZ+TS	% fishable
1990	12 345	101 844.5	47 584.0	1.2	3.4
1991	13 324	126 457.5	55 058.4	1.3	4.0
1992	14 567	137 294.0	66 617.1	1.6	4.8
1993	14 133	140 106.8	66 927.0	1.6	4.8
1994	13 413	122 080.2	56 931.5	1.4	4.1
1995	13 651	144 635.0	61 830.5	1.5	4.4
1996	13 647	144 433.7	62 726.2	1.5	4.5
1997	14 070	155 222.9	68 756.4	1.7	4.9
1998	15 443	171 901.7	77 090.5	1.9	5.5
1999	15 166	156 834.9	72 611.9	1.8	5.2
2000	15 360	150 733.1	74 023.2	1.8	5.3
2001	15 325	151 150.7	76 256.1	1.9	5.5
2002	17 070	155 213.9	81 004.8	2.0	5.8
2003	16 017	157 211.9	80 616.7	2.0	5.8
2004	14 133	131 779.7	67 794.8	1.6	4.9
2005	13 345	110 887.0	54 221.3	1.3	3.9
2006	12 399	95 332.0	50 099.2	1.2	3.6
2007	12 204	88 362.0	50 347.7	1.2	3.6
2008	13 192	85 589.0	51 022.2	1.2	3.7
2009	12 313	79 650.3	46 228.7	1.1	3.3
2010	12 477	87 835.8	49 886.4	1.2	3.6
2011	12 038	87 477.9	48 678.5	1.2	3.5
2012	11 447	86 230.1	46 923.5	1.1	3.4
2013	10 721	80 303.6	44 784.3	1.1	3.2
2014	11 755	82 825.1	47 578.7	1.2	3.4
2015	11 494	85 902.4	48 183.6	1.2	3.5
2016	11 557	84 765.1	46 678.6	1.1	3.4
2017	11 524	89 567.8	46 983.6	1.1	3.4
2018	11 092	97 044.7	48 027.3	1.2	3.5
2019	10 352	86 777.0	43 841.0	1.1	3.2
Total	38 872	3 475 450.1	351 683.5	8.6	25.3

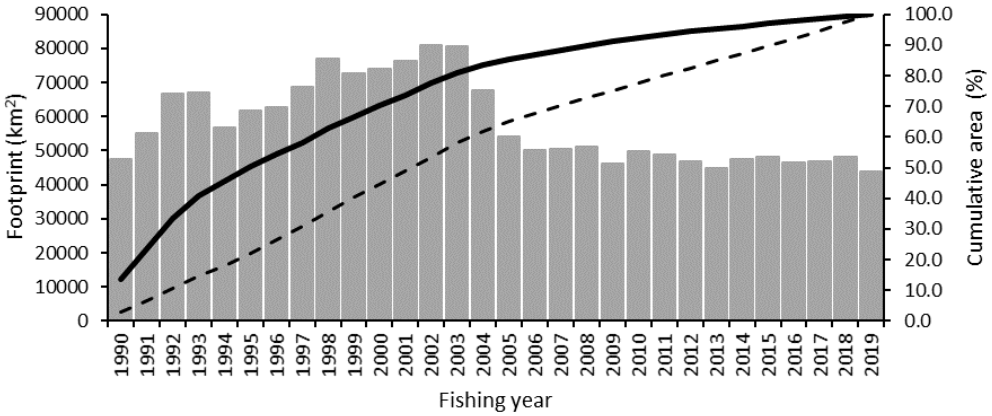


Figure 14: Annual deepwater footprint (bars) and cumulative footprint (solid line) and aggregate area (dashed line) presented as percent of the total (see Table 7), assuming 1990 is the first year of bottom-contacting effort.

The spatial distribution of the footprint and aggregate area for all years, and for 2019, is shown in Figure 15. The 2019 deepwater footprint shows the spread of the main Tier 1 fishery activity for hoki (Chatham Rise, west coast South Island, and Stewart-Snares shelf), arrow squid (Stewart-Snares shelf and Auckland Islands

Shelf), orange roughy (western Challenger Plateau, northern and southeastern Chatham Rise), and scampi (east coast North Island, Chatham Rise, southeast Auckland Islands Shelf).

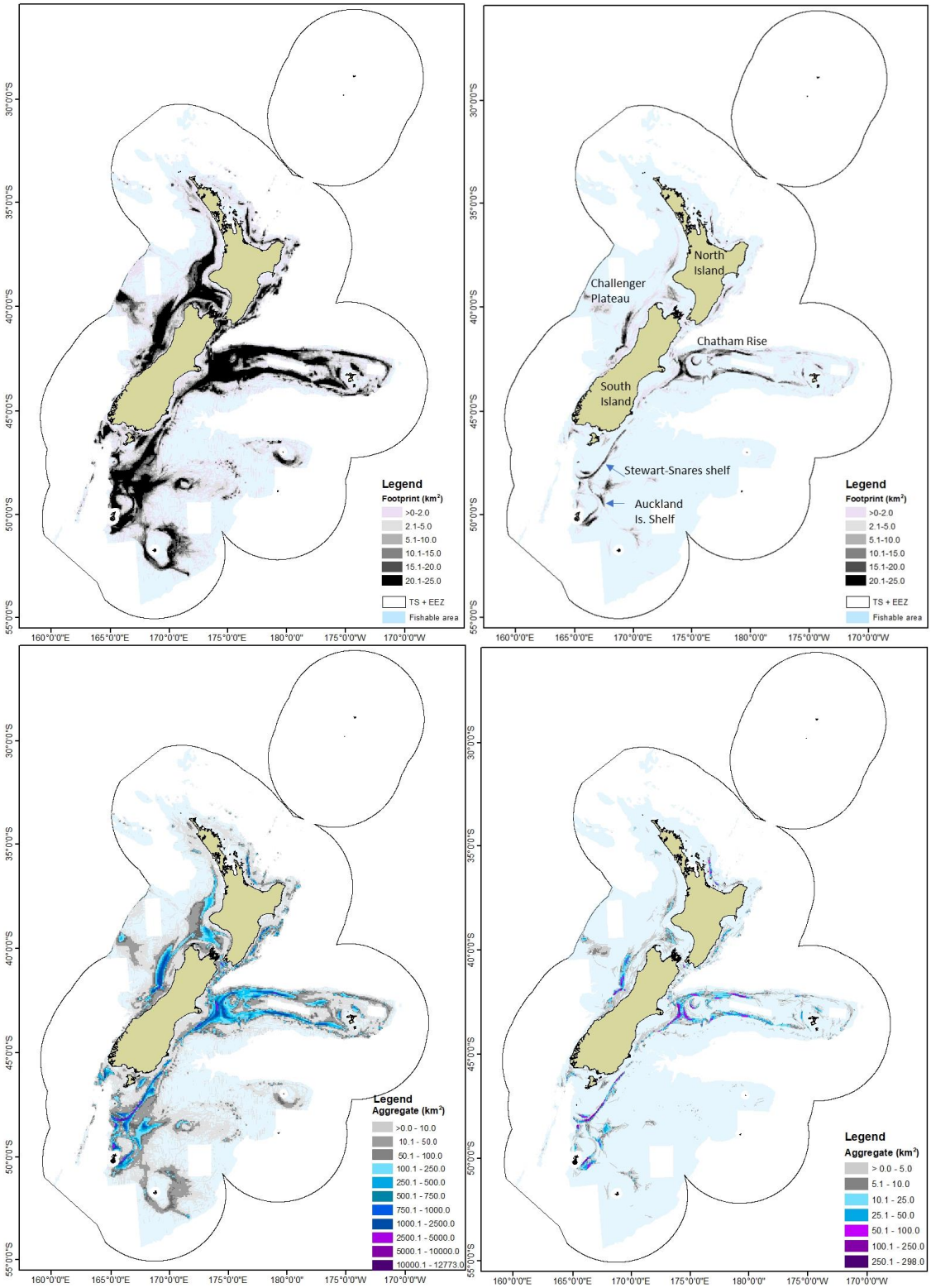


Figure 15: Distribution of the deepwater fishstocks footprint (upper maps) and aggregate area (lower), by 25-km^2 cells, 1990–2019 (left) and 2019 (right), with the fishable area (light blue background).

The greater extent of the Tier 1 component of the deepwater footprint and the overlap between fishery areas is evident in the spatial distribution of Tier 1 and Tier 2 footprints shown in Figures D1 and D2.

Deepwater Tier 1 and Tier 2 targets are listed in Table 1. There is overlap of the footprints for each tier, and Tier 1 targets contacted 96% of the cells containing deepwater tows, whereas Tier 2 targets contacted 40% of the cells (Table D4). Up to 2008, Tier 1 fishstocks contacted over 90% of the annual cells, but from 2008 (when TCER forms were introduced and some smaller vessel data entered the series, coincident with some decreases in effort for some Tier 1 components – this dropped to between 82% and 87% as the spread of the Tier 2 fishstocks effort increased (from mainly under 20% to over 30% from during 2008–2017 and 28% in 2018 and 2019.

This 2008 effect is not as strong in the relative contributions of each tier in the aggregate area estimates; almost 94% of the 1990–2019 deepwater aggregate area was from Tier 1 target fishstocks. Almost 93% of the footprint was from Tier 1 fishstocks, with over 95% each year in the late 1990s and early 2000s, and between 86% (in 2008) and 93% (in 2019) in the last 12 years.

4.2.1 Tier 1 fishstocks: number of cells, aggregate area, and footprint

Tier 1 targets contacted 37 352 cells during 1990–2019 and the total aggregate area and footprint were estimated at 3.26 million km^2 and 325 829 km^2, respectively (Table 8). These fishstocks accounted for 94% of the deepwater aggregate area and 93% of the footprint. Although there is overlap of effort for different targets, hoki contacted over 50% of the cells, the aggregate area, and the footprint for Tier 1 targets during the 30 years (Table 8), indicating the larger number of tows and swept areas made in relatively broad areas that describe the main hoki fishery areas. In comparison, orange roughy contacted 24.6% of cells, 3.9% of aggregate area, and 12.6% of the footprint for Tier 1 targets, numbers that indicate the use of a mix of short tows on features and longer tows on the flat, with fishery areas spread throughout the EEZ. Similarly, for oreo species, 15% of deepwater cells were contacted, with 1% of the aggregate area and 5% of the footprint.

Arrow squid effort contacted about 22% of cells and accounted for 20.5% of the aggregate area and almost 13% of the footprint. Scampi fisheries are in relatively small defined areas (Fisheries New Zealand 2020); scampi tows contacted 18% of the deepwater cells and accounted for 6.4% of the aggregate area and the footprint. For middle depth fishstocks such as hake, jack mackerels, ling, and southern blue whiting 11–18% of deepwater cells were contacted, with larger footprints relative to the aggregate area for targets with distinct fishery areas in different areas of the EEZ, such as jack mackerels which have been targeted off the west coasts of both main islands as well as Stewart-Snares shelf and western edge of the Chatham Rise.

During the most recent fishing year, 2019, hoki trawling contacted 44.5% of deepwater cells and accounted for 58% and 60% of the aggregate area and footprint, respectively; orange roughy contacted 18% of deepwater cells and accounted for almost 5% of the aggregate area and 7% of the footprint. Trawling for scampi, squid, and jack mackerels accounted for 11%, 10%, and 7% of the 2019 footprint area, respectively.

The Tier 1 outputs by target are given in Tables D5–D7. The annual deepwater footprint is dominated by hoki effort (Table D5) which drives the overall trend. After a peak in the early 2000s (at about 50 000 km$^{2)}$, the footprint area dropped to a low 2008 and 2009 (at about 18 180–18 655 km^2), then increased slightly to 2018 (to 20 900km^2, and dropped again in 2019 (24 392 km^2). Most other targets, at under 10 000 km^2 a year, showed different trends over the time series, with most showing declining trends overall, other than scampi which remained relatively steady throughout, and orange roughy which showed an increase after 2013 to similar levels seen in most years in the 1990s. Ling peaked in 2006 to 2009, between steady periods, at under 2000 km^2.

The hoki effort was the main contributor, throughout the series, to the annual aggregate area, with over 40 000 km^2 a year except in 1990 and 2006–2009 when it totalled 30 000–36 616 km^2 (Table D6). The aggregate area peaked at about 100 000 km^2 in 1998, was stable 1999 to 2003 at over 90 000 km^2, and was over 40 000 km^2 again from 2010 to 2019, with a high of 62 111 km^2 in 2018, then a drop to 47 267 km^2 in 2019.

Table 8: The total number of cells contacted, aggregate area (km^2) and footprint (km^2) for Tier 1 targets and the percentage contribution by each Tier 1 target for 1990–2019 (left) and for 2019 (right). Note that the footprints of some of the targets overlap.

	Percent of total Tier 1 for 1990–2019			Percent of total Tier 1 for 2019		
Target	Cells	Aggregate area	Footprint	Cells	Aggregate area	Footprint
HAK	11.8	2.9	6.5	3.0	0.5	0.9
HOK	58.2	55.3	51.5	44.5	58.2	60.0
JMA	16.8	6.3	14.3	12.8	4.1	7.0
LIN	17.8	2.1	8.5	8.9	3.2	4.0
OEO	15.0	1.3	5.4	4.7	0.5	0.7
ORH	24.6	3.9	12.6	17.7	4.6	7.4
SBW	10.8	1.3	7.2	3.8	1.1	1.9
SCI	18.1	6.4	6.4	11.8	10.4	11.3
SQU	21.8	20.5	12.8	10.4	17.5	9.7
Total	37 352	3 264 667.0	325 828.8	8 776	81 225.4	40 631.7

Arrow squid was the second largest contributor to the Tier 1 aggregate area before 2012, with about 22 000–40 785 km^2 (peak in 1995) for 1990–2006. From 2007 the aggregate area decreased from about 17 000 km^2 to below 10 000 km^2 from 2012 onwards and lows of close to 6500 km^2 in 2014 and 2015. The last four years have seen increases to 9877 km^2 in 2018 and 14 203 km^2 in 2019. The scampi annual aggregate area topped 10 000 km^2 in 2002 and was generally stable at over 7000 km^2 in most years after that, with 9500 km^2 in 2016 and 8445 km^2 in 2019.The annual aggregate areas for other targets were below 10 000 km^2 and most showed decreasing trends overall, in particular jack mackerels, except for orange roughy with an increasing trend in the last five years.

4.2.2 Tier 2 fishstocks: number of cells, aggregate area, and footprint

Summary tables for Tier 2 footprint, aggregate area, and number of cells contacted are given by target and fishing year in Tables D8–D10. The 1990–2019 footprint totalled 74 217 km^2, with a range from 3190 km^2 (in 2004) to 8700 km^2 (in 1990) and 8786 km^2 (in 2008) (Table D8). In subsequent years, the annual footprint decreased from almost 7000 km^2 in 2009 to 4069 km^2 in 2019. Barracouta and silver warehou dominated the data; barracouta accounted for 48% and silver warehou accounted 35% of the total Tier 2 footprint, and 46% and 33% of the total aggregate area, respectively. The annual footprints (and aggregate areas) indicate the nature of many Tier 2 fishstocks, often being secondary targets, with either strong annual fluctuations or groups of years when more effort is expended, perhaps because of TACC changes, market demand, or fleet activity. Both these targets showed a second peak in footprint in 2008 and this was followed by a drop in barracouta, then a slight rise to a level about 2000–2500 km^2 from 2012–2019; whereas the silver warehou footprint gradually decreased after 2008 to under 2000 km^2 and further to under 1000 km^2 in 2019. Sea perch accounted for 7%, and alfonsino for 3%, of the total Tier 2 footprint, with generally under 400 km^2 since 2008. The remaining targets contacted under 1500 km^2 throughout the 30-year dataset.

4.2.3 HAK/HOK/LIN/SWA/WWA: number of cells, aggregate area, and footprint

The combined main middle depths targets of hake, hoki, ling, silver warehou, and white warehou contacted about 61% of deepwater cells, 59% of deepwater aggregate area, and 54% of the deepwater footprint (Tables D4 & D11). These species are often targeted on the same trips and in the same areas and depths, with the same gear. Quota changes for one species (e.g., hoki) may result in an increase in effort for one or more of the other species in this group. Fisheries New Zealand requires summary footprint output for this group of species for provision to the Marine Stewardship Council (MSC) certification process and requested that the combined data are analysed by Bycatch Assessment Areas (see Anderson & Edwards 2018). These data are given in Tables D11–D14.

The total combined footprint for these targets contacted 4.6% of the EEZ+TS annual range 0.5–1.45) and 13.6% of the fishable area (annual range 1.5–4.0) (Table D11). The peak years were in the late 1990s to the mid-2000s when the aggregate area was close to or over 100 000 km^2, the footprint about or over 50000 km^2,

and the number or contacted cells close to or over 9000. In 2005, these measures showed large decreases (e.g., aggregate area of almost 55 000 km^2 and footprint of about 31 500 km^2). The subsequent years showed further aggregate area decrease to under 50 000 km^2 for 2006–2009, an increase from 2010 to a recent peak in 2018 (67 380 km^2), then a drop to under 52 000 km^2 in 2019. A similar trend was seen in the footprint, with the lowest footprint area (26 704 km^2), since 1990, estimated in 2019.

The spatial distribution of the footprint by the Bycatch Assessment Areas, for 1990–2019 and 2019, is shown in Figure 16. For 1990–2019, the extent of the contact by these combined targets is greatest in CHAT4, which accounted for 44% of the estimated HAK/HOK/LIN/SWA/WWA footprint, 53% of the aggregate area, and 33.5% of the contacted cells (Tables D12–D14). The area that encompasses the Stewart-Snares shelf (STEW5) accounted for 19% of the footprint, 17.5% of the aggregate area, and 16% of the cells, and the other main southern area (SUBA6) accounted for 12% of the total footprint, 3% of the aggregate area, and 22% of the cells (indicating the relatively small amount of effort spread over a larger number of cells). The latter area boundary does not appear to effectively separate the effort for these targets in the fisheries off the Stewart-Snares shelf, the Auckland Islands Shelf, and the wider sub-Antarctic waters.

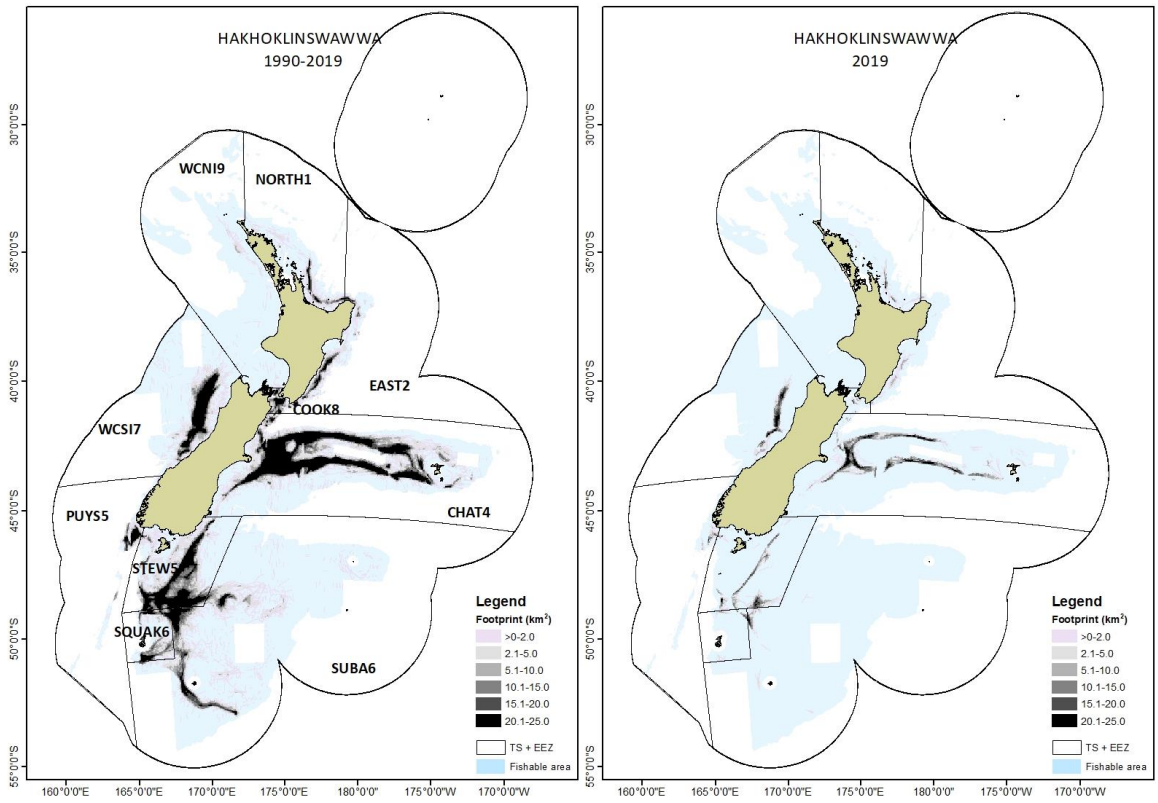


Figure 16: Distribution of the HAK/HOK/LIN/SWA/WWA footprint, by 25-km^2 cells in each Bycatch Assessment Area (see Anderson & Edwards 2018), 1990–2019 (left) and 2019 (right).

The other main area, WCSI7, accounted for 12% of the total combined footprint, 19.5% of the aggregate area, and 11% of the cells; the relatively larger percent of the aggregate area in WCSI7 is indicative of more effort in a relatively confined fishery area compared with other main areas (apart from CHAT4). Much of the WCSI7 data will be from the hoki spawning fishery, whereas areas such as CHAT4 and STEW5 are more likely to include a more even spread of effort by the five target species in this group.

In the most recent year, 2019, which had one of the lowest estimated annual footprints in the time series, decreases were seen in all the main areas, and slight increases were seen in the less fished areas such as EAST2, NORTH1, and PUYS5. For the main areas, 57% of the 2019 HAK/HOK/LIN/SWA/WWA footprint was in CHAT4, 15% in STEW5, 4% in SUBA6, and 16% in WCSI7; 58.5% of the aggregate area was in CHAT4, 14% in STEW5, 3% in SUBA6, and 17% in WCSI7; and 45% of cells contacted were in CHAT4, 18% in STEW5, 6% in SUBA6, and 12% in WCSI7.

4.2.4 ORH/OEO for MSC areas: number of cells, aggregate area, and footprint

Fisheries New Zealand requires summary footprint output for orange roughy and oreo species for provision to the Marine Stewardship Council (MSC) certification process and requested that the combined data are analysed by orange roughy areas ORH7A (Challenger Plateau), NWCR (northwest Chatham Rise), and ESCR (southeast Chatham Rise) (Figure 17).

The annual and total numbers of cells contacted, aggregate area, and footprint are given for each area in Table D15. The western area ORH7A has been subject to closures (Fisheries New Zealand 2020), with the first after the peak footprint in the 1990–2019 series during 1998 and 1999 when the footprint contacted over 2000 km^2 a year and about 888 cells (Table D15). The footprint halved in 2000 and there was very little contact in years with data until 2015–2019, when between 320 and 552 cells were contacted and the footprint ranged between 755 and 1493 km^2 (1366 km^2 in 2019 and aggregate area of 1546 km^2). In total, ORH7A had an aggregate area of 22 466 km^2 and a footprint of 8975 km^2 that contacted 1481 cells.

The NWCR area contacted fewer cells overall (859 cells), but had a similar aggregate area (22 011 km^2) and a smaller footprint (6882 km^2) to ORH7A (Table D15). The main period of contact in NWCR was during 1997–2005 (footprint range of 678 to 1623 km^2), with the peak years being 2001–2004. In 2008–2010, the annual footprints were between about 212 and 544 km^2, and in 2011–2013 there was very little trawling. From 2014 to 2019, the footprint was variable, at 235 km^2 in 2014, a peak at 888 km^2 in 2017, and 486 km^2 in 2019.

Overall, the ESCR area had an aggregate area of 39 529 km^2 and a footprint of 11 209 km^2 that contacted 1505 cells (Table D15). Of the three areas, ESCR is the only one with effort each year during 1990–2019; however, there were periods of smaller footprints (1993–2003, with footprints generally under 600 km^2, though with 4 years of 804–984 km^2 footprints). This was followed by increased footprints during 2004–2011 (1334–2065 km^2), lower footprints in 2011–2015 (340–498 km^2), before increasing to 700–842 km^2 in 2016–2019.

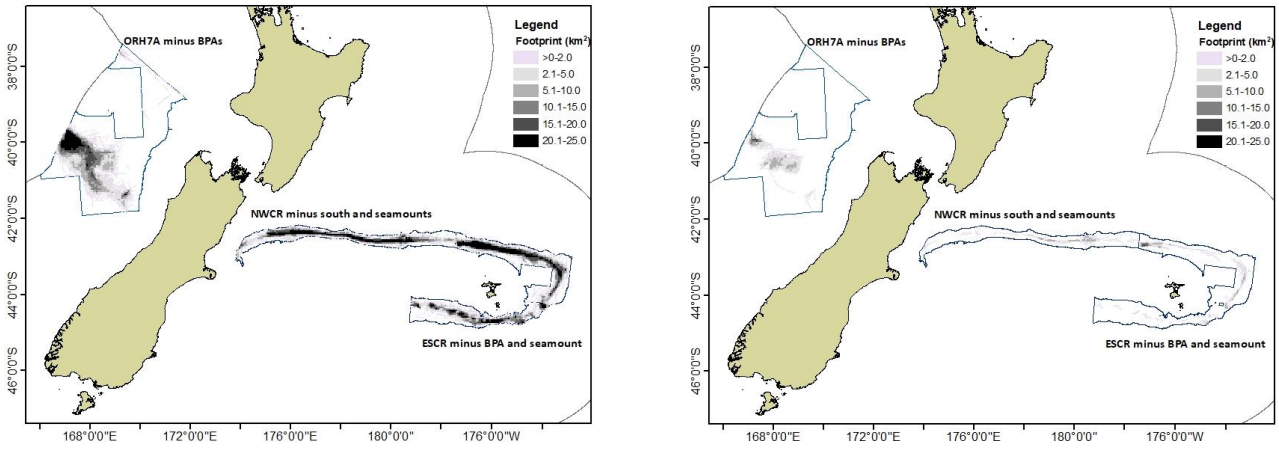


Figure 17: The extent of the footprint, based on 25-km^2 cells, for the ORH/OEO fishery (left) for the ORH MSC ORH7A, NWCR, and ESCR areas, in 800–1600 m, for 1990–2019 (left) and 2019 (right).

4.3 Extent of new cells contacted across the time series

The number of cells that were fished in one year, but not in previous years is shown in Table 9 for the combined deepwater fishstocks, where the base footprint was created for 1990–1994 and contacted 25 103 cells. It is evident from Tables 9 and D16 that in the many of these years the contact in the new cells is low intensity; there is little difference between the aggregate area and the footprint, which could indicate exploratory fishing or be an artefact of the methodology used to generate the spatial data. However, in years of higher effort and increased swept areas (as seen in 1998–2000), the numbers of new cells increased and the aggregate area relative to the footprint was greater. This larger difference is also evident in some of the Tier 1 targets, such as hoki in 1998 and 2000, orange roughy in 1998 and 2001, arrow squid in 1998 and 2001, and scampi in 2005 (Table D17).

The spatial distribution of where the footprint contacted the seafloor in one year but not the next, for deepwater targets is shown in Figure D3. This is not based on the cell grid, but is a direct comparison of the footprint of previous years and the footprint of the most recent year and indicates that in recent years there has been little expansion beyond the regularly fished areas, other than some contact in the Challenger area off the west coast of the South Island. The comparison of the 1990–2018 footprint with the 2018–2019 footprint for deepwater fishstocks (not based on cell differences) yielded a footprint of 2292.6 km^2 from 6393 cells, with a max of 9.8 km^2 per cell and mean of 0.36 km^2. This indicates that much of the difference is in cells that have been contacted previously, apart from the obvious dark areas in the last plot in Figure D3 – areas which correspond with the new cells identified in 2019 (Figure D4).

Table 9: For the deepwater fishstocks, the number of cells contacted in a year, that had not been contacted in previous years, and the aggregate area and footprint within those cells. A base of 25 103 cells were contacted in 1990–94, and, for example, 1316 cells were contacted in 1995 (but not in 1990–94), with an aggregate area of 1201 km^2 and footprint of 1022 km^2. Table D16 shows the equivalent data for Tier 1 and Tier 2 fishstocks.

Fishing year	No. new cells	Aggregate area (km^2)	Footprint (km^2)
No. cells contacted in 1990–94 = 25 103			
1995	1 316	1 201.5	1 022.3
1996	1 420	1 032.1	948.8
1997	1 185	916.0	868.5
1998	1 543	1 892.8	1 538.1
1999	1 388	1 360.6	1 172.7
2000	1 227	1 517.1	1 363.2
2001	737	715.7	614.1
2002	1 173	1 050.2	1 007.5
2003	633	703.5	629.7
2004	328	319.8	294.9
2005	557	587.0	519.9
2006	266	134.0	129.3
2007	251	153.4	143.7
2008	279	191.0	177.7
2009	220	99.7	96.6
2010	165	60.3	59.5
2011	167	59.1	58.7
2012	106	36.9	36.7
2013	74	35.6	35.0
2014	94	34.4	34.2
2015	178	171.8	157.7
2016	172	108.6	104.5
2017	100	60.8	59.4
2018	117	32.8	32.8
2019	73	89.9	85.7

4.4 Intensity

For the combined 1990–2019 deepwater fishstocks data, the median number of tows that contacted a cell was 13 tows (mean of 180), and 50% of cells had contact by between 3 and 83 tows, with a maximum of 19 434 tows over the total dataset (Table 10). Refer to Figure 15 which shows the areas where fishing was most intense in 1990–2019 and 2019.

For Tier 1 targets, the median number of tows in a cell in a year was about 4 tows during 1990–2019 (Table D18). The mean numbers increased during the 1990s to 2005 (peak at about 22 tows per cell), before dropping to a steady 14–16 tows and about 17–18 in 2018 and 2019. At the same time the maximum numbers of tows per cell decreased from over 1000 to about 500 in most years since 2006.

Table 10: Summary data for the number of tows that contact a cell, the aggregate area, and the footprint by 25-km^2 cell for the deepwater fishstocks data, for the combined fishing years 1990–2019. Annual summaries for Tier 1 are given in Table D18.

	Minimum	1st quarter	Median	Mean	3rd quarter	Maximum
No. of tows	1	3	13	180	83	19 434
Aggregate area (km^2)	< 0.1	1.0	5.3	89.4	35.5	12 772.9
Footprint (km^2)	< 0.1	1.0	4.7	9.0	17.6	25.0

The annual median values were 1–2 km^2, whereas the means ranged between about 7 and 11 km^2, with peak years during the mid-1990s to mid-2000s. The maximum aggregate areas were mostly during 1991–1995, at 800–1631 km^2, and in 2004 and 2005 (at about 920–950 km^2). Median footprint in comparison with aggregate area values indicated that many cells have low levels of contact (Table D18).

The influence of the HAK/HOK/LIN/SWA/WWA mixed fishery group is obvious when comparing summary data of Tables D18 and D19, particularly after the mid–1990s: hoki effort has the greatest effect, and note that silver warehou and white warehou are Tier 2 targets (compare data in Tables D5 and D8). Overall, the median aggregate area per cell has increased, and the highest median values for number of tows contacted, aggregate area, and footprint per cell was highest in 2019. When these mixed fishery group data are split by Bycatch Assessment Area, the areas with the greatest intensity as measured by the aggregate area per cell are CHAT4, COOK8, STEW5, and WCSI7 (Table D20). Different sized vessels fish in these areas and this is reflected in the data: for example, smaller vessels fish in Cook Strait waters than in the offshore areas. The maximum number of tows per cell for 1990–2019 was from Cook Strait. Most areas appeared to have more intense effort during the early-2000s.

Summary data for the ORH/OEO targets (Table D21) reflect the generally shorter tows for these targets, often in isolated areas, and the effects of quota changes in some years, in contrast to the larger HAK/HOK/LIN/SWA/WWA tows in broader fishery grounds where, despite some quota changes for hoki, the other targets can be fished.

For comparison, the summary data for Tier 2 targets are given in Table D22; these data reflect the lower level of effort for these targets.

Table 11: Number of tows per cell for five of the Bycatch Assessment Areas used to analyse the bottom-contacting trawl footprint of HAK/HOK/LIN/SWA/WWA, for 1990–2019 and 2019.

	1990–2019 no. tows per cell			2019 no. tows per cell		
	median	mean	maximum	median	mean	maximum
CHAT4	6	18	316	6	16	195
COOK8	3	30	1418	5	21	255
PUYS5	7	16	351	7	13	115
STEW5	4	15	633	4	11	271
SUBA6	2	6	394	2	7	59
WCSI7	6	27	1144	9	23	568

4.5 Number of years contacted

Of the 38 872 cells contacted by the 1990–2019 deepwater footprint, 60% had under 10 years of contact: 19% were contacted in 1 year, 10% in 2 years, 7% in 3 years, and 5.6% in 4 years. Another 5.6% were contacted each year in the 30-year dataset (Figure 18). The spatial distribution of these cells, by number of years contacted is shown in Figure 19 with the primary fishery areas for Tier 1 targets clearly distinguished.

About 27% (n = 10 352) of all deepwater cells were contacted in 2019, and 8.5% (n = 3298 cells) were last contacted in 2018 (see Figure 18); the distribution of these cells by last year fished is shown in Figure 19. Another 18% were last contacted during 2014–2017. About 17% have not been contacted since 2000.

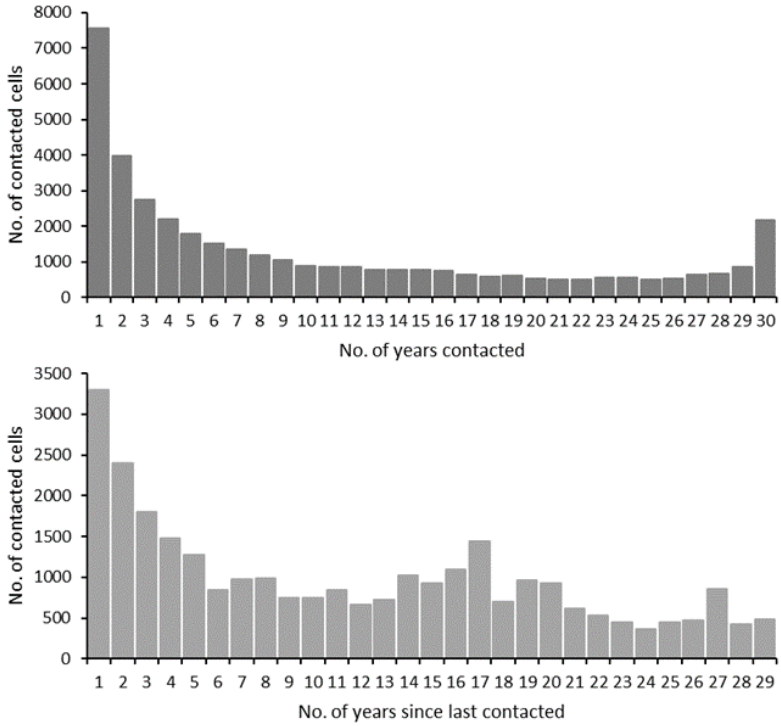


Figure 18: The number of cells contacted in annual year bins for 1990–2019 (upper) and the number of cells in each bin representing the number of years since a cell was last contacted (lower).

4.6 Overlap of the deepwater footprint and 200-m depth zones

The all-year deepwater contact (Tier 1 and Tier 2 combined) was greatest in middle depths: 29% of the total 1990–2019 footprint was in 400–600 m and 17% was in 600–800 m (Table D23). Shallower depths accounted for 24% in under 200 m and 12% in 200–400 m. Beyond 800 m, 10% of the total deepwater footprint was in 800–1000 m, 5% in 1000–1200 m, and almost 3% in 1200–1600 m. For 2019, the spread of the annual footprint by depth zone was similar to that above, but a greater percent was in 400–600 m (at 48%), with 92% in 0–800 m compared with 82% of the 30-year footprint. The extents of these footprints, by depth zones, are shown in Figure 20.

Overall, the total deepwater footprint contacted 25% of the seafloor area open to trawling in depths under 1600 m (Table 12). In the middle depths, 40% of 400–600 m and 32% of 600–800 m of the seafloor areas were contacted; in shallower depths, 42% in 200–400m and 34% in under 200 m were contacted; and 21% of 800–1000 m, 13% of 1000–1200 m, and under 5% of the two deepest zones were contacted. The 2019 overlap shows a similar pattern to the all-year pattern, being greatest in the under 800 m zones, with a maximum overlap of 8% in 400–600 m.

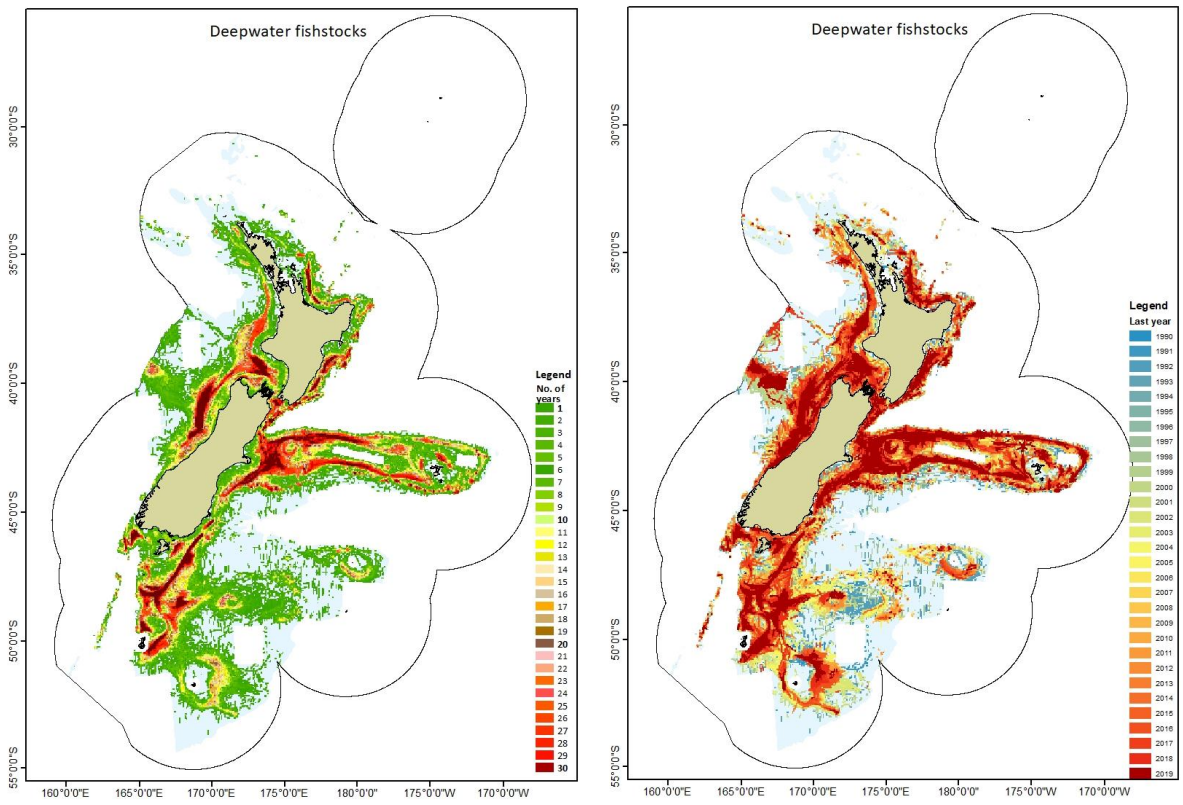


Figure 19: Distribution of the deepwater cells, by the number of years contacted (left), and by the year last fished (right).

The estimated footprints by Tier 1 and Tier 2 targets are given in Tables D24–D27. Jack mackerel, arrow squid, and hoki had the largest footprints in 0–200m; hoki, scampi, and arrow squid in 200–400 m; mainly hoki, then southern blue whiting, ling, hake, and scampi in 400–600 m; mainly hoki, then ling, hake, and arrow squid in 600–800 m; and in waters deeper than 800 m, mainly orange roughy, as well as oreo and hoki. Note that the distribution for some targets is outside their main depth range and this is an artefact of using the 25-km^2 cell grid with the depth value being the midpoint. The 2019 footprint has a similar pattern.

The 1990–2019 footprint overlap of each depth zone, expressed as the percentage contacted in each depth zone, is shown for Tier 1 targets separately and combined in Table 13. The total hoki footprint has the greatest coverage of 200–800 m waters, contacting about 20% of the 200–400 m zone, 28% of the 400–600 m zone, and 28% of the 600–800 m zone (Table 13). In less than 200 m, the targets with the greatest footprint overlap are jack mackerel species and arrow squid. Other targets with footprint overlap of at least 6% in the 200–400 m zone are jack mackerels, ling, scampi, and arrow squid. Hake, ling, and southern blue whiting cover 5–7% of the 400–600 m zone.

In the deep zones, the orange roughy footprint has an 11% overlap, and oreo species and hoki footprints each have 5% overlap in 800–1000 m. In 1000–1200 m, 8% of the seafloor area is contacted by the orange roughy footprint, and 3.5% by the oreo footprint. Orange roughy has the largest overlap in the two deepest zones, with 3% in 1200–1400 m and about 2% in 1400–1600 m. The patterns seen for the 2019 footprint for these species were similar to those described above, though the percentage overlap was substantially smaller, for only one year of footprint; for example, the hoki overlap in 2019 in 400–600 m was 7% (Table 14).

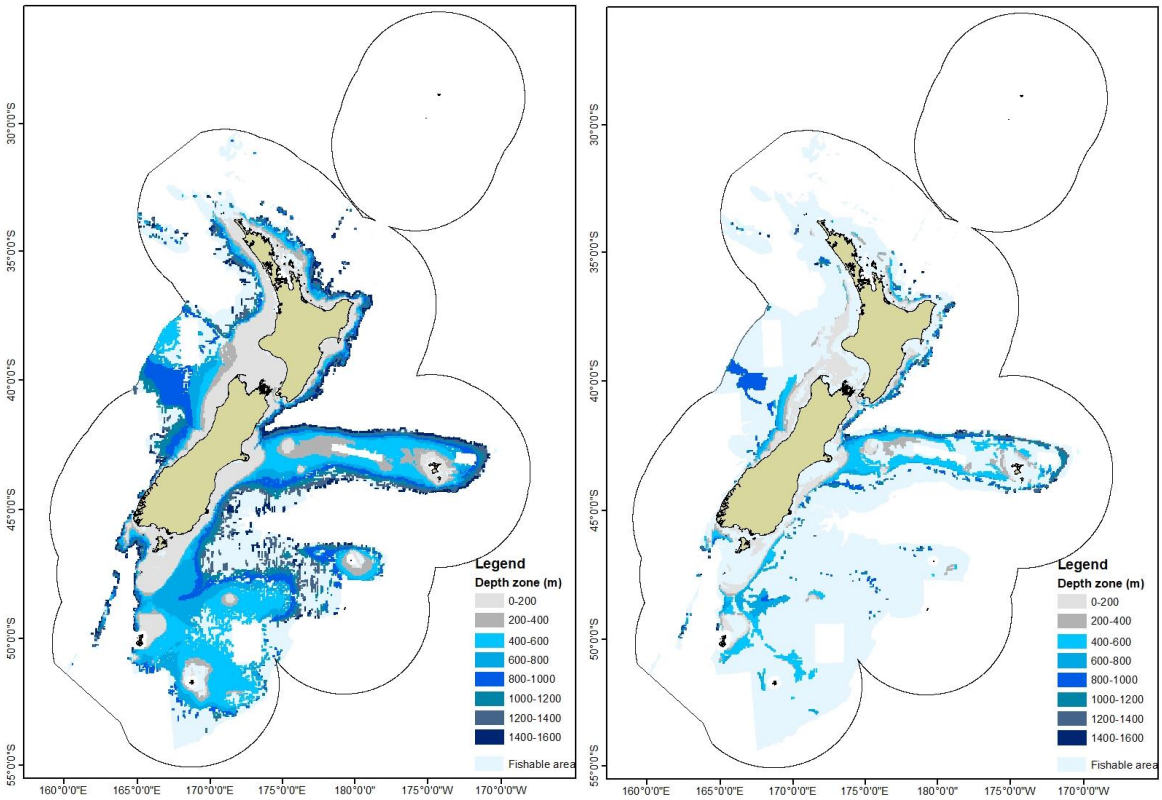


Figure 20: Extent of the deepwater footprint overlap with 200-m depth zones, represented by 25-km^2 cells for 1990–2019 (left) and 2019 (right).

Table 12: The total area of each fishable area depth zone and the percent contacted by the 1990–2019 and 2019 footprints for the Tier 1, Tier 2, and total deepwater target species.

Depth	Area	1990–2019 footprint overlap (%)			2019 footprint overlap (%)		
zone (m)	(km^2)	Tier 1	Tier 2	All	Tier 1	Tier 2	All
< 200	249 341.9	27.2	25.5	34.2	2.1	2.0	3.0
200–400	98 295.9	38.4	19.5	42.3	5.3	1.0	6.0
400–600	253 939.2	39.8	5.9	40.5	7.4	0.3	8.3
600–800	185 161.6	30.9	2.0	31.6	2.5	0.1	3.0
800–1000	166 645.0	20.4	1.0	20.8	1.3	0.0	1.5
1000–1200	144 930.5	12.7	0.7	13.0	0.5	0.0	0.7
1200–1400	168 376.8	4.2	0.3	4.3	0.1	0.0	0.2
1400–1600	124 988.8	2.2	0.3	2.3	0.0	0.0	0.1
≤ 1600	1 391 679.7	23.4	7.5	25.3	2.6	0.5	3.2

Table 13: The total seafloor area in each depth zone within 'fishable' depth zones ≤ 1600 m, and the percentage of each depth zone contacted by the 1990–2019 Tier 1 footprint.

Depth	Area	Footprint area overlap (%)									
zone (m)	(km^2)	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
< 200	249 341.9	0.13	5.17	15.82	1.08	0.04	0.11	0.04	0.71	9.71	27.17
200–400	98 295.9	1.35	19.79	5.96	7.39	0.07	0.20	3.94	9.59	8.51	38.38
400–600	253 939.2	5.00	28.03	0.35	4.58	0.08	0.22	7.46	3.47	2.04	39.77
600–800	185 161.6	3.02	28.20	0.18	3.12	0.80	0.90	0.18	0.24	1.57	30.93
800–1000	166 645.0	0.62	5.32	0.03	0.21	5.26	11.09	0.03	0.10	0.29	20.36
1000–1200	144 930.5	0.04	1.39	0.04	0.05	3.50	8.87	0.02	0.10	0.22	12.72
1200–1400	168 376.8	0.01	0.38	0.04	0.02	0.85	3.05	0.01	0.06	0.16	4.16
1400–1600	124 988.8	0.01	0.31	0.01	0.01	0.30	1.59	0.00	0.05	0.08	2.20
≤ 1600	1 391 679.7	1.51	12.05	3.36	2.00	1.26	2.96	1.68	1.50	3.01	23.41

Table 14: The total area of the seafloor in each depth zone within 'fishable' waters, all depth zones ≤ 1600 m combined, and the percentage of each depth zone covered by the 2019 trawl footprint for each Tier 1 target species and for the Tier 1 targets combined. – indicates no overlap.

Depth zone (m)	Area (km²)	Footprint area overlap (%)									
		HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
< 200	249 341.9	<0.01	0.15	1.08	0.03	<0.01		<0.01	0.05	1.02	2.33
200–400	98 295.9	0.01	1.60	0.12	0.32	<0.01	<0.01	0.10	2.28	1.20	5.62
400–600	253 939.2	0.09	6.66	<0.01	0.33	<0.01	<0.01	0.26	0.88	0.08	8.30
600–800	185 161.6	0.08	2.74	<0.01	0.21	<0.01	0.02	–	<0.01	<0.01	3.05
800–1000	166 645.0	<0.01	0.26	–	0.02	0.10	1.06	–	<0.01	–	1.45
1000–1200	144 930.5	–	<0.01	–	<0.01	0.08	0.58	–	<0.01	<0.01	0.67
1200–1400	168 376.8	–	<0.01	–	–	0.01	0.18	–	<0.01	–	0.18
1400–1600	124 988.8	–	<0.01	–	–	<0.01	0.04	–	–	–	0.05
≤ 1600	1 391 679.7	0.03	1.75	0.20	0.12	0.02	0.22	0.05	0.33	0.28	3.01

4.7 Overlap of the deepwater footprint and BOMEC classes

About 84% of the 1990–2019 footprint was distributed in 6 BOMEC classes: J (22%), H (18%), L (16%), I (11%), C (10%), and E (7%) (Table D28). Another 9% of the footprint was in classes M and N. The spatial distribution of the footprint by class is shown in Figure 21 and the annual footprints by Tier 1 and Tier 2 fishstocks are given in Tables D29 and D30.

When the overlap is expressed as a percent of the seafloor area of each class, deepwater footprint had the greatest overlap, in descending order, in BOMEC classes I (74% area contacted), G, H, C, and E (54%–40%) (Table 15). For some classes, the overlap was mainly from the Tier 1 footprint (C, G-J, and L), from the Tier 2 footprint (B), or more evenly spread (E). In the BOMEC classes M–O, the overlap is very small, mainly because these classes are in deeper waters. There was minimal overlap of class K, a very small area north of the North Island (see Figure B2). The percent overlap by Tier 1 target footprints is given in Tables 16 and 17: jack mackerel is the main contributor to class C; arrow squid, jack mackerel, and hoki for class E; hoki and ling in class G; hoki, jack mackerel, ling and arrow squid in class H; hoki in class I; hoki and orange roughy in class J; hoki and southern blue whiting in class L.

Table 15: The total area of each BOMEC class and the percentage of each class area covered by the 1990–2019 and 2019 bottom-contacting trawl footprint for the Tier 1, Tier 2, and combined deepwater fishstocks. – indicates no overlap.

BOMEC		1990–2019 footprint overlap (%)			2019 footprint area overlap (%)		
Class	Area (km²)	Tier 1	Tier 2	All	Tier 1	Tier 2	All
A	30 661.0	2.5	3.0	4.9	0.1	0.03	0.1
B	12 786.1	9.8	29.0	34.4	0.2	2.60	2.8
C	90 256.5	33.0	14.4	40.6	2.7	0.34	3.0
D	28 085.7	8.4	7.0	13.5	0.4	0.18	0.5
E	61 258.0	33.7	21.2	40.1	3.9	2.15	5.4
F	38 775.8	17.6	0.6	17.8	0.8	0.00	0.8
G	6 702.3	42.2	24.7	54.1	4.0	1.68	5.6
H	138 399.1	43.5	16.7	46.9	6.5	0.78	7.2
I	52 008.3	73.7	10.8	74.2	18.7	0.63	19.0
J	312 604.9	24.1	2.8	25.0	3.1	0.14	3.2
K	1 200.2	0.2	< 0.1	0.3	–	–	–
L	198 578.4	28.4	0.4	28.5	2.8	0.01	2.8
M	233 837.4	8.0	0.1	8.0	0.3	0.00	0.3
N	495 154.2	2.4	0.2	2.5	0.1	0.01	0.1
O	1 006 911.1	0.1	0.0	0.1	0.0	0.00	0.0
All	2 707 219.0	12.0	2.7	13.0	1.5	0.15	1.6

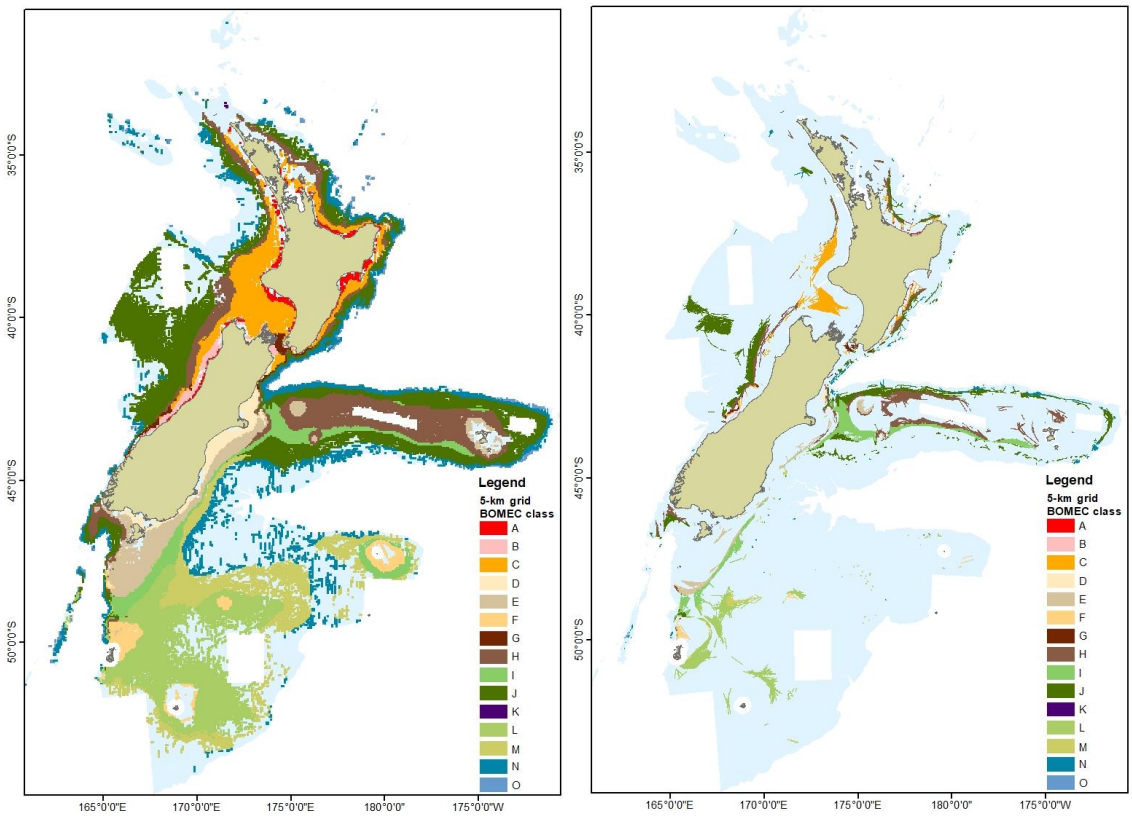


Figure 21: Extent of the deepwater Tier 1 footprint overlap with BOMEC classes, represented by 25-km^2 cells for 1990–2019 (left) and 2019 (right). The extent of the Tier 2 overlap is in Figure D5.

Table 16: The total area of each BOMEC class and the percentage of each area covered by the 1990–2019 footprint for the Tier 1 deepwater target species. Note: there are some large differences in the areas of some classes. – indicates no overlap.

		Footprint area overlap (%)									
Class	Area (km^2)	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
A	30 661.0	<0.01	0.50	0.40	0.02	0.01	0.14	0.01	0.20	1.25	2.49
B	12 786.1	0.29	6.21	0.67	2.51	0.03	0.11	0.06	0.06	0.36	9.77
C	90 256.5	0.09	3.15	27.82	0.35	0.01	0.10		0.67	1.68	33.00
D	28 085.7	0.04	3.08	1.68	0.63	0.06	0.13	0.01	0.33	4.16	8.36
E	61 258.0	0.38	9.00	14.29	2.29	0.12	0.03	<0.00	0.17	24.99	33.70
F	38 775.8	0.04	1.10	0.30	1.11	<0.01	0.02	5.09	0.78	11.21	17.64
G	6 702.3	1.02	31.94	0.29	11.09	0.05	1.40		1.51	0.09	42.18
H	138 399.1	5.57	28.04	7.63	7.13	0.05	0.17	0.02	8.18	5.17	43.47
I	52 008.3	3.75	66.06	0.65	8.50	0.53	0.24	4.36	0.09	9.58	73.75
J	312 604.9	3.14	12.05	0.32	0.78	2.51	9.74	0.01	0.85	0.59	24.07
K	1 200.2	–	0.20	–	–	–	0.04	–	–	–	0.24
L	198 578.4	0.45	15.93	0.03	3.77	0.04	0.01	9.27	2.72	2.15	28.40
M	233 837.4	0.09	4.57	<0.01	0.09	2.90	0.38	0.26	0.02	0.19	7.97
N	495 154.2	<0.01	0.35	0.01	0.01	0.44	1.77	0.01	0.04	0.08	2.43
O	1 006 911.1	<0.01	0.00	<0.01	<0.01	0.02	0.04	–	<0.01	<0.01	0.05
All	2 707 219.0	0.78	6.19	1.72	1.03	0.65	1.52	0.86	0.77	1.55	12.04

Table 17: The total area of each BOMEC class and the percentage of each area covered by the 2019 bottom-contacting trawl footprint for the Tier 1 deepwater target species. – indicates no overlap.

		Footprint area overlap (%)									
Class	Area (km^2)	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier1
A	30 661.0	–	<0.01	<0.01	<0.01	–	–	–	<0.01	–	0.01
B	12 786.1	<0.01	0.44	0.01	0.24	–	<0.01	–	<0.01	0.01	0.70
C	90 256.5	<0.01	0.09	3.65	0.05	–		–	<0.01	0.01	3.80
D	28 085.7	<0.001	0.07	0.01	0.02	–	–	–	<0.01	0.05	0.15
E	61 258.0	<0.01	0.37	0.28	0.10	<0.01	–	–	<0.01	2.58	3.15
F	38 775.8	–	<0.01	–	<0.01	–	<0.01	0.25	<0.01	2.05	2.12
G	6 702.3	0.09	3.13	<0.01	2.08	–	–	–	0.01	0.01	5.34
H	138 399.1	0.02	3.95	0.24	0.34	–	<0.01	–	<0.01	0.14	6.35
I	52 008.3	0.32	19.71	–	0.33	<0.01	<0.01	0.02	<0.01	0.63	2.60
J	312 604.9	0.43	2.31	<0.01	0.07	0.04	0.69	–	<0.01	0.01	3.38
K	1 200.2	–	–	–	–	–	–	–	–	–	–
L	198 578.4	<0.001	1.33	–	0.12	<0.01	–	0.07	<0.01	0.39	2.99
M	233 837.4	<0.001	0.30	–	<0.01	0.04	<0.01	0.02	<0.01	–	0.35
N	495 154.2	<0.001	<0.01	–	<0.01	0.01	0.11	–	<0.01	<0.01	0.12
O	1 006 911.1	–	–	–	–	<0.01	<0.01	–	<0.01	<0.01	0.00
All	2 707 219.0	0.06	1.02	0.14	0.05	0.01	0.10	<0.01	<0.01	0.14	1.68

4.8 Overlap of the Tier 1 target footprints and predicted habitat

The overlap of each Tier 1 species footprint on their 'preferred habitat' distribution (probability of occurrence) for the seven fish species (or annual distribution for scampi and arrow squid) is shown in Figures 22a–22d. This distribution represents the probability of capture (%) of a fish in a standardised trawl where, for example, 91–100% is the body of water in which a trawl is most likely to capture the species.

For all the Tier 1 fish species, except hake and jack mackerels, the footprint is mainly distributed in areas where the probability of occurrence in over 90% (Table D31). For hake and jack mackerels, the footprint is spread out in 50–90% and 20–80% occurrence, respectively. The footprint overlap of the seafloor area of each probability bin is given in Table 18 for the 1990–2019 and 2019 footprints.

The footprint overlap of the annual distributions for scampi and arrow squid is given in Table D31, the percent overlap of seafloor area in Table 18, and the spatial distribution in Figure 22e.

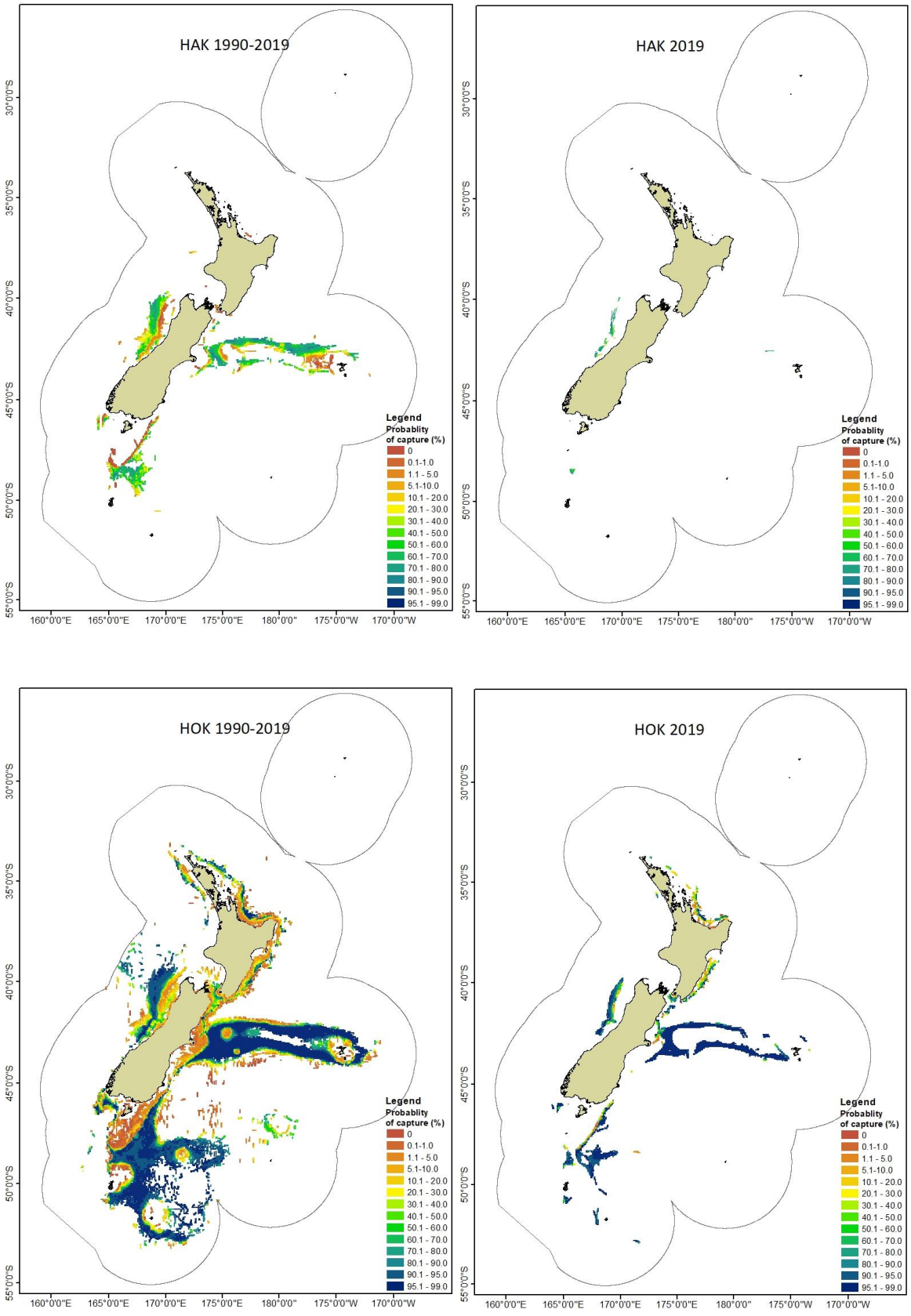


Figure 22a: Distribution of the 1990–2019 (left) and the 2019 trawl footprints (right) for hake (top) and hoki (bottom), displayed by 25-km^2 contacted cell, relative to the probablity of capture for that species (after Leathwick et al. 2006).

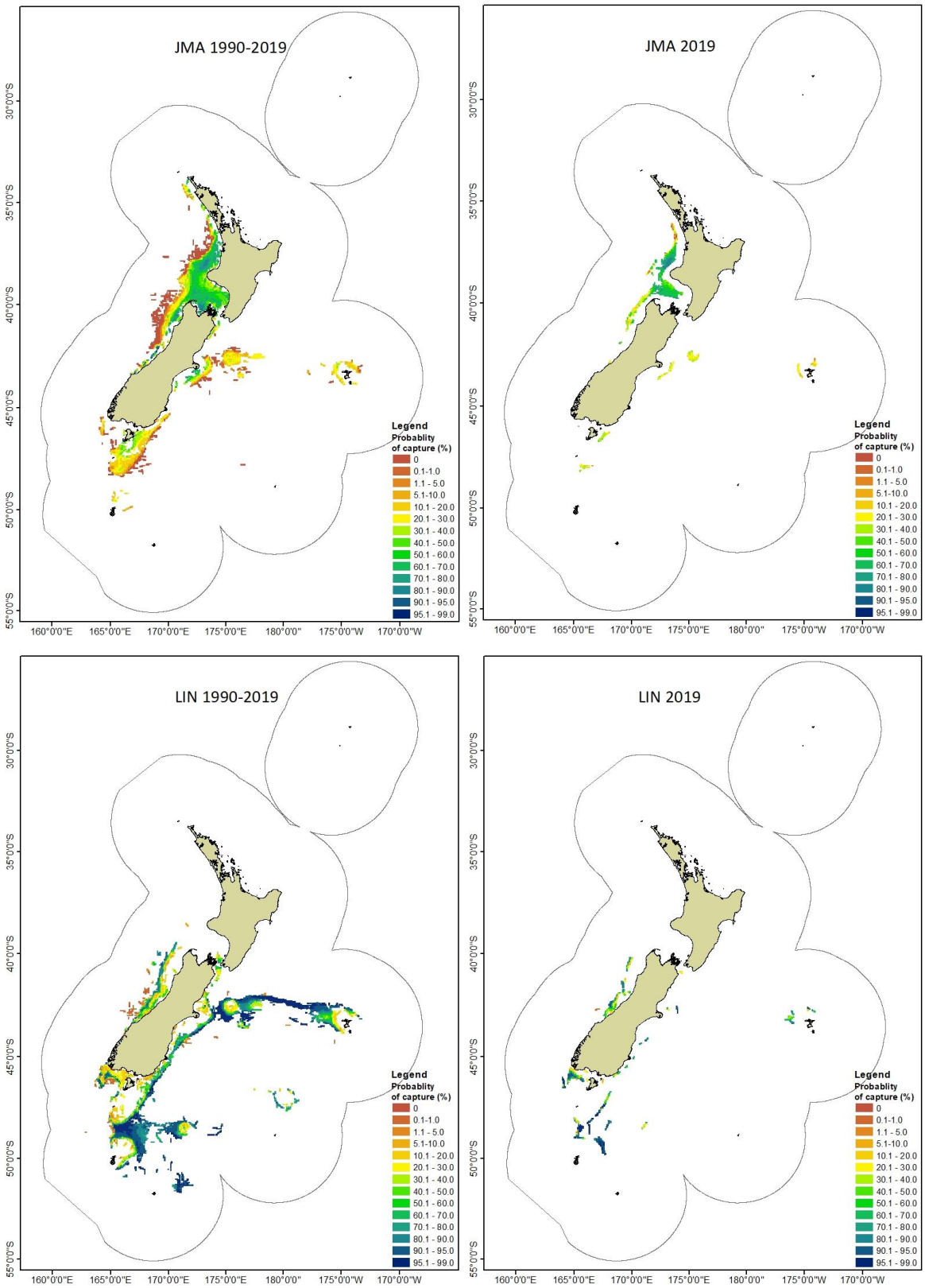


Figure 22b: Distribution of the 1990–2019 (left) and the 2019 trawl footprints (right) for jack mackerels (top) and ling (bottom), displayed by 25-km^2 contacted cell, relative to the probablity of capture for that species (after Leathwick et al. 2006).

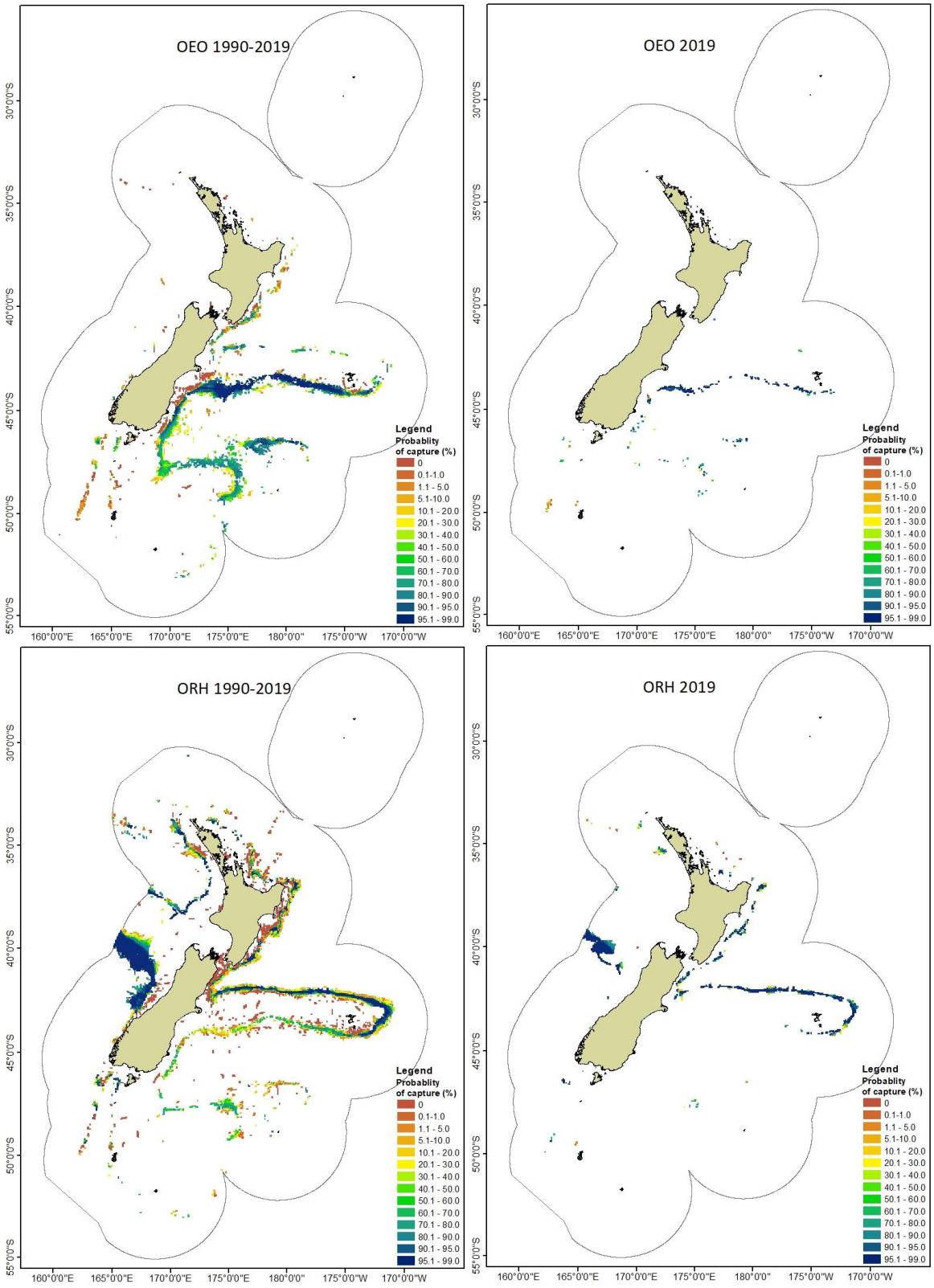


Figure 22c: Distribution of the 1990–2019 (left) and the 2019 trawl footprints (right) for oreo species (top) and orange roughy (bottom), displayed by 25-km^2 contacted cell, relative to the probablity of capture for that species (after Leathwick et al. 2006).

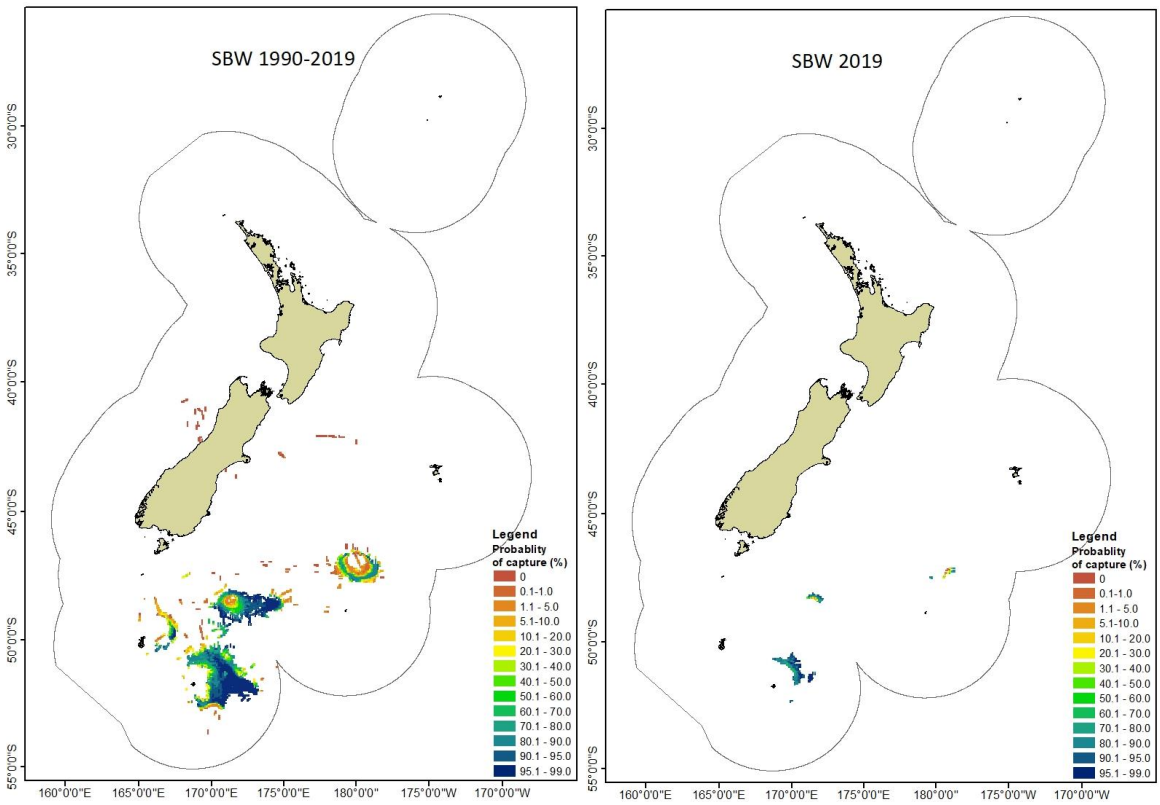


Figure 22d: Distribution of the 1990–2019 (left) and the 2019 trawl footprints (right) for southern blue whiting, displayed by 25-km^2 contacted cell, relative to the probablity of capture for that species (after Leathwick et al. 2006).

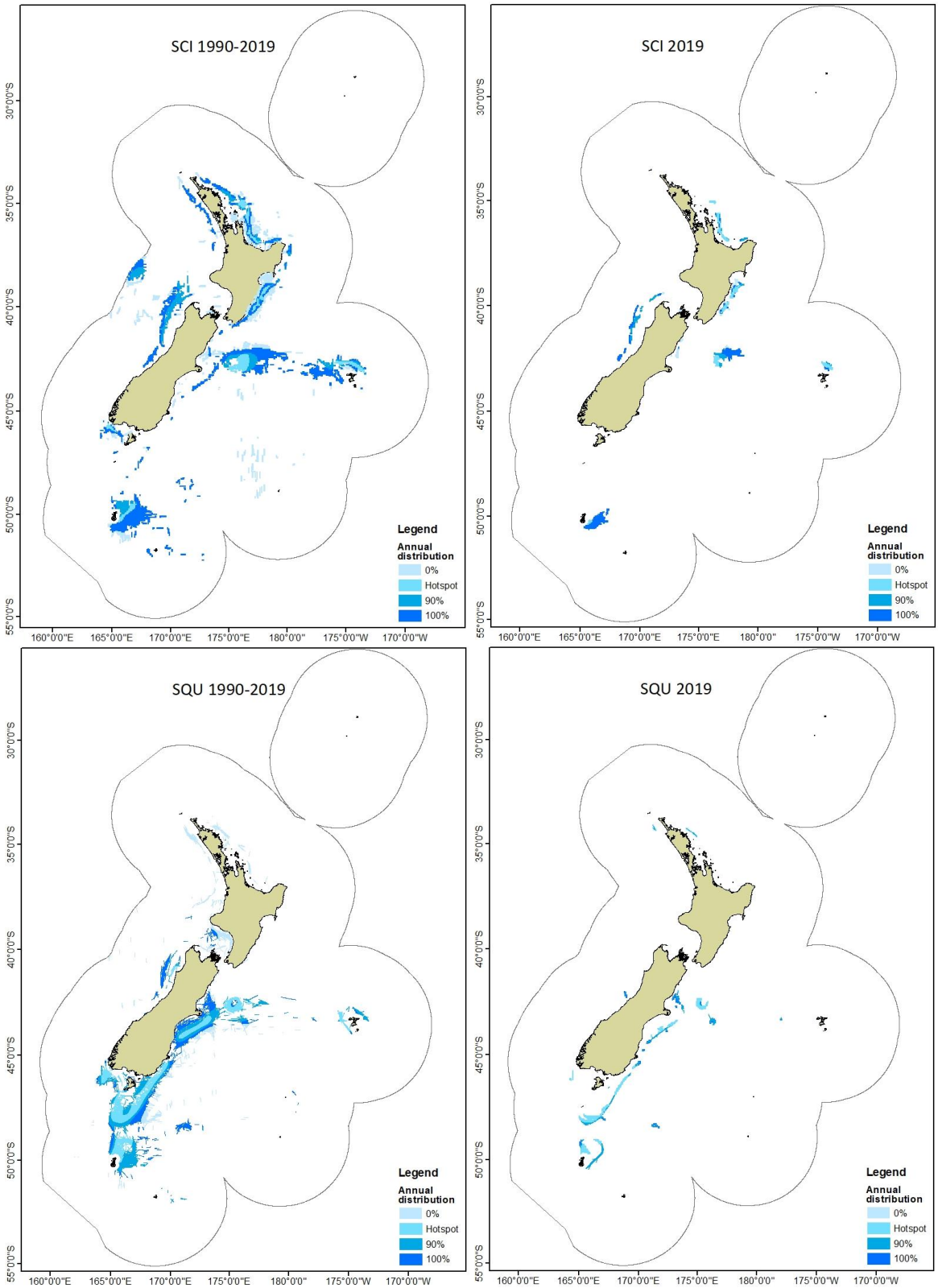


Figure 22e: Distribution of the 1990–2019 (left) and the 2019 trawl footprints (right) for scampi (top) and arrow squid (bottom), relative to the annual distribution of the species population (see www.nabis.govt.nz).

Table 18: The total area of each 'preferred habitat' (probability of capture) and the percentage of each species 'preferred habitat' (probability of capture) area (for HAK, HOK, JMA, LIN, OEO, ORH, and SBW) or area of the annual distribution (for SCI and SQU) covered by the 1990–2019 and 2019 bottom-contact trawl footprint for the Tier 1 deepwater target species. – indicates no data.

Probability occurrence	HAK area	HAK footprint overlap (%)		HOK area	HOK footprint overlap (%)		JMA area	JMA footprint overlap (%)	
(%)	(km^2)	1990–2019	2019	(km^2)	1990–2019	2019	(km^2)	1990–2019	2019
0	157 798.9	0.2	–	59 927.6	0.4	0.01	970 883.1	0.1	<0.01
0.1–1.0	143 613.4	0.2	–	191 141.7	0.6	0.01	32 448.6	<0.6	<0.01
1.1–5.0	372 123.2	0.1	<0.01	232 065.7	1.3	0.03	61 167.9	1.9	0.02
5.1–10.0	157 588.0	0.2	<0.01	94 978.0	3.3	0.10	44 463.3	2.2	0.01
10.1–0.0	136 822.9	0.4	<0.01	107 078.6	3.8	0.12	47 819.6	4.8	0.07
20.1–30.0	89 636.3	0.6	<0.01	47 646.2	5.9	0.24	47 433.6	12.4	0.31
30.1–40.0	71 790.2	1.1	0.01	38 300.4	6.7	0.33	40 735.0	15.9	0.66
40.1–50.0	64 748.6	2.5	0.03	31 571.6	8.4	0.55	35 569.3	13.1	0.63
50.1–60.0	60 031.3	3.9	0.11	27 614.6	10.2	0.64	31 777.9	16.3	1.28
60.1–70.0	55 069.8	5.8	0.16	31 773.8	8.5	0.83	34 795.2	27.3	2.41
70.1–80.0	53 189.8	11.5	0.26	35 949.5	10.6	1.00	27 510.5	24.4	1.45
80.1–90.0	26 263.0	16.6	0.16	58 122.5	11.2	1.39	13 200.3	20.1	3.67
90.1–95.0	2 801.7	10.2	0.06	118 974.0	17.4	2.38	3 330.3	2.0	–
95.1–99.0	202.6	2.1	–	316 535.4	35.3	6.08	545.2	1.6	–
0.0–99.0	1 391 679.7	1.5	0.03	1 391 679.7	12.0	1.75	1 391 679.7	3.4	0.20

Table 18: — *continued*.

Probability occurrence (%)	LIN area (km^2)	LIN footprint overlap (%)		OEO area (km^2)	OEO footprint overlap (%)		ORH area (km^2)	ORH footprint overlap (%)	
		1990–2019	2019		1990–2019	2019		1990–2019	2019
0	16 384.1	0.03	<0.01	591 875.4	0.1	<0.01	775 356.3	0.2	<0.01
0.1–1.0	421 963.7	0.02	<0.01	96 946.8	0.1	<0.01	83 107.9	0.2	<0.01
1.1–5.0	123 925.6	0.1	<0.01	133 348.9	0.2	<0.01	96 265.0	0.4	<0.01
5.1–10.0	70 480.9	0.2	<0.01	72 594.5	0.3	<0.01	44 139.3	0.9	0.02
10.1–0.0	106 096.8	0.4	0.01	79 444.5	0.3	<0.01	46 647.0	1.3	0.04
20.1–30.0	70 823.3	1.6	0.05	55 551.7	0.4	<0.01	35 606.4	1.7	0.06
30.1–40.0	43 367.4	2.7	0.13	37 984.7	0.5	<0.01	27 429.2	1.8	0.05
40.1–50.0	33 728.4	3.6	0.21	33 074.3	0.6	<0.01	23 537.9	2.2	0.07
50.1–60.0	36 340.8	3.0	0.19	33 600.8	0.8	<0.01	22 652.0	2.3	0.06
60.1–70.0	31 498.5	3.5	0.22	35 852.2	1.3	0.01	28 958.4	2.3	0.06
70.1–80.0	42 477.3	3.1	0.18	52 184.0	2.5	0.02	34 593.1	2.9	0.12
80.1–90.0	96 312.2	3.5	0.13	77 332.4	4.1	0.03	40 907.6	5.3	0.28
90.1–95.0	129 835.6	5.9	0.33	43 870.1	6.9	0.09	27 886.2	9.8	0.56
95.1–99.0	168 444.9	5.3	0.42	48 019.4	15.8	0.43	104 593.2	28.5	2.47
0.0–99.0	1 391 679.7	2.00	0.12	1 391 679.7	1.3	0.02	1 391 679.7	3.0	0.22

Table 18: — *continued*

Preferred habitat (%)	SBW Area (km^2)	SBW Footprint overlap (%) 1990–2019	SBW Footprint overlap (%) 2019	Annual distribution*	SCI Area (km^2)	SCI Footprint overlap (%) 1990–2019	SCI Footprint overlap (%) 2019	SQU Area (km^2)	SQU Footprint overlap (%) 1990–2019	SQU Footprint overlap (%) 2019
0	931 718.1	<0.1	–	Hotspot	14 914.5	33.9	8.2	56 994.5	28.2	2.5
0.1–1.0	122 249.7	0.1	<0.01	90% population	77 916.5	6.7	0.8	172 093.3	8.8	1.3
1.1–5.0	140 341.1	0.3	<0.01	100% population	463 031.2	2.0	0.6	306 136.0	2.4	0.1
5.1–10.0	23 088.7	1.5	<0.01	Not Exist /unknown	927 060.7	0.1	0.01	854 868.7	0.4	0.002
10.1–20.0	18 499.5	2.7	0.01							
20.1–30.0	13 156.5	3.3	<0.01							
30.1–40.0	11 096.7	3.4	<0.01							
40.1–50.0	9 764.8	3.6	<0.01							
50.1–60.0	8 856.4	6.2	0.01							
60.1–70.0	8 626.1	8.8	0.03							
70.1–80.0	11 355.4	11.9	0.26							
80.1–90.0	21 664.4	17.2	0.38							
90.1–95.0	20 464.7	26.4	0.50							
95.1–99.0	50 797.8	17.6	0.12							
0.0–99.0	1 391 679.7	1.7	0.02							

***** For SCI and SQU, the areas given here represent the areas shown for the annual distribution for scampi and arrow squid provided by MPI at www.nabis.govt.nz. The 'None' category is the area outside the 100% population area within the combined EEZ and Territorial Sea as Figure B2c.

4.9 Overlap of the deepwater target footprints and sediment layers

Note that these layers do not include the occlusions to the EEZ where the seafloor is beyond 200 nm from land (one southeast on Chatham Rise and one near Pukaki Rise in southern waters). The overlap of the 1990–2019 and 2019 footprints of the seafloor areas estimated for each sediment layer is summarised in Table D32.

The footprint is reasonably well spread throughout the carbonate classes (Table D32), whereas the footprint in the gravel classes is greatest in 0–20%. For mud, most of the footprint is with the 0–20%, 20–40%, and 40–60% classes, and for sand, in the 20–40%, 40–60%, and 60–80% classes. Refer to Figure 12 which shows the overlap of the All Stocks with the sediment layers and the extent of the deepwater footprint shown in Figure 16.

The overlap of the deepwater footprint in the carbonate layer is between 21% (for the 60–80% and 80–100%) to 43.5% (for the 0–20% class); from 11% (of the 80–100%) to 29% (20–40%) of the gravel layer; 21–28% of the mud classes; and 20–30% of the sand classes. The data for 2019 indicate that the percent overlap for all but carbonate 0–20% class is about 4% at the most.

Table 19: Percentage overlap of the seafloor area of the substrate classes by the fishable area 1990–2019 and 2019 deepwater footprint. For gravel, mud, and sand, the percentage classes total 100%, and for carbonate the percentage represents the proportion that is carbonate versus non-carbonate.

Substrate	Class (%)	Class area (km^2)	1990–2019 overlap (%)	2019 overlap (%)
Carbonate	0–20	138 252.7	43.5	8.1
Carbonate	20–40	282 469.8	30.3	3.6
Carbonate	40–60	275 070.0	24.8	2.6
Carbonate	60–80	288 732.7	20.7	2.6
Carbonate	80–100	369 402.8	20.6	2.1
Gravel	0–20	1 037 250.7	26.3	3.4
Gravel	20–40	188 550.0	28.9	3.7
Gravel	40–60	77 886.4	20.3	1.7
Gravel	60–80	26 682.0	19.7	0.9
Gravel	80–100	14 188.5	11.2	2.6
Mud	0–20	387 549.1	28.3	3.3
Mud	20–40	323 852.0	26.5	3.0
Mud	40–60	299 719.3	27.2	4.2
Mud	60–80	233 123.9	20.8	2.7
Mud	80–100	109 712.9	22.0	2.4
Sand	0–20	142 639.8	23.7	2.5
Sand	20–40	348 482.0	19.5	2.6
Sand	40–60	482 383.1	27.7	3.6
Sand	60–80	303 832.8	30.4	3.6
Sand	80–100	77 166.5	28.3	4.0

5. INSHORE FISHSTOCKS TRAWL FOOTPRINT, 2008–2019

5.1 Inshore data

The groomed inshore data for 2008–2019 yielded a dataset of 597 812 bottom-contacting tows for the spatial analysis (Table E1). The main form type used to report inshore data was the TCER (84% of inshore bottom-contacting tows), with another 14% from TCEPRs and 2% from ERS. Overall, 99.4% of the inshore data used bottom trawl gear.

These tows targeted at least 32 species (Table E1), 31% of which targeted flatfish species, 23% targeted tarakihi, 13% targeted red gurnard, 7% targeted snapper, 5% targeted red cod, and 5% trevally. Lesser targets included John dory, barracouta, giant stargazer, and blue warehou. This dataset included effort from 297 vessels, of which 245 were under 28 m (made 95% of tows), 21 were 28–46 m (4% of tows), and 31 vessels larger than 46 m (under 1% of tows). The largest vessels targeted mainly barracouta. Over the 12 years, the number of vessels steadily dropped from 215 in 2008 to 150 in 2019. In 2019, 88% of vessels were under 28 m and accounted for 95% of tows that year, 3% were 28–46 m (4.5% tows), and the remainder were over 46 m (0.4% tows in 2019).

The effort dropped from a peak in 2010 (at 58 487 bottom-contacting tows) to a low in 2019 (38 339 tows). Annual effort decreased for most of the main inshore targets, except for red gurnard (increased numbers of tows over the 12 years) and trevally which was reasonably steady throughout the series.

5.2 The spatial extent

The total number of cells, aggregate area, and footprint for the inshore targets during 2008–2019 are given in Table E2, listed in order of the greatest footprint, with the top 10 targets including tarakihi, red gurnard, flatfish species, snapper, trevally, red cod, barracouta, giant stargazer, John dory, and barracouta. The greatest aggregate area (for tarakihi) was more than twice the swept area estimated from red gurnard tows, and 30% larger than the flatfish aggregate area. The tarakihi footprint contacted 52% of the 2008–2019 footprint compared with the 24% contact by red gurnard tows, 18% by flatfish tows, and about 14% by snapper tows and red cod tows. Overall, 15 199 cells were contacted by inshore targets (based on TCERs, TCEPRs, and ERS data) during 2008–2019, with the swept areas for all tows summing to an estimated aggregate area of 811 595 km^2 to give an overall footprint of 148 276 km^2 (Table 20). This footprint represented 3.6% of the EEZ+TS and 10.7% of the fishable area; and the 2019 footprint represented 2.7% of the EEZ+TS and 0.9% of the fishable area.

Table 20: Annual summary for the spatial overlap of the inshore bottom-contacting effort for 2008–2019 and the overlap (%) with the EEZ+TS (4 111 569.7 km^2) and fishable area (1 391 679.7 km^2).

Fishing year	No. cells	Aggregate (km^2)	Footprint (km^2)	% EEZ+TS	% fishable
2008	9 459	70 357.5	44 237.2	1.1	3.2
2009	9 400	73 623.1	46 321.7	1.1	3.3
2010	9 479	76 839.1	47 219.3	1.1	3.4
2011	9 582	69 901.3	45 152.7	1.1	3.2
2012	9 299	67 975.4	43 572.7	1.1	3.1
2013	9 189	67 735.9	43 465.4	1.1	3.1
2014	9 578	71 053.1	45 608.2	1.1	3.3
2015	9 488	64 803.2	42 765.7	1.0	3.1
2016	9 366	63 334.7	41 718.4	1.0	3.0
2017	9 476	66 374.8	43 266.8	1.1	3.1
2018	9 249	62 985.5	42 585.4	1.0	3.1
2019	8 686	56 611.4	38 131.5	0.9	2.7
2008–2019	15 199	811 595.0	148 276.2	3.6	10.7

The number of cells contacted was between 9189 (in 2013) and 9582 (in 2011) each year for the first 11 years, but in 2019 (the year with the lowest number of tows, see Table E1) the number of cells contacted dropped to 8686. The aggregate area was generally over 67 000 km^2 (peak in 2010 at 76 839 km^2) until 2015 when it decreased in most years to a low of 52 611 km^2 in 2019. A similar trend was seen in the estimated footprint; during 2008–2018 the footprint was mainly in the range 41 718–47 219 km^2, but dropped to 38 131 km^2 in 2019. The spatial distribution of the 2008–2019 and 2019 footprints and aggregate areas are shown in Figure 23.

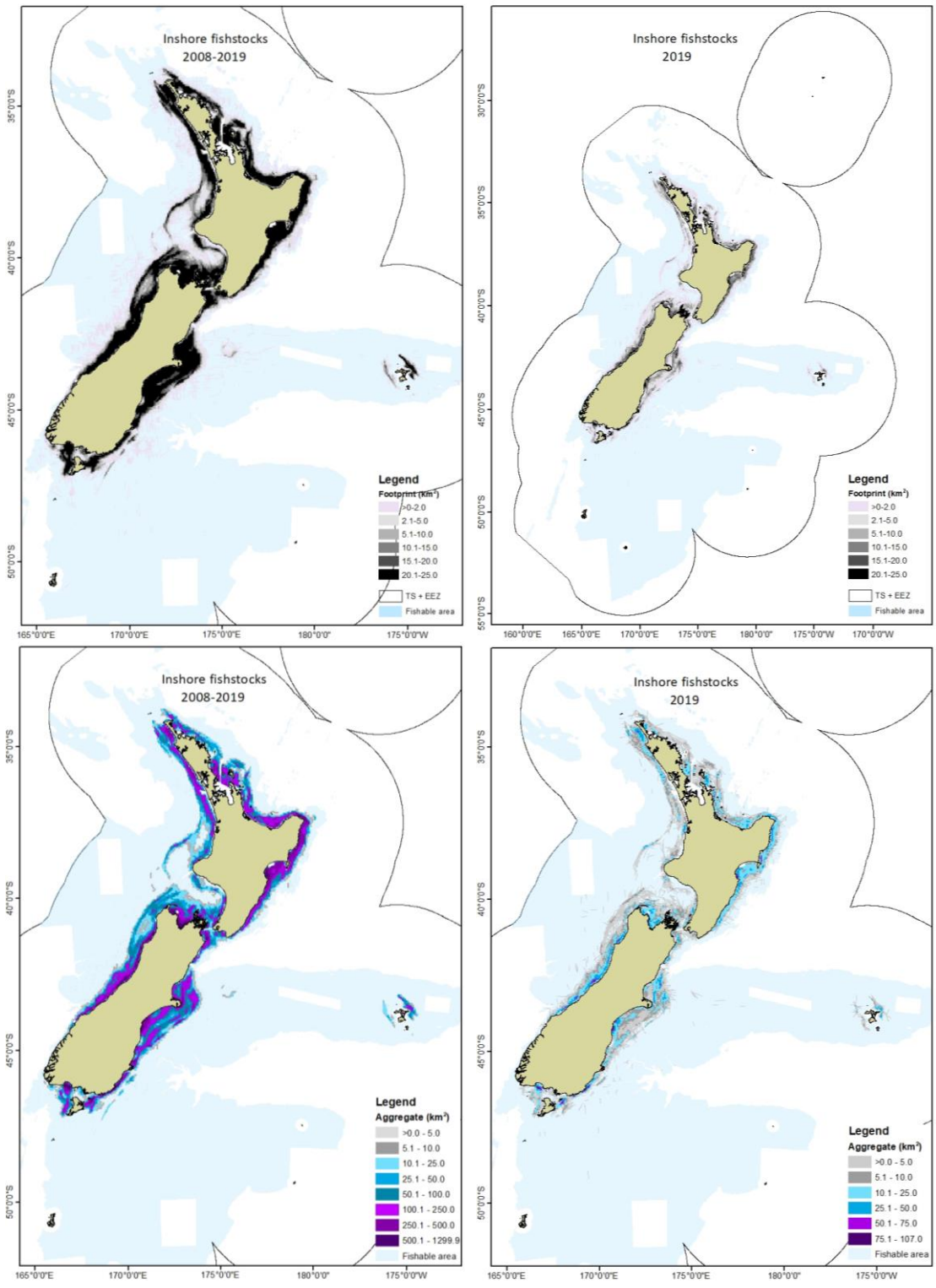


Figure 23: Distribution of the inshore fishstocks footprint (upper maps) and aggregate area (lower), by 25-km^2 cells, 2008–2019 (left) and 2019 (right), with the fishable area (light blue background).

Spatial analysis by fishstock. A fishstock analysis provides a spatial comparison of the effort for each target. When the data are combined by the main fishstocks for inshore bottom-contacting targets (see Table 2), 98.9% of the inshore contacted cells, 99.2% of the aggregate area, and 98.6% of the footprint is retained in the analysis (Table E3). The targets retained in these data include BAR, ELE, FLA, GSH, GUR, JDO, LEA, MOK, RCO, RSK, SCH, SKI, SNA, SPD, SPO, STA, TAR, TRE, and WAR; the annual totals of contacted cells, aggregate area, and footprint for the inshore fishstocks are given in Tables E4–E6 in Appendix E.

For all years, the inshore fishstock effort contacted 15 025 25-km^2 cells, with a total estimated aggregate area of 805 274 km^2 and a total fishstock footprint equivalent to about 18% of the aggregate area (146 224 km^2, see Table E3). Overall, the fishstock footprint contacted 3.6% of the area of the EEZ+TS and 10.5% of the fishable area. There was very little difference from year to year in the percent overlap.

Overall, the main contributors to the 2008–2019 aggregate area were flatfish and tarakihi (see Table E5), with FLA 3, FLA 7, and TAR 2 contributing 82 423–86 306 km^2. TAR 7, TAR 1, GUR 2, and TRE 7 contributed between 40 010 and 55 711 km^2, with SNA 1 totalling 33 232 km^2, and RCO 3 and GUR 7 between 20 893 and 22 512 km^2. The fishstocks that contributed the most to the footprint over the 12 years (see Table E6) were: TAR 7 (23 114 km^2), TAR 1 (19 022 km^2), TAR 2 (15 415 km^2), BAR 1 (13 952 km^2), FLA 2 (13 073 km^2), TRE 7 (11 289 km^2), SNA 1 (11 051 km^2), RCO 3 (10 381 km^2), GUR 7 (9931 km^2), and GUR 2 (9451 km^2). Note that fishstock numbers do not necessary match the FMA boundaries: for example, TAR 1 includes FMAs 1 and 9; BAR 1 includes FMAs 1–3; FLA 3, GUR 3, and RCO 3 include FMAs 3–5; and TRE 7 includes FMAs 7–9.

Annual footprints for the main targets, by fishstock, are shown in Figure 24. Fishstocks TAR 1, 2, and 7 were generally above 3000 km^2 a year but showed different trends. TRE 7 declined from about 3000km^2 a year to about 2000km^2 and other tarakihi and trevally fishstocks were reasonably steady, below 2500 km^2. The FLA 7 footprint decreased from about 5000 km^2 in 2009 and 2010 to a low in 2019 (about 3000 km^2). FLA 3 showed a slight increase to 4500 km^2 in 2013, then a decrease to a low in 2019 (under 3000 km^2). FLA2 and RCO 3 and 7 decreased overall. Apart from a peak in 2010, GUR 2 was steady at about 2500 km^2 a year, whereas GUR 7 increased over the time series to a high in 2019 (at about 2800 km^2), as did the GUR 3 footprint (to 1100 km^2).The SNA 1 footprint decreased to a low in 2016–17 then increased in 2018 to about 2600 km^2). From a peak in 2008, the SNA 8 footprint decreased by half (from 2011) and remained at this lower level of under 500 km^2 between 2016 and 2019. For most fishstocks, the 2019 footprint was very similar or lower than the previous year; GUR 3–8 fishstocks were the main exceptions, showing an increase in 2019.

Spatial analysis by the main coastal FMAs. Annual summaries of the inshore fishstock data by the coastal FMAs around the North Island, South Island, and Stewart Island are given in Tables E7 and E8. FMA 7, FMA 3, and FMA 2 accounted for most of the aggregate area, and FMA 7, FMA 3, and FMA 8/9 accounted for most of the footprint, for 2008–2019 (Table 21).

Table 21: The percent of the aggregate area and footprint totals for 2008–2019, for FMAs 1–3 and 5–8/9, based on the inshore fishstock data.

	FMA1	FMA2	FMA3	FMA5	FMA7	FMA8/9	Total
Aggregate area							
Area (km^2)	102 676.5	155 009.2	175 888.5	47 613.6	215 312.3	107 963.6	804 463.8
% Total	13	19	22	6	27	13	100
Footprint							
Area (km^2)	22 423.5	20 172.2	30 642.0	8 446.8	37 746.3	28 152.4	145 884.7
% Total	15	14	21	6	26	19	100

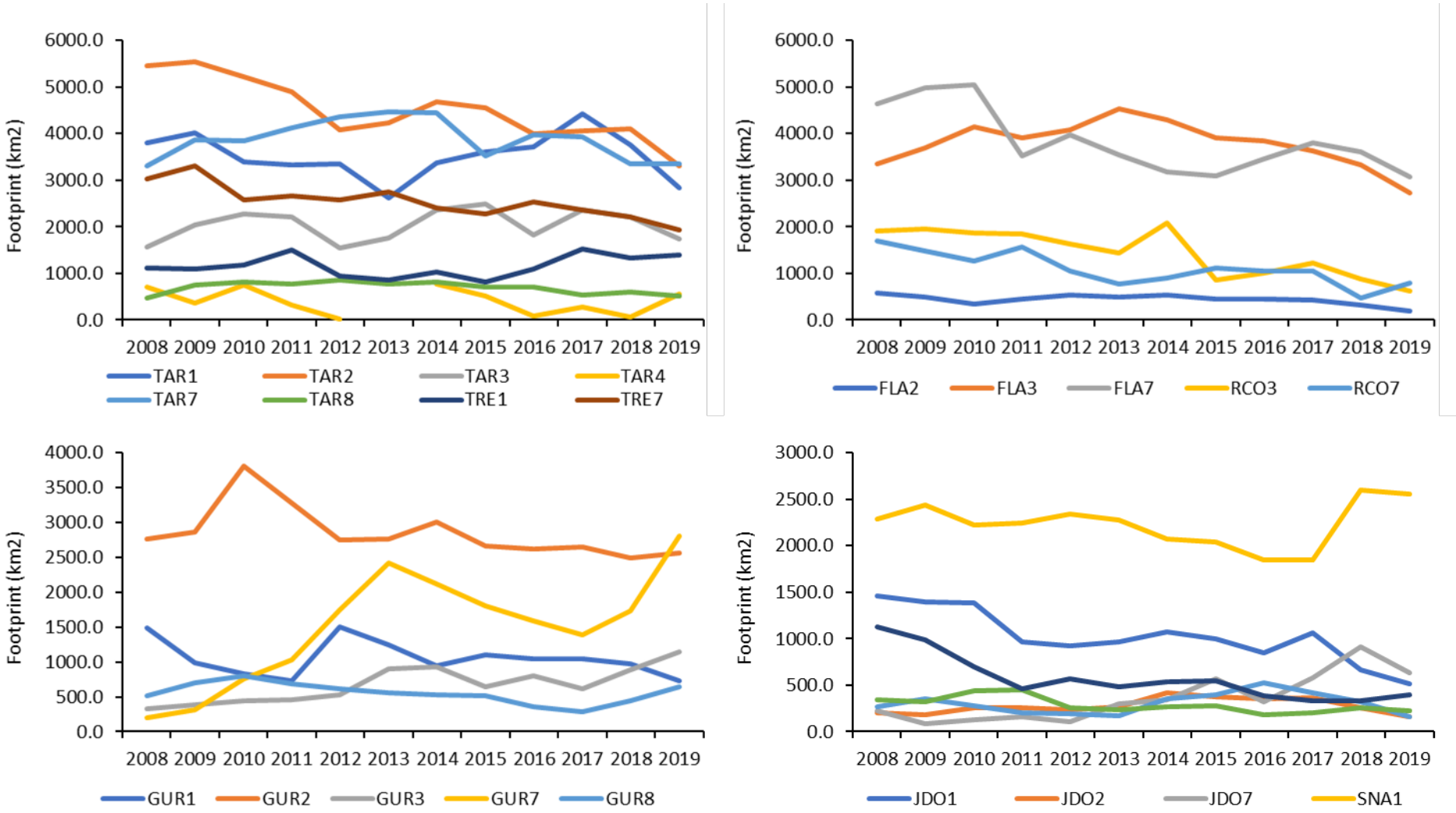


Figure 24: Annual footprints for the main inshore fishstocks, 2008–2019 (see also Tables E4–E6). Upper: tarakihi and trevally (left), flatfish and red cod (right). Lower: red gurnard (left) and John dory and snapper (right).

The main fishstocks in FMA 7 were TAR 7, FLA 7, TRE 7, GUR 7, RCO 7, WAR 7, and STA 7. For FMA 3, the main fishstocks included BAR 1, FLA 3, TAR 3, RCO 3, GUR 3, ELE 3, and WAR 3. In FMA 2, most of the footprint came from TAR 2, with the remainder mainly from GUR 2, JDO 2, and SNA 2. FMA 8/9 fishstocks included part of TAR 1, TAR 8, SNA 8, part of GUR 1, and GUR 8. FMA 1 fishstocks included part of TAR 1, part of GUR 1, SNA 1, TRE 1, and JDO 1, amongst others. The main fishstocks in the least contacted, FMA 5, were STA 5 and parts of FLA 3, GUR 3, RCO 3, and WAR 3.

Over the 12 years, the FMA annual aggregate areas generally decreased in FMAs 1, 2, and 8/9, whereas FMAs 3, 5, and 7 were reasonably steady, though all had the lowest annual aggregate in 2019. The footprint data show a similar pattern with the smallest footprints estimated for 2019. When comparing the annual aggregate area and the footprint, the intensity of bottom contact is greater in FMAs 2, 3, and 7 than in the other FMAs. This is not only because of the greater effort but also a result of the limited area for targeting these species in some areas: for example, the largest red gurnard aggregate area was from GUR 2, at more than twice the GUR 7 aggregate area (in FMA 7), but with a similar footprint area which indicates a wider extent of targeting in FMA 2 than in FMA 7.

5.3 Extent of new cells contacted across the time series

The number of cells that were fished in one year, but not in previous years is shown in Table 22 for the combined inshore fishstocks, where the base footprint was the 2008 footprint. These data are limited in extent because data before the 2008 fishing year were not available to generate a spatial analysis, and as shown in section 3.1, the substantial data from CELR data collection that occurred before the 2008 fishing year are not included here. Thus, Table 22 provides data relative to 2008 only. As with the deepwater data, it is evident that in most of the years the contact in the new cells is low intensity, as there is little difference between the aggregate area and the footprint. This is likely to be an artefact of the methodology used to generate the spatial data, particularly the endpoints of TCER tows. It is very likely that many of these 'new cells' have been fished in years before 2008.

Table 22: For the inshore fishstocks, the number of cells contacted in a year, that had not been contacted in previous years, and the aggregate area and footprint within those cells. A base of 9459 cells were contacted in 2008 (the fishing year that tow-level data were first collected for all inshore fisheries), and, for example, 1497 cells were contacted in 2009 (but not in 2008), with an aggregate area of 819.3 km^2 and footprint of 775.9 km^2.

Fishing year	No. new cells	Aggregate area (km^2)	Footprint (km^2)
No. cells contacted in 2008 = 9459			
2009	1497	819.3	775.9
2010	934	657.8	576.4
2011	771	304.1	296.9
2012	484	151.7	148.3
2013	384	145.4	142.4
2014	400	167.9	161.0
2015	316	133.0	130.2
2016	285	79.1	79.1
2017	275	80.6	80.5
2018	198	66.1	65.9
2019	196	63.5	62.3

5.4 Intensity

For the main inshore fishstocks during 2008–2019, the median number of tows that contacted a cell ranged from 3 or 4 (FLA 2, GUR 1, JDO 1 and 2, TAR 4) to 15 in GUR 2 and 21 in TAR 2), but the highest maximum number of tows in a cell (and aggregate area) was seen in the flatfish fishstocks

FLA 2, FLA 3, and FLA 7 (Table E9). These fishstocks also had some of the highest mean values for aggregate area, along with GUR 2. The highest median aggregate areas per cell were for TAR 2, SNA 1, TAR 7, GUR 2, and RCO 3. The most intensely contacted areas are shown in Figure 23, for the combined years data, and for 2019. Data for the most recent fishing year, 2019, indicate that for most fishstocks, the maximum aggregate areas represented at least the cell area (25 km^2), and for the flatfish fishstocks, that the maximum aggregate area of a cell was equivalent to the whole cell area being contacted three to four times (Table E10). These cells generally had footprint values close to the cell area and were located close inshore in FMA 2, FMA 3, FMA 7, and FMA 5 (see Figure 23). The annual spread of data available from the cell analysis is shown in Figure E1, for TAR 1 and TAR 2, and FLA 3 and FLA 7, with a comparison of the annual aggregate and footprint data per cell.

5.5 Number of years contacted

Of the 15 199 cells contacted by the inshore fishstocks (for 2008–2019), 40% were contacted in each year and 19% were contacted in one year, with another 9% in two years (Figure 25, upper plot). About 57% of inshore fishstock cells were contacted in 2019 (lower plot in Figure 25, Table 23), and another 10.5% were last contacted in 2018, and about 12% of cells have not been contacted since 2012.

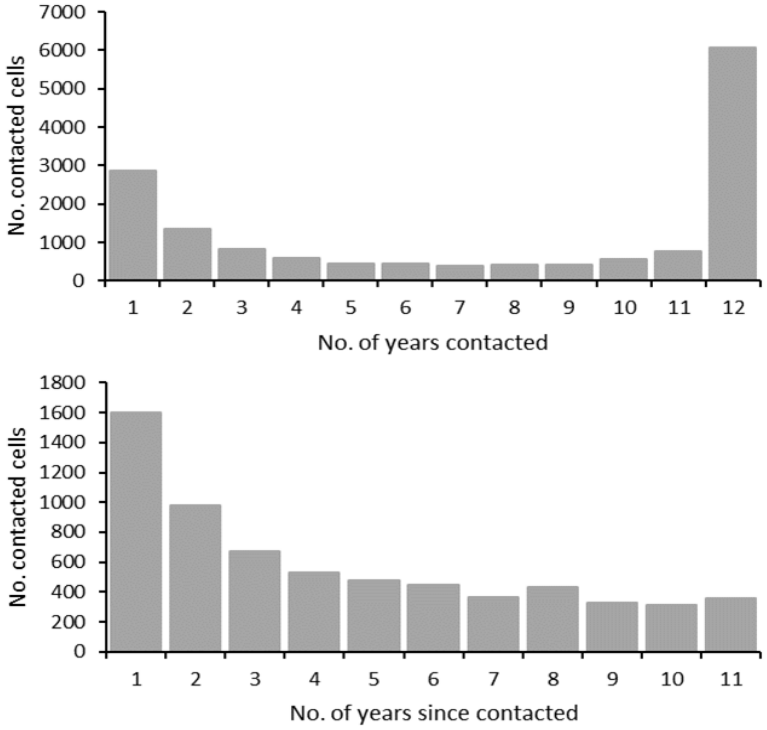


Figure 25: The number of cells contacted in annual bins by the inshore tows for 2008–2019 (upper) and the number of cells in each bin representing the number of years since a cell was last contacted (lower).

Table 23: The number of cells contacted for the most recent year that the cells were contacted, for inshore fishstocks, 2008–2019.

	The year of last contact by inshore tows												
	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	All
No. cells	8 686	1 598	979	675	529	481	451	367	434	327	316	356	15 199
% total	57.1	10.5	6.4	4.4	3.5	3.2	3.0	2.4	2.9	2.2	2.1	2.3	100

5.6 Overlap of inshore bottom contact on 50-m depth zones

The spatial distribution of the inshore fishstock footprint overlap with the 50-m depth zones is shown in Figure 26. Annual data for the number of contacted cells, aggregate area, and footprint, for each depth zone are given in Tables E11–E13. There were few differences in the annual patterns of the footprint in each depth zone. For 2008–2019, most of the 12-year footprint and aggregate area was in depths shallower than 150 m (Table 24), and this pattern was reflected in the 2019 data. The relatively large percent of the 12-year footprint in over 250 m depths compared with the percent of the aggregate area indicates that this 'deeper' swept area represents some of the difficulties in locating effort based on TCER forms, unlikely start position data, and the use of the 25-km^2 cell grid, where the cell depth represents the depth at the midpoint of each cell.

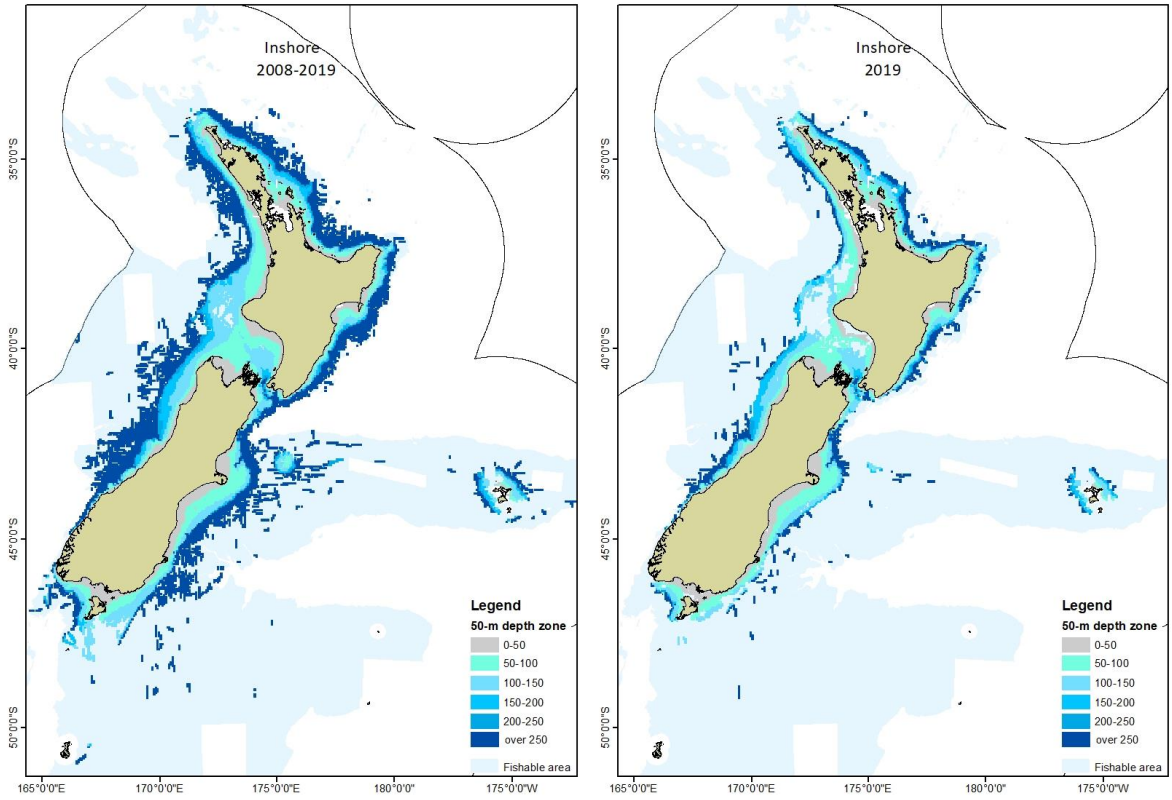


Figure 26: Distribution of the extent of the inshore fishstock footprint, as displayed by 25-km^2 cells, 2008–2019 (left) and 2019 (right), with the fishable area (light blue background).

Table 24: Percent of total inshore fishstock footprint (148 276 km^2) and total aggregate area (811 595 km^2), by 50-m depth zone, based on 25-km^2 cells, during 2008–2019 and 2019.

Depth	Footprint (%)		Aggregate area (%)	
zone (m)	2008–2019	2019	2008–2019	2019
0–50	25	33	41	37
50–100	29	35	31	35
100–150	22	19	16	17
150–200	9	6	6	5
200–250	3	2	2	2
Over 250	11	4	4	3

The footprint overlap of each depth zone is expressed as the percent of the depth zone seafloor area contacted by the 2008–2019 and 2019 footprints. The 100–150 m depth zone has the largest seafloor area and the 2008–2019 and 2019 footprints contacted 22% and 8%, respectively (Table 25).

Table 25: The total seafloor area of each 50-m depth zone and the percentage of each depth zone within the fishable area that was contacted by the 2008–2019 and 2019 inshore footprints. Note: 10.6% of the 2008–2019 footprint was deeper than 250 m (4% in 2019).

Depth zone (m)	Area (km^2)	Footprint area overlap (%)	
		2008–2019	2019
0–50	48 005.1	17.4	3.3
50–100	66 210.6	23.5	5.6
100–150	94 095.2	21.9	7.9
150–200	43 568.4	11.6	3.2
200–250	21 407.0	5.3	1.1

5.7 Overlap of inshore fishstock footprint with BOMEC classes

The extent of the distribution of the footprint by BOMEC class for all years and for 2019 is shown in Figure 27, and Tables E14–E16 in Appendix E provide the number of contacted cells and the overlap of the aggregate area and footprint for each class and fishing year.

About 35% of the 2008–2019 footprint was in class C (Table 26), the largest inshore class. About 14.5% was in class H close to the shelf edge and near Chatham Islands, 14% in class D in east and south coasts of the South Island inshore areas, 11% in class A inshore areas around the North Island and off the west coast South Island, 10.5% in class E on the shelf in deeper waters beyond the distribution of class D and on Mernoo Bank and near the Chatham Islands, 8% in class B beyond class A off the west coast South Island and in waters off the north coast of the South Island, and 3% in class G in Cook Strait. A small proportion of contact was in areas of deep water.

The distribution of the 2019 was similar to that for the 12-year dataset, although there was little overlap beyond the continental shelf with a more equal of contact in the inner shelf areas such as classes A, B, and D (Figure 27 and Table 26). All classes, except class B, showed a decrease in footprint contact in 2019 that was the lowest, or close to the lowest, compared with previous years (Table E16). Throughout the 12 years, contact in each class generally decreased, though annual footprints in classes B, D, E, and H were reasonably steady.

The footprint as a percent of the seafloor area of each class is greatest in the main inshore and shelf classes, classes A–D and G (Table 26), for both the 2008–2019 and the 2019 footprints.

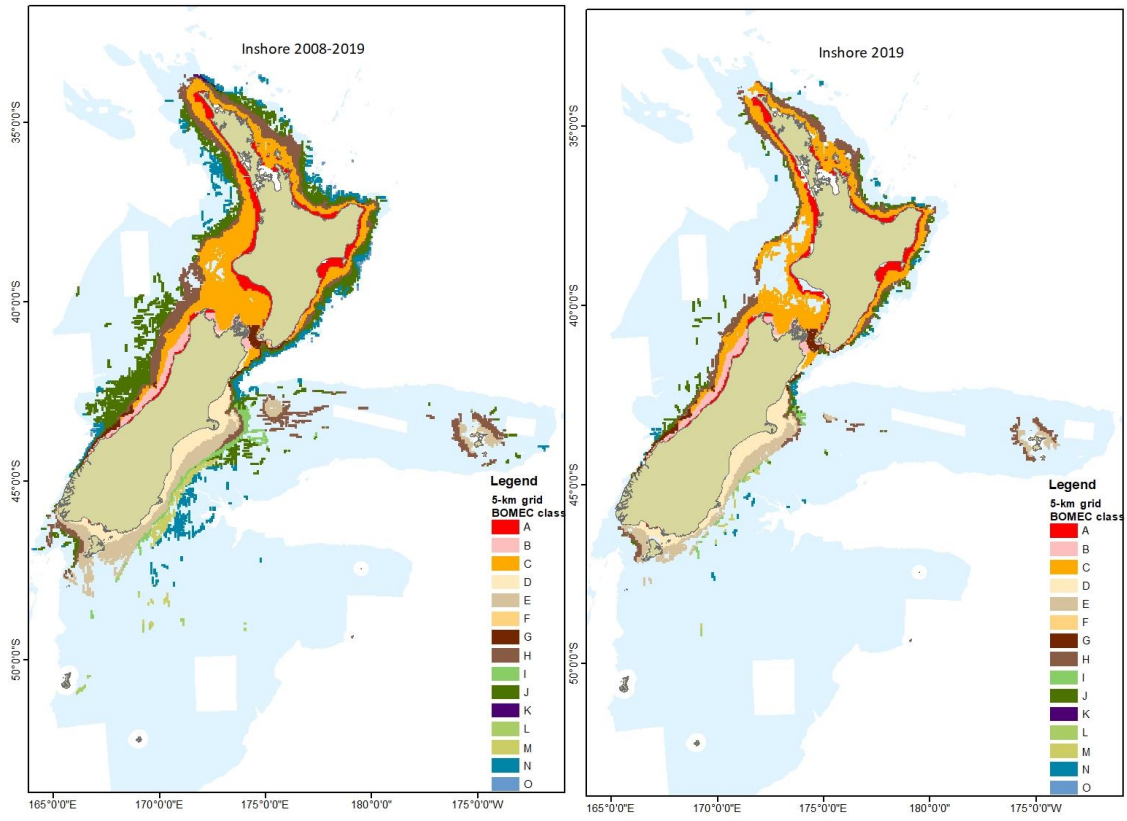


Figure 27: Extent of the inshore fishstocks footprint overlap with the BOMEC classes, represented by 25-km^2 cells for 2008–2019 (left) and 2019 (right).

Table 26: The total area of each BOMEC class and the percentage of each class area covered by the 2008–2019 and 2019 bottom-contacting trawl footprint for the combined inshore fishstocks.

BOMEC		% footprint		% each class contacted	
Class	Area (km^2)	2008–2019	2019	2008–2019	2019
A	30 661.0	10.9	13.7	52.9	17.0
B	12 786.1	7.5	13.5	87.5	40.1
C	90 256.5	35.1	34.7	57.7	14.6
D	28 085.7	13.8	18.0	73.0	24.4
E	61 258.0	10.5	8.4	25.5	5.2
F	38 775.8	0.0	0.0	0.0	0.0
G	6 702.3	2.9	2.1	64.0	11.8
H	138 399.1	14.5	8.7	15.5	2.4
I	52 008.3	0.5	0.1	1.4	0.1
J	312 604.9	3.3	0.8	1.6	0.1
K	1 200.2	0.0	0.0	2.0	0.0
L	198 578.4	0.0	0.0	0.0	0.0
M	233 837.4	0.2	0.0	0.1	0.0
N	495 154.2	0.6	0.1	0.2	0.0
O	1 006 911.1	0.0	0.0	0.0	0.0
All	2 707 219.0	100.0	100.0	5.5	1.4

5.8 Overlap of inshore fishstocks footprint with sediment classes

The overlap of the 2008–2019 and 2019 footprints of the seafloor areas estimated for each sediment layer is summarised in Table E17 and the inshore and shelf areas shown in Figure 12 when compared with Figure 23 provide an understanding of the spatial distribution of the inshore footprint relative to the sediment layers. The 12-year footprint overlap with the carbonate layer is mainly in the 0–20%, 20–40%, and 40–60% classes (Table E17), whereas the overlap with the gravel layer is mainly in 0–20%. The footprint is reasonably well spread across the first four classes (0–80%) of the mud layer and throughout most of the sand layer. A similar pattern is seen in the 2019 footprint overlap.

When the footprint overlap is considered as the percent contact of the seafloor area of each sediment class, the highest percent is in the 0–20% and 20–40% carbonate classes and the 80–100% sand class (Table 27). About 11% of the 0–20% and 20–40% gravel classes is contacted by the footprint, and 10–12.5% of the 0–20%, 20–40%, and 40–60% mud classes is contacted, whereas for the sand layer the 60–80% and 80–100% classes have 13% and 24% percent cover. The data for 2019 show a similar pattern to the overall footprint overlap.

Table 27: Percentage overlap of the seafloor area of the substrate classes by the fishable area 2008–2019 and 2019 inshore footprint. For gravel, mud, and sand, the percentage classes total 100%, and for carbonate the percentage represents the proportion that is carbonate versus non-carbonate.

Substrate	Class (%)	Class area (km^2)	2008–2019 overlap (%)	2019 overlap (%)
Carbonate	0–20	138 252.7	31.0	9.2
Carbonate	20–40	282 469.8	23.7	5.9
Carbonate	40–60	275 070.0	10.5	2.6
Carbonate	60–80	288 732.7	2.2	0.3
Carbonate	80–100	369 402.8	0.2	<0.1
Gravel	0–20	1 037 250.7	11.5	3.0
Gravel	20–40	188 550.0	10.8	2.6
Gravel	40–60	77 886.4	6.4	1.5
Gravel	60–80	26 682.0	2.7	0.5
Gravel	80–100	14 188.5	0.5	0.1
Mud	0–20	387 549.1	12.5	3.1
Mud	20–40	323 852.0	11.2	2.7
Mud	40–60	299 719.3	9.6	2.7
Mud	60–80	233 123.9	10.0	3.0
Mud	80–100	109 712.9	8.4	1.8
Sand	0–20	142 639.8	9.4	2.3
Sand	20–40	348 482.0	9.3	2.7
Sand	40–60	482 383.1	8.5	2.2
Sand	60–80	303 832.8	13.4	3.2
Sand	80–100	77 166.5	24.0	5.9

6. Comparison of ERS data position reporting with TCER and TCEPR data

The aim of the second objective of this project was to assess the effects of the footprint estimation methods used with less precise location data recorded on TCER and TCEPR data with the finer resolution start and finish data reported by ERS. In the footprint work reported on in the previous sections the groomed data were treated as described in the Methods section to generate tow polygons to represent the trackline of each trawl (assuming a straight line between start and end points), buffered

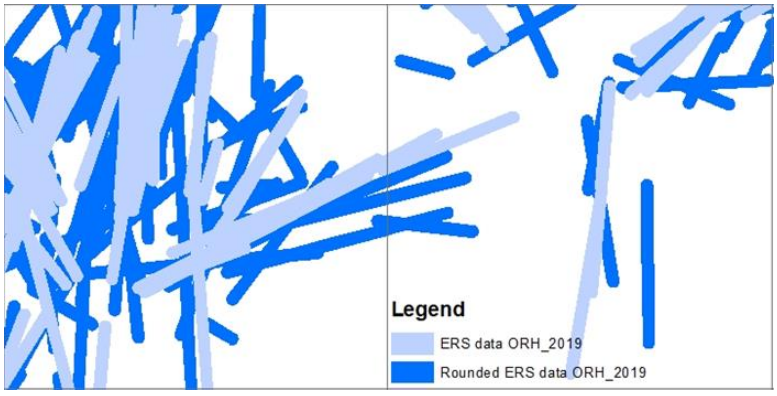
by the assigned doorspread: the TCEPR start and finish data were joined by a straight line, whereas the TCER data (with only start positions) required a speed x duration trawl distance (based on groomed reported data) and the generation of endpoints (see Methods section) to generate a trackline. The low precision in the position data reported on TCER and TCEPR gives an unrealistic regular patchiness of the trawl location data such that many of the tows appear to start in the same place, so the next step in the methodology in preparing data for spatial analysis is to jitter the start and finish positions to allow for some natural spread.

In contrast, there is no jittering of the ERS data because the finer resolution of these data better represents the start and end of trawling – although these data all represent the vessel location when the net reaches fishing depths (start of tow) and when the net leaves the fishing depth (end of tow). The resolution difference between the TCER and TCEPR data compared with the ERS data is evident in this example: the accuracy increases from about 111.12 km for 175.0° longitude, to 11.12 km for 175.1°, and 11.12 m for 175.0001°; the latter is the expected resolution of the ERS data.

Comparison methods. A subset of the tow data ready for spatial analysis, containing ERS data only, was used to assess the difference between the different levels of resolution. The resolution of these ERS data was reduced to the level of the TCER and TCEPR data and then the methods used for TCER and TCEPR data were applied to the ERS data:

1. the groomed ERS coordinates were rounded to the nearest minute of arc (i.e., the coordinates were moved up or down to the nearest 60th of a degree);
2. a random value +/- 0.0083333 was applied to the rounded coordinates (this is the jitter value);
3. the coordinates were joined to create tracklines, were shortened, or not, according to the 'long tow' rules, and buffered with the assigned doorspread value (half the width placed each side of the trackline) to create 'new' tow polygons. These were then joined to the cell grid data.

Comparison results. Of the data available, it was evident that the difference between the groomed reported ERS coordinates and the reduced (rounded) ERS coordinates changed the location of tows and this had an effect in the standard reporting measures: number of contacted cells, aggregate area, and footprint. This effect was more noticeable in some target fishstocks than others. At the level of a 25-km^2 cell, the example below shows a subset of two adjacent cells based on orange roughy tows reported in 2019 (Figure 28). The only thing to stay the same is the doorspread value, but the effect of changing the resolution will also change the tow length because of the straight-line rule used to develop a trackline. The tow polygons in Figure 28 show displacement of the rounded-coordinate tows relative to unchanged tows leading to different numbers of tows contacting cells, and variation in the aggregate area and the footprint.



ERS data	No. tows	Aggregate	Footprint	No. tows	Aggregate	Footprint
Unchanged	98	22.9 km^2	7.0 km^2	24	2,7 km^2	1.9 km^2
Rounded	88	21.1 km^2	11.3 km^2	24	3.4 km^2	3.0 km^2

Figure 28: Rounded ERS orange roughy tow data overlaid by unchanged ERS data at the edge of some underwater features. Data on the left apply to the left cell; data on the right apply to the right cell.

For the deepwater data, there was generally less contact by the unchanged ERS data compared with rounded ERS data (Table F1 in Appendix F). Of the Tier 1 targets, the deeper water targets such as oreo species and orange roughy showed larger differences than those in middle depths such as hoki, hake, jack mackerels, ling, and southern blue whiting – some of which indicated larger swept areas based from the unchanged ERS data (Figure 29). Scampi and arrow squid data also showed less contact by the unchanged ERS tows. It may be that the fishery areas are better defined by the unchanged ERS data for the orange roughy, oreo, scampi, and arrow squid; these fisheries generally have patchier spatial distributions than the other Tier 1 target fisheries. Some Tier 2 targets that are fished on underwater features also showed smaller swept area values with the unchanged ERS data (alfonsino and black cardinalfish).

The introduction of ERS to the inshore fleet was implemented gradually during 2019, beginning with core vessels, and the available ERS data for the inshore fishstocks represent 44% of the 2019 aggregate area and 48% of the footprint. The comparison of unchanged and rounded ERS data for these fishstocks is shown in Figure 30. However, for some fishstocks there are few data (see Table F2). Rather than a comparison of the swept area data, the biggest effect on the use of ERS data for the inshore vessels that previously reported on TCERs, during 2008–2019, is the addition of tow end position data which means that a trackline can be developed between the start and end position ERS data, the method currently used for the TCEPR and ERS data – in contrast to the duration x speed distance used for the TCER trackline. The use of ERS data will provide some certainty to the direction of an inshore tow, with the availability of start and end positions, and reduce the number of tows that appear to trawl in waters beyond known depths for inshore targets and create the unrealistic edge effect seen in the inshore footprint.

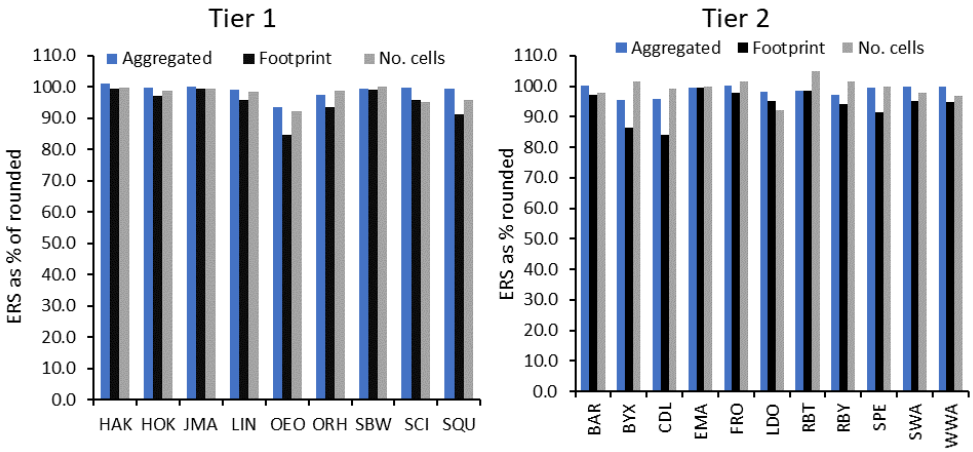


Figure 29: ERS data as a percent of rounded ERS data, for the deepwater Tier 1 target aggregate area, footprint area, and number of contacted cells, from 2018 and 2019 fishing years.

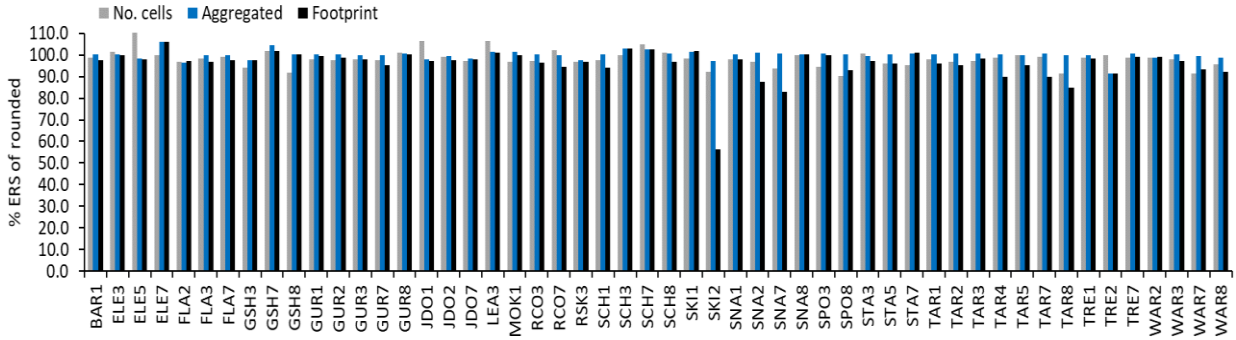


Figure 30: Unchanged ERS data as a percent of rounded ERS data, for the main inshore fishstock aggregate area, footprint, and number of contacted cells, during the 2019 fishing year.

7. DISCUSSION AND MANAGEMENT IMPLICATIONS

The nature of the data and the underlying assumptions mean that these relative measures reflect the fitness of the data and the relevance of the assumptions. The analyses presented here represent estimates of swept areas for bottom-contacting trawling within the EEZ+TS, with the main analyses restricted to the 'fishable area'; that is, a seafloor area that is open to trawling, to a maximum depth of 1600 m, that provides a comparable seafloor area across all years. This means that in some early years of the data, particularly in the deepwater water data, some legitimate effort is not included because the trawling took place before a closure was implemented (for example, closure of seamounts took place from 2001). In total, the retained data represented 98.7% of the All Stocks total aggregate area, and 93.9% of the footprint for all tows, including those totally in closed areas, on land, in depths over 1600 m, or portions of tows that crossed into closed areas or onto land (see Appendix C). For much of the non-retained portion, it is highly unlikely that the location data are correct, for either the whole tow or for either the start or end position; there is no way of knowing where this effort should be located.

For the All Stocks data, the 1990–2019 dataset represents different sets of data throughout the 30 years and includes only the effort collected on a tow-by-tow basis. Baird et al. (2011) indicated that for data between 1990 and 2005 fishing years, the footprint represented about 25% of the trawl and dredge effort for those years. During this period, the trawl footprint was based on TCEPRs only and predominantly represented the deepwater offshore trawling. At the same time, the inshore vessels mainly reported daily effort (number of tows) by main target and statistical area, on CELRs, and dredge activity (which was more prevalent in this period than in later years) was reported the same way on CELRs. Baird et al. (2011) summarised all the data at the statistical area level and showed that the areas of highest intensity were close inshore off the east coast of the North Island, mainly in FMA 2, and also in Statistical Area 038 in FMA 7 in inshore areas at the top of the South Island. The annual data summary given in Table A2 of Appendix A in this report indicates the large amount of data not able to be included in the trawl footprint analysis in the years in which CELR were used.

The most comparable years for the All Stocks data are for 2008–2019 — years in which the deepwater fleet trawl contact is represented mainly by TCEPR and also TCER during 2008–2017 and mainly by the ERS data in 2018 and 2019, and the inshore component is represented by the TCER in all years except for a small amount of effort in 2018 and under 50% in 2019 when ERS data collection replaced TCERs. The ERS data are comparable to the TCEPR other than the precision of the resolution of the start and end positions. The TCER data are comparable with the TCEPR data except the former reports only the start of tow data, and the estimated swept area of each TCER tow is developed using a tow distance calculated from the reported duration x speed that is then represented as a straight line to generate a potential tow endpoint (see Methods); whereas, the TCEPR tow is represented by a straight line distance (between reported start and end positions) (see Baird & Mules in review). This inevitably creates a disparity in the swept areas and a straight line may be more relevant for some target tows than others. The duration x speed distance may take into account the trackline that follows contours (a more realistic track), but when applied as a straight line the spatial representation may place parts of the tow in unlikely depths. Similarly, the straight-line representation of TCEPR and ERS data does not account for any trawling that follows contours or includes u-turns. However, until data such as that collected by vessel monitoring systems or geospatial position reporting systems are available for this analysis (depending on the frequency of pings), as well as defining the tow location by the net location when it is fishing rather than the vessel location when fishing, the potential to better represent the distribution of trawl contact on the seafloor is limited. As with the effect of ERS data allowing better placement of trawl start and end positions, the footprint of targets that are usually fished in depths defined by the seafloor topography, such as underwater features, are likely to be benefit the most from better data collection.

The development of the footprint would also be enhanced by a better representation of the likely width of the trawl gear on the seafloor. Doorspread data by tow are not collected; the wingspread is the reported value. The use of electronic gear providing doorspread by tow is not universal, though most

deepwater fleet vessels are likely to have this capability. When observers have been on commercial trawlers the doorspread data they report generally is the same for every tow. An approach has been made to the deepwater and inshore industry in an attempt to improve the doorspread values currently applied. This would be especially valuable for the inshore data where the vessel size and potentially gears used vary between areas and target fisheries.

The All Stocks analysis for 2008–2019 contacted between about 81 000 and 95 500 km^2 each year, decreasing over the 12 years, with the lowest value estimated for 2019. These data reflect the decreasing amount of bottom-contacting trawl effort during these years; the numbers of tows in the TCEPR, TCER, and ERS data steadily dropped from 89 236 in 2010 to 66 039 in 2019. The annual aggregate areas for All Stocks decreased overall from a peak of 164 795 km^2 in 2010 to the nadir of 143 500 km^2 in 2019. Over these years, the intensity of trawling within cells was steady despite the decrease in aggregate area, implying that the contact was more concentrated. The All Stocks footprint contacted about 2% of the EEZ+TS seafloor annually for 2008–2019 and about 6% of the fishable area each year

In the 30-year time series for deepwater data, there was a steady increase in the footprint from under 50 000 km^2 in 1990 to a sustained period of contact during 1998 to 2003 (range 72 612 to 81 005 km^2), followed by a steady decrease to 43 481 km^2 in 2019, the lowest of the full 30-year time series, with declines seen for most deepwater targets and the swept area data reflecting the drop in effort. The annual aggregate areas have decreased from 150 730–171 901 km^2 during 1997–2003 to under 100 000 km^2 after 2005, with a nadir in 2009 (79 650 km^2), between about 80 300 and 89 500 km^2 during 2010–2017, before another peak at 97 045 km^2 in 2018, and a drop to 86 777 km^2 in 2019. In total, the deepwater analysis estimated a 30-year total of 3 475 450 km^2 aggregate area and 351 683 km^2 footprint, representing 8.6% of the EEZ+TS and 25.3% of the fishable area. Between 1990 and 2007, the annual footprint contacted between 1.2% and 2.0% of the EEZ+TS and 3.4% and 5.8% of the fishable area (peaks in 2002 and 2003); whereas, between 2008 and 2019, the annual footprint contacted 1.1–1.2% and 3.2–3.7% of the fishable area (lowest values in 2019).

The 2008–2019 inshore footprint also decreased, from a peak of about 47 220 km^2 in 2010 to a nadir of 38 131 km^2 in 2019. This contact was equivalent to 0.9–1.1% of the EEZ+TS seafloor area, and 2.7–3.4% of the fishable area, with the lowest values from 2019. The aggregate areas during these years ranged between the low in 2019 (56 611 km^2) and the peak in 2014 (71 053 km^2). As noted above, the decrease in swept areas seen for each group of fishstocks reflects the drop in bottom-contacting effort.

The use of ERS trawl data in 2018 and 2019 has allowed for more precision in locating the start and end positions of tows and thus had an effect in the standard reporting measures: number of contacted cells, aggregate area, and footprint. The scale of this is indicated by the differences in accuracy depending on the data resolution; for example, at the equator, 11.12 km for 175.1° (predominant TCEPR/TCER resolution) and 11.12 m for 175.0001° (ERS resolution). This preliminary investigation used a relatively simple method to compare the effort location and indicated that some ERS tows may be shifted beyond the place of the tows based on a lower resolution. This effect is more likely to be seen in the footprint for tows in areas that are not regularly fished.

Although target fisheries that include short tows on underwater features were more likely to be better described by the ERS data, the footprint analysis (of these fisheries in particular) is affected by the fact the tow start and finish positions (from all data collection methods) represent the position of the vessel, not the trawl gear, when the gear has reached or left the fishing depth. For these targets, the added precision will still create difficulties when attempting to locate effort relative to underwater features, depending on the length of the sweep gear used.

It is also necessary to remember that the main assumptions that underlie the footprint generation still stand, with the use of ERS data; the tow path is not well understood and is treated in these analyses as being a straight line rather than one that may follow contours or include u-turns. For the latter, a more precise endpoint will not help to better describe the tow path or the swept area.

The greatest effect of the ERS data is in the inshore fishstock data because the ERS data provide both start and finish positions and therefore provide more certainty in the direction of a tow (with the assumption the tow is a straight line) and more comparability with the deepwater data. However, as noted above, the ERS data for inshore stocks will have the same concerns re the tow location being the vessel location and will not better describe the tow path. In the development of the TCER footprint, with only a start position provided, the duration x speed distance is used as the tow length to allow generation of the endpoint. Although this duration-speed distance may provide a more realistic tow length, when applied to the TCER tow start and new endpoint, it may create an artificially long tow; this is evident in some of the TCER tows which appear to go well beyond the likely target depth, some in a direction that appears to be unlikely. The use of ERS position data for inshore fisheries will decrease the number of tows with spurious directions and lengths and provide better placement of tow start and finish positions relative to the coastline.
These data bring together many different vessel, gear types and sizes, and comparison between years does not adequately reflect these differences, although there is likely to be better comparability from 2008 onwards (see Baird & Mules 2021).

The footprint overlap with various layers such as depth zones and BOMEC can be problematic because each of these layers is joined to the 25-km^2 cell grid and the cell midpoint is used to define the depth, or BOMEC class, etc. of that cell. For a cell that covers a range of depths, for example, the midpoint may not well represent the data within the cell.

However, the data behind these summaries are stored in a Ministry of Primary Industries Geographic Information System geodatabase at the level of each tow, with the potential to analyse data at regional or smaller scales by target or groups of targets, as well as at a 25-km^2 cell grid level for the broad analysis of the EEZ+TS given here.

Similarly, the data representing the dredge effort for scallop and oyster fisheries and Foveaux Strait swept area are held by the Ministry for Primary Industries Spatial Intelligence Team. The development of the Foveaux Strait oyster dredge swept area based on the number of standardised tows in each 1 nautical mile grid cell provides a finer scale measure of contacted area (compared with the larger fishery-specific areas). There were no ERS data for scallop fisheries in the data extract; these fishers will be reporting on a scale different to what they are used to (now ERS, at a 1 nautical mile scale, as opposed to a fishery-specific area as required by CELR), unlike the Foveaux Strait oyster fishers who have reported to their industry using the 1 nautical mile grid for at least 15 years.

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APPENDIX A: TRAWL FISHERY DATA

The data extract for this work (RepLog 12910) included all trawling effort reported on Catch Effort Landing Returns (CELRs), Trawl Catch Effort Returns (TCERs), Trawl Catch Effort Processing Returns (TCEPRs), and via the Electronic Reporting System (ERS). This effort was reported for the fishing years 1990–2019. Note that the data from 1990–2007 are from TCEPRs and include the effort from offshore fisheries but also a smaller amount of effort from inshore fisheries (in particular in northern waters from the mid-1990s). Data for 2008 to 2017 are from TCEPRs and TCERs, and data for 2018 and 2019 are from TCERs, TCEPRs, and ERS.

From a total of 2 219 469 data records, 2 044 718 tows were reported on TCERs, TCEPRs, and via ERS, available as tow-by-tow data (Table A1), as opposed to the daily data (with more than one tow reported per record) provided by the CELRs.

The TCER/TCEPR/ERS data were groomed following the methods described by Baird & Mules (2019, in review). These methods concentrate on the main variables required to generate the spatial output. Changes as described by Baird & Mules (2019, in review) were made to less than 1% of the data and were related to reported target species, depths fished and bottom depths, and incorrect position data such as placement east or west of 180°.

The TCER/TCEPR/ERS dataset retained for the spatial analysis included 2 044 718 bottom-contacting tows (tows that used bottom trawl gear and midwater trawl gear within a metre of the seafloor, based on reported depth values. Of these tows, 59% were for deepwater Tier 1 and Tier 2 fishstocks (see Table 1) with Tier 1 targets accounting for 91% of deepwater targets. Inshore targets accounted for 41% of the TCER/TCEPR/ERS for 1990–2019. A total of 2172 tows were not assigned to a stock (1233 had no target species); these data represent 0.1% of the total tows.

Of the retained tows (essentially the All Stocks dataset for the spatial analysis), 87% used bottom trawl gear (78% of deepwater tows in the dataset used bottom trawl gear and 99% of the inshore tows) throughout the 30-year dataset and the 12-year inshore dataset (2008–2019) used this gear type.

The CELR data with 'trawl' as the reported fishing method comprised 448 109 daily fishing records in the data extract. These data are from small domestic vessels fishing inshore. These records are not summarised in this report, but a broad summary was made to indicate the amount of effectively missing data from the 1990–2007 period because the data are inadequate for spatial analysis, other than at the General Statistical Area level. Minimal grooming checks were applied to the number of tows reported for each record: records that were null or had over 6 tows a day were assigned a median 'number of tows' of 3 (3% of records). Of the CELR data, 2.4% reported midwater gear as the fishing method, with the remainder using bottom trawl or bottom pair trawl. At least 67 targets were reported in the CELR data, and 42% of the tows were for flatfish species, 12% red cod, 10% tarakihi, 8% red gurnard, 7% snapper, and 6% barracouta. These annual numbers of tows are can be compared with the numbers of tows in the dataset used to estimate the footprints (see Table A2).

Table A1: Number of bottom-contacting tows in the 1990–2019 TCER/TCEPR/ERS dataset for the spatial analysis, by form type. 'na' means not assigned to a stock.

Form type	Inshore	Deepwater		na	All
		Tier 1	Tier 2		
ERS	13 019	39 732	3 461	88	56 300
TCE	501 943	17 408	14 301	1 215	534 867
TCP	321 889	1 044 768	86 025	869	1 453 551
All	836 851	1 101 908	103 787	2 172	2 044 718

Table A2: Number of records and number of tows reported as trawl tows on CELRs, and the number of tows in the dataset used for the spatial analysis (TCER/TCEPR/ERS data), for 1990–2019. * CELR data are preliminary.

		CELR data*	TCER/TCEPR/ERS
Fishing year	No. of records	No. of tows	No. of tows
1990	27 350	75 004	38 190
1991	30 043	83 547	45 784
1992	30 193	83 999	51 034
1993	32 218	90 778	56 662
1994	29 677	80 997	57 510
1995	28 785	78 113	65 542
1996	25 517	67 857	74 433
1997	26 711	73 364	76 486
1998	24 864	67 287	81 815
1999	25 599	69 438	76 046
2000	23 054	62 628	69 790
2001	21 240	59 779	66 501
2002	19 754	54 825	67 045
2003	20 792	58 221	65 880
2004	20 371	56 022	59 796
2005	21 196	58 795	56 700
2006	19 927	55 033	51 348
2007	19 122	52 899	46 603
2008	477	1 244	85 272
2009	622	1 690	82 615
2010	167	416	89 236
2011	60	130	81 838
2012	63	187	80 541
2013	63	160	79 820
2014	74	259	80 408
2015	38	99	73 887
2016	87	283	73 516
2017	39	154	73 686
2018	0	–	70 695
2019	6	17	66 039
All	448 109	1 233 225	2 044 718

APPENDIX B: SPATIAL OVERLAY LAYERS

Table B1: Seafloor area (km^2) of the full extent of the available data for the main overlap layers, within the EEZ+TS: depth zones, BOMEC, probability of occurrence for Tier 1 fish species and population extent for scampi and arrow squid, and surficial layers. The data are represented on a 25-km^2 cell grid.

Data layer	Seafloor area (km^2)		Data layer	Seafloor area (km^2)
200-m depth zones			**BOMEC class** (total for each = 2 627 072.6 km^2)	
0–200 m	272 378		A	27 55.07
200–400 m	105 006		B	12 420.0
400–600 m	283 302		C	89 710.2
600–800 m	226 302		D	27 267.9
800–1000 m	182 709		E	60 989.8
1000–1200 m	186 205		F	38 608.5
1200–1400 m	210 881		G	6 341.9
1400–1600 m	157 466		H	138 551.4
0–1600 m	1 624 249		I	52 223.9
50-m depth zones			J	311 360.4
0–50 m	62 497.0		K	1 289.1
50–100 m	69 070.9		L	198 577.0
100–150 m	97 181.4		M	233 825.5
150–200 m	47 595.3		N	493 034.7
200–250 m	22 458.9		O	935 315.2

Surficial layers – seafloor area (km^2)				
(%)	Carbonate	Gravel	Mud	Sand
0–20	926 764.1	2 535 379.0	762 571.7	1 169 746.0
20–40	818 608.4	504 713.7	732 798.3	1 099 216.0
40–60	782 044.8	318 555.8	739 087.0	944 924.3
60–80	600 899.8	170 432.6	695 296.7	370 066.2
80–100	519 662.3	108 750.5	768 737.1	116 733.9

Probability of occurrence seafloor area (km^2) (total for each = 1 872 931 km^2)							
%	HAK	HOK	JMA	LIN	OEO	ORH	SBW
0	202 097	204 964	1 418 074	26 441	706 800	994 473	1 197 845
0.1–1.0	244 964	330 294	33 410	718 182	171 801	141 916	240 707
1.1–5.0	577 217	291 969	67 480	205 226	260 248	156 027	201 706
5.1–10.0	204 473	111 676	49 148	81 338	124 020	67 560	28 602
10.1–0.0	170 408	134 901	54 084	114 741	114 076	73 394	22 369
20.1–30.0	103 565	59 165	49 732	77 477	70741	49 725	15 581
30.1–40.0	79 792	42 155	42 506	47 409	48 614	36 247	12 632
40.1–50.0	72 627	34 019	37 320	36 658	44 832	30 953	11 644
50.1–60.0	67 559	32 943	33 291	40 624	45 664	31 241	10 187
60.1–70.0	63 800	35 693	36 193	35 529	48 856	39 780	9 455
70.1–80.0	56 649	39 001	28 729	48 160	62 442	49 936	12 704
80.1–90.0	26 713	64 032	14 934	106 259	81 103	57 127	26 675
90.1–95.0	2 827	138 827	5 123	141 069	45 309	34 929	23 575
95.1–99.0	240	353 292	2 907	193 818	48 425	109 623	59 249
0.0–99.0	1 872 931	1 872 931	1 872 931	1 872 931	1 872 931	1 872 931	1 872 931

Estimated extent of population – seafloor area (km^2)					
Scampi	Hotspot	15 122	Arrow squid	Hotspot	58 591
	90%	78 404		90%	251 879
	100%	496 344		100%	605 231
	Unknown/ not exist	3 654 869		Unknown/ not exist	3 545 982

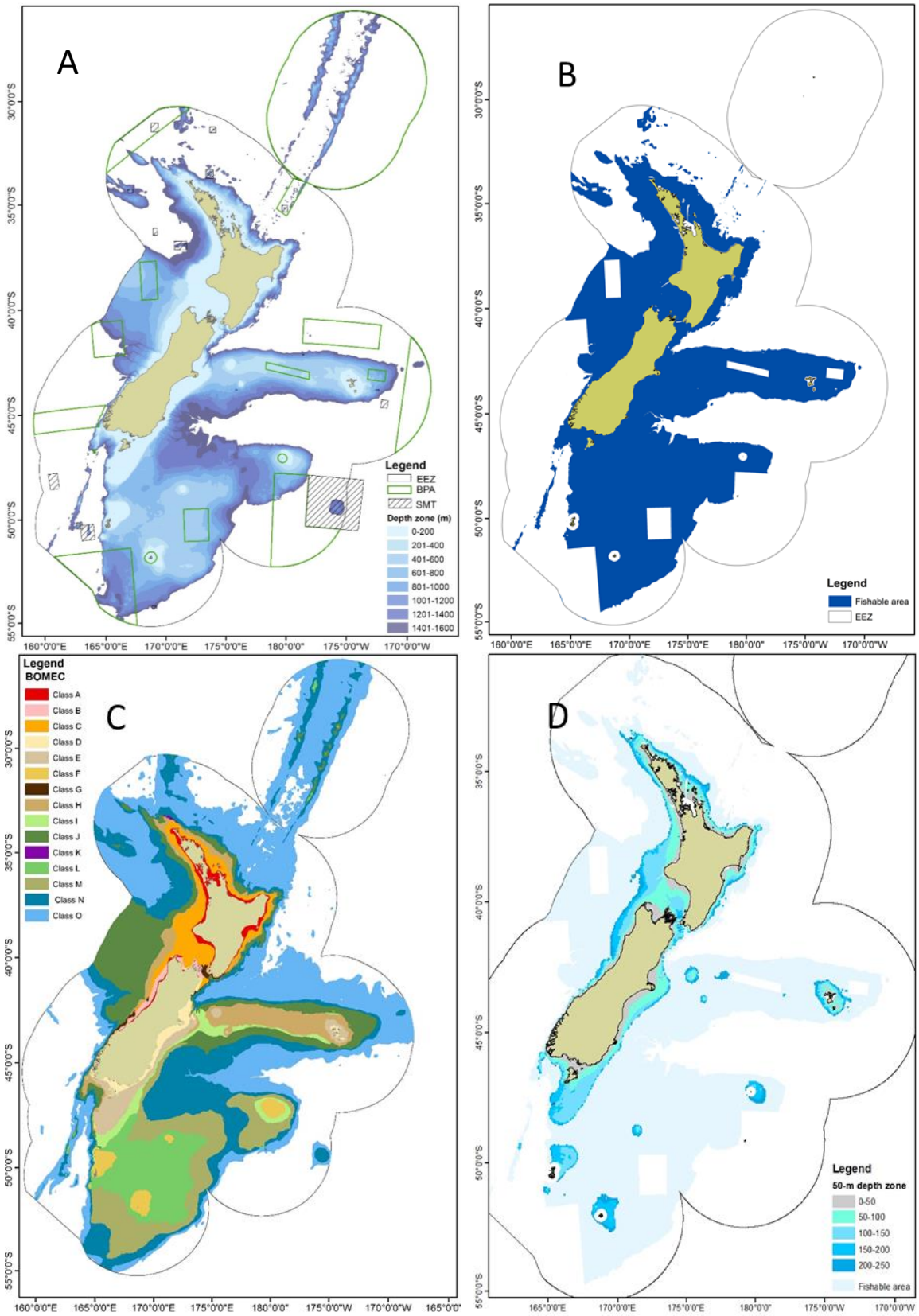


Figure B1: A. The extent of waters within the EEZ and Territorial Sea down to 1600 m depths, delineated by 200-m depth zones, showing the Benthic Protection Areas and closed seamounts. B. The 'fishable' area with areas closed to bottom trawling (including BPAs, closed seamounts, cable lanes, marine farms, and marine reserves) removed. C. The Benthic-optimised Marine Environment Classification (BOMEC) distribution (right), down to 3000 m (see Leathwick et al. 2012). D. Inshore 50-m depth zones. Note: the two EEZ occlusions are considered as part of the EEZ+TS; the outer boundary of the EEZ is shown.

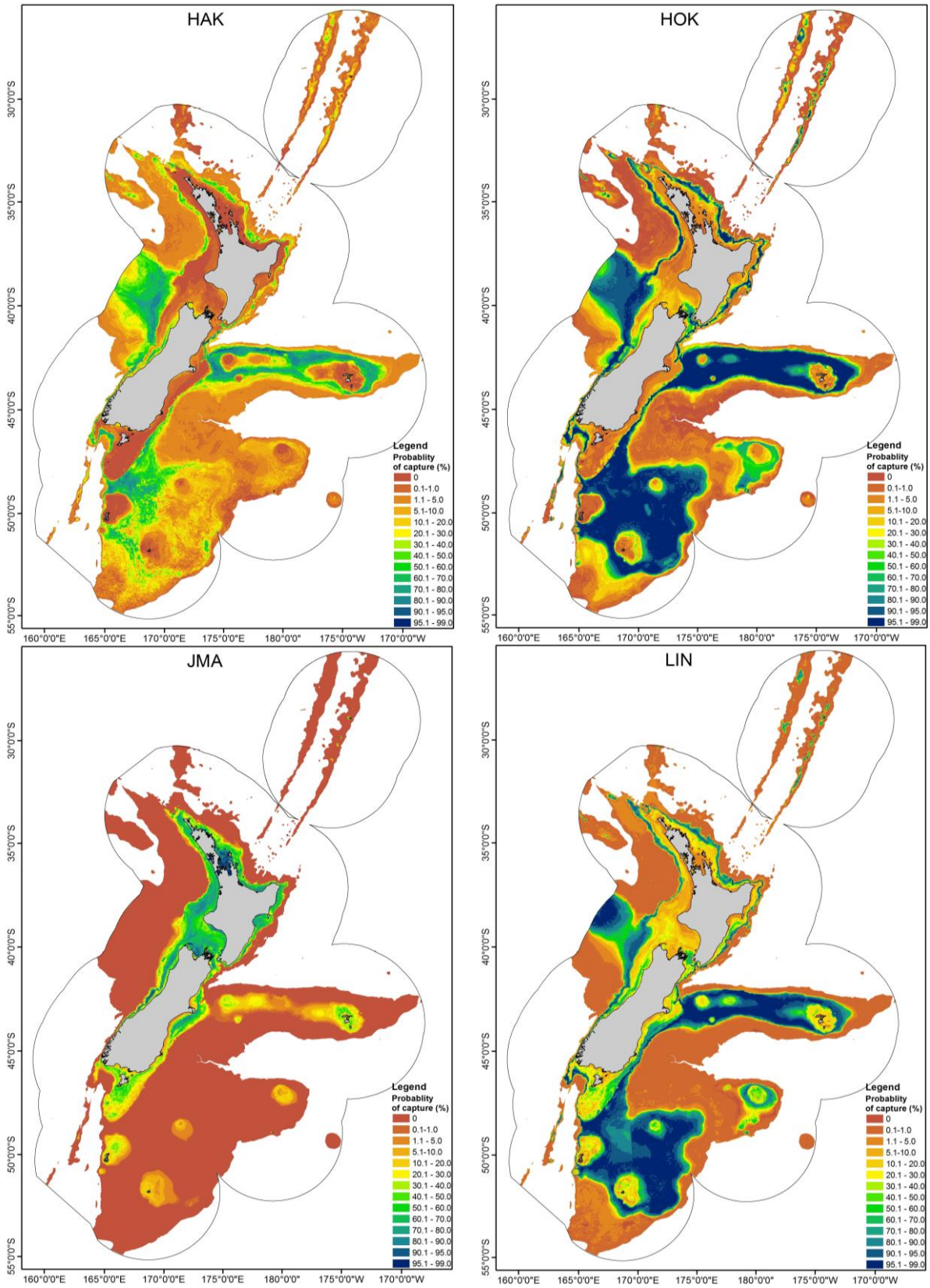


Figure B2a: The extent of the predicted distribution of the preferred habitat for hake (upper left), hoki (upper right), jack mackerels (lower left), and ling (lower right) (after Leathwick et al. 2006), where the preferred habitat represents the probability of capture of that species in a standardised trawl in waters down to 1950 m depth.

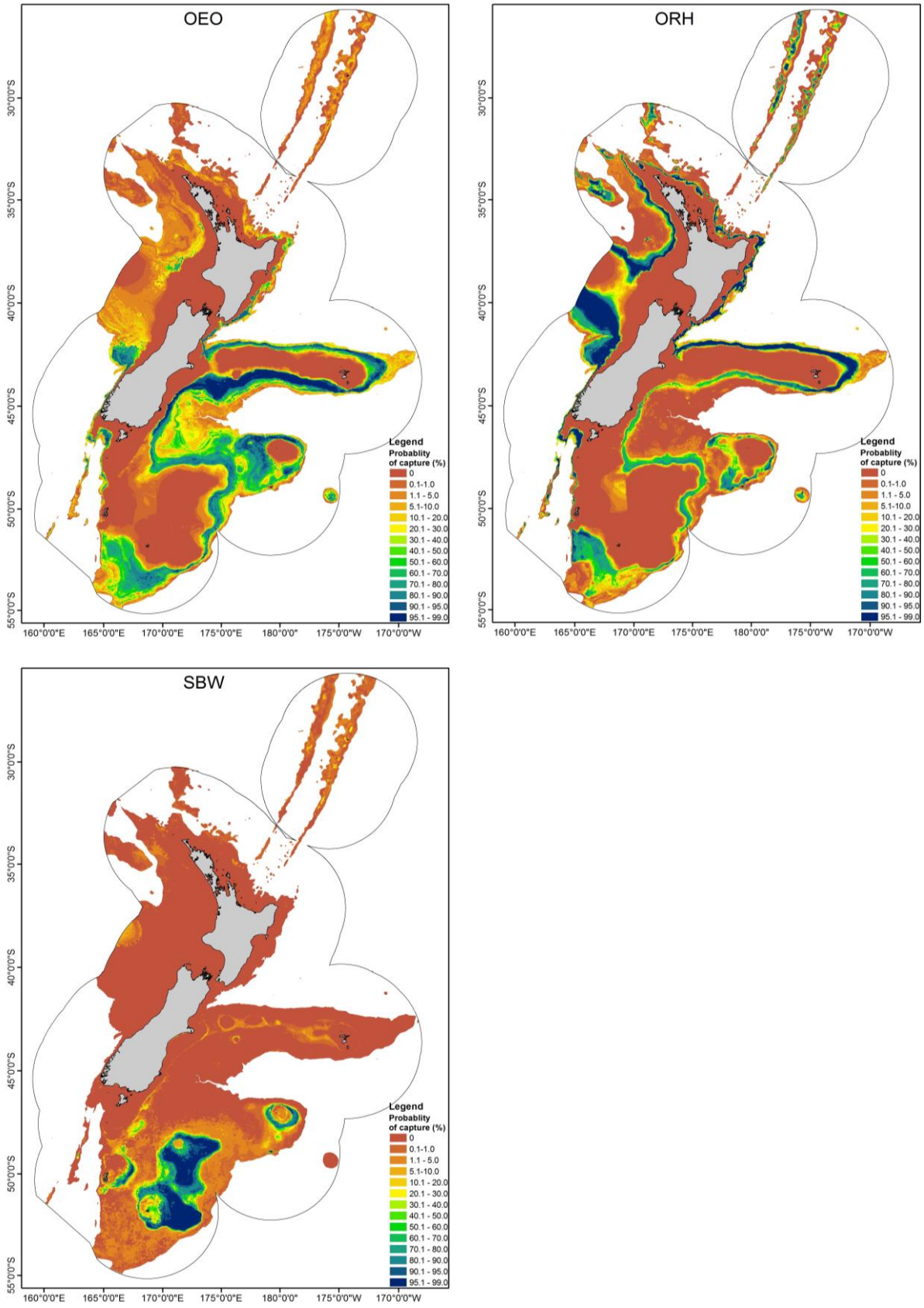


Figure B2b: The extent of the predicted distribution of the preferred habitat for oreo species (upper left), orange roughy (upper right), and southern blue whiting (lower left (after Leathwick et al. 2006), where the preferred habitat represents the probability of capture of that species in a standardised trawl in waters down to 1950 m depth.

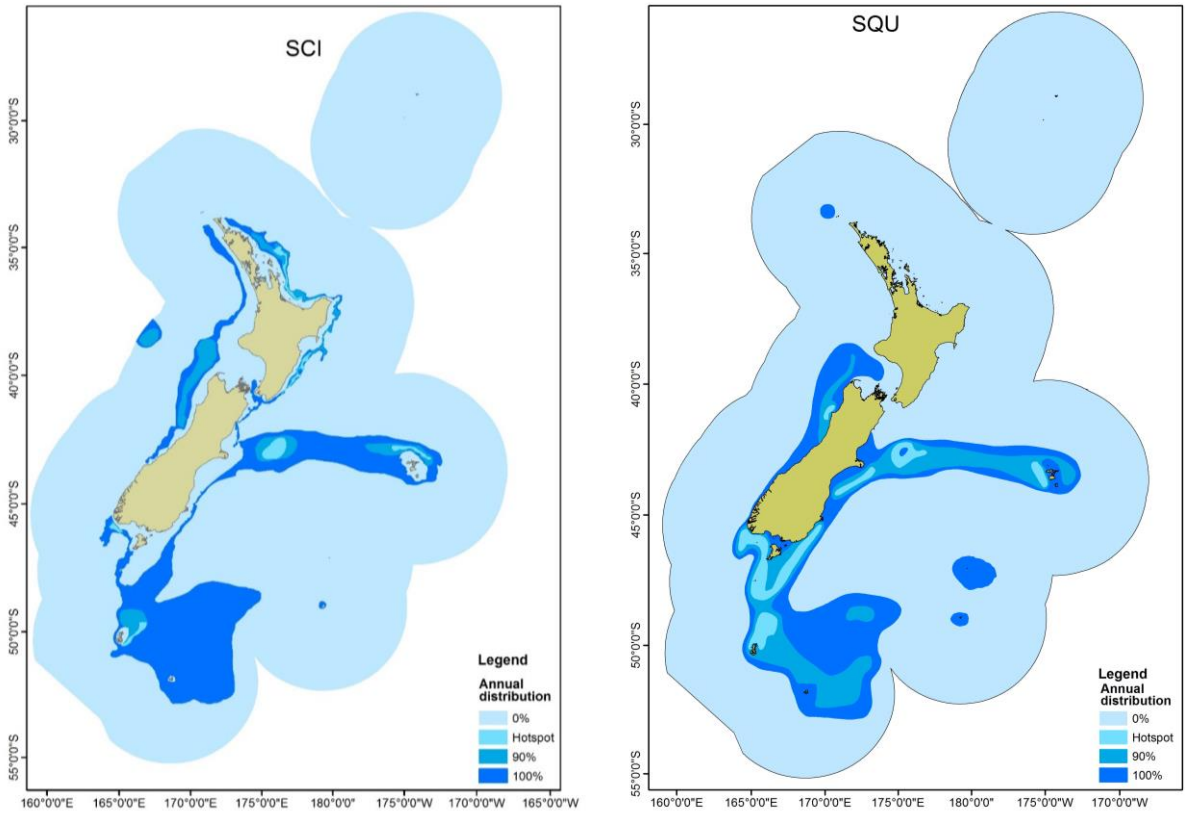


Figure B2c: The extent of the annual distribution of scampi (left) and arrow squid (right) (from www.nabis.govt.nz.)

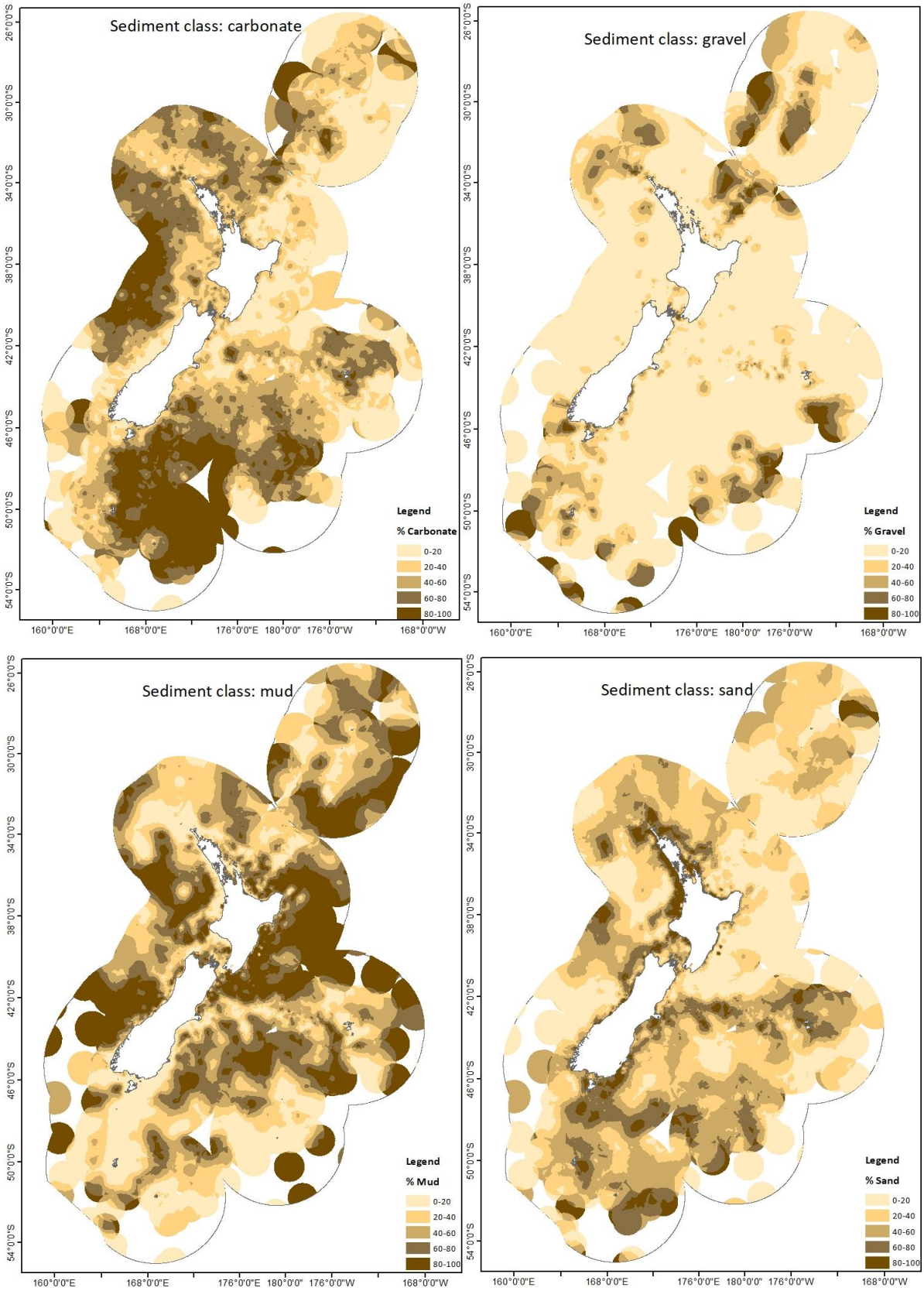


Figure B3: The interpolated distribution (%) of carbonate, gravel, mud, and sand based on the nzSEABED database (after Bostock et al. 2019a, 2019b).

APPENDIX C: ALL STOCKS SUMMARY

Fishable area analyses

When the tow data were imported into GIS for the spatial analysis, and any tows outside the EEZ outer boundary were ignored (e.g., tows fishing on features such as the Louisville Ridge, beyond the EEZ wasters), a total of 12 469 tows (less than 0.6% of tows retained for the spatial analysis) were identified as being either completely on land, completely in areas closed to trawling, or outside the depth considered the deepest at which trawl gear could be operated (1600 m) (Table C2). The largest number of tows, for any one year, that were not included in the spatial analysis was in 1999, and these tows represented 1.3% of the tows in that year. The total swept area not included because these tows were ignored was estimated at 14 053 km^2 for 1990–2019.

Other tows that crossed land, closed areas, or into depths beyond 1600 m were truncated or 'clipped' to the fishable area. Thus, parts of the tows were retained in the analyses and parts were cut out. It is likely that these tows had incorrect end position data which set them across land areas such as Farewell Spit or across closed areas such as marine mammal sanctuaries. The portions of these tows and the tows that were completely ignored (see above) are shown in Figure C1, and the associated swept areas are given in Table C3.

In total, 127 852 tows were affected by restricting the data to the fishable area: 12 469 tows that were completely ignored, as described above, and 107 790 that remained in the data but only where the tow was within the fishable area (6% of all bottom-contacting tows available for spatial analysis). About 77% of the affected tows targeted inshore species such as flatfish (35%), red gurnard (13%), snapper (12%), tarakihi (9%), trevally (6%), John dory (4%), and red cod (2%). For other targets, orange roughy/oreo/black cardinal fish tows accounted for 10.5% of all affected tows (mainly before 2001 when seamount closures were first implemented), and another 6% targeted barracouta, hoki, scampi, arrow squid, and common warehou. About 23% of these tows were in FMA 7 (especially Statistical Areas 038, 017, 033–035), 18% in FMA 2 (mainly 013, 014, 016, 011), 15% in FMA 1 (mainly 003, 009 005, 006, 008), 14% in FMA 3 (mainly 022, 020, 024, 026), 7% in FMA 9 (mainly 045, 047, 042, 046), 5% in FMA 5 (025, 028, 030, 032, 503), 3% in FMA 6 (601, 602), and 3% in FMA 4 (403, 406, 412, 050, 051).

There is no pragmatic way of knowing where to place the ignored tows and the portions of tows in closed areas or in depths beyond 1600 m. Over the years, the annual distribution of effort has shown defined trawling areas for many fishstocks and it is likely that the estimated swept area for these tows is within or close to the footprint of tows that can be spatially analysed. For some of the earlier effort, it may be that the tows are realistically placed inside a closed area, at a time before the closure legislation was enacted. For example, the marine mammal sanctuary around Auckland Island was implemented in 1993, the first seamount closures were implemented in 2001, the Benthic Protection Areas were closed in 2007, and the 2008 West Coast North Island Maui dolphin restrictions were extended in 2013.

Overall years, for the TCER, TCEPR, and ERS data, the retained aggregate area was estimated at 98.7% of the total aggregate area and 93.9% of the total footprint for effort within the EEZ outer boundary, for all years combined. Note that the years from 2008 best represent any patterns in these data. The effect of the addition of TCER data is evident and this is not unsurprising because of the resolution of the position data and the proximity of effort to the coastline and to closed areas such as marine reserves, marine mammal sanctuaries, or cable lanes.

Table C1: The number of contacted 25-km^2 cells, the aggregate area, and the footprint area for All Stocks in the fishable area, and the percent of the EEZ+TS seafloor and the fishable area seafloor that was contacted the footprint, by year and for 1990–2019.

Fishing year	No. of cells	Aggregate area (km^2)	Footprint (km^2)	EEZ+TS (%)	Fishable (%)
1990	13 747	110 358.5	52 690.0	1.3	3.8
1991	14 971	134 179.8	59 753.2	1.5	4.3
1992	16 765	147 696.1	73 195.0	1.8	5.3
1993	16 527	154 503.9	75 569.8	1.8	5.4
1994	15 985	133 380.8	64 830.4	1.6	4.7
1995	16 655	161 761.1	73 350.3	1.8	5.3
1996	16 899	171 825.0	79 873.8	1.9	5.7
1997	17 385	182 271.9	85 683.1	2.1	6.2
1998	18 778	202 434.8	95 120.3	2.3	6.8
1999	18 177	182 542.0	89 253.0	2.2	6.4
2000	18 304	175 234.7	90 525.4	2.2	6.5
2001	18 229	175 286.0	92 023.0	2.2	6.6
2002	20 008	179 588.2	97 683.1	2.4	7.0
2003	19 144	182 155.2	97 251.0	2.4	7.0
2004	17 756	158 914.5	85 667.5	2.1	6.2
2005	17 092	139 689.2	73 374.3	1.8	5.3
2006	16 131	120 888.4	68 281.4	1.7	4.9
2007	15 890	112 518.3	67 815.3	1.6	4.9
2008	18 606	156 006.2	93 220.2	2.3	6.7
2009	18 181	153 356.0	90 874.3	2.2	6.5
2010	18 103	164 795.5	95 488.5	2.3	6.9
2011	17 674	157 466.0	92 117.4	2.2	6.6
2012	17 276	154 317.6	88 931.1	2.2	6.4
2013	16 363	148 136.0	86 593.6	2.1	6.2
2014	17 425	153 953.5	91 430.4	2.2	6.6
2015	17 492	150 830.0	89 808.0	2.2	6.5
2016	17 627	148 274.7	87 220.0	2.1	6.3
2017	17 591	156 040.6	88 957.7	2.2	6.4
2018	17 289	160 150.8	89 431.7	2.2	6.4
2019	16 083	143 502.8	81 054.9	2.0	5.8
All	41 424	4 672 058.1	460 627.2	11.2	33.1

Table C2: Number of tows not included in the fishable area analysis because they were inside closed areas, on the land, or beyond 1600 m, by form type for 1990–2019. Note some tows may be in more than category.

Fishing	On land			In closed areas			Beyond 1600 m			Total		
year	ERS	TCE	TCP	ERS	TCE	TCP	ERS	TCE	TCP	ERS	TCE	TCP
1990	0	0	82	0	0	65	0	0	131	0	0	278
1991	0	0	54	0	0	64	0	0	161	0	0	279
1992	0	0	83	0	0	99	0	0	180	0	0	362
1993	0	0	182	0	0	133	0	0	239	0	0	554
1994	0	0	115	0	0	316	0	0	262	0	0	693
1995	0	0	132	0	0	459	0	0	289	0	0	880
1996	0	0	47	0	0	409	0	0	275	0	0	731
1997	0	0	81	0	0	470	0	0	315	0	0	866
1998	0	0	80	0	0	411	0	0	408	0	0	899
1999	0	0	45	0	0	392	0	0	594	0	0	1 031
2000	0	0	22	0	0	377	0	0	382	0	0	781
2001	0	0	14	0	0	250	0	0	241	0	0	505
2002	0	0	6	0	0	189	0	0	132	0	0	327
2003	0	0	8	0	0	231	0	0	158	0	0	397
2004	0	0	3	0	0	184	0	0	77	0	0	264
2005	0	0	2	0	0	156	0	0	71	0	0	229
2006	0	0	1	0	0	100	0	0	125	0	0	226
2007	0	0	8	0	0	61	0	0	66	0	0	135
2008	0	183	1	0	67	15	0	97	78	0	346	94
2009	0	93	3	0	27	30	0	95	52	0	215	85
2010	0	95	3	0	59	20	0	89	61	0	243	84
2011	0	109	2	0	61	21	0	67	37	0	236	60
2012	0	98	1	0	54	17	0	65	46	0	217	64
2013	0	69	9	0	46	5	0	64	26	0	179	40
2014	0	79	3	0	46	12	0	76	47	0	201	62
2015	0	53	0	0	52	8	0	47	27	0	152	35
2016	0	68	0	0	35	4	0	45	29	0	148	33
2017	0	96	6	0	26	13	0	44	28	0	166	47
2018	0	43	1	0	16	7	3	47	3	3	106	11
2019	11	98	2	5	32	11	2	50	7	16	180	20
All	11	1 084	996	5	521	4 529	5	786	4 547	19	2 389	10 072

Table C3:Swept areas for TCER, TCEPR, and ERS data were inside the EEZ outer boundary and the percentage retained for the 'fishable' area summaries for All Stocks, by fishing year, where 'Out' gives the swept area not included in the final spatial analysis (outside the fishable area), 'Fishable total' gives the estimated swept area within the fishable area, and '% kept' gives the percent retained in the 'fishable' area analyses.

Fishing	Aggregate area (km^2)			Footprint (km^2)		
year	Out	Fishable total	% kept	Out	Fishable total	% kept
1990	840.4	110 358.5	99.2	795.3	52 690.0	98.5
1991	727.9	134 179.8	99.5	689.4	59 753.2	98.9
1992	1 042.8	147 696.1	99.3	1 004.5	73 195.0	98.6
1993	1 476.8	154 503.9	99.1	1 345.8	75 569.8	98.3
1994	1 373.2	133 380.8	99.0	1 260.8	64 830.4	98.1
1995	1 663.4	161 761.1	99.0	1 543.1	73 350.3	97.9
1996	1 773.1	171 825.0	99.0	1 529.1	79 873.8	98.1
1997	1 651.3	182 271.9	99.1	1 489.4	85 683.1	98.3
1998	1 518.0	202 434.8	99.3	1 376.8	95 120.3	98.6
1999	1 565.5	182 542.0	99.1	1 363.8	89 253.0	98.5
2000	1 197.4	175 234.7	99.3	1 085.2	90 525.4	98.8
2001	910.9	175 286.0	99.5	799.7	92 023.0	99.1
2002	941.2	179 588.2	99.5	798.2	97 683.1	99.2
2003	809.9	182 155.2	99.6	710.5	97 251.0	99.3
2004	799.4	158 914.5	99.5	693.6	85 667.5	99.2
2005	817.6	139 689.2	99.4	665.0	73 374.3	99.1
2006	673.5	120 888.4	99.4	587.6	68 281.4	99.1
2007	588.4	112 518.3	99.5	521.2	67 815.3	99.2
2008	4 602.1	156 006.2	97.1	3 681.3	93 220.2	96.2
2009	4 245.0	153 356.0	97.3	3 357.7	90 874.3	96.4
2010	4 746.8	164 795.5	97.2	3 755.1	95 488.5	96.2
2011	4 286.9	157 466.0	97.3	3 467.8	92 117.4	96.4
2012	4 026.9	154 317.6	97.5	3 239.4	88 931.1	96.5
2013	3 920.8	148 136.0	97.4	3 170.0	86 593.6	96.5
2014	4 027.8	153 953.5	97.5	3 182.5	91 430.4	96.6
2015	3 246.6	150 830.0	97.9	2 655.9	89 808.0	97.1
2016	3 250.0	148 274.7	97.9	2 618.4	87 220.0	97.1
2017	3 456.3	156 040.6	97.8	2 808.0	88 957.7	96.9
2018	3 105.1	160 150.8	98.1	2 528.9	89 431.7	97.2
2019	2 525.3	143 502.8	98.3	2 118.7	81 054.9	97.5
All	65 810.2	4 672 058.1	98.6	32 756.6	460 627.2	93.4

Table C4: For All Stocks data, the number of cells contacted in 1990–94 and the number of 'new' cells contacted in subsequent years and the aggregate area and footprint estimated for those new cells, where data for 1995 represent cells contacted in 1995 but not in 1990–94, and data for 1996 represent cells contacted in 1996 but not in 1990–95, etc.

Number of cells contacted in 1990–94 = 27 820

Fishing year	No. new cells	Aggregate area (km^2)	Footprint (km^2)
1995	1439	1400.4	1171.5
1996	1469	995.1	909.7
1997	1235	932.7	884.3
1998	1519	1815.5	1471.4
1999	1297	1074.1	1008.2
2000	1147	1462.4	1306.9
2001	740	744.6	637.5
2002	958	906.1	869.3
2003	560	649.4	576.9
2004	293	295.7	271.5
2005	553	578.7	513.1
2006	227	112.3	107.6
2007	224	131.8	122.1
2008	528	1147.6	782.0
2009	210	80.0	76.7
2010	149	56.3	55.5
2011	210	103.3	98.5
2012	95	27.9	27.8
2013	66	30.4	30.1
2014	72	25.9	25.8
2015	176	166.5	152.3
2016	153	73.9	72.8
2017	118	59.6	59.2
2018	101	27.4	27.4
2019	65	81.6	78.4

Table C5: Annual summary data for the number of tows that contact each cell, the footprint, and the aggregate area for All Stocks data, 1990–2019, giving the 25th percentile (1st Qu), median, mean, 75th percentile (3rd Qu), and the maximum. The minimum number of tows that contacted each cell was 1 and the minimum values for the footprint and aggregate areas was < 0.0001.

Fishing	No. of tows					Footprint (km^2)					Aggregate area (km^2)				
year	1st Qu	Median	Mean	3rd Qu	Max	1st Qu	Median	Mean	3rd Qu	Max	1st Qu	Median	Mean	3rd	Max
1990	1	3	16.1	13	1099	0.5	1.3	3.8	4.8	25	0.5	1.4	8	5.5	725.5
1991	1	3	18.5	12	2427	0.6	1.4	4	4.8	25	0.6	1.5	9	5.5	1643.2
1992	1	4	18.7	15	1278	0.6	1.7	4.4	5.7	25	0.6	1.7	8.8	6.6	827.3
1993	2	5	19.2	16	1848	0.7	1.8	4.6	6.2	25	0.7	2	9.3	7.3	1392.4
1994	1	4	18.5	15	1288	0.6	1.6	4.1	5.2	25	0.6	1.6	8.3	6	808.2
1995	1	5	20.6	17	1124	0.6	1.8	4.4	5.9	25	0.6	1.9	9.7	6.9	874.8
1996	1	5	22.8	22	1313	0.6	1.8	4.7	6.7	25	0.6	1.9	10.2	8.2	621.2
1997	1	5	23.2	22	1419	0.7	2	4.9	7	25	0.7	2.1	10.5	8.7	546.7
1998	1	5	23.3	22	906	0.7	1.9	5.1	7.2	25	0.7	2	10.8	9	450.3
1999	1	5	22.2	21	1211	0.6	1.8	4.9	6.9	25	0.6	1.9	10	8.5	755.9
2000	2	5	21.1	22	823	0.7	1.9	4.9	7.1	25	0.7	2	9.6	8.9	408.2
2001	2	5	21.2	23	841	0.7	2	5	7.3	25	0.7	2.1	9.6	9.1	589.7
2002	2	5	20	20	1052	0.7	2	4.9	7	25	0.7	2.1	9	8.6	704.7
2003	2	6	20.6	21	992	0.8	2.2	5.1	7.4	25	0.8	2.4	9.5	9.2	680.8
2004	2	6	19.7	19	1458	0.7	2.1	4.8	7	25	0.7	2.3	8.9	8.5	933.7
2005	2	5	19.1	17	1486	0.7	1.8	4.3	5.7	25	0.7	1.9	8.2	6.9	959.1
2006	2	5	18	18	950	0.6	1.8	4.2	5.9	25	0.6	1.9	7.5	7.1	598.4
2007	2	5	17.1	19	574	0.6	1.9	4.3	6.1	25	0.7	2	7.1	7.5	281.6
2008	2	8	25.3	28	607	0.8	2.6	5	7.7	25	0.8	2.9	8.4	9.6	241
2009	2	8	24.8	28	542	0.7	2.5	5	7.6	25	0.7	2.7	8.4	9.6	285.8
2010	2	9	26.6	30	630	0.7	2.7	5.3	8.1	25	0.8	3	9.1	10.4	229.2
2011	2	9	25.7	30	641	0.7	2.7	5.2	8.1	25	0.8	2.9	8.9	10.4	287.4
2012	2	9	25.7	29	533	0.7	2.7	5.1	7.9	25	0.7	3	8.9	10.1	251.7
2013	2	9	26.8	31	695	0.8	2.9	5.3	8.1	25	0.8	3.1	9.1	10.6	297.2
2014	2	9	25.6	30	565	0.8	2.8	5.2	8	25	0.8	3.1	8.8	10.3	290.4
2015	2	9	24.2	29	535	0.8	2.7	5.1	7.8	25	0.8	3	8.6	9.9	324.2
2016	2	8	23.9	27	579	0.7	2.5	4.9	7.5	25	0.7	2.7	8.4	9.4	332.4
2017	2	8	24.5	28	631	0.8	2.7	5.1	7.6	25	0.8	2.9	8.9	9.5	208.5
2018	2	9	24.3	29	828	0.7	2.7	5.2	7.9	25	0.8	3	9.3	10.3	403.5
2019	2	8	24.2	28	609	0.7	2.7	5	7.7	25	0.8	3	8.9	10.2	298.1

Table C6: Estimated footprint (km^2) for All Stocks bottom-contacting trawls, by the 200-m depth zones, for 1990–2019.

	Depth zones (m)								
Fishing year	0–200	200–400	400–600	600–800	800–1000	1000–1200	1200–1400	1400–1600	0–1600
1990	18 191.2	8 262.3	11 372.0	7 205.8	3 426.5	2 333.0	1 583.2	316.1	52 690.0
1991	16 333.3	9 919.3	14 609.0	11 935.0	4 406.6	1 697.5	652.6	199.9	59 753.2
1992	20 400.1	10 712.3	21 276.5	14 771.0	3 930.2	1 243.8	548.6	312.5	73 195.0
1993	23 300.8	9 969.5	21 385.8	14 211.1	4 277.1	1 401.0	696.8	327.6	75 569.8
1994	21 667.4	9 908.2	19 506.4	7 396.9	3 350.5	1 788.5	798.8	413.7	64 830.4
1995	23 688.8	9 751.8	23 755.2	10 223.7	3 320.6	1 609.5	650.4	350.4	73 350.3
1996	28 842.4	11 099.7	25 086.5	9 457.8	3 312.6	1 369.5	471.9	233.4	79 873.8
1997	27 233.0	10 920.6	27 997.7	12 420.1	4 473.3	1 876.0	489.7	272.5	85 683.1
1998	29 405.5	11 423.9	33 324.9	12 321.0	5 300.4	2 278.4	724.8	341.3	95 120.3
1999	25 889.2	9 562.2	33 475.2	10 611.3	5 646.8	2 851.1	878.5	338.7	89 253.0
2000	24 846.7	9 385.3	34 262.2	13 793.3	4 872.2	2 437.3	634.0	294.4	90 525.4
2001	25 554.5	9 711.8	35 718.3	14 622.9	3 679.5	1 985.1	539.0	212.0	92 023.0
2002	27 663.2	10 362.2	36 367.8	16 430.0	4 131.9	2 003.8	553.4	170.8	97 683.1
2003	27 934.1	10 120.7	38 645.2	15 122.4	2 881.1	1 884.9	485.8	176.9	97 251.0
2004	26 460.1	8 213.9	32 355.9	11 969.6	3 513.5	2 454.3	528.8	171.3	85 667.5
2005	28 787.9	8 263.4	24 200.2	6 559.0	2 784.4	2 096.7	509.2	173.5	73 374.3
2006	27 929.4	8 667.5	21 608.8	5 287.5	2 637.6	1 588.9	431.8	129.9	68 281.4
2007	27 487.0	9 117.6	21 518.0	5 092.5	2 379.9	1 605.3	464.0	151.0	67 815.3
2008	51 685.1	10 210.9	20 928.3	6 206.8	2 051.8	1 508.4	482.6	146.1	93 220.2
2009	51 690.4	9 046.3	20 292.1	5 331.1	2 060.6	1 868.6	460.2	125.3	90 874.3
2010	53 803.2	8 826.3	22 648.6	5 794.6	1 995.2	1 807.3	480.9	132.4	95 488.5
2011	50 681.9	9 154.6	23 076.4	6 310.2	1 727.6	761.8	280.6	124.2	92 117.4
2012	49 266.6	8 561.0	22 715.9	5 984.5	1 363.9	723.3	234.4	81.6	88 931.1
2013	49 036.6	7 557.7	21 408.8	6 338.8	1 230.7	703.6	233.9	83.6	86 593.6
2014	49 942.5	8 090.1	21 069.4	9 469.3	1 660.4	809.1	267.8	121.8	91 430.4
2015	46 710.4	8 193.9	23 117.7	8 032.0	2 547.3	861.4	244.5	101.1	89 808.0
2016	44 996.5	8 587.8	23 053.4	6 332.2	2 280.9	1 367.7	491.4	110.2	87 220.0
2017	46 696.1	8 078.4	22 409.5	6 889.2	2 942.9	1 354.3	445.8	141.4	88 957.7
2018	44 894.2	7 769.3	24 097.3	8 527.4	2 269.1	1 229.2	487.7	157.6	89 431.7
2019	42 645.1	7 490.7	21 278.9	5 670.5	2 515.4	1 033.3	341.2	79.8	81 054.9
All	180 810.8	48 651.9	104 923.7	59 832.3	35 544.4	19 620.2	7 875.1	3 368.9	460 627.2

Table C7: Estimated aggregate area (km^2) for All Stocks bottom-contacting trawls, by the 200-m depth zones, for 1990–2019.

	Depth zones (m)								
Fishing year	0–200	200–400	400–600	600–800	800–1000	1000–1200	1200–1400	1400–1600	0–1600
1990	40 385.9	23 455.4	22 390.3	12 421.7	5 679.0	3 177.5	2 458.0	390.6	110 358.5
1991	44 757.6	25 549.0	29 917.1	23 546.8	7 003.3	2 244.7	914.3	247.0	134 179.8
1992	45 922.3	27 362.7	39 600.4	25 569.7	6 104.5	1 909.4	782.1	445.0	147 696.1
1993	53 942.6	23 156.3	42 572.8	24 922.1	6 242.3	2 154.4	1 064.0	449.4	154 503.9
1994	45 027.2	30 162.2	37 435.8	10 633.1	5 158.9	3 004.1	1 387.7	571.9	133 380.8
1995	56 253.9	27 873.6	52 926.7	15 409.4	5 277.5	2 502.5	975.4	542.1	161 761.1
1996	62 766.2	29 488.4	57 557.1	14 492.4	4 741.0	1 827.1	599.9	352.9	171 825.0
1997	53 356.5	30 916.0	65 639.5	22 343.5	6 362.5	2 596.5	621.3	435.9	182 271.9
1998	59 366.8	28 021.7	80 165.3	22 787.4	7 220.0	3 258.1	1 065.1	550.5	202 434.8
1999	56 384.5	22 103.5	72 466.4	18 274.2	7 522.3	4 064.0	1 231.1	496.0	182 542.0
2000	44 869.9	22 827.0	71 284.7	25 167.4	6 662.8	3 217.3	806.2	399.5	175 234.7
2001	48 322.8	23 011.5	69 245.1	26 236.0	5 057.3	2 454.4	682.9	276.2	175 286.0
2002	49 339.7	25 570.1	66 762.3	28 565.6	6 002.5	2 460.2	682.3	205.6	179 588.2
2003	50 697.6	26 198.6	75 138.5	23 095.8	3 748.1	2 397.7	658.3	220.5	182 155.2
2004	50 265.5	20 830.9	60 803.3	18 024.5	4 737.8	3 340.3	706.0	206.2	158 914.5
2005	59 485.1	19 249.6	44 054.9	9 617.1	3 604.9	2 770.5	665.3	241.7	139 689.2
2006	48 893.1	17 386.6	39 593.5	8 869.4	3 489.2	1 960.8	535.4	160.4	120 888.4
2007	43 229.5	17 363.8	37 869.5	8 191.5	3 110.6	1 990.2	580.4	182.9	112 518.3
2008	86 862.8	18 306.3	35 989.9	9 558.0	2 680.3	1 858.3	578.2	172.4	156 006.2
2009	86 260.2	15 355.7	37 371.7	8 855.4	2 611.5	2 200.4	556.9	144.1	153 356.0
2010	90 977.6	16 162.5	43 598.9	8 673.5	2 523.8	2 140.8	568.5	149.9	164 795.5
2011	83 510.2	16 854.8	44 183.8	9 312.4	2 230.9	910.4	320.9	142.6	157 466.0
2012	81 513.0	15 651.5	45 123.0	9 056.1	1 710.2	904.5	264.9	94.3	154 317.6
2013	79 593.7	13 754.9	41 784.0	10 292.9	1 467.9	896.5	252.1	93.9	148 136.0
2014	80 119.6	14 698.9	40 199.7	15 400.7	2 135.4	940.9	319.2	139.1	153 953.5
2015	73 383.6	14 457.3	45 525.3	12 701.8	3 339.9	1 021.2	284.2	116.6	150 830.0
2016	71 300.6	16 410.1	45 622.9	9 600.4	2 887.5	1 712.9	615.4	124.9	148 274.7
2017	74 911.2	15 156.9	48 579.0	11 477.3	3 559.0	1 671.7	526.2	159.2	156 040.6
2018	70 165.2	15 701.9	53 142.7	15 680.3	3 021.8	1 576.9	661.6	200.4	160 150.8
2019	70 133.7	15 406.8	43 873.6	9 047.0	3 195.2	1 286.1	461.2	99.4	143 502.8
All	1 861 997.9	628 444.7	1 490 417.7	467 823.4	129 087.9	64 450.2	21 825.1	8 011.1	4 672 058.1

Table C8: The number of cells contacted by All Stocks bottom-contacting trawls, by the 200-m depth zones, for 1990–2019.

	Depth zones (m)								
Fishing year	0–200	200–400	400–600	600–800	800–1000	1000–1200	1200–1400	1400–1600	0–1600
1990	4 943	1 482	2 554	2 018	1 112	824	501	313	13 747
1991	4 865	1 668	3 023	2 590	1 365	837	388	235	14 971
1992	5 514	1 853	4 174	2 650	1 215	722	356	281	16 765
1993	5 855	1 904	3 398	2 590	1 322	773	412	273	16 527
1994	6 167	1 774	3 043	2 132	1 147	877	473	372	15 985
1995	6 421	1 840	3 249	2 342	1 263	787	431	322	16 655
1996	6 555	1 831	3 372	2 182	1 298	858	478	325	16 899
1997	6 204	1 709	3 628	2 418	1 590	922	513	401	17 385
1998	6 316	1 969	4 069	2 554	1 892	1 052	518	408	18 778
1999	5 630	1 859	4 082	2 295	2 119	1 250	571	371	18 177
2000	5 613	1 875	4 288	2 561	1 882	1 216	500	369	18 304
2001	5 856	1 946	4 506	2 849	1 295	1 025	451	301	18 229
2002	6 398	2 073	5 329	3 114	1 361	1 001	436	296	20 008
2003	6 417	1 993	4 806	3 027	1 256	954	417	274	19 144
2004	6 103	1 563	4 495	2 699	1 257	940	420	279	17 756
2005	6 110	1 653	4 071	2 058	1 418	1 080	432	270	17 092
2006	6 268	1 881	3 509	1 653	1 318	862	386	254	16 131
2007	6 288	1 931	3 375	1 555	1 241	868	389	243	15 890
2008	8 404	2 053	3 465	1 761	1 216	932	491	284	18 606
2009	8 425	1 975	3 348	1 501	1 242	963	465	262	18 181
2010	8 505	1 947	3 253	1 543	1 167	976	456	256	18 103
2011	8 379	1 953	3 343	1 581	1 083	686	374	275	17 674
2012	8 304	1 936	3 328	1 568	992	665	304	179	17 276
2013	8 190	1 736	2 958	1 568	809	603	298	201	16 363
2014	8 289	1 797	3 187	1 855	950	767	333	247	17 425
2015	8 153	1 793	3 281	1 793	1 247	741	283	201	17 492
2016	8 113	1 750	3 233	1 677	1 301	880	444	229	17 627
2017	8 206	1 722	3 150	1 684	1 333	865	389	242	17 591
2018	7 921	1 690	3 425	1 833	1 088	777	356	199	17 289
2019	7 727	1 635	2 932	1 398	1 182	705	324	180	16 083
All	10 382	3 651	8 779	5 890	4 673	3 374	2 611	2 064	41 424

Table C9: Estimated footprint (km^2) for All Stocks bottom-contacting trawls, by BOMEC class A–O, for 1990–2019. Note: 41.5 km^2 (class K) and 44.7 km^2 (not assigned to a class) are not included in this table.

Fishing year	A	B	C	D	E	F	G	H	I	J	L	M	N	O	Total
1990	259.8	90.1	6 559.5	2 071.0	5 967.4	1 493.6	268.9	10 099.0	5 632.8	12 777.6	4 751.8	908.1	1 789.1	20.8	52 690.0
1991	416.8	74.2	5 028.6	1 566.8	6 652.3	1 720.7	330.0	11 500.1	7 414.8	14 137.9	7 530.5	2 155.1	1 201.9	23.4	59 753.2
1992	1 048.6	97.8	8 025.6	1 621.2	6 913.2	1 332.4	312.1	14 356.5	12 929.3	12 009.8	10 333.5	2 930.6	1 234.3	49.0	73 195.0
1993	1 857.9	289.9	8 786.7	1 783.2	8 119.7	846.7	491.1	15 344.1	12 857.3	15 348.7	5 695.0	2 610.8	1 496.0	41.7	75 569.8
1994	1 606.2	332.8	8 949.9	1 317.6	6 220.6	1 299.1	540.9	14 269.9	10 012.5	12 709.6	4 677.6	997.9	1 838.6	56.5	64 830.4
1995	2 169.9	342.2	8 747.5	1 579.0	7 345.2	1 349.7	737.0	15 933.7	12 861.8	14 382.4	5 075.4	1 327.3	1 431.2	67.1	73 350.3
1996	3 867.7	179.1	10 721.1	1 930.8	7 884.4	1 640.1	1 083.5	17 451.8	14 269.7	13 378.8	5 150.3	1 311.7	946.3	55.1	79 873.8
1997	3 768.7	285.6	10 356.9	1 676.5	7 214.0	1 380.2	1 142.4	16 685.2	15 424.3	17 618.2	7 212.5	1 751.0	1 080.8	84.6	85 683.1
1998	3 607.3	214.0	12 425.5	1 825.3	8 247.9	1 134.1	866.5	19 525.2	18 665.5	18 161.4	6 947.1	1 919.0	1 499.6	76.8	95 120.3
1999	3 510.3	195.4	11 701.2	1 075.1	7 241.1	642.8	712.1	19 108.5	18 837.6	17 656.3	5 030.1	1 790.0	1 670.5	79.0	89 253.0
2000	3 272.6	264.6	10 166.9	1 116.8	7 058.0	596.0	745.2	18 895.8	18 504.2	17 979.9	8 064.5	2 453.2	1 327.6	73.7	90 525.4
2001	4 317.2	279.2	11 688.9	493.6	5 856.8	631.6	639.3	20 022.3	17 778.5	17 343.6	9 227.1	2 556.2	1 130.7	57.9	92 023.0
2002	4 260.6	472.7	12 741.2	875.2	6 323.0	1 115.7	569.7	18 836.0	16 950.1	17 477.2	11 956.2	4 844.3	1 182.6	78.3	97 683.1
2003	3 859.2	348.0	13 110.9	1 037.4	6 131.5	1 301.7	582.7	21 399.3	16 563.3	16 499.0	13 198.5	2 062.5	1 082.0	73.2	97 251.0
2004	4 357.2	291.7	12 797.4	912.2	4 948.1	1 471.2	662.3	17 074.8	13 670.0	15 444.8	10 577.8	2 277.5	1 116.6	63.9	85 667.5
2005	4 375.3	470.8	14 057.8	789.2	5 564.3	1 405.5	638.7	15 318.2	10 293.5	11 932.0	5 649.0	1 714.7	1 104.7	60.5	73 374.3
2006	3 270.9	425.5	13 350.4	806.8	6 364.9	1 626.2	462.1	14 930.3	9 968.3	11 543.4	3 578.3	1 128.0	784.1	41.1	68 281.4
2007	3 371.7	272.9	13 959.8	766.8	5 684.2	1 114.8	506.8	15 301.6	11 173.8	9 725.4	3 991.4	1 146.2	757.9	41.9	67 815.3
2008	7 467.7	4 754.3	21 471.9	7 115.3	6 261.8	972.4	1 537.8	16 713.0	9 841.1	10 882.7	4 531.1	811.8	801.0	49.5	93 220.2
2009	7 551.0	4 811.9	20 764.3	7 890.7	6 080.3	1 345.2	1 559.0	14 042.0	10 667.4	9 758.0	4 693.4	923.7	754.7	26.0	90 874.3
2010	7 848.9	5 430.1	20 455.8	8 657.8	7 318.4	1 399.7	1 682.7	13 412.9	12 354.3	10 267.0	4 632.4	1 124.8	864.8	30.6	95 488.5
2011	7 206.8	4 844.5	18 822.3	7 958.8	7 719.0	931.9	1 826.4	13 606.8	11 406.0	9 639.0	6 221.2	1 329.6	571.2	26.5	92 117.4
2012	7 447.8	5 290.8	18 158.0	8 029.7	6 746.1	671.6	1 656.7	13 560.9	11 793.8	9 679.2	4 646.5	698.4	525.8	17.2	88 931.1
2013	6 928.7	5 454.3	17 835.8	8 427.3	6 711.5	685.1	1 717.1	12 223.3	12 196.1	9 050.9	4 359.0	471.7	505.5	16.7	86 593.6
2014	6 912.0	5 374.0	17 894.5	8 522.1	7 251.3	431.9	1 773.4	13 033.4	11 594.2	10 706.5	6 251.1	1 049.8	593.4	32.0	91 430.4
2015	6 145.4	4 954.4	17 248.1	7 717.4	7 023.4	412.8	1 566.1	14 141.4	12 368.3	11 763.1	5 130.7	800.3	508.3	17.5	89 808.0
2016	6 353.8	5 071.8	16 423.0	7 191.9	6 278.5	473.1	1 472.8	14 878.7	10 855.5	11 347.7	5 185.5	787.5	859.0	28.9	87 220.0
2017	5 914.3	5 103.9	17 418.8	7 067.0	7 015.1	794.4	1 389.0	14 020.3	10 963.2	11 882.5	5 609.4	898.8	841.6	27.4	88 957.7
2018	5 560.1	4 704.1	17 016.7	7 329.9	6 325.5	385.8	1 289.4	14 551.5	10 884.9	11 585.5	7 531.3	1 464.3	769.7	22.8	89 431.7
2019	5 236.8	5 297.1	15 782.4	6 934.7	6 316.9	316.7	1 092.4	12 987.0	9 906.8	10 365.4	5 518.0	719.9	555.4	19.7	81 054.9
All	17 481.6	11 374.4	74 461.7	21 748.7	34 431.6	6 900.9	5 173.3	78 072.4	38 811.1	81 921.7	56 638.2	19 138.8	13 771.8	614.7	460 627.2

Table C10: Estimated aggregate area (km^2) for All Stocks bottom-contacting trawls, by BOMEC class A-O, for 1990–2019. Note: 44.4 km^2 (class K) and 117.5 km^2 (not assigned to a class) are not included in this table. Annual totals are given in Table C1. Year is fishing year.

Year	A	B	C	D	E	F	G	H	I	J	L	M	N	O
1990	280.1	94.5	8 269.0	2 817.5	14 746.0	8 950.7	431.9	20 885.9	11 589.4	25 323.5	13 315.5	1 029.5	2 601.1	23.4
1991	448.1	77.3	6 297.0	1 930.1	29 440.9	4 267.6	884.7	23 913.1	16 648.3	30 207.0	15 162.0	3 214.4	1 660.0	29.2
1992	1 327.9	107.9	10 996.5	2 253.3	25 469.3	3 545.9	690.9	30 449.1	25 963.2	22 102.7	17 783.7	5 132.6	1 786.4	85.7
1993	3 015.5	375.5	12 582.5	2 195.2	32 536.4	1 435.1	1 278.8	30 327.9	27 847.8	28 663.7	8 194.8	3 717.9	2 268.6	62.9
1994	2 022.3	366.3	11 634.4	1 678.0	19 274.2	9 819.3	1 205.7	29 580.5	18 603.8	25 293.6	9 608.6	1 245.8	2 959.5	87.9
1995	2 736.5	370.8	10 913.7	2 059.7	28 515.5	8 489.7	1 910.0	34 149.8	28 103.5	30 002.6	10 444.0	1 804.3	2 126.8	133.3
1996	6 303.9	249.4	13 725.4	2 672.7	25 871.6	9 127.5	4 392.9	35 118.9	33 073.5	26 009.3	12 081.5	1 787.0	1 280.0	128.1
1997	6 221.2	369.8	13 612.1	2 309.9	22 499.0	4 351.0	4 157.3	35 818.0	36 260.8	36 274.0	15 968.2	2 707.3	1 492.1	229.0
1998	6 003.3	243.6	17 858.1	2 769.1	28 475.6	3 022.2	2 615.7	41 011.3	45 935.8	37 682.5	11 491.6	2 878.2	2 252.8	189.8
1999	5 865.8	220.2	16 493.1	1 351.3	28 916.3	1 162.5	2 113.1	39 595.2	43 170.9	31 251.0	7 059.1	2 837.8	2 367.4	135.2
2000	5 182.3	298.0	14 577.6	1 350.5	18 839.6	948.9	2 276.2	37 359.3	41 400.9	33 302.5	14 268.5	3 471.3	1 829.9	122.6
2001	7 080.2	343.2	16 845.0	561.5	20 592.6	915.8	1 650.7	39 817.1	35 876.1	32 988.4	13 422.9	3 611.2	1 484.1	97.1
2002	6 673.2	557.1	17 567.6	1 029.1	19 231.7	2 720.9	1 421.2	37 695.7	33 200.7	31 003.7	18 529.8	8 302.5	1 548.5	106.1
2003	5 916.8	408.9	18 592.5	1 205.5	20 006.7	3 083.3	1 602.3	43 004.1	32 794.8	31 004.8	20 484.2	2 448.2	1 501.8	99.5
2004	7 087.8	352.2	17 627.9	1 077.8	18 481.4	4 593.9	1 914.6	33 180.2	25 162.5	26 687.2	18 324.2	2 815.5	1 523.9	83.5
2005	7 436.7	589.8	19 967.8	958.5	23 741.4	4 618.2	1 883.6	27 640.5	20 381.9	19 074.3	9 814.3	1 988.3	1 491.5	102.3
2006	4 780.3	472.9	17 939.0	990.2	19 189.9	3 412.2	1 084.0	24 793.7	19 614.8	19 246.7	6 847.1	1 411.0	1 045.1	60.5
2007	4 812.2	308.4	18 408.1	895.2	14 009.9	1 894.4	1 159.9	24 448.6	22 317.4	14 476.1	7 334.5	1 454.8	937.9	60.7
2008	13 105.3	9 707.1	30 875.6	12 522.3	13 784.9	2 162.7	2 836.9	26 081.7	18 672.9	17 052.0	7 001.9	1 123.1	1 004.9	65.7
2009	13 150.9	8 922.5	30 982.2	13 990.7	11 652.6	2 929.2	2 842.9	21 493.5	22 320.3	15 315.6	7 564.4	1 207.9	937.7	37.7
2010	14 268.6	10 629.4	29 934.8	16 023.6	14 742.9	2 217.5	2 884.6	21 865.4	26 419.8	16 094.6	7 100.1	1 530.0	1 037.3	36.0
2011	12 513.4	8 372.6	26 366.2	14 220.3	15 404.0	1 657.0	3 145.9	22 294.4	23 044.7	16 749.8	11 164.3	1 808.6	683.4	32.4
2012	12 878.3	9 880.4	24 997.0	14 571.2	13 544.9	978.1	2 884.8	23 137.7	24 403.3	16 806.7	8 665.0	906.9	628.1	24.8
2013	11 626.8	9 744.3	24 677.2	15 826.7	11 947.7	969.0	3 035.6	20 846.9	26 210.4	14 543.2	7 448.4	648.3	575.4	22.4
2014	11 925.5	9 851.3	24 450.6	15 916.9	12 389.5	514.7	3 367.1	22 002.9	23 334.9	17 938.0	9 878.0	1 622.6	706.9	42.4
2015	10 103.2	9 101.6	24 258.3	13 223.3	11 701.1	646.1	2 674.2	24 311.3	26 356.7	19 277.9	7 447.5	1 091.4	603.7	21.2
2016	10 406.1	9 118.8	22 017.5	13 376.0	10 363.2	1 008.0	2 663.8	26 833.2	22 390.6	18 667.2	9 296.3	1 014.5	1 067.6	38.5
2017	9 533.2	9 881.0	23 470.0	13 259.8	12 146.6	1 521.2	2 472.1	24 303.4	23 648.2	23 657.0	9 849.5	1 207.4	1 043.3	34.4
2018	8 722.8	8 095.5	23 344.3	12 473.7	11 649.9	524.5	2 221.2	26 685.8	22 945.4	24 259.1	15 453.4	2 631.8	1 095.6	36.3
2019	8 185.8	9 120.3	21 718.6	11 767.3	14 400.4	445.6	1 837.9	23 988.1	23 014.1	16 983.5	10 231.0	975.0	795.7	33.0
All	219 614.0	118 230.6	570 999.6	197 276.7	563 565.9	91 932.6	65 540.2	872 633.1	800 707.4	717 938.5	341 234.4	67 624.8	42 336.8	2 261.6

Table C11: The number of cells contacted by All Stocks bottom-contacting trawls, by BOMEC class A–O, for 1990–2019. Out gives cells not assigned to a class.

Fishing year	Out	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Total
1990	4	269	108	1 931	628	1 322	295	99	2 038	1 082	2 973	–	1 501	623	823	51	13 747
1991	3	346	85	1 878	587	1 314	389	100	2 182	1 293	3 262	–	1 915	855	720	42	14 971
1992	4	449	107	2 166	627	1 436	371	106	2 515	1 609	2 975	1	2 742	897	716	44	16 765
1993	6	498	198	2 224	705	1 523	308	137	2 819	1 593	3 361	2	1 613	730	740	70	16 527
1994	6	678	249	2 464	648	1 330	294	162	2 639	1 510	3 121	2	1 401	481	933	67	15 985
1995	4	757	260	2 485	615	1 473	307	177	2 923	1 499	3 436	2	1 335	492	813	77	16 655
1996	8	798	129	2 578	683	1 446	332	167	2 829	1 551	3 241	7	1 584	604	866	76	16 899
1997	8	799	165	2 485	526	1 336	275	185	2 784	1 517	3 891	5	1 666	672	969	102	17 385
1998	11	778	179	2 545	562	1 434	258	175	3 217	1 588	4 262	8	1 793	857	1 007	104	18 778
1999	10	722	195	2 230	462	1 272	248	162	3 089	1 634	4 478	1	1 716	734	1 094	130	18 177
2000	8	605	229	2 249	431	1 303	256	135	3 100	1 603	4 153	10	2 148	954	1 004	116	18 304
2001	4	735	151	2 647	340	1 202	227	151	3 247	1 568	3 516	–	2 441	1 048	875	77	18 229
2002	1	769	298	2 846	401	1 211	295	155	3 315	1 589	3 371	2	3 272	1 472	905	106	20 008
2003	3	742	260	2 933	448	1 203	244	142	3 473	1 540	3 422	6	2 794	1 002	834	98	19 144
2004	2	770	207	2 817	440	1 085	253	144	2 952	1 466	3 362	7	2 365	982	816	88	17 756
2005	3	751	240	2 826	376	1 102	216	132	3 079	1 370	3 040	–	1 776	1 190	911	80	17 092
2006	1	678	283	2 855	330	1 257	266	142	3 230	1 370	3 000	2	1 136	748	764	69	16 131
2007	2	739	268	2 900	344	1 222	240	161	3 207	1 333	2 877	1	1 086	714	720	76	15 890
2008	41	1 078	546	3 315	1 111	1 405	239	248	3 407	1 359	3 276	7	1 070	577	844	83	18 606
2009	41	1 076	540	3 355	1 111	1 389	284	243	3 063	1 351	3 080	1	1 137	656	790	64	18 181
2010	54	1078	544	3 318	1 115	1 457	318	251	2 950	1 328	3 028	–	1 171	585	832	74	18 103
2011	47	1 072	550	3 297	1 122	1 324	277	257	3 002	1 260	2 666	1	1 345	651	734	69	17 674
2012	46	1 089	543	3 279	1 128	1 342	232	255	2 932	1 343	2 791	1	1 201	446	602	46	17 276
2013	45	1 059	550	3 282	1 120	1 278	216	257	2 664	1 325	2 635	–	1 020	278	589	45	16 363
2014	41	1 055	543	3 316	1 133	1 278	220	254	2 840	1 345	2 994	7	1 331	332	661	75	17 425
2015	46	1 027	547	3 183	1 131	1 371	140	255	2 966	1 261	3 415	10	1 236	281	578	45	17 492
2016	43	1 024	541	3 181	1 097	1 331	162	241	2 924	1 295	3 326	12	1 224	372	796	58	17 627
2017	40	1 032	540	3 282	1 077	1 327	192	242	2 789	1 284	3 309	11	1 311	346	759	50	17 591
2018	41	1 004	547	3 216	1 098	1 146	168	253	2 801	1 308	3 099	13	1 458	438	657	42	17 289
2019	35	954	539	3 120	1 071	1 213	143	236	2 653	1 150	2 931	1	1 096	298	591	52	16 083
All	93	1 180	554	3 601	1 203	2 322	845	264	5 080	2 008	9 188	25	5 725	3 997	4 867	472	41 424

Table C12: The estimated footprint (km^2) for All Stocks during 1990–2019 and 2019 by the surficial layers representing the percent of carbonate, gravel, mud, and sand. 'unk' is where there was no overlap.

	1990–2019 footprint (km^2)			
Sediment (%)	Carbonate	Gravel	Mud	Sand
0–20	87 682.8	358 985.2	149 884.1	41 265.5
20–40	135 047.6	69 668.0	110 723.2	91 271.7
40–60	91 710.7	20 072.8	102 242.8	163 863.7
60–80	65 283.0	5 769.8	64 197.9	121 048.2
80–100	76 777.3	1 636.0	29 122.7	39 053.9
unk	4 125.7	4 495.4	4 456.5	4 124.3
Total	460 627.2	460 627.2	460 627.2	460 627.2

	2019 footprint (km^2)			
Sediment (%)	Carbonate	Gravel	Mud	Sand
0–20	23 508.4	65 619.4	24 467.2	6 623.8
20–40	26 543.9	11 745.4	18 007.5	17 914.1
40–60	14 348.9	2 447.6	20 366.6	27 997.3
60–80	8 382.8	380.3	13 177.7	20 427.9
80–100	7 791.4	379.4	4 553.1	7 612.3
unk	479.5	482.8	482.8	479.5
Total	81 054.9	81 054.9	81 054.9	81 054.9

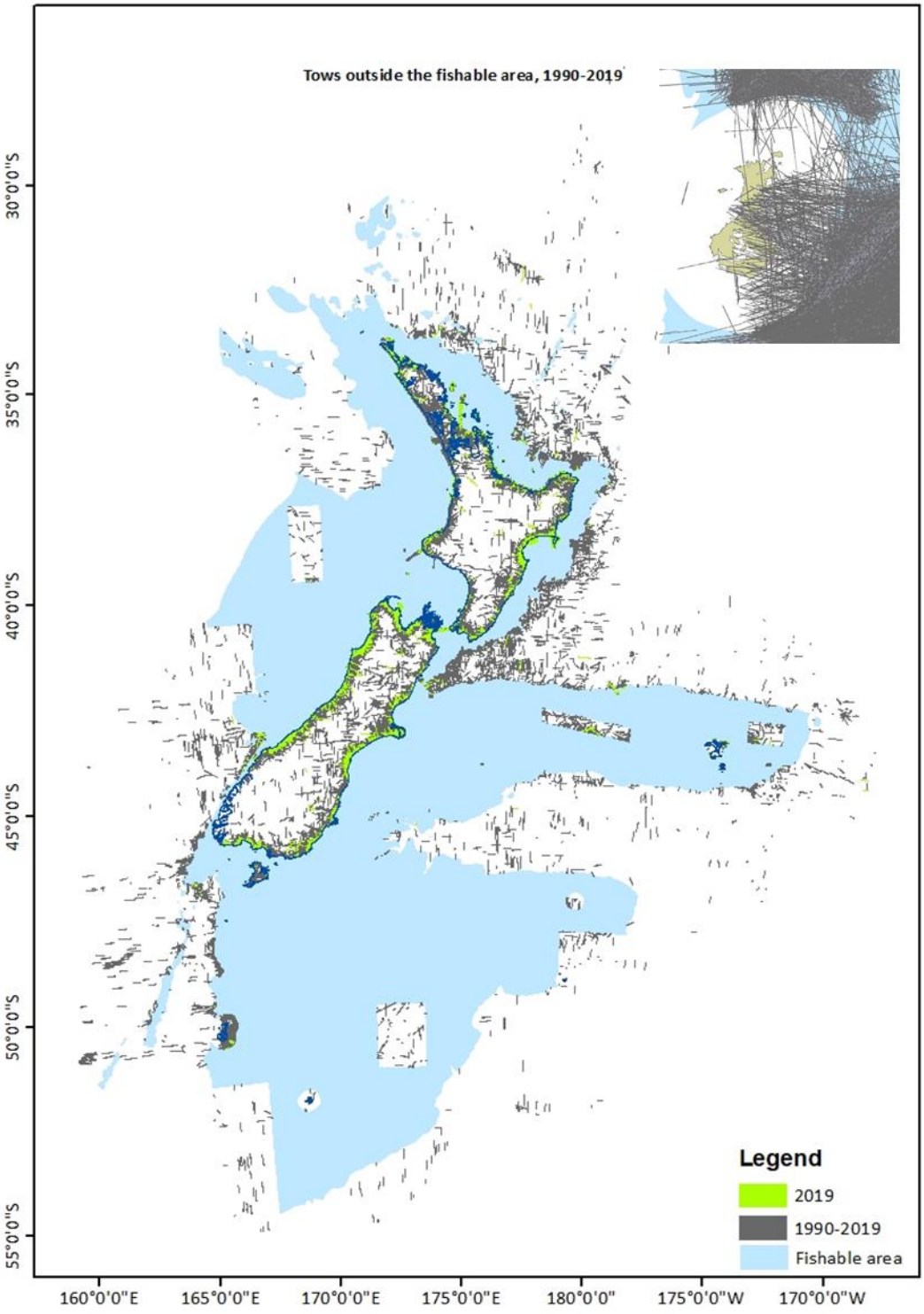


Figure C1: Tows and portions of tows either completely or partially removed from the footprint analyses, for 1990–2019 fishing years combined, and for 2019. The coastline is defined by a blue line. The inset shows where portions of tows that are outside the fishable area are removed from the footprint analyses; these tows cross the marine mammal sanctuary extent (12 nm beyond land, established in 1978) and the Auckland Islands.

APPENDIX D: DEEPWATER FISHSTOCKS TOW DATA

Table D1: Percent of deepwater tows by data collection method, the number of tows, and number of vessels (based on unique vessel key), by deepwater stock and fishing year for 1990–2019. ERS is Electronic Reporting System, TCE is Trawl Catch Effort Return, and TCP is Trawl Catch Effort Processing Return.

	Tier 1					Tier 2					Tier 1 & Tier 2
Fishing year	ERS (%)	TCE (%)	TCP (%)	No. tows	No. vessels	ERS (%)	TCE (%)	TCP (%)	No. tows	No. vessels	No. vessels
1990	0	0	100.0	31 222	127	0	0	100.0	3 368	50	127
1991	0	0	100.0	39 617	147	0	0	100.0	2 912	53	148
1992	0	0	100.0	43 170	150	0	0	100.0	2 659	58	150
1993	0	0	100.0	46 103	137	0	0	100.0	3 297	64	138
1994	0	0	100.0	47 796	144	0	0	100.0	3 038	75	149
1995	0	0	100.0	51 133	158	0	0	100.0	4 306	82	162
1996	0	0	100.0	51 087	150	0	0	100.0	4 569	86	156
1997	0	0	100.0	53 313	160	0	0	100.0	3 447	76	168
1998	0	0	100.0	57 598	150	0	0	100.0	2 947	75	152
1999	0	0	100.0	54 086	134	0	0	100.0	3 465	74	139
2000	0	0	100.0	50 053	103	0	0	100.0	3 309	63	112
2001	0	0	100.0	46 893	100	0	0	100.0	3 016	59	103
2002	0	0	100.0	47 433	98	0	0	100.0	3 434	57	104
2003	0	0	100.0	45 986	94	0	0	100.0	3 979	55	101
2004	0	0	100.0	40 311	92	0	0	100.0	2 594	50	95
2005	0	0	100.0	36 771	81	0	0	100.0	3 454	57	87
2006	0	0	100.0	33 363	77	0	0	100.0	4 027	54	80
2007	0	0	100.0	29 424	70	0	0	100.0	4 149	50	72
2008	0	4.8	95.2	28 810	94	0	32.6	67.4	5 186	81	112
2009	0	4.1	95.9	25 509	88	0	29.4	70.6	4 283	80	106
2010	0	5.3	94.7	26 495	95	0	31.7	68.3	4 113	88	114
2011	0	4.9	95.1	24 495	93	0	31.4	68.6	3 818	88	114
2012	0	5.4	94.6	23 717	92	0	33.3	66.7	3 545	79	104
2013	0	6.5	93.5	22 883	87	0	48.8	51.2	3 060	78	101
2014	0	7.5	92.5	23 521	87	0	41.3	58.8	3 440	83	105
2015	0	7.1	92.9	23 469	89	0	36.7	63.3	3 262	78	103
2016	0	7.1	92.9	24 197	96	0	36.4	63.6	2 953	72	105
2017	0	6.1	93.9	23 597	90	0	29.3	70.7	2 852	73	97
2018	75.7	6.3	18.0	24 973	88	55.8	37.0	7.2	2 652	63	96
2019	83.7	5.9	10.4	24 883	89	74.7	25.2	0.1	2 653	61	93
Total	3.6	1.6	94.8	1 101 908	549	3.3	13.8	82.9	103 787	363	570

Table D2: Total number of bottom-contacting Tier 1 tows and percentage by target species, for each fishing year during 1990–2019. Target species codes are defined in Table 1.

Fishing year	No. of Tier 1 tows	Percentage of total Tier 1 tows by target								
		HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU
1990	31 222	0.8	26.2	7.2	2.2	6.8	20.0	3.1	7.2	26.6
1991	39 617	0.2	33.8	4.0	2.5	6.6	12.8	3.5	10.6	26.0
1992	43 170	1.3	36.3	6.3	1.5	3.0	15.3	5.5	13.4	17.4
1993	46 103	2.1	36.5	5.8	1.2	4.4	21.5	1.1	11.6	15.9
1994	47 796	1.2	28.3	5.9	0.9	3.4	28.9	0.9	10.9	19.6
1995	51 133	1.5	34.4	4.0	0.5	3.5	28.2	0.4	7.6	19.9
1996	51 087	1.0	42.9	3.9	0.8	6.0	19.3	0.7	6.8	18.6
1997	53 313	0.9	47.7	3.0	0.6	6.5	15.4	0.6	6.7	18.5
1998	57 598	0.8	48.4	5.7	0.6	5.5	17.9	1.4	6.1	13.7
1999	54 086	1.3	44.9	4.7	0.7	6.3	19.8	1.4	7.5	13.4
2000	50 053	0.8	50.6	3.4	0.9	6.8	16.5	1.1	9.2	10.6
2001	46 893	1.2	51.1	3.4	0.7	6.9	11.0	1.0	10.2	14.6
2002	47 433	1.7	46.6	5.0	0.9	5.7	9.7	1.8	13.8	14.8
2003	45 986	2.0	47.3	5.4	0.8	5.4	10.8	0.8	9.9	17.5
2004	40 311	4.0	42.7	4.7	0.9	5.6	12.0	1.2	9.2	19.7
2005	36 771	3.8	30.8	5.2	1.8	6.4	12.4	1.1	12.6	25.9
2006	33 363	3.8	27.6	6.7	3.0	6.1	13.9	0.9	14.6	23.3
2007	29 424	4.2	28.8	6.8	4.6	7.2	13.5	1.2	17.4	16.4
2008	28 810	5.3	27.4	6.9	7.0	8.6	12.8	1.5	16.7	13.8
2009	25 509	6.7	27.9	6.2	4.6	8.5	13.9	2.4	15.6	14.2
2010	26 495	3.1	32.3	7.2	3.8	9.6	11.0	2.8	16.0	14.2
2011	24 495	3.3	34.2	5.1	3.9	7.7	7.7	2.8	18.2	17.1
2012	23 717	2.7	37.9	6.4	3.5	7.0	6.7	2.1	19.0	14.6
2013	22 883	3.0	41.1	6.0	4.4	5.6	7.0	1.7	19.8	11.5
2014	23 521	3.3	44.1	5.7	4.1	5.4	8.6	1.3	18.8	8.7
2015	23 469	4.0	43.4	4.1	4.2	5.4	10.0	1.9	18.8	8.2
2016	24 197	2.0	39.3	3.7	4.0	3.3	12.9	1.4	21.5	11.8
2017	23 597	2.3	42.3	3.3	4.3	3.0	12.6	1.3	19.9	11.0
2018	24 973	1.0	43.3	3.7	4.0	3.4	13.7	1.4	18.3	11.3
2019	24 883	0.6	34.9	3.5	4.8	3.2	12.6	1.6	21.6	17.2
All	1 101 908	2.1	39.4	5.0	2.1	5.7	15.3	1.6	12.3	16.6

Table D3: Total number of bottom-contacting Tier 2 tows and percentage by target species, for each fishing year during 1990–2019. Target species codes are defined in Table 1.

Fishing year	No. of Tier 2 tows	Percentage of Tier 2 tows by target															
		BAR	BYX	CDL	EMA	FRO	GSH	LDO	PRK	PTO	RBT	RBY	RIB	SKI	SPD	SPE	SWA	WWA
1990	3 368	51.8	5.9	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	4.6	0.9	0.4	27.7	5.4
1991	2 912	51.7	8.4	13.2	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	2.3	1.0	0.5	20.7	1.5
1992	2 659	45.6	12.9	6.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	1.5	0.0	4.1	0.3	1.2	27.2	0.6
1993	3 297	45.5	11.2	6.1	0.0	0.2	0.0	0.3	0.1	0.0	0.0	2.4	0.0	4.6	0.0	1.2	28.2	0.1
1994	3 038	34.7	20.4	12.4	0.2	0.0	0.0	0.1	0.0	0.0	0.0	1.7	0.0	0.8	0.0	1.4	28.0	0.3
1995	4 306	41.3	16.0	13.2	0.0	0.7	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.4	0.0	1.0	25.1	0.1
1996	4 569	36.1	15.9	20.4	0.0	0.0	0.0	0.0	0.0	6.9	0.0	1.6	0.0	0.4	0.0	0.4	18.3	0.0
1997	3 447	36.1	22.3	27.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.8	0.1	0.3	11.5	0.0
1998	2 947	36.7	22.7	24.4	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.5	0.0	1.6	12.2	0.2
1999	3 465	22.2	37.1	26.2	1.3	3.2	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.1	6.7	1.8
2000	3 309	24.7	26.6	32.7	0.0	0.3	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.5	0.0	0.0	10.5	2.2
2001	3 016	31.8	24.4	24.6	0.0	2.4	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.1	9.4	3.1
2002	3 434	30.1	16.5	22.2	0.0	2.2	0.0	0.8	0.0	0.0	0.0	2.4	0.0	0.0	1.1	2.4	15.5	6.8
2003	3 979	24.2	23.1	28.5	0.2	0.1	0.0	0.1	0.0	0.0	0.0	1.2	0.0	0.5	0.0	7.6	6.0	8.4
2004	2 594	23.6	28.8	22.8	0.0	0.1	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.1	0.1	5.3	4.8	11.8
2005	3 454	22.5	28.5	22.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	3.4	0.2	0.0	0.2	0.3	11.7	10.3
2006	4 027	14.4	32.2	24.8	0.9	0.3	0.0	0.0	0.0	0.0	0.3	3.8	0.3	0.0	1.0	0.8	15.3	6.1
2007	4 149	23.0	20.0	25.1	0.3	0.1	0.0	0.0	0.0	0.0	0.1	2.7	0.0	0.0	0.3	3.9	19.3	5.2
2008	5 186	42.4	12.5	10.4	0.3	0.0	0.0	0.5	0.0	0.0	0.1	1.9	0.0	0.2	3.3	2.4	21.8	4.3
2009	4 283	30.7	18.1	9.7	0.6	0.0	0.0	0.2	0.0	0.0	0.4	1.5	0.0	0.2	5.7	0.7	24.6	7.6
2010	4 113	24.8	22.7	12.8	0.0	0.0	0.0	0.9	0.0	0.0	0.2	4.9	0.0	0.4	6.3	3.8	18.0	5.0
2011	3 818	24.1	23.0	10.1	0.1	0.0	0.0	1.5	0.0	0.0	0.1	4.6	0.0	1.9	3.9	5.8	21.8	3.1
2012	3 545	32.7	22.2	10.7	0.7	0.0	0.1	1.3	0.0	0.0	0.6	3.2	0.0	2.3	3.2	1.3	17.3	4.3
2013	3 060	36.5	8.4	7.5	0.2	0.0	0.4	3.5	0.0	0.0	1.3	4.0	0.0	2.4	1.7	6.3	22.9	5.1
2014	3 440	34.4	15.2	9.0	0.0	0.1	0.1	1.3	0.0	0.0	1.0	3.3	0.0	1.1	2.1	4.2	21.1	7.1
2015	3 262	35.7	15.8	5.9	0.0	0.1	0.0	2.2	0.0	0.0	0.5	3.2	0.0	1.4	2.6	10.0	19.3	3.1
2016	2 953	34.9	14.1	4.9	0.0	0.4	0.1	2.2	0.0	0.0	0.2	8.5	0.0	1.4	0.0	10.1	19.7	3.5
2017	2 852	39.0	16.0	4.1	0.0	0.4	0.0	1.5	0.0	0.0	0.5	5.0	0.0	0.7	0.0	7.7	21.3	3.9
2018	2 652	34.7	18.4	3.1	0.0	0.5	0.0	2.1	0.0	0.0	0.1	3.8	0.1	0.5	0.0	11.1	22.4	3.3
2019	2 653	36.5	25.0	6.6	0.6	0.8	0.0	1.3	0.0	0.0	0.2	3.2	0.0	0.2	0.0	10.6	12.6	2.5
All	103 787	33.1	19.5	15.3	0.2	0.4	0.0	0.6	0.0	0.3	0.2	2.7	0.0	1.0	1.3	3.2	18.2	3.9

Table D4: The annual number of cells contacted and the estimated aggregate and footprint areas for Deepwater Tier 1 and Tier 2 fishstocks combined, within the fishable area, for 1990–2019.

	Contacted cells			Aggregate area			Footprint		
Fishing year	No.	Tier 1 (%)	Tier 2 (%)	Area (km^2)	Tier 1 (%)	Tier 2 (%)	Area (km2)	Tier 1 (%)	Tier 2 (%)
1990	12 345	93.1	25.0	101 844.5	88.8	11.2	47 584.0	88.4	17.1
1991	13 324	94.9	19.3	126 457.5	93.8	6.2	55 058.4	93.5	10.3
1992	14 567	95.3	17.5	137 294.0	94.0	6.0	66 617.1	94.4	8.9
1993	14 133	93.5	21.0	140 106.8	92.7	7.3	66 927.0	93.4	10.4
1994	13 413	93.8	20.4	122 080.2	93.2	6.8	56 931.5	94.4	9.6
1995	13 651	92.3	25.6	144 635.0	91.9	8.1	61 830.5	92.8	12.2
1996	13 647	91.6	22.8	144 433.7	93.7	6.3	62 726.2	93.9	10.1
1997	14 070	96.2	15.7	155 222.9	96.5	3.5	68 756.4	96.4	6.1
1998	15 443	96.0	15.0	171 901.7	97.0	3.0	77 090.5	97.2	5.1
1999	15 166	95.2	15.1	156 834.9	97.1	2.9	72 611.9	97.5	4.9
2000	15 360	95.1	13.9	150 733.1	96.9	3.1	74 023.2	97.0	4.7
2001	15 325	94.1	15.8	151 150.7	96.9	3.1	76 256.1	96.5	4.8
2002	17 070	92.2	18.8	155 213.9	96.2	3.8	81 004.8	95.7	6.0
2003	16 017	92.8	18.4	157 211.9	95.7	4.3	80 616.7	95.1	6.4
2004	14 133	94.0	14.5	131 779.7	97.1	2.9	67 794.8	96.3	4.6
2005	13 345	94.1	18.2	110 887.0	94.7	5.3	54 221.3	94.3	8.4
2006	12 399	93.8	20.9	95 332.0	93.5	6.5	50 099.2	93.8	9.7
2007	12 204	91.6	26.6	88 362.0	91.1	8.9	50 347.7	91.2	12.4
2008	13 192	83.3	36.3	85 589.0	87.6	12.4	51 022.2	85.7	16.9
2009	12 313	84.3	31.9	79 650.3	89.3	10.7	46 228.7	87.4	14.9
2010	12 477	85.3	32.6	87 835.8	92.1	7.9	49 886.4	90.2	12.1
2011	12 038	82.5	34.9	87 477.9	91.8	8.2	48 678.5	89.4	12.8
2012	11 447	83.0	33.1	86 230.0	92.6	7.4	46 923.5	90.2	11.9
2013	10 721	83.0	33.0	80 303.6	91.6	8.4	44 784.3	89.3	12.9
2014	11 755	82.1	34.0	82 825.1	91.8	8.2	47 578.7	90.0	12.4
2015	11 494	84.2	30.9	85 902.4	92.0	8.0	48 183.6	90.9	11.4
2016	11 557	84.6	30.7	84 765.1	93.3	6.7	46 678.6	91.2	10.4
2017	11 524	84.2	30.3	89 567.8	93.1	6.9	46 983.6	91.3	10.5
2018	11 092	87.4	27.8	97 044.7	94.1	5.9	48 027.3	92.1	9.6
2019	10 352	84.8	27.9	86 777.0	93.6	6.4	43 841.0	92.7	9.2
All	38 872	96.1	40.1	3 475 450.1	93.9	6.1	351 683.5	92.6	21.1

Table D5: Estimated footprint (km^2) for Deepwater Tier 1 bottom-contacting trawls, by target, for 1990–2019. Codes are defined in Table 1.

Fishing year	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
1990	627.9	16 834.2	7 345.4	2 054.0	2 094.9	5 578.2	1 685.0	1 172.9	6 565.8	42 043.8
1991	248.9	26 860.2	5 844.6	2 627.3	1 626.8	3 816.1	2 519.1	2 251.0	7 939.2	51 474.2
1992	1 587.1	33 165.3	8 791.9	2 107.5	796.5	3 326.2	5 248.6	3 848.0	7 058.5	62 885.8
1993	2 403.2	35 209.1	8 492.0	1 810.4	1 108.8	3 707.2	1 083.7	3 906.0	7 337.6	62 534.1
1994	1 678.7	26 466.5	8 652.7	1 432.8	1 313.1	4 558.8	735.8	3 953.0	7 646.7	53 747.6
1995	1 396.1	34 680.3	6 102.9	838.9	1 017.1	3 924.4	403.3	3 177.7	9 464.5	57 368.4
1996	1 286.6	36 689.0	6 480.6	1 313.0	1 654.2	2 742.8	684.7	2 786.1	8 530.1	58 903.4
1997	1 442.0	42 968.7	4 830.5	1 062.7	1 958.7	3 925.3	846.0	3 044.5	9 450.1	66 306.7
1998	1 461.1	48 321.1	7 556.4	1 151.7	1 500.7	5 665.1	1 742.3	3 021.8	7 930.4	74 906.1
1999	1 655.1	45 043.0	5 711.7	1 104.8	2 245.2	6 328.0	1 530.5	3 332.1	7 137.1	70 781.9
2000	1 576.5	49 069.3	4 086.7	1 518.7	2 094.1	4 508.6	1 217.5	3 795.1	7 485.7	71 806.9
2001	1 795.6	50 830.2	3 818.9	1 161.9	1 448.4	3 149.2	1 172.2	3 753.6	9 235.6	73 572.9
2002	2 477.8	50 925.5	5 926.1	1 316.4	1 455.0	3 182.3	2 428.4	4 593.8	7 820.6	77 529.4
2003	2 965.9	51 949.3	5 990.4	1 099.4	988.9	2 844.8	667.8	4 346.8	8 468.7	76 651.1
2004	3 938.1	41 192.5	4 335.8	1 042.5	1 192.7	3 764.6	845.8	4 071.8	7 439.4	65 281.3
2005	3 819.5	25 818.9	4 667.1	1 749.4	1 625.9	3 026.5	760.2	3 792.2	8 142.7	51 125.6
2006	2 921.5	21 429.4	5 519.8	2 510.5	1 260.9	2 687.2	657.7	4 180.1	7 827.4	46 987.5
2007	3 229.9	20 232.2	5 669.6	3 289.5	1 218.4	2 597.9	727.0	4 385.6	6 363.1	45 894.1
2008	4 383.7	18 180.4	5 646.7	4 843.7	951.9	2 072.4	855.8	4 329.9	4 175.7	43 735.2
2009	3 941.0	18 655.8	4 545.2	2 510.7	1 013.5	2 589.7	1 121.8	3 684.2	4 263.3	40 405.4
2010	1 879.8	23 284.6	5 442.0	1 826.3	1 093.6	2 522.7	1 487.7	3 881.4	4 794.8	45 010.7
2011	2 312.2	24 378.2	3 986.0	1 514.3	837.9	1 055.8	1 439.7	4 259.3	5 442.3	43 502.5
2012	1 999.1	24 722.1	4 609.0	1 542.0	724.9	831.1	1 039.9	4 184.2	4 281.4	42 312.9
2013	1 594.2	24 217.6	4 325.8	1 096.2	559.5	904.3	855.9	4 108.7	3 440.9	39 997.7
2014	2 007.0	26 882.8	4 036.1	1 602.2	475.3	1 317.0	670.5	4 086.5	2 944.8	42 819.7
2015	2 420.5	27 766.2	2 965.4	1 190.3	588.2	2 191.1	960.0	4 021.2	3 004.5	43 819.6
2016	1 438.7	25 325.0	2 838.4	1 683.9	407.2	2 864.5	858.0	4 814.7	3 374.8	42 548.8
2017	1 241.2	26 314.8	2 602.7	1 365.2	316.9	3 595.3	594.4	4 640.9	3 549.9	42 905.9
2018	598.6	29 083.7	2 697.7	1 422.1	386.5	2 911.8	731.8	4 586.8	3 018.2	44 228.9
2019	374.4	24 392.1	2 825.0	1 645.4	300.6	3 008.2	757.3	4 598.1	3 925.5	40 631.7
All	21 049.2	167 648.6	46 697.5	27 852.5	17 481.0	41 174.6	23 348.2	20 937.6	41 848.2	325 828.8

Table D6: Estimated aggregate area (km^2) for Deepwater Tier 1 bottom-contacting trawls, by target, for 1990–2019. Codes are defined in Table 1.

Fishing	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
1990	943.8	30 685.6	9 311.5	2 705.6	2 596.9	8 692.9	2 283.6	2 138.9	31 098.8	90 457.7
1991	283.1	52 615.6	7 353.2	3 901.7	2 057.2	5 402.3	3 198.6	4 982.3	38 793.8	118 587.7
1992	2 579.7	58 956.6	11 959.3	2 622.3	1 098.0	4 975.6	6 342.3	7 584.7	32 903.9	129 022.6
1993	5 119.1	63 416.9	12 293.0	2 169.6	1 460.0	5 814.8	1 197.0	6 686.2	31 689.5	129 846.1
1994	2 455.0	47 547.5	11 580.9	1 751.2	1 747.3	7 627.6	822.6	7 249.1	33 048.8	113 829.9
1995	2 601.2	67 326.6	7 933.2	963.3	1 260.7	6 493.5	415.9	5 182.0	40 784.8	132 961.1
1996	1 751.3	76 059.0	8 589.5	1 514.7	2 154.9	3 638.5	737.0	4 555.7	36 355.0	135 355.6
1997	2 015.5	92 159.2	5 906.3	1 185.2	2 813.0	5 090.0	946.1	4 969.2	34 682.4	149 767.0
1998	1 708.7	107 903.8	11 760.5	1 263.3	1 847.9	7 674.9	2 031.6	4 821.0	27 731.6	166 743.1
1999	2 075.3	92 598.0	8 527.3	1 217.6	2 907.4	8 448.2	1 754.3	5 500.9	29 210.3	152 239.3
2000	1 885.3	98 135.9	5 794.7	1 680.2	2 720.1	5 693.4	1 377.1	7 037.1	21 669.0	145 992.8
2001	2 246.4	95 510.9	5 141.9	1 298.8	1 770.5	3 963.2	1 287.3	7 306.7	27 963.5	146 489.2
2002	4 118.2	90 927.3	7 802.2	1 507.0	1 735.1	3 849.6	2 659.0	10 249.4	26 396.8	149 244.6
2003	4 126.9	93 754.5	8 162.3	1 280.9	1 176.3	3 643.3	792.6	7 905.5	29 682.4	150 524.9
2004	7 781.2	70 265.0	6 055.4	1 189.0	1 427.6	4 957.9	1 063.2	7 134.8	28 120.1	127 994.2
2005	6 031.3	43 837.8	6 355.1	2 223.7	1 823.9	4 092.9	865.7	6 826.6	32 979.5	105 036.5
2006	5 076.0	36 616.8	7 049.8	3 473.7	1 526.1	3 487.8	722.9	7 160.0	24 026.4	89 139.5
2007	4 409.1	34 565.5	7 109.3	4 339.3	1 449.6	3 296.3	820.0	7 579.2	16 919.6	80 487.9
2008	7 012.9	30 076.4	6 626.5	6 383.3	1 269.9	2 526.7	986.3	7 974.2	12 143.5	74 999.7
2009	6 469.9	33 043.9	5 303.8	3 354.7	1 245.0	3 075.5	1 223.8	6 424.3	11 024.5	71 165.4
2010	3 105.4	42 795.1	7 012.1	2 274.3	1 395.4	2 984.6	1 660.4	7 418.0	12 279.7	80 925.2
2011	3 527.1	43 760.9	4 841.4	1 991.6	1 010.6	1 261.3	1 713.0	8 076.3	14 156.7	80 339.2
2012	3 144.2	45 918.4	5 759.4	1 976.5	901.3	1 010.0	1 141.4	7 695.7	12 320.9	79 867.7
2013	2 177.4	45 186.1	5 209.5	2 002.5	666.2	1 124.9	1 021.1	7 540.3	8 604.9	73 533.0
2014	2 702.4	49 266.2	4 842.8	2 414.0	560.5	1 546.9	757.5	7 273.2	6 637.4	76 000.9
2015	3 610.8	51 549.6	3 532.3	1 973.2	713.4	2 785.2	1 092.2	7 535.5	6 249.8	79 041.9
2016	1 831.7	48 588.6	3 273.4	2 300.7	472.8	3 668.7	947.8	9 521.0	8 508.4	79 113.0
2017	1 781.7	54 076.5	2 987.6	1 940.3	347.3	4 314.0	651.9	8 436.7	8 850.8	83 386.9
2018	693.0	62 113.1	3 304.2	2 083.3	484.2	3 675.4	807.7	8 310.5	9 877.3	91 348.7
2019	417.1	47 266.7	3 309.4	2 578.4	369.1	3 775.3	860.2	8 445.8	14 203.5	81 225.4
All	93	1 806	204 687.7	67	43	128	42	209	668 913.7	3 264 666.6

Table D7: The number of 25-km^2 cells contacted by Deepwater Tier 1 bottom-contacting trawls, by target, for 1990–2019. Codes are defined in Table 1.

Fishing year	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
1990	457	4 474	2 262	1 050	1 054	2 072	598	807	1 858	11 498
1991	188	5 927	1 818	1 229	1 050	1 812	831	1 064	2 147	12 638
1992	726	6 212	2 117	1 232	528	1 578	2 132	1 568	1 731	13 886
1993	840	6 698	2 038	945	665	1 737	711	1 979	1 716	13 219
1994	506	5 857	2 168	738	747	2 166	535	1 464	2 244	12 575
1995	519	6 955	2 057	611	648	1 824	443	1 316	2 634	12 597
1996	501	6 884	2 100	758	955	1 599	539	1 116	2 150	12 504
1997	535	7 760	1 816	691	1 190	1 861	509	1 125	2 344	13 529
1998	753	8 109	2 236	849	1 079	2 503	670	1 335	2 178	14 822
1999	880	7 137	1 688	687	1 293	2 750	850	1 581	1 967	14 431
2000	718	8 029	1 554	995	1 198	2 403	572	1 206	2 390	14 607
2001	778	8 839	1 287	777	1 103	1 609	619	1 006	2 372	14 421
2002	855	8 647	1 849	763	1 123	1 651	1 219	1 375	2 089	15 732
2003	949	8 588	2 011	749	886	1 509	406	1 198	2 224	14 866
2004	896	7 755	1 399	564	960	1 665	423	961	1 718	13 292
2005	976	5 679	1 462	900	1 406	1 629	486	1 300	1 805	12 561
2006	723	4 301	1 752	1 263	1 140	1 413	410	1 256	2 110	11 635
2007	1 078	3 963	1 726	1 505	1 200	1 280	427	1 145	1 681	11 176
2008	1 012	4 146	1 685	2 072	885	1 293	365	1 075	1 183	10 992
2009	1 109	3 801	1 541	1 348	909	1 444	663	945	1 044	10 382
2010	504	3 991	1 496	1 413	864	1 437	729	1 018	1 291	10 641
2011	598	4 360	1 387	1 105	758	832	602	1 038	1 281	9 936
2012	460	4 295	1 356	883	667	765	629	942	1 137	9 499
2013	505	4 310	1 426	739	494	698	344	1 016	842	8 898
2014	572	4 664	1 499	879	486	1 116	326	1 083	745	9 647
2015	617	4 748	1 148	719	475	1 323	385	1 055	826	9 673
2016	469	4 293	1 149	877	477	1 684	463	1 104	1 063	9 781
2017	378	4 430	1 064	773	422	1 715	368	1 063	1 062	9 701
2018	284	4 610	1 107	858	438	1 518	356	1 246	756	9 689
2019	266	3 906	1 119	778	416	1 549	334	1 033	912	8 776
All	4 411	21 740	6 268	6 660	5 618	9 186	4 034	6 753	8 150	37 352

Table D8: Estimated footprint (km^2) for Deepwater Tier 2 bottom-contacting trawls, by target, for 1990–2019. Codes are defined in Table 2. Not included in the table: 9.6 km^2 for PRK, 73.7 km^2 for PTO.

Fishing year	BAR	BYX	CDL	EMA	FRO	GSH	LDO	RBT	RBY	RIB	SKI	SPD	SPE	SWA	WWA	All
1990	4 756.6	80.5	44.9		5.0	2.0			12.4		513.0	110.7	29.5	2 653.8	492.0	8 700.4
1991	3 230.6	54.8	131.8	36.7	11.3				6.1		224.3	97.6	34.6	2 006.7	158.4	5 993.0
1992	3 297.3	162.4	91.8	0.9	7.5			0.6	30.0		439.9	26.5	26.6	2 037.8	49.5	6 170.8
1993	3 525.0	261.3	97.9	4.2	40.1		25.2		35.7		412.1		24.2	2 780.5	8.2	7 224.0
1994	2 495.1	317.5	182.1	29.3	0.4		5.2		24.1		72.2		29.4	2 486.6		5 642.0
1995	4 080.1	302.3	140.0		96.7				56.5		48.9		25.2	3 141.2	9.1	7 899.9
1996	3 415.2	249.5	273.7						27.4		88.1	5.8	14.5	2 406.8		6 554.8
1997	2 486.6	257.7	178.7	49.3					23.4		98.0	18.3	30.1	1 084.0	3.0	4 229.1
1998	2 390.0	239.0	254.7		73.1				49.7		47.5		81.0	859.1	13.0	4 007.1
1999	1 851.1	250.9	400.7	125.7	250.5				58.9				5.1	643.6	77.7	3 664.2
2000	1 721.8	256.3	435.0		32.7				77.8		61.5			909.7	107.6	3 602.2
2001	1 885.0	218.9	225.0		241.2				119.7				7.0	900.5	170.7	3 768.0
2002	2 253.2	163.7	191.5		229.0	1.7	47.8		61.4			94.9	302.5	1 395.4	305.7	5 046.8
2003	2 192.2	229.7	260.6	12.5	10.2		7.1		29.9		130.4		1 247.5	793.0	343.7	5 256.8
2004	1 482.9	203.3	135.7		10.5				53.2		16.9	16.4	650.6	311.8	309.1	3 190.4
2005	2 104.7	291.3	169.5	28.3	6.1			0.9	60.9	38.6		37.7	40.9	1 492.1	417.7	4 688.8
2006	1 411.3	366.2	208.0	91.4	37.6			38.8	75.0	60.6	2.1	125.7	166.4	1 956.1	389.2	4 928.4
2007	2 222.3	301.4	261.1	26.4	8.2	1.6		3.3	92.8			49.8	612.5	2 537.1	289.5	6 406.1
2008	3 887.3	272.7	164.7	46.4			73.3	22.1	77.5		21.2	130.5	412.2	3 430.9	247.2	8 786.1
2009	2 633.3	217.9	114.4	52.9			13.0	43.8	41.9		37.6	225.2	45.4	3 199.2	329.7	6 954.5
2010	1 997.5	355.8	162.0	1.5			86.3	28.4	154.1		34.8	243.8	243.5	2 444.2	336.8	6 088.8
2011	1 781.3	351.2	134.5	5.1			126.6	7.0	139.0		126.5	162.0	505.8	2 770.7	150.1	6 260.0
2012	2 223.1	401.3	92.1	47.7		16.1	99.4	34.4	123.6		150.8	105.9	123.3	1 975.4	214.0	5 607.1
2013	2 198.7	142.8	58.7	10.9		42.8	257.6	106.3	128.4		157.1	48.8	248.2	2 191.9	260.7	5 852.8
2014	2 523.3	273.6	90.4		2.2	20.3	121.9	87.3	97.6		84.2	79.9	205.4	1 998.1	353.7	5 937.9
2015	2 694.6	293.7	84.4		11.5	4.7	184.5	25.2	70.9	0.4	88.3	100.0	269.6	1 479.3	195.4	5 502.3
2016	2 186.0	210.0	54.3		39.2	11.3	154.6	5.8	133.1		83.1		261.7	1 552.9	192.3	4 884.3
2017	2 414.2	229.3	58.8		24.4		90.2	31.0	72.0		44.5	0.7	217.7	1 615.1	183.6	4 981.3
2018	2 024.7	154.3	35.5		23.2		157.0	12.9	107.8	5.6	19.8		214.6	1 752.6	137.6	4 645.6
2019	2 082.1	321.0	70.1	24.4	68.3		89.7	9.1	72.1		15.1		247.3	958.4	112.1	4 069.5
All	35 422.5	3 847.5	2 213.6	570.2	1 032.2	88.5	1 113.2	440.6	1 564.0	104.2	2 579.5	1 428.5	4877.4	26 149.5	3 689.3	74 217.1

Table D9: Estimated aggregate area (km^2) for Deepwater Tier 2 bottom-contacting trawls, by target, for 1990–2019. Codes are defined in Table 2. Not included in the table: 10.4 km^2 for PRK, 74.6 km^2 for PTO.

Fishing year	BAR	BYX	CDL	EMA	FRO	GSH	LDO	RBT	RBY	RIB	SKI	SPD	SPE	SWA	WWA	All
1990	6 262.9	123.8	65.3		5.0	2.0			12.4		612.9	111.5	29.8	3 590.2	571.1	11 386.9
1991	4 419.1	109.0	261.1	36.9	11.3				6.3		242.8	101.3	34.7	2 484.2	163.1	7 869.7
1992	4 402.6	281.9	119.4	0.9	7.5			0.6	31.8		484.9	27.3	27.9	2 835.6	50.9	8 271.4
1993	5 123.8	374.6	116.4	4.2	40.2		30.5		36.9		443.4		25.7	4 046.4	8.2	10 260.8
1994	3 620.6	405.8	253.7	29.4	0.4		5.2		25.7		75.5		30.0	3 804.0		8 250.3
1995	6 439.2	385.4	213.9		105.4				66.3		49.3		26.6	4 378.9	9.1	11 673.9
1996	4 948.1	320.4	403.5						29.0		89.7	5.8	14.5	3 192.5		9 078.1
1997	3 205.6	355.8	330.4	50.1					24.7		103.0	19.1	30.5	1 333.7	3.0	5 455.9
1998	3 179.7	317.9	350.9		76.3				51.7		48.7		84.1	1 036.0	13.2	5 158.6
1999	2 357.0	333.4	569.3	131.6	300.6				61.4				5.1	742.1	95.0	4 595.6
2000	2 422.6	342.7	590.2		35.0				82.0		63.8			1 074.1	129.8	4 740.3
2001	2 452.2	287.7	291.9		275.1				135.5				7.0	1 002.4	209.9	4 661.5
2002	2 597.5	205.6	270.6		254.3	1.7	52.0		66.6			97.5	327.2	1 707.4	388.7	5 969.3
2003	3 024.0	317.7	383.1	12.6	10.2		7.1		30.8		135.5		1 463.5	871.5	431.1	6 687.1
2004	1 761.9	274.6	176.5		10.5				56.3		16.9	16.4	762.9	335.7	373.8	3 785.5
2005	2 570.5	451.7	242.0	28.4	6.1			0.9	67.2	38.8		37.7	41.1	1 841.8	524.2	5 850.5
2006	1 720.8	562.9	319.2	93.3	41.1			41.0	82.0	60.6	2.1	128.0	169.6	2 493.6	478.1	6 192.4
2007	2 650.6	427.9	405.2	26.8	8.5	1.6		3.3	100.7			50.2	665.6	3 185.7	347.8	7 874.0
2008	4 620.2	352.1	213.1	47.4			77.5	22.4	84.6		21.3	136.4	435.3	4 275.3	303.7	10 589.3
2009	3 000.0	324.6	144.6	54.9			13.1	44.9	43.9		37.8	240.2	46.6	4 113.0	421.2	8 484.9
2010	2 190.6	469.6	204.3	1.5			89.9	28.7	167.3		35.5	277.0	250.8	2 815.1	380.3	6 910.6
2011	1 962.7	465.5	163.8	5.2			141.2	7.0	158.8		140.5	177.1	564.7	3 186.1	166.2	7 138.8
2012	2 472.3	532.9	112.2	49.7		16.3	112.0	34.6	135.2		160.6	115.3	124.7	2 234.5	262.3	6 362.3
2013	2 490.2	169.2	69.6	11.0		46.5	289.8	109.0	142.9		164.9	52.9	280.8	2 636.6	307.2	6 770.6
2014	2 783.4	339.4	106.9		2.2	20.7	130.5	90.9	112.6		86.0	84.6	230.6	2 394.6	441.8	6 824.2
2015	3 300.0	369.7	95.9		11.5	4.7	202.2	25.3	87.3	0.4	94.5	104.1	383.6	1 959.4	221.9	6 860.4
2016	2 607.2	250.4	63.1		40.7	12.1	164.8	5.8	175.8		86.5		302.2	1 736.3	207.1	5 652.2
2017	3 192.6	280.5	73.0		25.6		93.6	31.3	77.8		45.6	0.7	292.9	1 861.4	206.0	6 180.9
2018	2 644.7	215.2	46.8		23.4		165.1	12.9	114.8	5.6	20.5		289.0	2 004.7	153.4	5 696.0
2019	3 076.8	437.9	91.9	24.7	74.7		94.6	9.1	77.4		15.1		323.4	1 196.5	129.5	5 551.5
All	97 499.5	10 085.5	6 747.9	608.7	1 365.7	105.6	1 669.0	467.8	2 345.6	105.4	3 277.5	1 783.0	7 270.5	70 369.2	6 997.6	210 783.5

Table D10: The number of 25-km^2 cells contacted by Deepwater Tier 2 bottom-contacting trawls, by target, for 1990–2019. Codes are defined in Table 2.

Fishing year	BAR	BYX	CDL	EMA	FRO	GSH	LDO	PRK	PTO	RBT	RBY	RIB	SKI	SPD	SPE	SWA	WWA	All
1990	1 792	57	33		8	5					15		326	129	56	1 227	336	3 090
1991	1 393	39	92	52	16						13		166	103	61	1 070	186	2 567
1992	1 351	104	80	2	14					2	39		193	43	47	1 126	63	2 551
1993	1 456	165	108	6	48		33	17			65		325		37	1 271	15	2 972
1994	1 192	264	157	48	1		15				37		113		54	1 283		2 739
1995	1 789	292	132		55						60		77		44	1 516	15	3 491
1996	1 670	260	209						120		47		99	11	46	1 151		3 107
1997	1 187	218	133	53							61		74	23	38	646	6	2 212
1998	1 230	219	191		63						75		68		94	661	21	2 321
1999	1 080	265	291	100	137						82				11	594	67	2 293
2000	1 068	237	293		32						115		55			621	70	2 133
2001	1 259	207	209		111						144				14	723	102	2 420
2002	1 665	180	177		146	5	39				135			102	187	865	190	3 207
2003	1 345	204	234	22	20		24				63		120		491	562	226	2 947
2004	971	203	180		15						76		16	28	249	345	180	2 048
2005	1 078	236	190	53	15					3	91	43		71	68	707	223	2 425
2006	790	293	153	104	32					41	141	84	7	155	194	943	210	2 594
2007	1 277	243	195	43	14	6				7	141			66	427	1 187	219	3 249
2008	2 322	235	155	70			55			34	121		49	168	403	1 688	208	4 787
2009	1 795	182	117	65			31			46	78		65	205	124	1 441	307	3 925
2010	1 564	307	161	3			88			51	218		42	204	392	1 322	225	4 068
2011	1 678	307	144	6			135			9	158		127	157	400	1 490	151	4 198
2012	1 668	312	113	64		18	106			58	133		149	117	193	1 230	139	3 786
2013	1 604	148	81	22		28	185			128	134		170	73	242	1 178	206	3 539
2014	1 884	249	101		4	16	128			71	114		118	106	244	1 193	255	3 991
2015	1 680	255	109		17	10	154			42	72	2	108	129	208	984	191	3 551
2016	1 633	209	84		41	9	172			15	143		108		285	1 085	191	3 550
2017	1 695	255	80		29		112			39	132		61	2	231	1 093	175	3 490
2018	1 279	194	55		36		173			26	176	17	42		205	1 127	140	3 082
2019	1 329	367	85	34	61		122			19	122		28		188	727	138	2 884
All	7 371	1 844	1 039	474	374	56	476	17	120	369	922	118	1 196	834	1 789	6 556	1 571	15 587

Table D11: The number of contacted 25-km^2 cells, estimated aggregate area, and footprint for combined targets HAK/HOK/LIN/SWA/WWA bottom-contacting trawls, for 1990–2019. Codes are defined in Tables 1 and 2.

Fishing year	No. cells	Aggregate area (km^2)	Footprint (km^2)	EEZ+TS (%)	Fishable (%)
1990	5 302	38 600.3	20 934.0	0.5	1.5
1991	6 617	59 749.7	30 331.8	0.7	2.2
1992	7 049	67 330.3	36 875.8	0.9	2.6
1993	7 464	74 947.4	40 209.1	1.0	2.9
1994	6 642	55 727.6	30 517.4	0.7	2.2
1995	7 617	75 409.9	38 453.3	0.9	2.8
1996	7 537	82 681.8	40 290.4	1.0	2.9
1997	8 150	96 940.6	45 394.0	1.1	3.3
1998	8 559	112 327.2	50 788.5	1.2	3.6
1999	7 622	96 883.0	47 357.7	1.2	3.4
2000	8 612	103 132.9	51 587.4	1.3	3.7
2001	9 154	100 577.9	53 308.8	1.3	3.8
2002	9 391	99 116.2	54 775.9	1.3	3.9
2003	9 291	100 903.0	55 618.5	1.4	4.0
2004	8 281	80 309.8	45 439.5	1.1	3.3
2005	6 508	54 725.2	31 589.8	0.8	2.3
2006	5 512	48 210.7	27 314.3	0.7	2.0
2007	5 546	46 909.1	27 777.8	0.7	2.0
2008	6 408	48 186.4	29 169.4	0.7	2.1
2009	5 535	47 527.5	26 748.8	0.7	1.9
2010	5 393	51 472.4	28 416.5	0.7	2.0
2011	5 734	52 844.5	29 538.6	0.7	2.1
2012	5 529	53 617.5	29 042.4	0.7	2.1
2013	5 449	52 432.2	28 193.6	0.7	2.0
2014	5 843	57 544.0	31 467.6	0.8	2.3
2015	5 863	59 537.3	31 854.5	0.8	2.3
2016	5 498	54 859.8	29 214.3	0.7	2.1
2017	5 543	60 012.8	29 601.9	0.7	2.1
2018	5 690	67 380.6	31 993.3	0.8	2.3
2019	4 753	51 822.6	26 704.5	0.6	1.9
All	23 636	2 051 720.2	188 823.8	4.6	13.6

Table D12: Estimated footprint (km^2) for HAK/HOK/LIN/SWA/WWA bottom-contacting trawls, by Bycatch Assessment Area (see Figure 16), for 19690–2019.

Fishing year	CHAT4	COOK8	EAST2	NORTH1	PUYS5	SQUAK6	STEW5	SUBA6	WCNI9	WCSI7	All
1990	7 507.6	135.5	11.1		1 288.2	150.2	6 008.9	810.1	9.9	5 012.5	20 934.0
1991	11 612.6	261.7	43.6		1 187.8	167.4	8 882.9	1 848.4	15.9	6 311.5	30 331.8
1992	15 375.8	298.0	38.4		1 290.3	190.6	11 999.5	2 090.3	13.0	5 579.9	36 875.8
1993	18 319.6	473.3	127.3	46.5	1 008.4	286.8	11 607.1	630.1	13.8	7 696.0	40 209.1
1994	13 115.1	543.1	434.9	32.8	885.9	395.3	6 836.8	559.3	11.0	7 703.1	30 517.4
1995	20 635.3	579.6	212.3	84.1	791.0	347.7	8 124.9	427.3	13.0	7 238.1	38 453.3
1996	20 995.1	1 292.5	838.4	430.4	1 029.6	516.1	8 276.7	540.0	15.1	6 356.7	40 290.4
1997	23 298.1	1 489.1	1 608.6	843.5	1 091.8	717.7	9 124.5	460.5	37.8	6 722.4	45 394.0
1998	29 287.7	1 091.0	1 611.9	731.8	1 167.0	1 531.0	9 077.6	623.6	33.9	5 633.0	50 788.5
1999	29 670.5	816.6	578.3	543.7	931.5	717.4	7 481.2	553.8	31.3	6 033.4	47 357.7
2000	28 677.6	910.4	463.5	315.9	1 212.4	1 419.1	9 474.6	3 275.9	104.2	5 733.9	51 587.4
2001	28 665.7	673.7	628.9	162.0	1 406.6	1 695.7	9 135.9	4 263.8	79.9	6 596.6	53 308.8
2002	26 282.4	519.1	297.1	306.8	945.5	1 576.4	10 631.1	5 667.0	50.6	8 499.9	54 775.9
2003	28 733.1	619.3	403.4	151.3	792.5	1 621.3	8 029.4	7 385.4	10.0	7 872.8	55 618.5
2004	25 142.8	651.3	396.8	326.6	531.4	1 094.1	6 060.9	4 666.9	44.4	6 524.2	45 439.5
2005	17 484.1	618.4	293.3	185.5	790.9	652.2	3 943.2	2 198.4	1.6	5 422.2	31 589.8
2006	15 180.3	449.1	150.1	264.1	812.0	112.7	3 764.9	393.7	6.8	6 180.4	27 314.3
2007	16 528.7	406.1	138.4	228.5	656.8	130.9	4 387.0	815.5		4 485.9	27 777.8
2008	16 439.9	409.6	150.8	123.4	770.7	391.7	3 867.4	1 153.9	2.1	5 859.8	29 169.4
2009	15 187.0	363.0	238.7	141.6	424.6	367.6	4 479.9	961.3	17.1	4 568.2	26 748.8
2010	16 705.3	408.3	240.4	352.1	406.7	209.7	5 062.8	678.3	8.8	4 344.2	28 416.5
2011	16 274.1	309.0	411.6	350.7	570.8	370.9	5 053.9	1 202.8	5.4	4 989.4	29 538.6
2012	16 663.4	292.9	261.1	394.9	658.8	222.9	5 029.9	631.2	46.6	4 840.6	29 042.4
2013	16 101.1	383.2	316.2	433.0	463.9	237.7	4 910.9	839.9	11.7	4 496.0	28 193.6
2014	15 095.3	445.8	570.0	356.7	610.8	588.5	6 881.1	1 645.9	8.0	5 265.5	31 467.6
2015	16 272.7	405.6	334.5	381.3	458.6	556.1	6 588.9	932.0	1.8	5 923.1	31 854.5
2016	17 103.8	347.3	351.0	256.5	723.8	362.1	4 226.8	615.5	1.2	5 226.0	29 214.3
2017	15 885.2	362.5	337.6	321.8	465.9	414.0	5 328.4	845.6	2.6	5 638.3	29 601.9
2018	16 189.9	283.9	479.0	464.0	357.5	594.1	6 092.1	1 717.7	3.3	5 811.7	31 993.3
2019	14 976.9	222.2	485.2	651.4	526.1	369.7	4 089.9	1 023.3	3.6	4 356.4	26 704.5
All	83 210.1	3 398.4	5 121.5	3 432.2	3 905.2	7 243.8	36 590.0	23 112.5	579.1	22 231.0	188 823.8

Table D13: Estimated aggregate area (km^2) for HAK/HOK/LIN/SWA/WWA bottom-contacting trawls, by Bycatch Assessment Area (see Figure 16), for 1990–2019.

Fishing year	CHAT4	COOK8	EAST2	NORTH1	PUYS5	SQUAK6	STEW5	SUBA6	WCNI9	WCSI7	All
1990	10 951.6	280.9	11.5	–	2 509.5	163.1	10 415.8	909.1	9.9	13 348.9	38 600.3
1991	22 774.9	878.9	52.3	–	3 232.5	185.0	15 737.7	2 514.4	16.2	14 357.8	59 749.7
1992	27 107.0	774.9	41.0	–	3 781.5	229.3	21 525.6	2 679.6	13.0	11 178.4	67 330.3
1993	33 242.8	1 409.4	138.3	51.1	2 058.1	367.9	21 263.1	779.7	14.8	15 622.2	74 947.4
1994	19 889.5	1 306.0	503.2	33.8	1 393.3	525.6	11 409.0	706.3	11.0	19 949.9	55 727.6
1995	39 485.6	1 903.0	283.0	86.7	1 283.1	482.7	12 084.0	494.9	13.4	19 293.5	75 409.9
1996	43 544.2	5 175.3	1 322.2	544.6	2 018.0	622.5	13 802.3	611.9	15.6	15 025.3	82 681.8
1997	51 445.2	5 434.0	2 460.3	1 259.1	2 017.4	889.3	15 832.2	531.0	39.2	17 032.8	96 940.6
1998	66 542.3	3 252.8	2 666.4	912.8	2 220.9	2 200.0	17 167.1	921.9	37.4	16 405.6	112 327.2
1999	60 542.4	2 595.6	1 167.3	717.1	1 700.1	879.8	13 453.1	1 143.3	31.4	14 652.9	96 883.0
2000	56 365.4	2 862.2	962.3	377.3	2 523.3	2 016.9	19 146.4	4 371.3	110.2	14 397.6	103 132.9
2001	52 486.3	1 911.8	995.4	175.3	2 628.7	2 235.2	17 417.6	5 794.9	82.0	16 850.8	100 577.9
2002	46 782.2	1 487.5	434.0	417.0	1 464.5	2 277.0	20 395.6	7 747.8	51.2	18 059.3	99 116.2
2003	53 499.6	1 775.1	655.5	179.8	1 117.0	2 126.3	12 126.3	9 765.7	10.6	19 647.0	100 903.0
2004	44 498.8	2 063.3	624.4	425.4	644.3	1 384.9	9 075.3	5 962.0	46.5	15 584.8	80 309.8
2005	30 264.8	2 089.1	514.5	226.7	1 148.2	812.6	6 297.7	2 857.7	1.9	10 512.2	54 725.2
2006	26 083.6	1 191.0	260.5	301.6	1 391.9	131.5	6 220.2	432.6	6.8	12 190.9	48 210.7
2007	28 323.2	1 120.4	180.6	285.2	881.9	164.2	7 738.7	975.3		7 239.5	46 909.1
2008	26 554.5	1 196.9	184.7	136.7	1 055.1	595.2	6 125.7	1 751.4	2.1	10 584.1	48 186.4
2009	27 595.6	1 055.7	307.9	147.1	553.3	546.9	7 762.6	1 513.9	17.2	8 027.3	47 527.5
2010	31 056.3	933.9	275.4	381.9	497.4	307.7	8 991.7	937.8	9.2	8 081.3	51 472.4
2011	29 251.1	707.9	577.7	381.0	811.8	774.3	8 326.8	2 227.8	5.4	9 780.7	52 844.5
2012	31 417.9	774.9	301.3	464.9	897.8	276.8	8 774.1	800.8	47.1	9 862.0	53 617.5
2013	30 536.8	1 135.5	388.7	506.0	632.1	306.6	9 230.6	1 051.1	11.7	8 632.9	52 432.2
2014	27 881.9	1 350.0	781.2	404.2	973.1	941.5	12 378.0	2 186.5	8.1	10 639.5	57 544.0
2015	30 908.4	1 117.6	432.4	449.6	572.9	863.9	12 266.8	1 219.4	1.8	11 704.6	59 537.3
2016	33 341.5	1 184.0	436.4	292.2	1 024.2	503.7	6 333.6	959.4	1.4	10 783.6	54 859.8
2017	32 380.0	1 062.1	426.4	392.6	613.0	494.3	8 461.9	1 038.9	2.6	15 140.9	60 012.8
2018	33 305.0	934.3	566.5	609.4	488.7	975.9	11 265.0	2 661.3	3.4	16 571.1	67 380.6
2019	30 321.5	572.3	604.7	1 257.9	810.5	548.5	7 040.1	1 662.5	3.6	9 000.9	51 822.6
All	1078 380.0	49 536.3	18 555.6	11 416.9	42 944.1	24 829.1	358 064.6	67 210.2	625.0	400 158.5	2 051 720.2

Table D14: The number of 25-km^2 cells contacted by HAK/HOK/LIN/SWA/WWA trawls, by Bycatch Assessment Area (see Figure 16), for 1990–2019.

Fishing year	CHAT4	COOK8	EAST2	NORTH1	PUYS5	SQUAK6	STEW5	SUBA6	WCNI9	WCSI7	All
1990	1 975	69	11	0	206	115	1 534	739	17	680	5 302
1991	2 459	100	32	0	157	171	1 677	1 119	26	940	6 617
1992	2 900	117	60	0	181	100	1 970	827	24	935	7 049
1993	3 313	153	149	44	177	161	2 106	298	14	1 116	7 464
1994	2 786	183	322	40	176	216	1 658	276	22	1 021	6 642
1995	3 574	177	230	110	176	101	1 876	246	24	1 148	7 617
1996	3 226	259	401	305	173	247	1 739	385	42	822	7 537
1997	3 579	305	592	319	188	254	1 655	338	75	923	8 150
1998	3 983	248	521	311	187	419	1 598	545	63	772	8 559
1999	3 789	186	258	306	140	263	1 553	315	58	810	7 622
2000	3 608	187	240	193	183	466	1 677	1 237	91	795	8 612
2001	3 859	163	376	126	200	536	1 633	1 433	108	817	9 154
2002	3 434	152	203	154	160	520	1 722	2 095	93	959	9 391
2003	3 619	168	218	93	159	519	1 521	1 957	23	1 119	9 291
2004	3 621	155	163	164	143	403	1 298	1 453	57	916	8 281
2005	2 897	128	154	119	155	326	1 048	965	3	790	6 508
2006	2 891	134	75	168	141	112	964	211	19	835	5 512
2007	2 899	149	107	120	151	67	1 047	290		754	5 546
2008	3 403	131	139	133	171	207	1 001	332	7	928	6 408
2009	2 863	119	151	175	133	134	921	275	32	774	5 535
2010	2 703	158	188	262	133	63	926	205	22	770	5 393
2011	2 720	109	235	271	207	98	986	360	14	780	5 734
2012	2 605	103	253	285	164	124	947	197	97	795	5 529
2013	2 474	137	255	254	168	93	921	381	28	776	5 449
2014	2 354	153	315	257	148	180	1 142	566	18	771	5 843
2015	2 613	145	257	253	152	175	1 112	306	9	901	5 863
2016	2 628	124	232	205	167	148	1 107	166	5	767	5 498
2017	2 360	133	254	198	141	178	1 109	389	6	833	5 543
2018	2 432	91	321	244	129	165	1 087	497	9	770	5 690
2019	2 159	85	294	304	132	118	850	274	8	579	4 753
All	7 918	379	1 041	987	445	945	3 685	5 139	598	2 697	23 626

Table D15: The number of contacted 25-km^2 cells, estimated aggregate area (km^2), and footprint (km^2) for combined targets ORH/OEO bottom-contacting trawls, for 1990–2019. Areas are shown in Figure 17.

Fishing	ORH7A			NWCR			ESCR		
year	No. cells	Aggregate	Footprint	No. cells	Aggregate	Footprint	No. cells	Aggregate	Footprint
1990	132	829.1	486.6	462	1 535.4	1 148.1	879	5 820.4	3 435.9
1991	137	835.4	581.1	305	868.2	714.8	723	2 327.7	1 601.8
1992	156	853.9	604.2	88	105.1	96.6	352	1 020.5	679.0
1993	184	1 327.2	910.2	138	178.9	143.0	273	462.5	321.5
1994	162	979.6	674.8	195	344.5	262.7	309	798.6	478.9
1995	168	758.0	559.1	186	465.8	373.9	364	898.3	600.9
1996	201	992.0	768.2	181	357.8	291.5	314	637.6	482.3
1997	349	1 824.5	1 458.4	297	1 112.7	851.1	366	733.4	585.7
1998	587	2 627.4	2 172.3	327	1 063.7	886.2	488	1 103.2	856.9
1999	888	2 735.4	2 393.4	353	1 485.2	1 151.2	489	1 278.2	959.3
2000	714	1 247.2	1 154.7	246	807.3	678.3	395	807.5	636.3
2001	7	2.6	1.4	356	1 590.2	1 273.6	352	714.2	570.7
2002				430	1 658.8	1 376.9	508	1 256.5	984.5
2003				394	1 603.4	1 277.6	373	1 167.4	803.7
2004	2	0.9	0.4	430	2 048.6	1 623.0	521	2 001.6	1 391.1
2005	58	29.9	27.4	349	889.2	769.0	508	2 049.7	1 334.7
2006	47	21.7	21.5	321	674.5	597.9	554	1 820.1	1 402.1
2007				71	58.4	50.5	780	2 567.6	2 065.2
2008				185	256.8	212.7	653	1 740.6	1 414.4
2009	50	23.5	23.3	216	263.9	235.1	666	2 066.7	1 719.0
2010	54	26.9	26.6	301	575.0	514.6	562	1 776.2	1 465.6
2011	57	108.2	95.8	16	10.0	6.3	252	388.8	339.6
2012	60	83.0	75.8	16	5.6	5.0	306	509.7	428.5
2013	74	107.3	94.5	15	5.5	5.5	241	449.1	380.4
2014	142	275.0	229.1	225	282.6	235.2	345	509.8	429.7
2015	472	1 599.1	1 187.4	269	401.3	345.8	292	611.7	498.3
2016	373	948.2	755.1	332	760.8	643.5	474	857.6	702.5
2017	552	1 697.0	1 492.6	372	1 116.2	888.0	439	919.2	736.2
2018	320	987.1	868.3	368	915.6	712.0	421	1 116.2	842.4
2019	494	1 546.4	1 366.0	278	570.3	486.2	415	1 118.5	780.2
All	1 481	22 466.5	8 975.1	859	22 011.2	6 882.1	1 505	39 529.2	11 209.5

Table D16: For deepwater Tier 1 and Tier 2 fishstocks, the number of 25-km^2 cells contacted during 1990–1994 and the number of 'new' cells contacted for the first time in subsequent years and the aggregate area (km^2) and footprint (km^2) estimated for those new cells, where data for 1995 represent cells contacted in 1995 but not in 1990–1994, and data for 1996 represent cells contacted in 1996 but not in 1990–1995, etc.

Fishing year	Tier 1 targets			Tier 2 targets		
	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint
1990–1994	No. cells = 24 150			No. cells = 6525		
1995	1 220	1 032.8	901.6	905	732.7	666.0
1996	1 137	775.7	715.4	890	686.7	642.1
1997	1 251	970.6	921.2	289	143.5	137.9
1998	1 604	2 077.1	1 697.7	388	276.2	259.8
1999	1 362	1 280.1	1 162.6	453	421.3	338.6
2000	1 204	1 534.0	1 380.0	310	161.5	156.1
2001	737	717.5	615.6	384	190.7	187.3
2002	1 060	957.3	922.6	696	530.2	503.9
2003	655	728.1	651.1	453	703.1	622.2
2004	352	332.7	308.5	178	94.8	92.8
2005	575	621.8	550.6	359	571.1	512.9
2006	274	134.7	130.1	254	150.1	146.9
2007	241	142.5	133.8	326	190.1	187.3
2008	190	125.6	120.1	669	574.1	510.5
2009	170	73.5	71.0	392	209.2	204.6
2010	148	60.0	59.3	311	154.7	146.3
2011	146	52.5	52.3	355	180.4	176.9
2012	99	37.0	36.9	262	130.8	129.1
2013	61	33.6	33.1	250	165.7	161.9
2014	82	31.7	31.7	264	176.7	170.2
2015	163	168.6	154.3	142	53.7	53.7
2016	175	112.8	109.0	148	56.7	55.2
2017	97	60.0	58.6	167	91.6	89.9
2018	127	33.6	33.5	99	51.1	50.4
2019	72	88.8	84.6	118	52.2	51.9

Table D17: For deepwater Tier 1 targets, the number of 25-km^2 cells contacted during 1990–1994 and the number of 'new' cells contacted for the first time in subsequent years and the aggregate area (km^2) and footprint (km^2) estimated for those new cells, where data for 1995 represent cells contacted in 1995 but not in 1990–1994, and data for 1996 represent cells contacted in 1996 but not in 1990–1995, etc.

	HAK			HOK			JMA		
Fishing year	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint
1990–1994	No. cells = 1742			No. cells = 11 945			No. cells = 3899		
1995	217	159.4	155.7	1 129	1 003.2	940.4	338	265.4	259.2
1996	171	139.5	134.6	1 133	1 170.3	914.4	347	389.4	363.8
1997	92	85.8	82.9	1 016	745.1	709.7	166	100.0	99.0
1998	256	158.7	157.8	1 193	1 364.2	1 102.1	357	367.7	332.7
1999	269	237.3	226.9	680	492.4	482.4	209	130.1	128.2
2000	143	178.2	159.4	1 156	1 737.4	1 584.8	133	91.2	89.2
2001	133	88.9	88.3	854	843.6	813.0	31	12.4	12.4
2002	236	359.1	318.7	848	738.9	721.2	118	91.0	87.8
2003	208	148.3	147.5	670	765.9	696.2	143	113.6	110.7
2004	134	188.3	170.3	254	242.8	231.4	83	67.0	63.7
2005	115	137.1	128.9	105	69.1	67.8	58	30.5	30.4
2006	99	72.2	71.8	54	26.9	26.4	43	23.8	23.8
2007	90	63.2	60.9	54	33.0	32.9	48	27.7	27.6
2008	79	61.6	61.0	39	18.4	18.4	47	23.1	23.1
2009	159	151.3	141.4	43	30.2	30.2	20	9.7	9.7
2010	15	9.3	9.2	74	30.3	30.1	38	11.3	11.3
2011	61	38.6	37.7	88	44.9	44.8	63	24.4	24.4
2012	46	18.6	18.6	86	34.1	34.0	6	3.3	3.3
2013	52	38.4	35.8	43	26.4	26.3	25	7.9	7.9
2014	20	6.1	6.1	71	29.4	29.4	18	9.7	9.7
2015	33	10.5	10.5	51	24.3	24.3	24	8.4	8.4
2016	22	9.6	9.6	46	23.7	23.7	8	3.9	3.9
2017	7	3.7	3.7	25	10.2	10.2	27	9.3	9.3
2018	90	1.2	1.2	34	12.9	12.9	7	1.1	1.1
2019	3	2.0	2.0	49	22.6	21.3	12	5.2	5.2

Table D17: continued.

Fishing year	LIN			OEO			ORH		
	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint
1990–1994	No. cells = 2788			No. cells = 2165			No. cells = 4692		
1995	133	68.7	68.0	139	85.2	73.9	348	289.3	211.7
1996	68	44.3	44.0	292	194.5	176.8	343	221.3	183.8
1997	192	140.0	138.2	320	196.7	181.0	460	459.9	430.4
1998	228	255.6	248.2	290	168.6	158.3	559	831.2	720.0
1999	77	44.2	43.1	298	263.7	240.0	611	616.9	583.4
2000	344	473.3	423.5	297	242.4	204.7	303	263.2	242.2
2001	253	260.8	249.9	180	98.9	87.1	204	313.8	192.9
2002	217	196.8	191.1	201	121.5	116.9	185	105.0	99.0
2003	190	135.5	132.6	97	69.8	60.8	141	79.4	73.7
2004	96	112.5	104.7	117	49.5	48.6	187	111.7	109.3
2005	110	129.5	112.6	465	456.9	436.6	236	131.0	126.3
2006	199	205.1	190.7	206	150.6	135.5	72	26.4	25.9
2007	214	128.4	128.0	192	108.4	103.9	94	52.1	46.4
2008	463	458.5	418.8	55	20.7	19.4	38	11.0	11.0
2009	182	85.2	83.6	66	31.4	29.8	69	32.7	31.4
2010	239	111.3	108.9	68	39.1	37.1	47	20.0	20.0
2011	138	47.1	46.5	41	32.3	20.7	21	8.0	8.0
2012	72	22.7	22.7	33	13.5	13.4	24	8.3	8.3
2013	70	31.3	30.8	12	2.0	2.0	18	8.9	8.4
2014	60	45.2	41.1	11	4.2	4.2	41	18.6	17.4
2015	49	24.0	23.9	25	29.2	22.7	157	181.0	166.4
2016	104	61.4	58.0	16	7.4	7.4	146	81.4	80.2
2017	39	14.4	14.4	11	2.8	2.8	82	52.1	51.6
2018	89	51.7	50.7	15	6.6	5.8	51	19.1	19.1
2019	46	19.4	19.4	6	2.8	2.8	57	99.3	94.7

Table D17: continued.

Fishing year	SBW			SCI			SQU		
	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint	No. new cells	Aggregate	Footprint
1990–1994	No. cells = 2818			No. cells = 3873			No. cells = 4230		
1995	133	129.0	125.3	265	67.4	67.0	585	412.3	404.5
1996	108	90.3	88.6	113	19.9	19.9	298	184.2	182.6
1997	51	41.7	40.5	159	30.5	30.4	346	203.4	202.0
1998	79	130.0	116.3	261	58.8	58.5	252	165.6	164.3
1999	182	143.8	142.4	393	90.2	89.8	224	439.0	310.6
2000	30	17.5	17.3	124	27.3	27.2	443	508.7	415.4
2001	49	31.4	31.3	52	11.0	10.9	416	340.8	323.5
2002	297	405.0	387.1	161	34.3	34.2	183	86.1	86.1
2003	37	21.4	21.4	107	25.0	25.0	341	273.9	258.6
2004	57	105.6	95.8	31	5.2	5.2	128	82.7	81.7
2005	31	44.8	39.5	286	574.4	396.8	96	77.8	73.8
2006	3	0.8	0.8	170	45.9	45.4	151	76.8	76.7
2007	11	5.9	5.9	57	11.7	11.7	96	56.4	56.3
2008	24	13.5	13.5	50	8.2	8.2	42	17.3	17.3
2009	33	16.6	16.4	34	6.5	6.5	26	12.1	12.1
2010	33	22.5	22.3	46	9.2	9.2	55	29.2	29.2
2011	15	28.9	24.0	22	3.7	3.7	19	8.6	8.6
2012	13	7.8	7.6	20	4.3	4.3	21	10.4	10.4
2013	3	3.6	3.6	69	16.9	16.9	22	9.8	9.8
2014	4	2.4	2.4	73	17.2	16.9	20	30.8	28.5
2015	9	8.2	8.1	48	11.8	11.8	15	7.3	7.1
2016	2	1.0	1.0	43	12.5	12.1	59	31.6	30.7
2017	5	2.9	2.9	57	31.3	27.9	46	15.9	15.9
2018	1	0.3	0.3	156	72.1	59.9	9	1.8	1.8
2019	6	11.5	10.9	83	18.3	17.9	27	11.2	11.2

Table D18: Summary data for the number of tows, the aggregate area, and the footprint for Tier 1 bottom-contacting effort per 25-km^2 cell, for each year, from 1990–2019. In any year, the minimum number of tows per cell was 1, and the aggregate area or footprint was < 0.00001 km^2. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year.

Fishing	No. tows per cell					Aggregate area per cell (km^2)					Footprint per cell (km^2)				
year	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
1990	1	2	15.51	11	1 099	0.48	1.11	7.87	5.03	725.49	0.48	1.09	3.66	4.44	25.00
1991	1	3	19.08	12	2 406	0.56	1.42	9.38	5.66	1 631.06	0.56	1.38	4.07	4.94	25.00
1992	1	4	19.27	15	1 258	0.63	1.75	9.29	7.26	815.36	0.63	1.70	4.53	6.12	25.00
1993	1	4	19.47	17	1 839	0.62	1.92	9.82	8.04	1 386.55	0.62	1.82	4.73	6.59	25.00
1994	1	4	19.26	15	1 288	0.59	1.58	9.05	6.72	808.15	0.58	1.53	4.27	5.66	25.00
1995	1	4	20.97	16	1 014	0.61	1.75	10.56	7.43	792.66	0.60	1.67	4.55	6.17	25.00
1996	1	4	21.75	17	1 313	0.61	1.68	10.83	7.72	621.15	0.61	1.60	4.71	6.30	25.00
1997	1	4	21.94	18	1 418	0.63	1.76	11.07	8.37	546.40	0.63	1.69	4.90	6.75	25.00
1998	1	4	21.91	19	901	0.66	1.78	11.25	8.64	444.91	0.65	1.70	5.05	7.03	25.00
1999	1	4	20.97	18	1 202	0.60	1.76	10.55	8.10	749.94	0.60	1.67	4.90	6.59	25.00
2000	1	4	19.97	18	823	0.62	1.76	10.00	8.49	408.19	0.61	1.70	4.92	6.78	25.00
2001	1	4	20.00	19	840	0.71	1.93	10.16	9.06	589.03	0.71	1.85	5.10	7.22	25.00
2002	1	4	19.19	17	1 045	0.66	1.88	9.49	8.47	701.28	0.65	1.80	4.93	6.95	25.00
2003	1	5	19.72	18	989	0.73	2.08	10.13	9.25	679.18	0.72	1.99	5.16	7.47	25.00
2004	1	5	18.64	17	1 439	0.74	2.15	9.63	8.67	920.13	0.73	2.03	4.91	7.07	25.00
2005	1	4	17.59	13	1 484	0.60	1.56	8.36	6.08	957.62	0.59	1.50	4.07	5.15	25.00
2006	1	4	16.74	14	925	0.53	1.50	7.66	6.09	588.12	0.53	1.44	4.04	5.15	25.00
2007	1	4	16.01	15	574	0.59	1.64	7.20	6.78	277.27	0.58	1.57	4.11	5.65	25.00
2008	1	4	15.52	13	575	0.61	1.74	6.82	6.16	238.88	0.60	1.67	3.98	5.31	25.00
2009	1	4	13.90	12	475	0.54	1.54	6.85	5.65	284.23	0.53	1.49	3.89	4.87	24.99
2010	1	4	14.62	13	505	0.51	1.61	7.61	6.61	229.23	0.50	1.54	4.23	5.52	24.97
2011	1	4	15.63	14	485	0.52	1.63	8.09	7.02	287.39	0.52	1.56	4.38	5.82	24.98
2012	1	4	15.73	14	417	0.51	1.59	8.41	7.40	251.36	0.51	1.53	4.45	6.08	25.00
2013	1	4	15.91	15	458	0.56	1.92	8.26	7.51	297.18	0.55	1.81	4.50	6.13	24.98
2014	1	4	14.91	14	463	0.55	1.85	7.88	7.63	289.10	0.54	1.76	4.44	6.21	24.99
2015	1	4	15.21	14	514	0.59	1.82	8.17	7.67	323.88	0.57	1.72	4.53	6.33	25.00
2016	1	4	15.59	14	572	0.52	1.57	8.09	7.15	331.26	0.51	1.51	4.35	5.94	25.00
2017	1	4	15.73	13	411	0.54	1.72	8.60	6.83	207.81	0.54	1.64	4.42	5.66	24.98
2018	1	4	16.55	14	815	0.53	1.77	9.43	7.81	399.50	0.52	1.65	4.56	6.24	25.00
2019	1	4	17.92	15	568	0.56	2.01	9.26	8.27	287.72	0.55	1.84	4.63	6.47	25.00

Table D19: Summary data for the number of tows, the aggregate area, and the footprint for HAK/HOK/LIN/SWA/WWA bottom-contacting effort per 25-km^2 cell, for each year, from 1990–2019. In any year, the minimum number of tows per cell was 1, and the aggregate area or footprint was < 0.00001 km^2. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year.

Fishing	No. of tows					Aggregate area (km^2)					Footprint (km^2)				
year	1st Qu	Median	Mean	3rd Qu	Max	1st Qu	Median	Mean	3rd Qu	Max	1st Qu	Median	Mean	3rd	Max
1990	1	2	12.9	11	333	0.52	1.07	7.22	5.32	206.30	0.50	1.06	3.92	4.64	25.00
1991	1	3	16.07	14	386	0.63	1.40	8.94	6.84	217.94	0.61	1.34	4.54	5.64	25.00
1992	1	4	17.19	18	351	0.75	2.03	9.46	9.59	223.86	0.75	1.96	5.18	7.65	25.00
1993	1	5	17.59	18	633	0.77	2.39	9.95	9.96	467.62	0.76	2.25	5.34	7.88	24.99
1994	1	3	14.89	14	376	0.70	1.64	8.32	7.42	214.94	0.68	1.57	4.55	6.19	25.00
1995	1	4	16.98	17	753	0.75	1.88	9.84	9.44	295.24	0.73	1.80	5.02	7.55	25.00
1996	1	4	19.54	18	1 313	0.75	1.99	10.88	9.87	480.96	0.75	1.86	5.30	7.66	25.00
1997	1	4	20.45	20	1 418	0.75	2.05	11.78	10.94	546.40	0.75	1.92	5.52	8.25	25.00
1998	1	4	22.00	23	901	0.75	2.07	12.99	12.07	350.40	0.75	1.96	5.87	9.12	25.00
1999	1	5	21.32	26	738	0.76	2.33	12.62	14.42	311.15	0.75	2.19	6.17	10.34	25.00
2000	1	4	20.14	23	823	0.76	2.29	11.89	13.15	321.89	0.75	2.13	5.95	9.78	25.00
2001	1	4	17.95	21	705	0.78	2.25	10.87	12.36	484.03	0.77	2.12	5.76	9.32	25.00
2002	1	4	17.44	22	643	0.78	2.35	10.44	12.40	350.08	0.77	2.15	5.77	9.37	24.95
2003	1	5	17.74	21	667	0.85	2.85	10.74	12.46	375.88	0.82	2.63	5.92	9.46	25.00
2004	1	5	16.04	17	1 144	0.88	2.79	9.59	10.29	622.12	0.86	2.54	5.43	8.13	24.95
2005	1	4	14.30	15	717	0.80	2.13	8.31	8.55	384.93	0.78	2.01	4.80	6.88	24.95
2006	1	4	14.84	16	536	0.75	1.98	8.69	9.36	306.54	0.75	1.87	4.92	7.45	24.94
2007	1	4	14.16	17	436	0.80	2.32	8.40	9.49	277.12	0.78	2.18	4.97	7.54	24.94
2008	1	4	13.12	14	422	0.75	2.02	7.47	7.85	216.57	0.72	1.93	4.52	6.51	24.89
2009	1	4	12.78	14	339	0.75	2.01	8.52	8.41	207.00	0.71	1.94	4.80	6.91	24.99
2010	1	4	13.03	15	334	0.69	2.21	9.48	10.05	229.23	0.67	2.11	5.23	7.83	24.97
2011	1	4	12.78	15	287	0.70	2.09	9.14	9.92	129.21	0.68	2.02	5.11	7.82	24.87
2012	1	4	13.07	15	308	0.66	2.12	9.63	10.70	192.35	0.64	2.03	5.21	8.15	25.00
2013	1	4	13.57	15	458	0.70	2.34	9.56	9.70	297.18	0.67	2.19	5.14	7.55	24.98
2014	1	4	13.87	16	463	0.75	2.56	9.75	10.45	289.10	0.75	2.36	5.33	7.99	24.99
2015	1	4	14.05	16	514	0.75	2.36	10.05	10.75	323.88	0.74	2.17	5.38	8.24	25.00
2016	1	4	13.48	15	572	0.70	2.23	9.89	10.44	330.83	0.67	2.10	5.26	7.96	25.00
2017	1	4	14.15	14	411	0.73	2.26	10.71	9.93	207.81	0.70	2.12	5.29	7.75	24.98
2018	1	4	14.88	16	814	0.77	2.60	11.73	11.56	399.50	0.75	2.37	5.57	8.33	25.00
2019	1	5	14.52	17	568	0.70	2.80	10.79	12.19	272.25	0.66	2.53	5.56	8.74	25.00

Table D20: Summary data for the aggregate area (km^2) for HAK/HOK/LIN/SWA/WWA bottom-contacting effort per 25-km^2 cell, for Bycatch Assessment Areas CHAT4, COOK8, PUYS5, STEW5, SUBA6, and WCSI7, from 1990–2019. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year. The minimum values given for each area are the largest over the time series.

Fishing	CHAT4 (min. < 0.0003 km^2)					COOK8 (min. < 0.07 km^2)					PUYS5 (min. = 0.02 km^2)				
year	1st Qu.	Median	Mean	3rd	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
1990	0.5	1.3	5.5	6.1	66.4	0.3	0.6	4.1	1.0	66.7	0.8	3.2	12.2	16.3	105.4
1991	0.8	1.9	9.3	7.8	217.7	0.4	0.8	8.8	1.9	191.0	0.9	4.5	20.6	23.5	217.9
1992	0.8	2.3	9.3	9.9	120.7	0.4	0.8	6.6	2.1	128.5	0.8	4.1	20.9	18.0	223.9
1993	0.8	2.4	10.0	10.9	149.1	0.6	1.2	9.2	3.8	163.8	0.8	2.9	11.6	12.4	116.5
1994	0.8	2.1	7.1	8.5	65.2	0.6	1.0	7.1	3.0	148.7	1.1	4.3	7.9	10.5	56.4
1995	0.8	2.4	11.0	13.0	179.7	0.4	1.2	10.8	3.9	295.2	0.7	2.2	7.3	8.5	47.1
1996	0.8	3.3	13.5	14.5	372.9	0.8	2.1	20.0	9.8	481.0	0.8	3.5	11.7	14.0	98.2
1997	0.8	2.7	14.4	16.0	260.2	0.8	2.2	17.8	9.3	546.4	0.7	2.9	10.7	14.8	84.8
1998	0.8	3.1	16.7	20.9	323.1	0.5	2.0	13.1	8.0	350.4	0.7	3.1	11.9	17.0	75.9
1999	0.9	4.3	16.0	24.1	145.7	0.7	1.9	14.0	7.0	311.1	0.8	5.6	12.1	16.7	73.0
2000	1.0	5.7	15.6	22.4	156.5	0.8	2.5	15.3	8.9	321.9	0.8	4.8	13.8	17.9	97.9
2001	1.0	4.3	13.6	21.4	111.7	0.8	1.5	11.7	7.2	194.2	0.8	4.1	13.1	19.6	77.4
2002	1.0	5.5	13.6	21.1	157.0	0.5	1.3	9.8	4.9	150.8	1.0	4.5	9.2	15.0	54.9
2003	1.0	6.0	14.8	21.7	135.8	0.6	1.3	10.6	4.8	210.0	0.8	3.4	7.0	10.8	39.3
2004	1.0	5.0	12.3	15.4	157.1	0.6	1.3	13.3	6.4	261.1	1.0	3.4	4.5	6.6	23.2
2005	1.0	3.6	10.4	12.3	106.2	0.7	1.9	16.3	10.4	234.3	1.0	3.6	7.4	11.5	39.8
2006	0.8	2.2	9.0	10.4	114.9	0.5	1.4	8.9	4.5	131.6	1.0	3.7	9.9	14.5	75.3
2007	0.9	3.0	9.8	12.1	125.2	0.5	1.0	7.5	2.5	141.2	0.9	3.6	5.8	8.0	34.8
2008	0.8	2.4	7.8	8.8	152.3	0.5	0.9	9.1	3.9	156.1	0.7	2.8	6.2	10.0	38.5
2009	0.8	2.2	9.6	10.3	207.0	0.5	0.9	8.9	3.8	118.4	0.8	1.7	4.2	6.0	24.7
2010	0.8	3.2	11.5	14.0	143.2	0.3	0.8	5.9	2.4	110.8	0.4	2.2	3.7	6.3	16.8
2011	0.8	3.0	10.8	13.4	128.0	0.4	0.9	6.5	3.2	92.4	0.4	1.1	3.9	4.7	37.3
2012	1.0	3.9	12.1	14.8	170.3	0.4	0.9	7.5	3.1	100.1	0.5	3.0	5.5	8.1	29.1
2013	1.0	3.9	12.3	14.8	158.1	0.4	0.8	8.3	3.5	114.7	0.4	1.2	3.8	5.1	21.5
2014	1.0	4.1	11.8	14.1	116.0	0.4	0.8	8.8	4.0	145.0	0.4	1.9	6.6	7.0	57.0
2015	0.9	3.0	11.8	14.0	143.6	0.2	0.8	7.7	3.1	107.5	0.5	1.7	3.8	5.4	24.3
2016	0.9	3.6	12.7	14.7	125.6	0.2	0.8	9.5	4.4	126.3	0.6	2.6	6.1	9.4	39.2
2017	1.0	4.0	13.7	16.1	186.5	0.3	0.8	8.0	3.0	119.2	0.6	2.1	4.3	5.7	23.4
2018	1.0	4.1	13.7	16.5	158.0	0.4	0.9	10.3	5.3	106.4	0.6	1.3	3.8	3.7	37.4
2019	1.0	4.6	14.0	17.6	180.0	0.3	1.1	6.7	4.7	79.4	0.8	2.4	6.1	7.3	50.3

Table D20: continued.

Fishing	STEW5 (min. < 0.001 km^2)					SUBA6 (min. < 0.01 km^2)					WCSI7 (min. < 0.008 km^2)				
year	1st Qu.	Median	Mean	3rd	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
1990	0.6	1.2	6.8	5.2	106.8	0.3	0.7	1.2	1.0	15.6	0.8	3.0	19.6	19.8	206.3
1991	0.8	2.2	9.4	10.5	121.3	0.4	0.8	2.2	1.2	49.3	0.7	1.7	15.3	18.7	134.0
1992	0.9	2.9	10.9	13.4	202.8	0.6	1.0	3.2	3.3	31.6	0.7	1.9	12.0	13.5	171.9
1993	1.0	3.3	10.1	9.7	467.6	0.7	1.1	2.6	3.1	19.0	0.9	3.3	14.0	17.9	249.2
1994	0.7	1.5	6.9	5.9	92.6	0.5	0.9	2.6	2.9	29.5	0.8	3.3	19.5	20.4	214.9
1995	0.8	2.0	6.4	7.6	67.9	0.5	1.0	2.0	2.1	14.0	0.7	2.0	16.8	13.5	210.0
1996	0.8	2.0	7.9	7.3	103.6	0.5	1.0	1.6	1.7	15.2	0.9	4.0	18.3	22.4	162.1
1997	0.8	2.6	9.6	10.9	113.1	0.5	1.0	1.6	1.7	13.7	0.8	2.8	18.5	17.5	174.0
1998	1.0	2.9	10.7	10.5	148.5	0.4	0.9	1.7	1.1	101.7	0.8	2.5	21.3	21.3	220.2
1999	0.8	2.1	8.7	7.3	128.9	0.4	1.0	3.6	1.8	240.7	0.8	3.0	18.1	21.3	250.5
2000	0.8	2.3	11.4	10.1	212.4	0.6	1.1	3.5	3.3	156.8	0.8	2.7	18.1	18.1	237.8
2001	0.9	2.5	10.7	10.1	201.6	0.8	1.3	4.0	4.0	153.0	0.8	4.1	20.6	26.2	484.0
2002	0.9	2.8	11.8	14.1	129.7	0.7	1.1	3.7	3.5	165.1	1.0	7.1	18.8	29.0	350.1
2003	1.0	3.0	8.0	10.6	77.7	0.8	1.8	5.0	6.2	53.8	0.7	2.4	17.6	18.5	375.9
2004	1.0	2.6	7.0	8.7	129.0	0.8	1.8	4.1	4.7	60.6	0.8	2.8	17.0	21.0	622.1
2005	0.8	1.8	6.0	6.4	169.1	0.6	1.0	3.0	2.3	61.3	0.8	4.0	13.3	17.6	384.9
2006	0.8	1.7	6.5	6.0	179.8	0.7	1.4	2.1	2.8	10.3	0.8	5.3	14.6	19.4	306.5
2007	0.8	1.7	7.4	6.7	277.1	0.8	1.7	3.4	4.3	23.0	0.9	3.5	9.6	12.8	96.4
2008	0.8	1.9	6.1	6.7	190.1	0.7	1.6	5.3	4.3	62.2	0.8	3.2	11.4	14.3	216.6
2009	0.8	2.2	8.4	9.9	200.7	0.7	1.8	5.5	5.2	72.6	0.8	2.9	10.4	12.8	103.3
2010	0.7	2.4	9.7	12.2	229.2	0.7	2.0	4.6	4.1	38.9	0.7	2.4	10.5	11.5	202.3
2011	0.8	2.5	8.4	10.4	112.9	0.8	1.5	6.2	4.4	129.2	0.7	2.4	12.5	15.1	96.5
2012	0.8	2.5	9.3	12.4	192.3	0.8	1.9	4.1	5.5	31.2	0.5	1.8	12.4	13.7	139.9
2013	0.8	2.6	10.0	10.9	297.2	0.7	1.6	2.8	2.6	56.1	0.6	2.6	11.1	12.6	252.1
2014	1.0	3.5	10.8	13.5	282.2	0.8	2.0	3.9	4.5	49.6	0.8	3.8	13.8	16.0	289.1
2015	0.9	3.4	11.0	14.0	252.7	1.0	2.1	4.0	5.0	39.1	0.9	3.3	13.0	14.4	323.9
2016	0.6	1.7	5.7	6.3	132.1	0.8	2.0	5.8	4.7	53.8	0.8	3.0	14.1	18.4	330.8
2017	0.8	2.3	7.6	9.1	172.8	0.6	1.0	2.7	2.7	23.6	0.8	2.8	18.2	15.3	207.8
2018	1.0	2.9	10.4	12.5	171.7	0.7	1.9	5.4	4.4	83.6	0.9	3.0	21.5	22.7	399.5
2019	0.7	2.7	8.3	9.9	179.0	0.8	1.6	6.1	5.1	61.9	0.9	5.0	15.5	21.6	272.2

Table D21: Summary data for the number of tows, the aggregate area, and the footprint for bottom-contacting effort for ORH/OEO targets combined per 25-km^2 cell, for each year, from 1990–2019. In any year, the minimum number of tows per cell was 1, and the aggregate area or footprint was < 0.00001 km^2. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year.

Fishing	No. tows per cell					Aggregate area per cell (km^2)					Footprint per cell (km^2)				
year	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
1990	1	2	9.52	9	252	0.41	1.00	4.15	3.73	174.37	0.41	1.00	2.72	3.26	24.23
1991	1	2	7.55	6	328	0.34	0.77	2.83	2.42	68.64	0.33	0.77	2.05	2.25	21.89
1992	1	2	9.52	8	358	0.31	0.77	3.13	2.41	110.28	0.31	0.76	2.10	2.18	22.14
1993	1	2	10.23	8	392	0.28	0.75	3.32	2.30	142.80	0.28	0.75	2.17	2.12	21.87
1994	1	2	10.61	8	428	0.29	0.75	3.47	2.39	157.49	0.29	0.75	2.15	2.12	23.10
1995	1	3	10.62	9	365	0.28	0.75	3.39	2.70	183.26	0.28	0.75	2.14	2.41	24.70
1996	1	2	8.10	8	248	0.26	0.75	2.54	2.28	69.96	0.26	0.74	1.90	2.06	21.73
1997	1	2	8.15	9	358	0.30	0.76	2.86	2.79	97.24	0.29	0.76	2.12	2.52	22.53
1998	1	3	8.84	9	364	0.36	0.86	2.95	3.14	80.21	0.35	0.85	2.20	2.80	21.95
1999	1	3	8.32	9	244	0.40	0.94	2.99	3.10	134.41	0.40	0.93	2.24	2.82	22.81
2000	1	3	7.37	7	166	0.33	0.87	2.45	2.41	54.17	0.33	0.86	1.91	2.23	20.23
2001	1	3	6.90	8	145	0.31	0.80	2.23	2.31	45.02	0.30	0.79	1.78	2.07	15.69
2002	1	3	6.22	7	184	0.28	0.77	2.12	2.43	35.04	0.28	0.77	1.76	2.23	17.04
2003	1	2	6.64	7	259	0.27	0.75	2.09	1.95	55.05	0.27	0.75	1.65	1.77	19.09
2004	1	2	6.99	8	173	0.27	0.77	2.56	2.55	83.22	0.27	0.76	1.98	2.27	23.82
2005	1	2	5.97	6	185	0.30	0.76	2.05	2.06	111.00	0.30	0.75	1.61	1.88	23.91
2006	1	2	6.22	6	182	0.25	0.75	2.06	2.11	73.85	0.25	0.74	1.61	1.94	23.08
2007	1	2	5.99	6	154	0.26	0.75	2.01	1.86	45.86	0.26	0.75	1.61	1.72	17.64
2008	1	2	6.23	7	165	0.26	0.75	1.84	2.01	83.56	0.25	0.74	1.46	1.82	19.23
2009	1	2	5.94	7	119	0.26	0.76	1.92	2.15	34.90	0.26	0.76	1.59	1.96	15.79
2010	1	2	5.91	7	115	0.25	0.75	1.97	2.17	35.90	0.24	0.75	1.62	1.92	16.63
2011	1	2	5.11	6	65	0.20	0.60	1.48	1.53	24.66	0.20	0.59	1.23	1.42	12.64
2012	1	2	4.72	5	123	0.20	0.52	1.37	1.30	57.85	0.20	0.50	1.12	1.22	15.36
2013	1	2	5.08	6	162	0.22	0.64	1.53	1.62	91.30	0.22	0.61	1.25	1.51	17.06
2014	1	2	4.61	5	78	0.23	0.61	1.34	1.41	23.43	0.23	0.59	1.14	1.30	13.06
2015	1	2	5.68	6	210	0.30	0.75	1.98	1.96	69.11	0.30	0.75	1.57	1.80	22.59
2016	1	2	5.26	5	148	0.28	0.75	1.94	1.63	80.10	0.28	0.74	1.53	1.54	23.59
2017	1	2	5.59	6	121	0.33	0.84	2.21	2.67	30.10	0.33	0.82	1.86	2.46	16.93
2018	1	2	5.69	6	134	0.30	0.76	2.17	2.28	31.87	0.29	0.75	1.72	2.06	17.26
2019	1	3	5.77	6	147	0.30	0.83	2.15	2.52	53.17	0.29	0.79	1.71	2.23	18.72

Table D22: Summary data for the number of tows, the aggregate area, and the footprint for bottom-contacting effort for Tier 2 targets combined per 25-km^2 cell, for each year, from 1990–2019. In any year, the minimum number of tows per cell was 1, and the aggregate area or footprint was < 0.00001 km^2. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year.

Fishing	No. tows per cell					Aggregate area per cell (km^2)					Footprint per cell (km^2)				
year	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
1990	1	2	7.1	8	99	0.50	1.03	3.69	3.19	62.13	0.50	1.02	2.63	2.94	22.41
1991	1	2	6.5	6	250	0.44	0.90	3.07	2.72	157.91	0.43	0.89	2.22	2.48	20.53
1992	1	2	6.3	6	221	0.43	0.96	3.24	2.86	91.97	0.43	0.94	2.33	2.66	23.79
1993	1	2	6.9	7	156	0.47	0.95	3.45	2.96	101.94	0.47	0.92	2.34	2.62	23.65
1994	1	2	6.5	5	143	0.39	0.80	3.01	2.22	84.33	0.38	0.79	2.00	2.06	23.32
1995	1	2	7.2	5	248	0.39	0.80	3.34	2.34	90.85	0.38	0.79	2.16	2.24	23.76
1996	1	2	6.7	5	222	0.34	0.77	2.92	2.09	95.73	0.33	0.77	2.03	1.96	24.32
1997	1	2	6.2	6	355	0.33	0.78	2.47	2.11	80.59	0.33	0.77	1.89	1.95	21.63
1998	1	2	5.3	4	172	0.33	0.75	2.22	1.80	65.03	0.33	0.75	1.70	1.75	23.27
1999	1	1	5.0	4	127	0.28	0.69	2.00	1.41	49.41	0.28	0.68	1.55	1.37	19.72
2000	1	2	5.7	5	150	0.30	0.75	2.22	1.96	101.90	0.29	0.75	1.64	1.83	19.38
2001	1	2	5.0	5	109	0.29	0.74	1.93	1.73	76.26	0.29	0.73	1.51	1.64	22.89
2002	1	2	4.8	5	134	0.32	0.75	1.86	1.67	57.67	0.32	0.74	1.52	1.61	20.29
2003	1	2	5.5	5	187	0.34	0.75	2.27	2.05	87.79	0.34	0.75	1.76	1.96	24.34
2004	1	2	4.6	4	109	0.31	0.75	1.85	1.61	37.59	0.31	0.75	1.54	1.55	18.38
2005	1	2	5.6	5	191	0.33	0.80	2.41	2.19	86.82	0.33	0.79	1.88	2.05	18.77
2006	1	2	5.6	5	187	0.37	0.82	2.39	2.27	67.90	0.36	0.80	1.87	2.13	19.68
2007	1	2	5.5	5	170	0.39	0.90	2.42	2.35	61.48	0.38	0.88	1.92	2.20	22.48
2008	1	2	5.7	6	133	0.36	0.81	2.21	2.17	49.93	0.36	0.80	1.80	2.04	20.65
2009	1	2	5.5	5	123	0.35	0.77	2.16	1.98	49.29	0.35	0.77	1.75	1.85	18.61
2010	1	2	4.6	5	133	0.34	0.77	1.70	1.91	26.91	0.34	0.76	1.48	1.80	15.33
2011	1	2	4.5	5	109	0.33	0.75	1.70	1.70	27.45	0.32	0.75	1.48	1.62	14.65
2012	1	2	4.4	5	119	0.34	0.78	1.68	1.96	34.85	0.33	0.77	1.47	1.89	15.53
2013	1	2	4.9	5	92	0.33	0.76	1.91	2.02	36.58	0.33	0.76	1.63	1.90	19.42
2014	1	2	4.5	5	115	0.35	0.78	1.71	1.89	32.98	0.35	0.78	1.48	1.80	18.17
2015	1	2	4.9	5	137	0.31	0.73	1.93	1.65	61.75	0.31	0.72	1.54	1.60	22.99
2016	1	2	4.1	4	106	0.33	0.70	1.59	1.64	42.60	0.33	0.69	1.36	1.55	19.34
2017	1	2	4.3	4	117	0.31	0.70	1.77	1.55	61.45	0.30	0.69	1.42	1.50	22.94
2018	1	2	4.6	5	137	0.34	0.76	1.85	1.82	50.04	0.34	0.75	1.50	1.73	21.34
2019	1	2	4.8	4	116	0.31	0.68	1.92	1.49	76.73	0.31	0.67	1.40	1.41	23.38

Table D23: The deepwater (Tier 1 and Tier 2 combined) footprint (km^2) by depth zone within the fishable area, for 1990–2019.

Fishing year	0–200 m	200–400 m	400–600 m	600–800 m	800–1000 m	1000–1200 m	1200–1400 m	1400–1600 m	0–1600 m
1990	13 608.0	7 881.3	11 309.1	7 172.5	3 411.7	2 319.7	1 573.4	308.1	47 584.0
1991	12 261.2	9 471.9	14 505.9	11 896.5	4 395.5	1 687.5	648.0	191.9	55 058.4
1992	14 685.6	10 116.6	21 125.0	14 725.0	3 909.7	1 225.7	530.3	299.3	66 617.1
1993	15 706.7	9 176.1	21 252.0	14 178.9	4 246.6	1 374.4	675.3	317.1	66 927.0
1994	14 992.2	8 879.0	19 418.3	7 363.9	3 321.8	1 774.4	779.8	402.3	56 931.5
1995	14 072.7	8 381.7	23 398.5	10 142.5	3 276.4	1 590.3	629.7	338.6	61 830.5
1996	14 473.9	8 989.2	24 679.2	9 351.3	3 234.8	1 340.5	444.2	213.2	62 726.2
1997	12 700.4	9 175.4	27 615.7	12 301.5	4 402.2	1 857.3	466.0	237.9	68 756.4
1998	13 781.2	9 556.4	32 979.5	12 255.2	5 251.7	2 255.3	705.5	305.8	77 090.5
1999	10 927.9	8 264.7	33 255.6	10 541.5	5 608.6	2 829.0	855.3	329.4	72 611.9
2000	9 929.6	8 180.6	34 033.4	13 736.9	4 832.2	2 415.4	616.4	278.6	74 023.2
2001	11 531.1	8 417.7	35 443.8	14 540.7	3 639.7	1 963.9	522.1	197.0	76 256.1
2002	12 549.2	9 104.3	36 161.7	16 389.3	4 103.8	1 993.3	538.0	165.3	81 004.8
2003	12 755.9	9 004.7	38 440.5	15 042.1	2 853.2	1 876.0	475.5	168.8	80 616.7
2004	9 963.4	7 130.6	32 201.9	11 910.3	3 485.8	2 439.5	506.6	156.6	67 794.8
2005	11 016.6	7 131.5	24 068.2	6 504.0	2 760.8	2 081.1	493.6	165.5	54 221.3
2006	11 441.3	7 298.5	21 396.5	5 227.4	2 613.5	1 579.6	419.8	122.6	50 099.2
2007	11 602.9	7 804.5	21 347.0	5 045.2	2 355.9	1 595.7	455.5	141.0	50 347.7
2008	12 619.0	8 068.6	20 416.9	6 021.0	1 928.2	1 421.2	428.8	118.5	51 022.2
2009	10 360.5	6 648.9	19 795.0	5 166.5	1 953.4	1 790.2	412.9	101.4	46 228.7
2010	11 273.8	6 652.9	22 190.8	5 624.1	1 889.6	1 723.8	425.5	105.9	49 886.4
2011	10 334.0	6 932.9	22 637.5	6 148.3	1 619.2	682.0	228.7	95.9	48 678.5
2012	9 940.1	6 718.3	22 310.3	5 826.3	1 239.0	638.6	186.0	64.9	46 923.5
2013	9 717.2	5 884.2	20 978.3	6 188.0	1 131.6	635.1	193.1	56.9	44 784.3
2014	9 058.7	6 013.4	20 635.2	9 280.3	1 538.8	733.4	222.4	96.4	47 578.7
2015	8 039.3	6 041.0	22 708.1	7 852.3	2 436.0	798.6	220.0	88.2	48 183.6
2016	7 601.4	6 280.7	22 621.3	6 175.9	2 170.7	1 298.5	434.5	95.6	46 678.6
2017	7 989.8	5 696.5	21 935.6	6 728.6	2 829.0	1 277.4	414.4	112.3	46 983.6
2018	6 761.8	5 398.8	23 613.5	8 337.7	2 155.2	1 165.6	451.6	143.2	48 027.3
2019	7 568.3	5 857.9	21 008.2	5 564.3	2 453.9	1 002.1	323.5	62.8	43 841.0
All	85 314.5	41 599.3	102 762.5	58 479.2	34 586.2	18 813.3	7 202.1	2 926.3	351 683.5

Table D24: The deepwater Tier 1 footprint (km^2) by depth zone within the fishable area, for 1990–2019.

Fishing year	0–200 m	200–400 m	400–600 m	600–800 m	800–1000 m	1000–1200 m	1200–1400 m	1400–1600 m	0–1600 m
1990	10 550.0	6 397.9	10 573.5	6 989.6	3 362.1	2 309.1	1565.8	295.8	42 043.8
1991	10 442.8	8 408.0	14 057.2	11 746.0	4 333.5	1 669.4	635.8	181.5	51 474.2
1992	12 497.5	9 137.0	20 791.6	14 635.7	3 845.3	1 198.8	500.7	279.3	62 885.8
1993	13 435.5	7 818.9	20 732.7	14 079.3	4 177.1	1 345.1	647.3	298.2	62 534.1
1994	13 448.2	7 871.8	19 065.4	7 263.8	3 234.4	1 729.6	751.4	383.1	53 747.6
1995	11 418.2	7 310.8	22 958.7	9 999.4	3 197.5	1 552.7	609.2	321.8	57 368.4
1996	12 387.5	7 855.4	24 413.1	9 225.4	3 115.8	1 292.5	420.8	192.9	58 903.4
1997	11 281.2	8 565.5	27 427.9	12 230.4	4 306.2	1 821.2	451.8	222.5	66 306.7
1998	12 774.1	8 834.5	32 797.6	12 152.9	5 171.0	2 205.2	678.2	292.6	74 906.1
1999	10 016.9	7 882.8	33 084.2	10 395.3	5 494.8	2 781.1	824.3	302.5	70 781.9
2000	8 842.6	7 690.4	33 810.6	13 619.2	4 682.6	2 345.8	567.4	248.4	71 806.9
2001	10 099.9	7 710.7	35 142.5	14 463.8	3 554.5	1 928.2	500.2	173.2	73 572.9
2002	10 635.6	8 181.1	35 787.3	16 286.8	4 011.5	1 956.0	521.4	149.7	77 529.4
2003	10 831.3	7 868.4	37 875.0	14 929.3	2 734.9	1 815.4	452.4	144.4	76 651.1
2004	8 792.8	6 721.0	31 548.6	11 806.8	3 379.1	2 405.6	485.6	142.0	65 281.3
2005	9 442.2	6 440.5	23 611.5	6 345.5	2 638.4	2 029.8	478.5	139.2	51 125.6
2006	10 259.5	6 564.2	20 655.6	5 024.7	2 448.9	1 538.8	392.2	103.6	46 987.5
2007	9 653.2	6 555.8	20 542.9	4 847.1	2 214.7	1 531.2	425.3	123.8	45 894.1
2008	8 957.4	6 094.1	19 197.1	5 836.6	1 788.5	1 356.8	405.2	99.6	43 735.2
2009	7 609.0	4 920.6	18 734.8	5 040.8	1 861.9	1 758.0	393.0	87.1	40 405.4
2010	8 993.2	5 557.7	20 990.4	5 512.4	1 786.2	1 671.4	408.0	91.4	45 010.7
2011	7 981.1	5 663.8	21 412.2	5 998.2	1 515.1	633.8	211.8	86.4	43 502.5
2012	7 637.9	5 536.1	21 506.8	5 695.2	1 133.7	598.7	153.8	50.6	42 312.9
2013	7 093.5	4 834.0	20 153.4	6 006.9	1 071.4	601.9	185.7	50.9	39 997.7
2014	6 289.3	5 238.5	19 701.3	9 152.4	1 461.5	685.4	205.2	86.0	42 819.7
2015	5 282.4	5 278.8	22 117.0	7 721.9	2 365.4	764.7	211.2	78.3	43 819.6
2016	5 322.9	5 502.8	21 796.2	6 046.1	2 111.3	1 263.2	422.1	84.2	42 548.8
2017	5 588.5	4 916.2	21 267.9	6 610.7	2 763.2	1 245.7	404.8	108.9	42 905.9
2018	4 782.8	4 536.8	22 841.9	8 243.9	2 105.6	1 139.8	441.8	136.3	44 228.9
2019	5 672.4	5 227.2	20 543.8	5 459.1	2 398.5	964.2	309.4	57.3	40 631.7
All	67 744.3	37 727.3	100 979.3	57 264.6	33 929.7	18 430.2	7 000.3	2 753.1	325 828.8

Table D25: The deepwater Tier 2 footprint (km^2) by depth zone within the fishable area, for 1990–2019.

Fishing year	0–200 m	200–400 m	400–600 m	600–800 m	800–1000 m	1000–1200 m	1200–1400 m	1400–1600 m	0–1600 m
1990	9 717.9	3 250.1	1 477.1	282.5	63.6	18.3	9.4	16.5	14 835.4
1991	7 285.0	2 694.6	903.2	255.2	104.7	33.0	15.3	11.6	11 302.6
1992	10 073.0	2 794.0	963.5	179.7	95.8	40.2	36.8	23.4	14 206.4
1993	10 746.1	2 830.7	1 187.9	171.8	109.7	49.7	43.7	21.8	15 161.4
1994	9 984.6	2 586.4	854.9	144.0	137.0	78.1	39.5	27.2	13 851.7
1995	8 657.5	2 584.6	1 197.6	247.1	126.9	60.6	31.1	18.8	12 924.1
1996	8 143.2	2 595.2	698.0	176.9	156.0	83.7	28.5	30.8	11 912.1
1997	5 963.0	1 659.9	503.5	104.0	128.0	53.6	17.2	27.1	8 456.4
1998	8 094.7	1 612.6	449.0	146.6	124.0	78.4	44.9	25.9	10 576.2
1999	6 499.0	995.6	468.7	210.9	198.6	114.4	51.4	38.1	8 576.8
2000	4 975.2	1 229.4	498.9	158.7	219.2	122.0	63.1	41.5	7 308.0
2001	5 027.8	1 366.7	592.0	94.8	104.5	41.5	25.2	25.3	7 277.9
2002	7 546.3	1 902.3	748.5	146.8	107.0	42.2	17.5	18.3	10 528.9
2003	7 571.4	2 155.0	912.3	134.9	129.7	72.0	27.2	27.9	11 030.4
2004	5 246.4	977.6	889.0	121.1	117.2	39.8	29.0	19.2	7 439.5
2005	6 359.0	1 383.5	789.7	201.4	137.6	60.1	21.0	32.0	8 984.3
2006	6 898.7	1 443.0	1 339.1	259.3	171.4	48.1	31.3	20.2	10 211.1
2007	7 811.7	2 037.7	1 317.9	241.8	154.8	76.5	31.6	17.7	11 689.9
2008	9 364.7	2 553.7	1 625.2	240.5	163.4	74.3	31.2	19.5	14 072.5
2009	7 306.2	2 228.5	1 432.0	149.8	101.7	39.4	21.3	14.5	11 293.4
2010	7 794.5	1 483.7	1 804.5	126.8	108.6	57.0	22.7	14.6	11 412.3
2011	6 488.7	1 598.7	1 656.5	173.3	117.3	54.8	18.5	9.5	10 117.3
2012	6 980.4	1 548.5	1 152.4	151.1	112.6	44.5	32.8	14.5	10 036.7
2013	7 115.1	1 352.7	1 218.7	222.7	64.0	34.7	8.9	6.1	10 022.8
2014	6 863.2	1 150.5	1 350.5	173.4	82.3	51.8	18.5	10.5	9 700.7
2015	5 841.6	1 076.0	831.0	193.7	77.7	35.0	9.3	10.8	8 075.1
2016	5 109.5	1 017.8	1 112.7	162.7	64.6	36.2	13.0	11.9	7 528.2
2017	5 204.5	1 065.4	929.5	139.9	72.0	34.4	9.9	3.4	7 459.2
2018	4 743.3	1 111.5	1 102.3	116.0	57.4	28.7	10.1	6.9	7 176.2
2019	4 921.2	942.4	648.8	125.0	58.8	39.8	14.6	5.9	6 756.3
All	63 459.9	19 153.4	15 067.9	3 661.9	1 583.8	1 009.4	522.7	332.8	104 791.8

Table D26: The estimated 1990–2019 footprint (km^2) for Tier 1 targets, by 200-m depth zones.

Depth zone (m)	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
0–200	329.2	12 897.1	39 435.4	2 700.4	105.1	279.9	94.2	1 771.6	24 206.3	67 744.3
200–400	1 328.6	19 449.5	5 856.2	7 261.5	70.5	196.7	3871.5	9 426.4	8 360.3	37 727.3
400–600	12 688.3	71 190.8	881.1	11 628.2	208.6	570.9	18 936.0	8 823.6	5 192.3	100 979.3
600–800	5 593.0	52 217.8	341.2	5 782.6	1 474.1	1 670.3	339.7	443.8	2 905.8	57 264.6
800–1000	1 038.6	8 863.8	56.8	356.1	8 758.3	18 483.9	58.2	171.1	485.0	33 929.7
1000–1200	51.3	2 013.2	53.1	79.6	5 069.6	12 851.7	22.9	145.0	319.2	18 430.2
1200–1400	11.9	633.8	60.9	30.7	1 423.5	5 128.4	22.2	96.5	275.2	7 000.3
1400–1600	8.4	382.6	13.0	13.3	371.4	1 992.8	3.5	59.6	104.2	2 753.1
0–1600	21 049.2	167 648.6	46 697.5	27 852.5	17 481.0	41 174.6	23 348.2	20 937.6	41 848.2	325 828.8

Table D27: The estimated 2019 footprint (km^2) for Tier 1 targets, by 200-m depth zones. – indicates no contact.

Depth zone (m)	HAK	HOK	JMA	LIN	OEO	ORH	SBW	SCI	SQU	Tier 1
0–200	1.7	376.6	2 693.1	76.0	0.6	–	2.8	122.1	2 539.6	5 812.5
200–400	5.3	1 570.7	121.3	309.9	1.0	1.1	95.5	2 243.2	1 179.3	5 527.3
400–600	220.2	16 923.1	10.4	842.3	0.8	4.7	659.1	2 222.5	202.3	21 085.3
600–800	146.6	5 074.3	0.3	382.5	4.9	34.0	–	7.7	3.9	5 654.1
800–1000	0.6	437.0	–	33.7	167.5	1 774.3	–	1.3	–	2 414.4
1000–1200	–	7.1	–	1.1	109.3	846.9	–	1.0	0.4	965.7
1200–1400	–	2.9	–	–	11.4	295.3	–	0.3	–	310.0
1400–1600	–	0.4	–	–	5.1	51.8	–	–	–	57.3
0–1600	374.4	24 392.1	2 825.0	1 645.4	300.6	3 008.2	757.3	4 598.1	3 925.5	41 826.7

Table D28: The deepwater (Tier 1 and Tier 2 combined) footprint (km^2) by BOMEC class within the fishable area, for 1990–2019. The 'All' includes 10 km^2 not assigned to a class and 3.1 km^2 in class K. Year is fishing year.

Year	A	B	C	D	E	F	G	H	I	J	L	M	N	O	All
1990	50.3	76.7	5 900.8	334.0	4 253.3	1 491.3	200.5	9 532.0	5 577.6	12 730.5	4 751.8	886.2	1 777.9	20.8	47 584.0
1991	21.0	70.0	4 308.5	335.5	5 143.8	1 720.7	260.4	10 935.1	7 302.7	14 076.0	7 526.9	2 149.6	1 184.8	23.3	55 058.4
1992	49.9	79.4	6 933.4	226.7	4 964.0	1 331.8	266.6	13 579.1	12 797.0	11 925.2	10 308.0	2 904.3	1 202.8	48.4	66 617.1
1993	58.2	206.3	7 095.3	246.5	6 050.1	846.7	400.6	14 261.5	12 741.1	15 235.8	5 694.2	2 575.7	1 474.8	39.9	66 927.0
1994	68.3	207.4	6 427.6	267.2	5 278.6	1 297.9	454.4	12 833.8	9 961.2	12 611.1	4 677.6	983.3	1 806.7	56.1	56 931.5
1995	44.7	256.5	4 033.9	296.8	6 449.8	1 347.0	606.4	14 084.3	12 801.6	14 062.1	5 064.4	1 320.1	1 396.5	66.3	61 830.5
1996	113.0	106.3	4 339.1	336.4	6 338.9	1 639.6	995.6	14 283.5	14 187.2	12 991.2	5 146.2	1 301.9	895.4	51.5	62 726.2
1997	118.5	146.6	3 199.6	397.8	5 935.0	1 379.8	1 005.5	13 951.2	15 353.2	17 215.5	7 210.3	1 740.4	1 019.5	83.4	68 756.4
1998	73.3	113.4	4 104.1	423.2	6 930.4	1 133.3	754.7	16 719.1	18 603.6	17 861.7	6 947.0	1 905.6	1 441.8	75.6	77 090.5
1999	115.7	74.4	3 042.3	301.8	6 150.5	642.8	614.2	16 945.9	18 784.9	17 412.9	5 030.1	1 785.5	1 631.7	76.2	72 611.9
2000	78.4	108.1	2 008.3	283.6	5 679.8	596.0	685.9	16 503.8	18 452.8	17 758.0	8 063.8	2 443.3	1 288.2	70.2	74 023.2
2001	341.8	109.5	3 995.2	175.7	5 042.9	630.7	552.1	17 670.4	17 752.3	17 057.3	9 227.1	2 546.6	1 097.0	57.5	76 256.1
2002	238.2	167.8	5 056.6	226.4	4 973.9	1 102.1	468.7	16 558.2	16 919.7	17 260.3	11 951.0	4 842.6	1 162.5	76.5	81 004.8
2003	209.4	94.9	5 047.9	218.1	4 925.7	1 301.2	516.5	19 145.3	16 536.5	16 276.0	13 171.3	2 036.4	1 065.4	72.1	80 616.7
2004	58.7	53.1	3 734.7	129.3	3 948.1	1 471.2	575.0	14 965.0	13 616.1	15 253.8	10 577.4	2 271.6	1 076.7	63.9	67 794.8
2005	15.2	44.7	4 622.8	68.2	4 213.4	1 372.8	501.9	12 853.4	10 255.8	11 778.8	5 648.9	1 710.9	1 075.4	59.2	54 221.3
2006	8.7	31.4	4 392.1	73.3	4 863.1	1 626.2	355.5	11 972.0	9 947.9	11 324.2	3 576.6	1 127.5	760.0	41.0	50 099.2
2007	19.3	29.4	4 890.2	81.8	4 526.0	1 111.0	339.3	12 735.9	11 162.7	9 540.1	3 990.5	1 146.0	734.8	40.6	50 347.7
2008	139.6	789.7	6 193.3	225.7	3 459.6	972.2	656.3	12 415.0	9 779.5	10 323.2	4 528.4	783.1	708.8	47.8	51 022.2
2009	126.1	523.8	4 711.6	240.6	2 877.0	1 342.5	578.1	9 731.2	10 576.2	9 255.2	4 689.4	880.3	671.8	24.8	46 228.7
2010	74.8	490.9	5 606.0	328.5	3 362.5	1 399.7	617.3	9 439.8	12 250.7	9 806.0	4 629.7	1 092.9	758.1	29.0	49 886.4
2011	93.3	382.0	4 158.6	295.0	3 954.4	931.9	627.8	9 685.9	11 349.7	9 183.2	6 219.7	1 291.8	479.3	25.8	48 678.5
2012	79.5	544.7	4 522.1	255.7	3 402.1	671.3	543.8	10 182.7	11 733.2	9 213.8	4 645.8	672.9	438.8	16.7	46 923.5
2013	67.8	598.4	4 225.8	267.2	3 190.1	685.1	654.0	9 121.0	12 125.2	8 600.4	4 358.9	452.6	422.0	15.8	44 784.3
2014	99.5	591.6	4 144.5	253.4	2 853.3	431.9	664.9	8 998.2	11 531.9	10 185.1	6 251.1	1 036.2	505.8	31.3	47 578.7
2015	34.4	351.7	3 501.4	198.5	2 968.7	412.8	522.9	10 197.8	12 301.9	11 311.9	5 130.4	779.0	455.4	16.8	48 183.6
2016	17.8	370.7	2 892.9	142.9	2 906.6	473.1	484.8	10 976.5	10 780.9	10 893.7	5 182.3	738.6	789.7	27.7	46 678.6
2017	15.5	274.1	2 884.9	164.4	3 095.3	794.4	498.9	9 710.0	10 897.1	11 368.6	5 609.4	878.7	765.5	26.5	46 983.6
2018	26.9	355.5	2 529.7	118.8	2 466.2	385.8	424.9	10 120.7	10 821.5	11 079.7	7 531.3	1 445.3	698.5	22.4	48 027.3
2019	25.7	360.7	2 704.4	151.3	3 290.2	316.7	374.2	9 904.4	9 870.5	10 094.0	5 516.1	705.7	507.9	19.2	43 841.0
All	1 505.7	4 394.1	36 642.9	3 790.2	24 569.7	6 891.5	3 623.8	64 974.9	38 597.9	78 170.5	56 587.4	18 785.3	12 548.9	587.6	351 683.5

Table D29: The deepwater Tier 1 footprint (km^2) by BOMEC class within the fishable area, for 1990–2019. The 'All' includes 8.8 km^2 not assigned to a class and 2.9 km^2 in class K. Year is fishing year.

Year	A	B	C	D	E	F	G	H	I	J	L	M	N	O	All
1990	29.6	32.8	5 338.0	131.0	2 594.5	1 446.3	116.1	7 369.0	5 237.9	12 443.4	4 657.2	866.2	1 761.5	20.2	42 043.8
1991	12.5	28.4	3 987.1	139.3	4 191.7	1 715.6	215.4	9 463.9	7 112.7	13 850.7	7 443.2	2 140.0	1 150.8	22.7	51 474.2
1992	25.4	38.5	6 342.4	159.8	3 859.9	1 292.6	251.6	12 360.9	12 528.7	11 665.1	10 261.9	2 894.8	1 155.9	47.6	62 885.8
1993	23.0	87.6	6 548.5	124.6	4 946.7	822.0	316.8	12 488.3	12 558.2	14 920.2	5 664.3	2 569.1	1 426.9	37.3	62 534.1
1994	27.0	104.3	6 043.7	224.1	4 535.8	1 291.4	384.9	11 644.0	9 785.2	12 283.8	4 646.5	981.6	1 741.4	53.8	53 747.6
1995	22.2	113.3	3 090.3	195.5	5 357.5	1 344.2	472.6	12 769.4	12 551.8	13 738.1	5 001.1	1 310.1	1 348.0	54.3	57 368.4
1996	28.8	51.0	3 773.6	258.7	5 332.2	1 618.9	991.1	12 873.9	14 074.7	12 669.0	5 087.9	1 256.8	839.9	46.4	58 903.4
1997	27.3	84.0	2 651.7	338.3	5 419.8	1 373.3	1 000.4	13 191.6	15 304.0	16 918.3	7 200.0	1 735.2	983.0	79.6	66 306.7
1998	48.3	72.0	3 900.9	362.3	6 433.3	1 125.0	742.4	15 842.9	18 536.7	17 557.4	6 930.2	1 894.5	1 385.3	71.1	74 906.1
1999	62.8	50.5	2 752.5	276.9	5 877.5	635.6	589.2	16 326.6	18 731.5	17 053.3	5 017.5	1 773.8	1 563.4	67.7	70 781.9
2000	46.3	48.8	1 646.3	212.6	5 295.1	584.6	657.9	15 864.8	18 375.2	17 338.3	8 048.1	2 431.1	1 195.7	59.3	71 806.9
2001	307.3	37.6	3 469.0	116.3	4 705.3	624.8	520.8	16 569.5	17 666.5	16 710.9	9 213.1	2 540.5	1 045.3	45.9	73 572.9
2002	178.7	44.1	4 312.7	165.1	4 364.9	1 099.4	435.2	15 252.7	16 827.0	16 918.9	11 910.2	4 837.5	1 116.4	66.0	77 529.4
2003	108.8	60.9	4 413.4	139.2	4 036.7	1 296.9	501.7	17 538.9	16 460.6	15 871.3	13 132.6	2 036.2	995.2	58.5	76 651.1
2004	3.3	32.5	3 436.6	52.4	3 314.9	1 467.3	560.6	14 040.0	13 594.0	14 939.4	10 514.5	2 271.6	1 002.2	52.0	65 281.3
2005	2.6	29.7	3 901.5	55.8	3 619.5	1 372.7	498.2	11 858.0	10 169.9	11 299.5	5 587.0	1 703.8	981.6	45.7	51 125.6
2006	3.4	27.2	4 152.2	63.5	4 094.2	1 624.5	350.8	10 927.7	9 685.3	10 688.1	3 519.3	1 127.3	697.3	26.6	46 987.5
2007	8.6	16.2	4 489.6	44.7	3 298.2	1 101.3	322.4	11 031.7	10 852.2	8 918.3	3 948.2	1 141.8	687.0	33.8	45 894.1
2008	5.2	89.9	4 753.2	89.0	2 628.2	970.1	510.2	9 758.3	9 288.0	9 696.5	4 475.4	778.9	651.8	40.5	43 735.2
2009	5.3	61.2	3 836.7	51.7	1 956.0	1 329.5	444.8	7 783.4	10 024.5	8 786.6	4 600.4	872.1	634.3	18.9	40 405.4
2010	11.5	96.5	4 972.5	72.5	2 576.3	1 397.6	472.5	7 989.7	11 852.8	9 196.1	4 548.2	1 090.6	713.0	20.8	45 010.7
2011	11.7	88.5	3 673.6	67.5	2 848.4	931.6	435.2	8 022.7	10 907.7	8 592.8	6 183.0	1 286.5	434.1	19.1	43 502.5
2012	8.4	62.5	3 850.7	66.1	2 656.1	664.4	355.0	8 869.2	11 495.9	8 662.6	4 552.8	667.8	390.7	10.4	42 312.9
2013	5.8	70.7	3 641.2	91.2	2 094.7	684.4	363.8	8 014.6	11 734.6	8 130.9	4 295.8	451.0	408.1	10.8	39 997.7
2014	6.3	48.6	3 192.7	57.2	2 110.2	425.1	458.8	7 959.8	11 146.8	9 692.3	6 189.8	1 032.0	474.3	25.7	42 819.7
2015	4.4	79.0	2 397.7	45.8	1 980.8	409.3	385.9	9 300.9	12 070.4	10 875.4	5 079.9	769.6	407.5	13.0	43 819.6
2016	2.6	41.1	2 386.5	69.4	1 782.8	471.8	329.9	9 856.0	10 469.7	10 479.8	5 158.2	729.6	748.8	22.1	42 548.8
2017	2.6	103.6	2 440.3	45.5	1 758.1	792.6	415.8	8 509.1	10 605.7	11 016.2	5 583.4	868.9	739.4	24.8	42 905.9
2018	5.1	70.4	2 240.2	77.3	1 455.3	385.8	299.0	8 782.1	10 462.8	10 811.5	7 511.6	1 440.8	666.5	20.4	44 228.9
2019	16.7	29.6	2 412.9	100.2	2 403.8	316.7	264.8	8 927.9	9 738.2	9 713.1	5 509.5	702.4	478.9	16.9	40 631.7
All	763.9	1 249.0	29 786.6	2 348.1	20 644.1	6 839.0	2 826.8	60 161.5	38 355.1	75 251.8	56 388.4	18 634.9	12 024.2	543.7	325 828.8

Table D30: The deepwater Tier 2 footprint (km^2) by BOMEC class within the fishable area, for 1990–2019. The 'All' includes 1.2 km^2 not assigned to a class and 0.2 km^2 in class K. Year is fishing year.

Year	A	B	C	D	E	F	G	H	I	J	L	M	N	O	All
1990	20.7	44.2	613.2	214.9	2 314.6	53.8	85.0	3 319.5	821.2	450.0	156.8	21.7	17.2	0.6	8 133.2
1991	8.5	41.6	347.0	198.5	1 701.4	5.8	45.5	2 255.9	491.0	389.0	150.2	10.4	52.6	0.7	5 698.0
1992	25.3	41.1	717.2	72.3	1 758.0	44.5	15.1	1 885.3	725.8	512.3	86.8	11.3	58.9	1.7	5 955.6
1993	35.2	120.3	561.0	123.5	1 998.8	32.6	85.3	2 669.2	647.6	526.1	98.7	7.5	54.7	2.9	6 963.5
1994	41.3	103.6	396.3	43.6	1 441.7	10.4	71.2	1 996.9	602.5	571.7	111.6	1.8	82.0	2.4	5 477.0
1995	22.6	145.4	1 049.3	104.4	2 129.1	6.4	140.9	2 399.3	749.3	568.5	130.0	10.3	61.0	13.6	7 530.2
1996	86.9	56.7	630.0	84.3	1 943.7	24.8	11.0	2 257.9	467.7	470.7	146.5	45.8	73.9	12.5	6 312.5
1997	94.2	65.8	635.2	75.2	1 161.6	11.7	10.5	1 296.8	259.7	443.5	51.6	6.4	51.8	14.4	4 178.2
1998	26.1	41.8	293.9	88.2	1 462.2	12.4	14.3	1 224.1	167.9	473.9	36.8	12.3	87.9	14.9	3 956.8
1999	58.1	24.0	367.0	39.5	1 068.7	9.4	27.2	984.0	199.4	615.7	31.0	12.5	102.3	12.6	3 551.3
2000	32.3	59.7	429.7	71.5	896.1	15.5	40.9	886.6	235.8	651.1	34.6	12.9	126.3	15.1	3 508.0
2001	34.5	72.3	536.3	59.4	612.9	7.0	37.2	1 499.3	237.6	455.3	28.9	7.2	58.1	11.8	3 657.9
2002	62.0	123.8	764.0	62.5	1 013.4	2.8	46.7	1 805.3	354.2	472.1	90.0	5.0	50.4	12.6	4 864.9
2003	151.2	34.5	747.1	80.4	1 120.0	12.8	24.2	2 145.6	251.3	477.1	51.4	0.2	79.0	16.9	5 191.7
2004	55.4	20.7	320.3	77.1	832.2	4.9	23.3	1 191.3	94.4	363.4	73.4		78.1	13.3	3 148.0
2005	12.6	15.0	845.2	12.7	1 133.0	0.8	3.9	1 339.3	312.8	640.7	104.2	7.3	105.3	15.5	4 548.4
2006	5.3	4.2	298.2	9.9	1 383.7	2.7	5.1	1 435.8	689.7	819.8	112.3	0.3	65.1	15.4	4 847.4
2007	10.7	13.3	517.2	38.1	1 830.0	12.7	17.1	2 149.9	763.1	734.8	98.4	4.4	52.0	7.0	6 248.8
2008	134.5	709.2	1523.8	136.9	1 148.4	3.0	167.1	3 058.2	770.1	786.2	95.4	4.2	61.8	7.5	8 606.3
2009	120.8	467.8	923.1	189.1	1 209.2	22.4	155.0	2 161.5	872.8	554.2	143.5	8.2	39.6	6.0	6 873.5
2010	63.3	400.9	686.9	256.2	1 041.8	4.0	163.1	1 690.5	819.5	728.3	124.4	2.3	46.7	8.3	6 036.4
2011	81.6	300.4	493.3	229.6	1 395.6	0.4	211.7	1 937.8	746.3	676.1	79.6	5.6	47.6	6.6	6 212.6
2012	71.2	489.4	722.1	191.1	1 028.6	8.3	204.0	1 583.1	462.0	612.3	129.4	5.1	50.9	6.4	5 563.9
2013	62.1	539.7	608.6	180.9	1 364.4	1.3	311.8	1 267.8	729.1	561.7	122.0	1.6	15.2	5.1	5 771.5
2014	93.1	548.1	1147.2	198.7	998.4	7.3	223.7	1 200.3	747.6	585.2	101.2	4.2	34.6	5.6	5 895.3
2015	30.0	277.1	1395.3	153.0	1 301.1	3.5	146.4	989.4	474.2	555.2	83.7	9.4	50.9	3.9	5 473.2
2016	15.2	332.5	586.5	74.1	1 304.8	1.3	165.8	1 277.9	478.3	513.6	33.4	9.1	42.2	6.0	4 840.6
2017	12.9	174.7	473.3	119.1	1680.4	2.1	93.0	1 361.1	528.8	423.7	33.0	9.8	29.6	1.7	4 943.3
2018	21.8	291.9	330.3	41.5	1 254.0		133.7	1 486.5	649.4	336.7	27.7	4.6	37.2	2.0	4 617.3
2019	9.0	332.6	307.1	51.0	1 317.2		112.7	1 082.5	326.1	431.3	27.9	3.3	31.3	2.5	4 034.6
All	928.0	3 712.4	13 019.8	1 953.1	13 015.6	240.7	1 657.6	23 056.4	5 603.2	8 703.3	890.8	227.8	1 119.8	87.2	74 217.1

Table D31: Estimated footprint (km^2) for the Tier 1 target fish species relative to the probability of occurrence of each target and for the scampi and arrow squid targets relative to the estimated extent of the species (based on www.nabis.govt.nz).

Probability occurrence (%)	HAK		HOK		JMA		LIN		OEO		ORH	
	1990-2019	2019	1990-2019	2019	1990-2019	2019	1990-2019	2019	1990-2019	2019	1990-2019	2019
0	240.4		236.8	5.0	1 011.8	4.8	4.8	0.0	381.0	2.2	1 174.2	1.2
0.1–1.0	241.3		1 126.2	15.2	182.4	0.9	83.4	1.4	64.7	0.3	171.4	1.7
1.1–5.0	459.1	0.6	2 983.4	60.6	1 141.0	12.6	92.2	0.4	203.6	2.6	380.3	5.7
5.1–10.0	356.5	4.1	3 145.1	90.4	983.2	4.1	119.4	2.3	193.3	2.0	386.6	7.4
10.1–0.0	527.4	2.1	4 048.9	133.3	2 278.4	35.2	461.4	10.8	229.1	3.3	614.3	19.4
20.1–30.0	508.3	1.9	2 801.7	115.4	5 875.8	149.6	1 140.8	33.2	238.8	2.6	590.5	20.5
30.1–40.0	788.8	7.1	2 563.8	127.9	6 459.0	268.0	1 177.0	56.1	187.5	2.5	507.3	14.4
40.1–50.0	1 629.5	20.2	2 667.3	174.0	4 653.6	224.3	1 213.6	72.2	211.7	1.7	506.4	15.3
50.1–60.0	2 322.2	65.6	2 805.5	176.1	5 170.0	405.9	1 093.5	68.0	274.1	0.7	511.8	14.5
60.1–70.0	3 190.0	90.3	2 711.2	262.9	9 513.3	837.3	1 104.6	69.6	463.3	3.2	654.9	16.0
70.1–80.0	6 135.0	138.1	3 806.3	358.3	6 704.9	398.0	1 334.8	75.0	1 289.1	9.4	1 008.1	41.3
80.1–90.0	4 359.8	42.8	6 499.3	810.2	2 649.8	484.2	3 335.3	129.0	3 138.9	21.9	2 155.7	113.6
90.1–95.0	286.8	1.7	20 643.5	2 829.3	65.9		7 685.7	424.0	3 038.3	40.8	2 745.4	155.5
95.1–99.0	4.2		111 609.6	19 233.5	8.5		9 005.9	703.5	7 583.8	207.4	29 767.8	2 581.8
0.0–99.0	21 049.2	374.4	167 648.6	24 392.1	46 697.5	2 825.0	27 852.5	1 645.4	17 481.0	300.6	41174.6	3 008.2

Table D31: continued.

Probability	SBW	
(%)	1990–2019	2019
0	100.8	
0.1–1.0	102.9	1.3
1.1–5.0	382.2	1.3
5.1–10.0	349.4	0.7
10.1–0.0	491.5	1.8
20.1–30.0	433.6	0.8
30.1–40.0	380.9	0.7
40.1–50.0	355.5	0.1
50.1–60.0	547.7	0.9
60.1–70.0	758.5	2.8
70.1–80.0	1 355.3	30.0
80.1–90.0	3 722.9	82.8
90.1–95.0	5 401.8	103.0
95.1–99.0	8 965.3	61.4
0.0–99.0	23 348.2	287.3

Population	SCI		SQU	
extent	1990–2019	2019	1990-2019	2019
Hotspot	5 048.9	1 216.4	16 070.3	1 406.8
90% population	5 225.2	602.8	15 202.8	2 169.4
100% population	9 450.2	2 688.5	7 283.0	319.0
Not Exist /unknown	1 208.1	90.5	3 292.0	19.6
All	20 932.3	4 598.1	41 848.2	3 925.5

Table D32: The estimated footprint (km^2) for deepwater fishstocks during 1990–2019 ad 2019 by the surficial layers representing the percent of carbonate, gravel mud, and sand. 'unk' is where there was no overlap.

	1990–2019 footprint (km^2)			
Sediment (%)	Carbonate	Gravel	Mud	Sand
0–20	60 203.8	272 347.0	109 566.3	33 773.2
20–40	85 639.4	54 456.4	85 836.3	68 039.7
40–60	68 161.1	15 836.4	81 526.1	133 783.7
60–80	59 846.8	5 266.9	48 493.2	92 406.6
80–100	76 021.8	1 594.4	24 116.6	21 873.9
unk	1 810.6	2 182.4	2 145.1	1 806.5
Total	351 683.5	351 683.5	351 683.5	351 683.5

	2019 footprint (km^2)			
Sediment (%)	Carbonate	Gravel	Mud	Sand
0–20	11 177.8	35 005.0	12 720.4	3 534.4
20–40	10 232.9	6 922.3	9 631.3	8 913.0
40–60	7 276.0	1 289.6	12 445.1	17 472.1
60–80	7 459.6	241.8	6 379.9	10 802.0
80–100	7 687.4	371.2	2 653.3	3 112.0
unk	7.4	11.0	11.0	7.4
Total	43 841.0	43 841.0	43 841.0	43 841.0

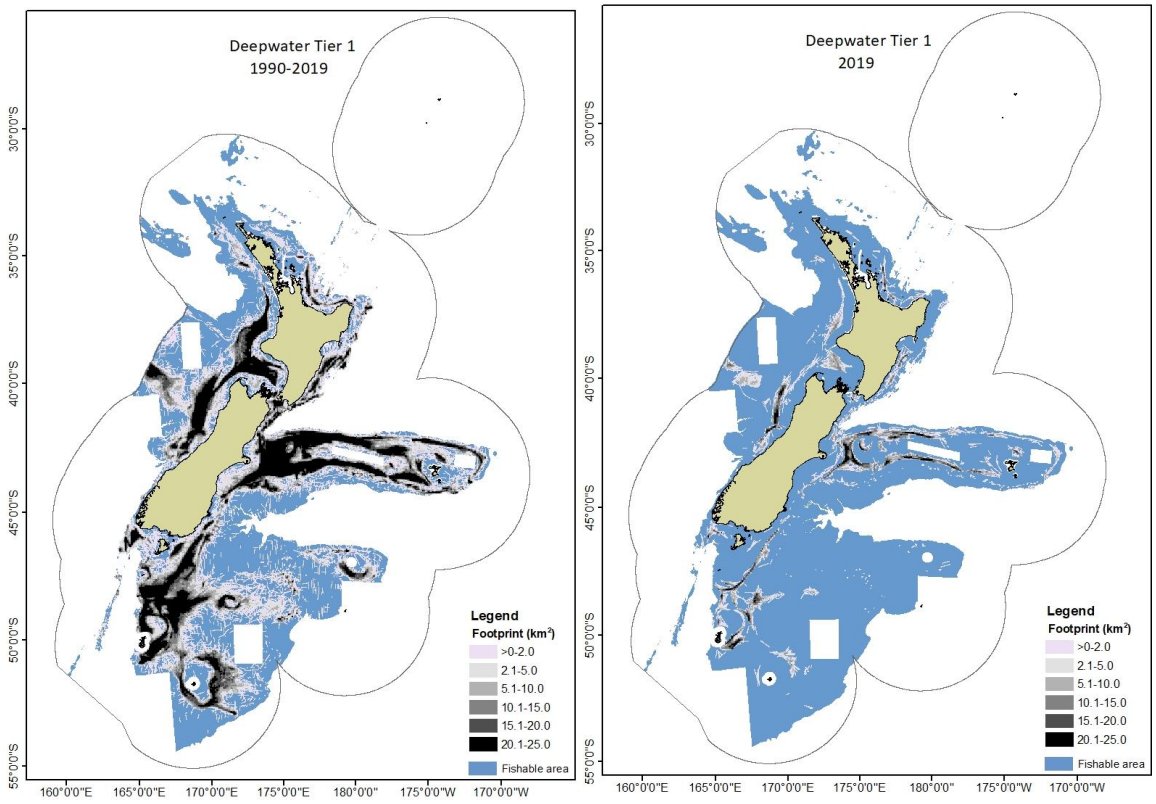


Figure D1: Distribution of the deepwater Tier 1 footprint, by 25-km^2 cells, 1990–2019 and 2019.

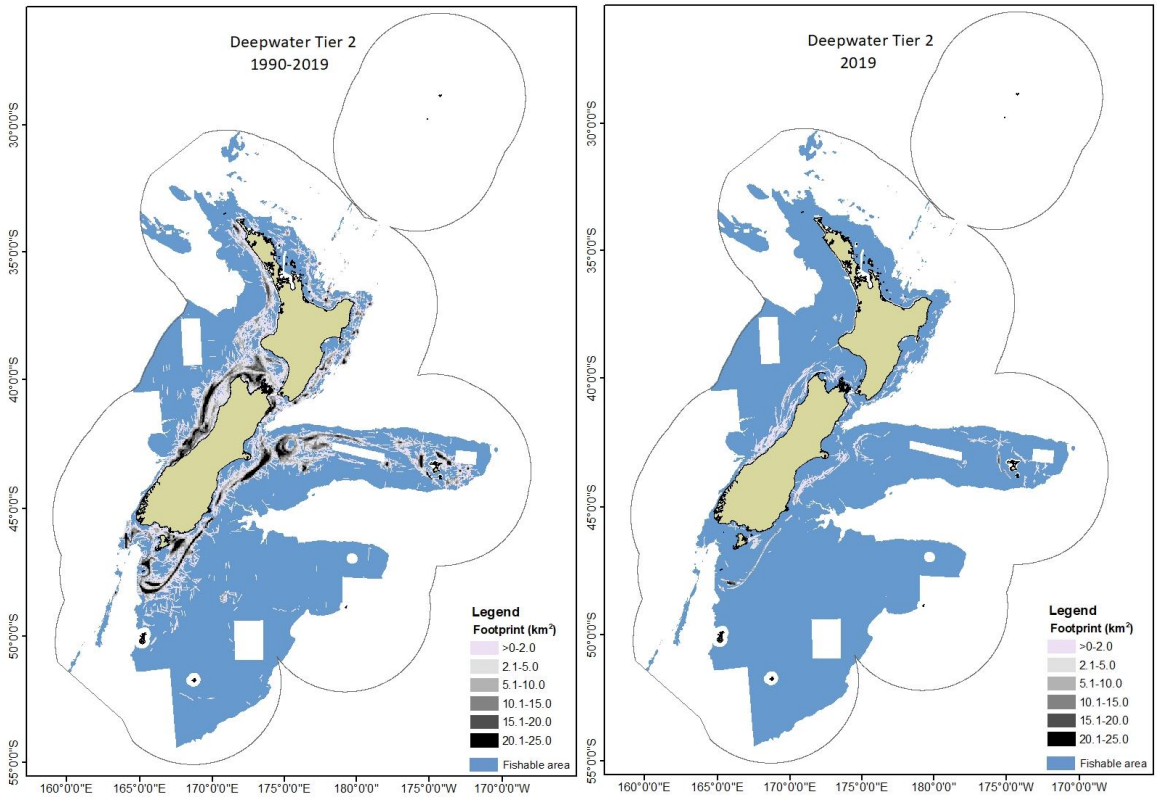


Figure D2: Distribution of the deepwater Tier 2 footprint, by 25-km^2 cells, 1990–2019 and 2019.

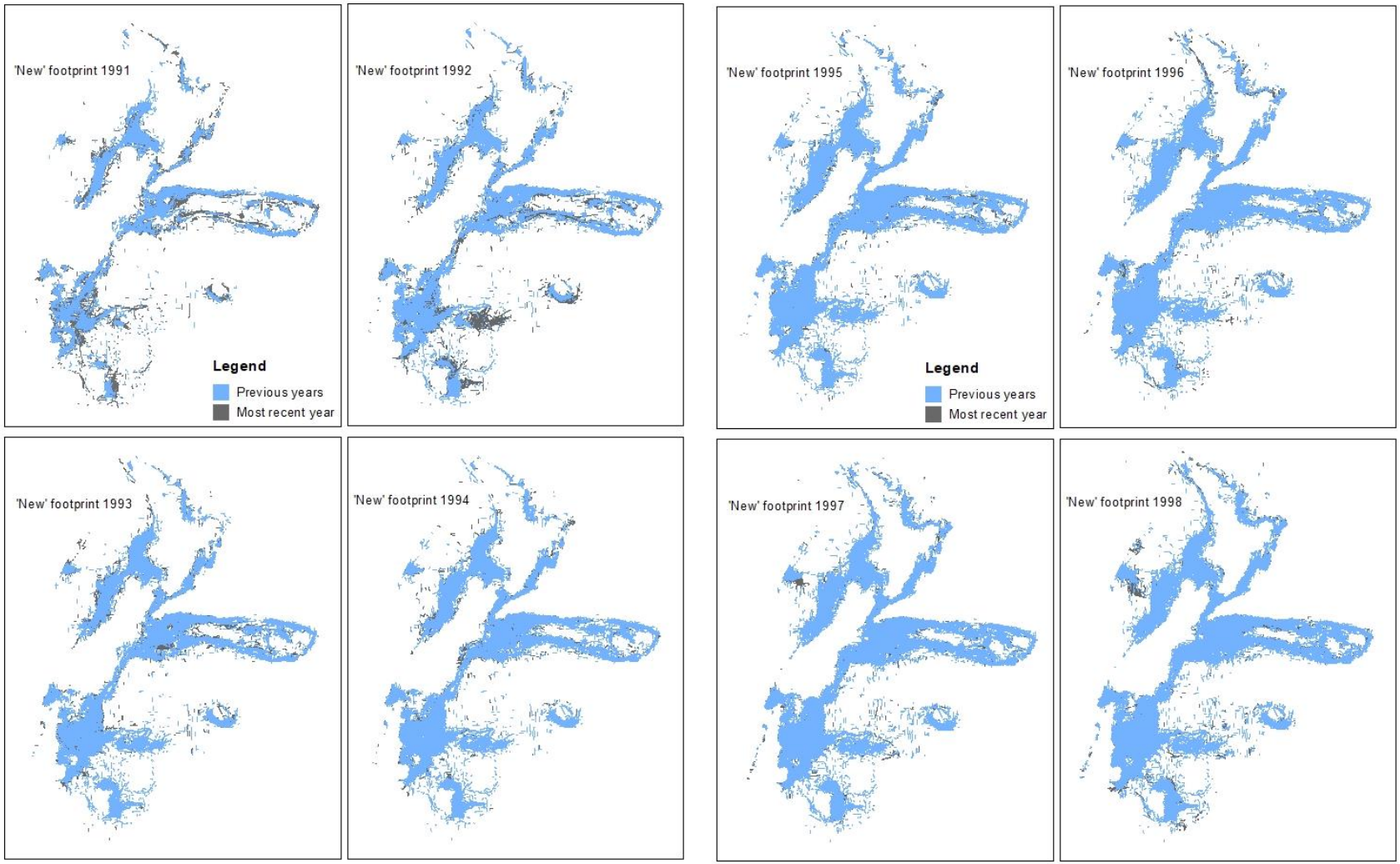


Figure D3: Distribution of new deepwater footprint each fishing year, relative to previous years, for 1990–2019. This figure shows 1991–1994 (left) and 1995–1998 (right).

Figure D3: continued. This figure shows 1999–2002 (left) and 2003–2006 (right).

Figure D3: continued. This figure shows 2007–2010 (left) and 2011–2014 (right).

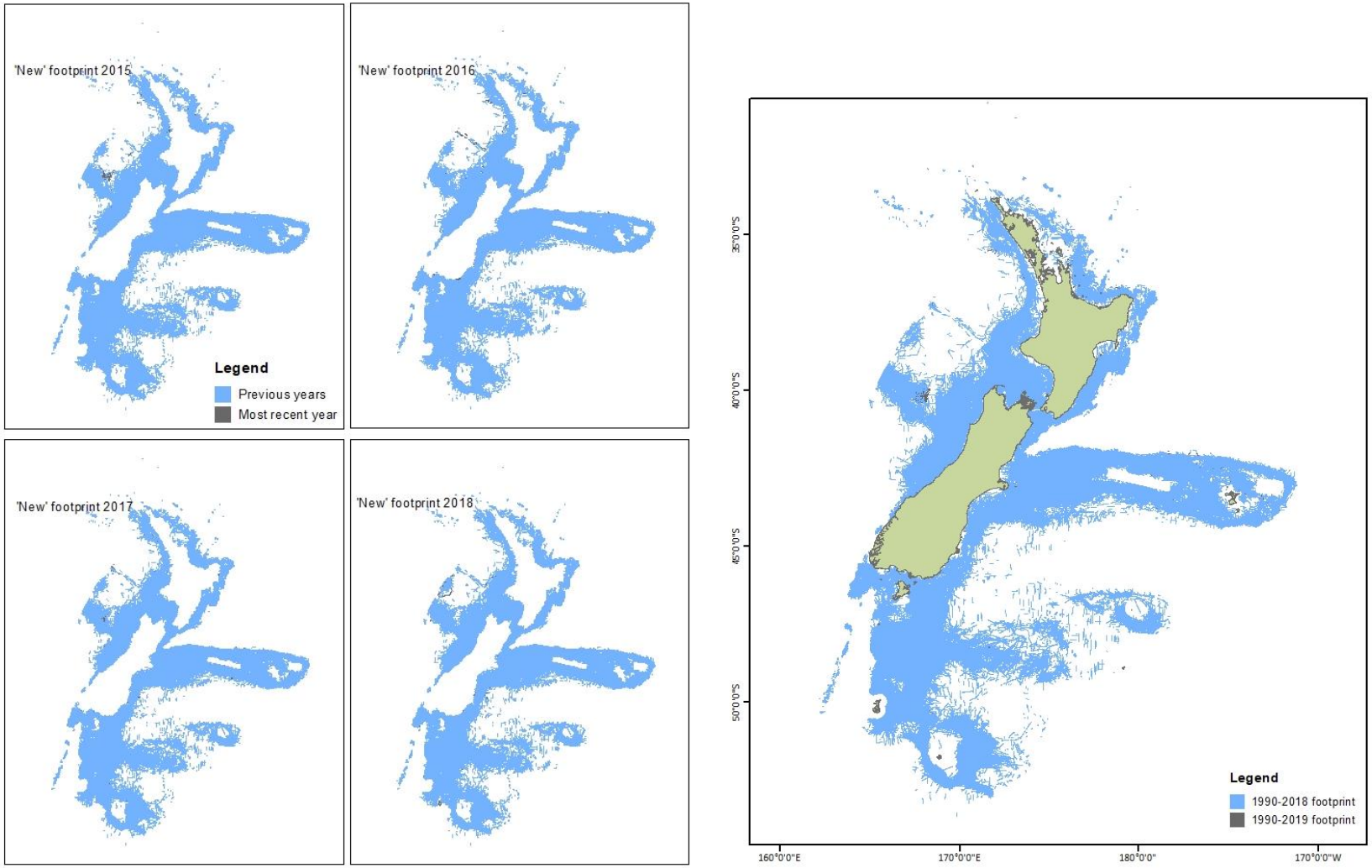


Figure D3: continued. This figure shows 2015–2018 (left) and 2019 (right).

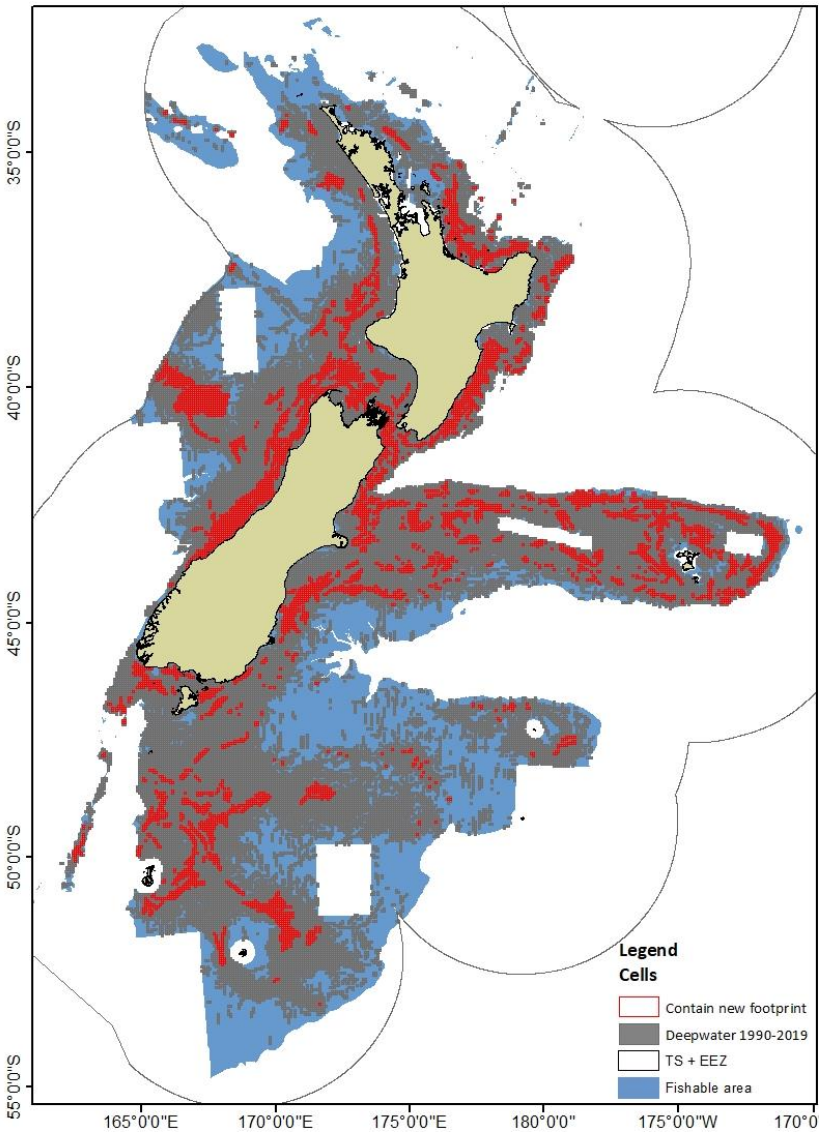


Figure D4a: The location of cells that had deepwater footprint contact in 2019 within them (n=6393 red cells) in parts of the cells that had not been contacted before (that is 1990–2018). The deepwater 1990–2019 set of cells is also shown. Refer to next figure

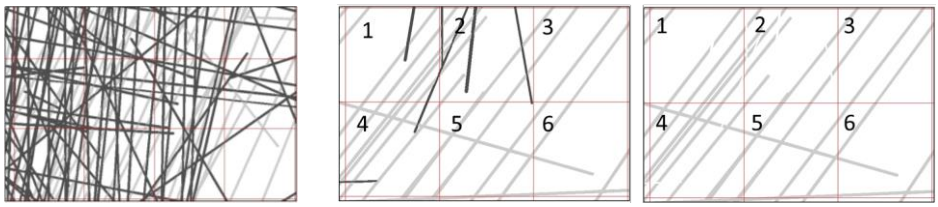


Figure D4b: Tows across red cells (cells with new deepwater footprint area contacted in 2019 but not in 1990–2018). Black tows are those made during 1990–2018, and light grey tows are those made in 2019. Right image shows the segments of tows that represent the new 2019 footprint (grey) in the cells shown in the lower left image.

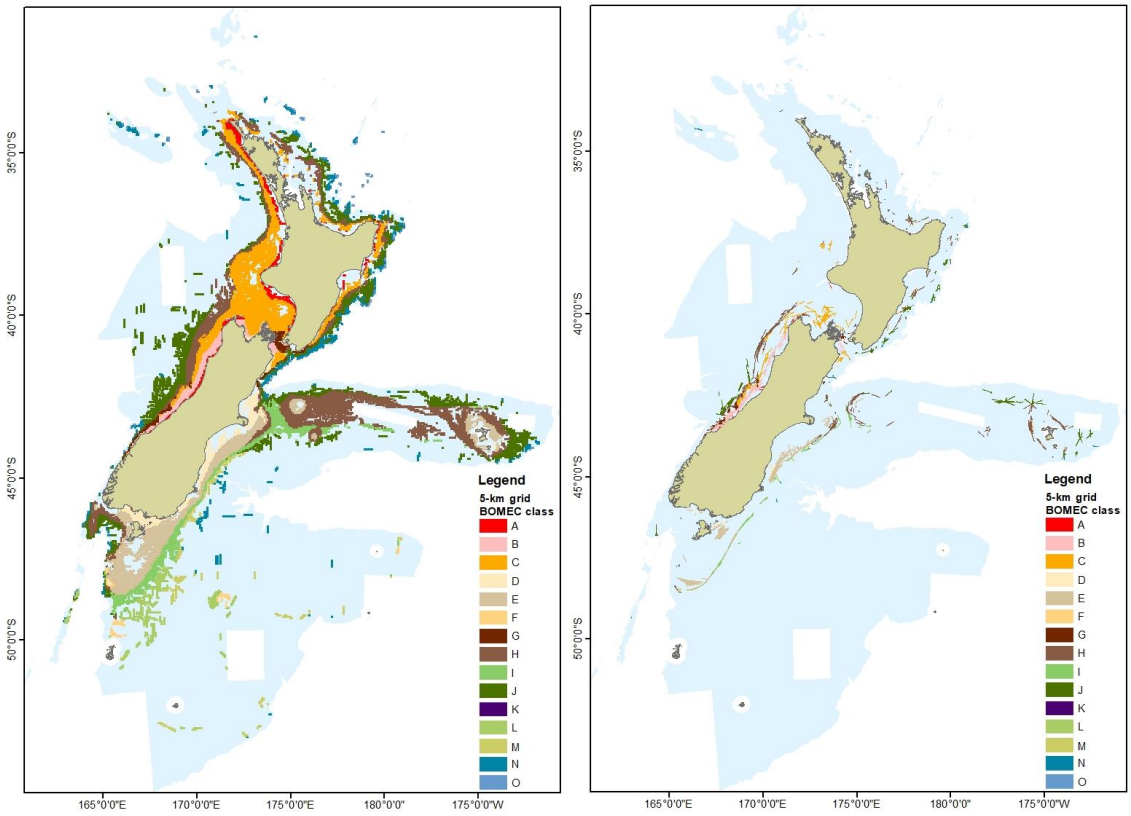


Figure D5: Tier 2 footprint overlap with BOMEC for 1990–2019 (left) and 2019 (right).

APPENDIX E: INSHORE FISHSTOCKS

Table E1: The number of bottom-contacting tows by inshore target retained for the inshore spatial analysis, for 2008–2019. 'Others' include BCO, BNS, FRO, HPB, QSC, PAD, POR, RSN, TRU. [See Table 2 and Table E2 for definition of codes.]

Target	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
BAR	923	1 171	1 235	1 199	1 212	1 510	1 314	1 384	1 151	1 545	2 178	1 263	16 085
ELE	647	698	865	678	792	659	606	791	649	660	650	889	8 584
FLA	17 795	17 213	19 731	15 358	17 212	17 022	15 976	13 434	15 018	14 773	12 413	10 014	185 959
GSH	173	565	705	806	488	515	419	247	99	92	70	114	4 293
GUR	4 906	4 921	6 872	6 420	6 703	7 608	7 368	6 280	6 087	5 407	6 018	7 032	75 622
JDO	2 104	1 941	2 070	1 654	1 420	1 746	2 040	1 972	1 608	2 144	1 492	1 004	21 195
JMA	0	0	2	2	1	1	1	1	1	0	0	2	11
KAH	5	0	3	10	4	3	22	8	13	8	0	5	81
LEA	67	87	224	155	324	193	134	81	36	58	30	13	1 402
LIN	198	216	196	147	109	145	164	141	166	217	168	58	1 925
MOK	73	80	62	143	85	106	94	97	77	116	137	274	1 344
RCO	3 059	2 910	3 001	2 908	2 635	2 366	2 574	1 620	1 822	2 068	1 198	1 403	27 564
RSK	3	8	72	65	29	125	228	237	78	250	227	127	1 449
SCH	76	102	69	106	101	106	88	75	90	133	220	237	1 403
SKI	107	124	167	215	83	133	186	82	159	165	147	71	1 639
SNA	3 997	4 239	3 926	3 968	4 205	3 973	3 708	3 521	3 035	2 821	3 184	3 099	43 676
SPD	123	174	127	74	63	9	11	26	0	14	0	1	622
SPO	16	68	132	114	171	146	233	203	196	189	336	193	1 997
SSK	0	0	0	0	0	5	0	1	0	0	0	0	6
STA	1 397	1 414	1 990	1 879	1 616	1 556	1 682	1 600	1 807	1 455	1 548	1 321	19 265
TAR	11 351	12 347	12 891	12 770	11 851	11 419	12 763	11 466	10 143	10 986	9 548	8 341	135 876
TRE	2 825	3 085	2 877	3 385	2 593	2 739	2 592	2 306	2 512	2 712	2 220	2 156	32 002
WAR	1 064	1 041	1 041	1 243	1 358	1 243	1 129	1 410	1 333	1 117	989	627	13 595
Others	323	325	229	128	103	442	37	65	104	186	180	95	2 217
Total	51 232	52 729	58 487	53 427	53 158	53 770	53 369	47 048	46 184	47 116	42 953	38 339	597 812
No. vessels	215	195	202	207	192	182	180	170	171	162	152	150	297

Table E2: The number of 25-km^2 cells contacted by inshore targets (ordered from largest to smallest footprint), and the estimated aggregate area and footprint for 2008–2019. Targets not included are identified with an asterisk.

Target	Common name	No. of cells	Aggregate (km^2)	Footprint (km^2)
TAR	Tarakihi	11 371	237 421.3	77 311.1
GUR	Red gurnard	6 828	102 414.3	35 885.3
FLA	Flatfish species	5 092	181 589.5	26 686.1
SNA	Snapper	3 835	49 250.4	20 345.8
TRE	Trevally	3 817	57 489.0	18 847.6
RCO	Red cod	4 087	38 588.4	18 667.0
BAR	Barracouta	2 983	31 741.0	13 952.3
STA	Giant stargazer	3 205	28 614.5	12 866.6
JDO	John dory	3 705	23 052.4	12 100.2
WAR	Blue warehou	3 431	23 236.0	11 541.3
ELE	Elephantfish	1 909	11 356.8	5 865.6
LIN	Ling	1 258	4 870.0	3 080.8
SCH	School shark	2 408	3 101.2	2 680.2
SPO	Rig	1 686	2 789.1	2 248.7
GSH	Ghost shark	1 242	4 708.1	2 167.9
SKI	Gemfish	905	3 840.4	1 894.4
LEA	Leatherjacket	955	2 069.9	1 666.0
RSK	Rough skate	773	1 920.6	1 577.1
MOK	Moki	802	1 742.8	1 213.2
SPD	Spiny dogfish	835	877.3	823.1
HPB*	Hāpuku/Bass	711	712.6	641.2
QSC*	Queen scallop	130	395.1	201.1
BNS*	Bluenose	250	225.7	171.6
KAH	Kahawai	244	134.7	130.0
BCO*	Blue cod	122	52.4	50.2
PAD*	Paddle crab	51	35.8	29.2
JMA	Jack mackerel species	41	16.5	16.4
RSN*	Red snapper	46	12.0	12.0
SSK	Smooth skate	19	7.3	7.2
TRU*	Trumpeter	15	6.0	6.0
FRO*	Frostfish	9	2.3	2.3
POR*	Porae	10	2.2	2.2
All	All forms (includes CELR)	15 289	812 275.6	148 528.8
All	**TCE, TCP, ERS**	**15 199**	**811 595.0**	**148 276.2**

Table E3: Comparison of annual totals (number of cells contacted, aggregate area, and footprint) for combined TCE, TCP, and ERS data for inshore Targets (those listed without an asterisk in Table E2) and inshore Fishstocks and the percent of the Target totals retained in the Fishstock totals, 2008–2019. The annual overlap of the Fishstock footprint on the EEZ+TS and fishable area is given in the lower part of the table.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
No. cells contacted													
Target	9 459	9 400	9 479	9 582	9 299	9 189	9 578	9 488	9 366	9 476	9 249	8 686	15 199
Fishstock	**9 299**	**9 261**	**9 356**	**9 476**	**9 218**	**9 075**	**9 483**	**9 395**	**9 297**	**9 339**	**9 170**	**8 625**	**15 025**
%	98.3	98.5	98.7	98.9	99.1	98.8	99.0	99.0	99.3	98.6	99.1	99.3	98.9
Aggregate (km^2)													
Target	70 357.5	73 623.1	76 839.1	69 901.3	67 975.4	67 735.9	71 053.1	64 803.2	63 334.7	66 374.8	62 985.5	56 611.4	811 595.0
Fishstock	**69 580.3**	**72 823.1**	**76 284.7**	**69 480.0**	**67 671.6**	**67 228.4**	**70 641.8**	**64 378.6**	**62 806.5**	**65 614.7**	**62 400.3**	**56 364.4**	**805 274.4**
%	98.9	98.9	99.3	99.4	99.6	99.3	99.4	99.3	99.2	98.9	99.1	99.6	99.2
Footprint (km^2)													
Target	44 237.2	46 321.7	47 219.3	45 152.7	43 572.7	43 465.4	45 608.2	42 765.7	41 718.4	43 266.8	42 585.4	38 131.5	148 276.2
Fishstock	**43 638.7**	**45 714.8**	**46 787.4**	**44 815.4**	**43 334.4**	**43 076.5**	**45 261.4**	**42 426.8**	**41 315.7**	**42 650.3**	**42 117.1**	**37 929.5**	**146 223.8**
%	98.6	98.7	99.1	99.3	99.5	99.1	99.2	99.2	99.0	98.6	98.9	99.5	98.6
Overlap of fishstock footprint with EEZ+TS													
% overlap	1.1	1.1	1.1	1.1	1.1	1.0	1.1	1.0	1.0	1.0	1.0	0.9	3.6
Overlap of fishstock footprint with fishable area													
% overlap	3.1	3.3	3.4	3.2	3.1	3.1	3.3	3.0	3.0	3.1	3.0	2.7	10.5

Table E4: The number of cells contacted by inshore fishstocks during 2008–2019. [Continued on next page]

Fishstock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
BAR1	1 078	1 223	1 075	1 139	1 223	1 140	1 222	1 412	1 241	1 239	1 539	1 260	2 983
ELE3	468	626	640	552	601	483	449	517	495	429	528	610	1 192
ELE5	78	60	62	86	50	115	106	127	116	132	135	110	306
ELE7	41	23	33	113	30	54	40	107	90	140	154	75	427
FLA2	270	249	172	185	218	234	204	172	217	122	118	104	575
FLA3	1 113	1 093	1 173	1 156	1 116	1 149	1 102	1 123	1 098	1 079	1 013	849	2 373
FLA7	1 163	1 178	1 217	929	1 073	1 006	865	814	856	857	966	923	2 083
GSH3	109	117	126	154	36	91	212	152	45	27	97	35	451
GSH7	116	233	277	338	207	286	256	126	67	74	72	127	715
GUR1	792	762	688	596	686	668	574	673	542	592	497	375	1 631
GUR2	731	718	784	785	725	710	757	681	723	785	751	704	1 248
GUR3	373	473	468	501	501	714	714	554	709	587	692	760	1 375
GUR7	335	427	732	868	923	1 053	982	870	902	863	902	1 091	1 812
GUR8	325	392	428	417	412	422	394	376	359	304	369	409	836
JDO1	626	560	667	541	526	640	754	742	608	682	478	423	1 628
JDO2	219	289	300	294	277	328	414	393	358	402	299	244	958
JDO7	294	153	210	177	233	395	382	595	440	483	767	634	1 243
LEA2	126	186	280	240	269	277	182	138	91	88	23	5	541
LEA3	8	14	22	86	30	4	39	47	60	38	50	33	249
MOK1	123	171	128	206	145	130	117	186	150	179	299	358	733
RCO2	57	26	26	122	129	79	10	22	72	107	7	34	358
RCO3	1 080	979	1037	1 047	1 120	1 005	1 244	942	769	990	937	548	2 023
RCO7	945	884	892	821	766	590	587	643	677	638	577	582	1 776
RSK3	15	45	83	127	109	211	349	413	213	273	371	320	747
SCH1	69	131	108	208	162	194	231	122	68	58	173	123	655
SCH3	66	65	82	82	11	97	51	61	64	61	146	110	553
SCH7	134	144	100	133	120	129	20	52	130	98	267	135	839
SCH8	65	106	48	62	125	96	94	81	74	140	143	162	351

Table E4: continued.

Fishstock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
SKI1	182	86	107	67	97	108	158	59	72	113	66	49	381
SKI2	56	100	148	237	91	136	180	151	146	155	214	144	551
SNA1	831	860	831	881	887	813	815	851	784	857	904	851	1473
SNA2	237	294	209	211	199	171	263	209	332	290	331	143	632
SNA7	254	244	297	314	207	240	262	212	214	194	212	180	567
SNA8	586	557	476	444	516	425	353	464	404	397	397	406	1 211
SPD3	344	379	348	213	120	42	47	74	–	–	–	–	775
SPO3	53	154	320	192	348	289	357	307	303	289	546	328	1 030
SPO7	9	9	21	83	105	75	13	44	87	36	47	42	399
SPO8	20	10	20	12	9	–	28	44	88	61	103	63	226
STA3	134	283	390	397	262	319	277	318	417	418	476	404	1 148
STA4	38	–	77	24	–	–	9	–	–	–	–	–	126
STA5	360	346	393	370	384	407	378	377	373	335	366	283	748
STA7	522	471	561	579	516	503	530	502	630	597	570	497	1 198
TAR1	1 653	1 570	1 576	1 508	1 478	1 376	1 639	1 655	1 609	1 740	1 508	1 262	3 008
TAR2	1 203	1 108	1 096	1 124	1 120	1 075	1 160	1 153	1 131	1 061	1 130	932	1 743
TAR3	949	1 009	1 023	1 094	909	927	1 060	1 166	1 119	1 115	1 031	877	1 905
TAR4	161	86	213	114	30	–	166	145	56	99	95	240	423
TAR5	45	47	84	158	141	132	109	162	103	111	79	96	386
TAR7	1 518	1 674	1 667	1 947	1 883	1 869	1 876	1 749	1 732	1 771	1 733	1 539	3 234
TAR8	327	567	524	554	575	541	618	552	565	489	436	357	1 348
TRE1	767	678	661	648	566	564	593	548	589	697	645	610	1 248
TRE2	134	241	164	75	27	155	179	132	227	135	39	49	603
TRE7	918	1050	966	1 010	944	912	907	791	843	902	836	692	2 012
WAR2	223	192	191	92	130	86	104	110	161	178	164	108	461
WAR3	472	421	361	380	430	378	350	432	389	432	338	422	1 318
WAR7	628	627	614	672	564	663	625	648	688	588	637	346	1 491
WAR8	22	–	12	36	84	37	98	56	126	53	43	44	244
Total	9 299	9 261	9 356	9 476	9 218	9 075	9 483	9 395	9 297	9 339	9 170	8 625	15 025

Table E5: The estimated aggregate area (km^2) for inshore fishstocks, by fishing years 2008–2019. [Continued on next page]

Fishstock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
BAR1	1 761.8	2 161.7	2 513.9	2 471.7	2 299.3	2 710.2	2 649.7	2 744.5	2 298.7	3 166.5	4 386.3	2 576.7	31 741.0
ELE3	846.4	916.8	1 065.7	790.9	988.5	743.6	679.1	913.4	780.7	755.4	746.6	1 080.9	10 308.1
ELE5	37.1	42.1	37.4	41.9	22.3	65.4	61.1	100.0	59.5	67.2	73.2	66.4	673.6
ELE7	15.0	5.5	17.2	51.0	12.3	15.4	17.3	44.3	47.6	61.0	56.7	29.4	372.8
FLA2	1 091.9	905.6	603.2	913.6	1 010.6	929.1	1 087.4	877.8	847.6	793.8	643.7	333.5	10 038.0
FLA3	6 478.7	6 653.4	7 845.9	6 851.1	7 880.9	8 895.2	8 468.6	6 661.5	7 426.5	7 148.2	5 883.0	4 835.9	85 028.9
FLA7	9 637.1	9 863.3	10 349.7	6 219.9	7 214.3	6 094.3	5 781.2	5 699.2	6 649.5	7 743.0	6 271.6	4 782.8	86 305.9
GSH3	59.1	44.0	40.7	73.5	12.4	101.7	97.7	66.8	14.5	8.1	37.4	11.0	566.8
GSH7	117.1	515.4	669.3	832.8	500.0	516.3	369.5	197.9	77.1	85.0	38.5	116.5	4 035.3
GUR1	1 699.9	1 103.4	972.7	842.1	1 850.7	1 581.0	1 216.6	1 304.0	1 234.5	1 319.3	1 298.5	969.8	15 392.5
GUR2	4 015.1	4 096.5	6 121.1	5 078.7	4 048.5	3 919.0	4 280.5	3 899.7	3 697.8	3 535.3	3 379.9	3 465.8	49 537.9
GUR3	368.8	405.6	470.8	500.6	566.1	968.7	1 053.7	709.2	873.1	677.2	977.3	1 325.8	8 897.0
GUR7	206.7	337.4	824.5	1 127.4	2 017.8	2 887.4	2 527.8	2 114.7	1 810.8	1 563.6	1 972.8	3 501.8	20 892.6
GUR8	583.7	802.4	972.7	788.8	710.8	643.5	590.8	580.4	388.1	298.1	510.6	759.0	7 628.8
JDO1	1 877.5	1 750.4	1 722.3	1 199.9	1 059.9	1 111.4	1 251.0	1 154.3	964.4	1 218.0	788.0	581.1	14 678.3
JDO2	237.8	183.7	271.4	279.5	258.8	280.2	461.3	412.3	381.2	395.3	281.4	167.2	3 610.1
JDO7	232.5	90.6	140.6	175.3	111.2	326.1	386.5	636.9	335.5	631.1	998.7	694.7	4 759.7
LEA2	132.9	151.0	385.4	159.7	402.4	245.5	143.1	75.6	30.6	47.5	7.8	1.4	1 783.1
LEA3	2.9	3.5	7.1	29.4	25.3	0.9	13.7	16.3	19.1	11.6	24.0	9.9	163.9
MOK1	102.6	99.0	73.7	190.4	100.8	107.9	98.4	115.0	90.1	140.4	196.8	405.3	1 720.3
RCO2	21.9	5.8	7.9	53.9	146.6	39.3	2.9	10.8	31.3	44.0	1.6	10.5	376.4
RCO3	2 537.9	2 836.1	2 535.8	2 491.4	2 033.7	2 024.9	2 556.2	964.4	1 226.6	1 513.4	997.8	793.7	22 512.0
RCO7	2 118.6	1 714.5	1 464.3	1 913.8	1 256.4	927.2	1 040.6	1 367.3	1 249.4	1 229.0	512.2	904.7	15 697.9
RSK3	3.0	13.0	78.8	78.6	41.5	144.8	304.5	344.1	129.7	311.3	284.6	178.1	1 912.1
SCH1	19.8	50.3	60.5	167.8	163.3	144.6	179.2	86.9	50.6	31.5	143.1	89.0	1 186.5
SCH3	19.5	18.8	27.0	22.0	4.1	35.7	17.4	15.5	18.4	23.6	65.2	44.2	311.3
SCH7	60.3	71.2	36.1	47.4	39.1	47.3	5.5	16.7	48.5	36.9	130.6	72.9	612.6
SCH8	63.2	104.4	28.3	19.7	51.4	49.5	52.3	48.3	51.6	127.4	141.3	222.1	959.4

Table E5: continued.

Fishstock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
SKI1	284.4	169.8	255.2	237.1	172.1	205.1	221.4	27.8	194.5	213.3	122.3	35.3	2 138.3
SKI2	30.6	153.3	128.8	231.5	53.9	118.9	185.6	125.8	190.4	174.3	210.9	98.0	1 702.0
SNA1	2 816.7	3134.3	2 772.1	2 751.6	2 955.1	2 929.1	2621.1	2 467.7	2 162.5	2 122.9	3 260.3	3 238.8	33 232.1
SNA2	290.1	416.7	303.2	216.5	205.8	178.3	425.0	466.1	671.2	508.3	407.2	277.5	4 365.8
SNA7	446.7	402.2	529.6	543.3	308.4	264.0	309.6	320.6	207.7	223.7	295.3	251.2	4 102.2
SNA8	1 317.9	1 118.9	782.4	486.7	610.9	512.4	592.5	581.2	399.8	352.4	357.7	437.2	7 550.2
SPD3	165.6	220.8	241.8	99.4	75.9	11.1	13.1	25.5	–	–	–	–	853.2
SPO3	19.1	90.6	162.0	131.2	221.3	172.4	280.7	244.1	202.3	197.1	410.3	208.9	2 340.0
SPO7	2.6	3.5	5.9	41.7	60.3	22.2	2.2	15.5	23.3	8.2	11.0	11.1	207.4
SPO8	5.7	1.9	6.2	7.6	2.1	–	8.5	24.1	32.1	36.8	63.3	44.0	232.4
STA3	54.3	161.1	269.8	417.6	177.3	241.7	175.9	301.9	370.3	322.3	331.8	440.5	3 264.5
STA4	34.7	–	74.3	85.9	–	–	7.5	–	–	–	–	–	202.3
STA5	1 127.2	1 080.3	1 566.8	1 439.8	1 569.8	1 384.0	1 572.1	1 388.4	1 454.9	839.0	1 470.8	828.8	15 721.8
STA7	735.6	695.7	916.2	830.2	628.6	699.9	628.8	685.7	986.7	963.8	755.8	890.5	9 417.5
TAR1	4 615.0	5 179.5	4 219.0	4 166.5	4 105.6	3 232.6	4 057.2	4 438.4	4 548.1	5 358.5	4 661.4	3 523.7	52 105.5
TAR2	8 624.9	9 145.4	8 405.7	7 614.2	6 550.9	6 432.4	7 352.0	6 808.1	5 597.4	5 762.3	5 574.3	4 555.6	82 423.3
TAR3	1 743.1	2 353.9	2 698.0	2 685.2	1 745.5	2 060.1	2 915.8	3 039.5	2 084.7	2 902.4	2 719.6	2 188.4	29 136.2
TAR4	1 295.8	470.9	1 011.7	553.0	17.8	–	1 218.6	725.2	103.9	438.9	60.7	878.5	6 774.9
TAR5	22.4	16.5	106.5	176.6	134.2	162.4	85.9	96.0	141.4	95.3	67.6	48.1	1 152.9
TAR7	3 852.2	4 629.3	4 767.6	4 964.6	5 360.2	5 392.3	5 293.0	4 055.5	4 670.0	4 638.5	3 896.5	4 191.1	55 710.8
TAR8	585.3	850.2	997.4	876.2	1 004.5	884.5	916.4	792.5	798.1	614.0	729.2	726.0	9 774.4
TRE1	1 290.8	1 263.3	1 425.5	1 903.4	1 084.4	1 023.7	1 267.3	992.1	1 355.4	1 842.8	1 568.3	1 752.5	16 769.4
TRE2	62.9	107.7	79.9	21.8	7.1	67.1	61.0	69.1	110.5	55.2	12.5	30.3	685.0
TRE7	3 928.6	4 330.8	3 360.8	3 374.5	3 339.3	3 625.9	3 032.8	3 168.2	3 474.6	3 112.2	2 818.0	2 444.3	40 010.1
WAR2	317.7	230.2	210.5	144.3	155.9	145.9	162.1	110.7	173.5	222.2	182.5	102.4	2 157.8
WAR3	565.8	506.4	776.7	854.0	1 288.5	775.4	773.5	843.8	793.8	724.0	501.7	718.2	9 121.9
WAR7	953.8	1 119.0	835.9	1 125.4	915.8	1 083.2	962.9	1 334.0	1 117.4	816.4	1 003.9	351.7	11 619.6
WAR8	9.2	–	2.4	13.2	39.3	9.4	51.1	17.2	75.0	33.7	36.9	26.5	313.8
Total	69 580.3	72 823.1	76 284.7	69 480.0	67 671.6	67 228.4	70 641.8	64 378.6	62 806.5	65 614.7	62 400.3	56 364.4	805 274.4

Table E6: The estimated footprint (km^2) for inshore fishstocks, by fishing years 2008–2019. [Continued on next page]

Fishstock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
BAR1	1 531.7	1 769.6	1 893.7	1 962.3	1 868.4	2 158.4	2 122.4	2 245.2	1 969.7	2 430.8	3 358.3	2 268.4	13 952.3
ELE3	723.0	786.3	908.6	680.9	831.3	634.0	572.5	763.2	655.8	627.9	652.4	928.8	4 951.1
ELE5	35.7	39.0	35.2	40.6	21.7	63.1	59.2	95.1	58.6	65.0	70.5	64.7	562.2
ELE7	15.0	5.5	16.6	48.7	12.2	15.3	15.9	43.5	46.5	59.2	56.3	29.3	352.3
FLA2	589.1	499.1	352.4	455.5	533.3	496.2	531.3	450.2	455.5	430.5	313.2	181.5	1 818.3
FLA3	3 349.7	3 702.9	4 138.0	3 907.6	4 087.1	4 531.7	4 289.4	3 917.2	3 848.5	3 619.2	3 321.7	2 718.2	13 072.8
FLA7	4 631.1	4 985.2	5 040.8	3 525.5	3 962.8	3 545.7	3 182.7	3 102.1	3 464.7	3 796.4	3 598.5	3 075.9	11 700.5
GSH3	57.7	43.7	39.6	72.6	12.3	80.1	95.9	64.9	13.5	8.0	35.8	10.9	501.4
GSH7	106.5	383.0	504.3	614.5	378.2	430.0	314.4	176.4	72.0	80.6	36.6	106.9	1 617.0
GUR1	1 486.6	985.8	828.9	723.7	1 498.3	1 242.0	948.4	1 103.2	1 039.2	1 043.9	966.8	734.0	6 872.4
GUR2	2 762.3	2 856.3	3 807.5	3 283.6	2 750.0	2 767.2	3 001.3	2 666.4	2 615.6	2 648.5	2 489.7	2 557.0	9 451.3
GUR3	330.7	384.7	441.3	460.0	524.5	896.1	924.9	648.6	800.2	615.1	886.8	1 140.9	5 674.9
GUR7	199.8	320.3	755.6	1 029.4	1 751.3	2 412.6	2 122.2	1 803.4	1 595.3	1 382.9	1 727.7	2 810.5	9 931.2
GUR8	516.9	706.0	796.1	682.3	619.8	551.2	523.4	513.7	361.8	279.3	443.1	641.0	3 977.0
JDO1	1 460.3	1 393.8	1 390.2	966.3	918.1	969.0	1 073.3	999.5	843.9	1 057.5	669.5	516.4	6 203.3
JDO2	206.3	177.6	253.3	257.3	237.3	263.3	418.8	374.5	356.3	367.0	258.0	156.9	2 497.9
JDO7	222.2	82.0	131.6	156.6	108.1	300.0	347.4	573.2	318.1	575.6	913.8	637.8	3 425.9
LEA2	116.1	144.2	341.8	156.2	355.8	236.4	137.7	73.7	30.5	46.8	7.8	1.4	1 396.1
LEA3	2.9	3.5	7.0	29.4	22.7	0.9	13.5	16.3	19.1	11.5	23.6	9.9	156.6
MOK1	93.0	87.6	69.1	166.0	89.6	93.7	88.7	104.9	83.6	123.6	184.8	369.1	1 190.7
RCO2	21.6	5.8	6.4	53.0	121.3	34.4	2.9	10.6	30.1	41.6	1.6	10.5	325.1
RCO3	1 905.0	1 960.8	1 876.4	1 843.8	1 635.0	1 438.8	2 075.6	864.8	1 000.5	1 219.0	875.8	620.6	10 381.2
RCO7	1 701.9	1 470.4	1 273.1	1 561.2	1 058.8	768.4	899.2	1 120.6	1 059.3	1 059.6	478.6	803.2	7 981.7
RSK3	3.0	13.0	62.0	71.5	39.4	138.2	282.7	327.6	123.2	279.5	265.8	170.5	1 568.6
SCH1	19.8	50.2	59.9	163.2	149.9	142.1	171.9	85.2	48.5	31.2	130.7	86.8	992.2
SCH3	19.1	18.8	26.8	21.7	4.1	35.4	17.0	15.5	18.4	22.3	64.0	43.4	303.6
SCH7	59.2	69.8	35.8	47.1	39.0	47.0	5.5	16.7	48.3	36.6	127.2	70.5	581.7
SCH8	60.4	98.3	26.4	19.6	50.8	48.2	51.6	46.5	49.2	120.3	134.6	202.8	791.7

Table E6: continued.

Fishstock	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	All
SKI1	223.5	120.3	185.8	176.3	146.7	162.7	188.6	26.9	144.1	155.8	107.6	34.4	822.5
SKI2	29.7	133.2	114.8	203.4	51.2	112.4	169.3	119.1	171.8	158.3	194.2	93.9	1 120.5
SNA1	2 292.2	2 433.8	2 222.4	2 239.7	2 338.4	2 271.4	2 069.2	2 036.1	1 852.1	1 852.1	2 602.7	2 551.8	11 051.5
SNA2	264.3	356.5	274.5	203.5	196.5	169.4	354.3	397.5	528.2	421.4	324.1	165.6	2 394.5
SNA7	341.9	320.8	443.8	452.9	260.7	238.1	269.8	277.6	186.1	199.4	260.3	220.7	2 046.6
SNA8	1 132.5	984.1	701.8	461.2	573.1	479.0	539.3	547.9	382.6	333.2	337.1	401.8	4 858.0
SPD3	163.6	215.4	231.4	97.9	72.6	11.0	13.0	25.3	–	–	–	–	800.0
SPO3	19.1	87.6	157.6	124.1	212.6	165.9	252.6	224.1	190.3	188.4	385.1	198.6	1 825.0
SPO7	2.6	3.5	5.9	40.9	59.1	22.2	2.2	15.5	23.3	8.2	11.0	11.1	201.5
SPO8	5.7	1.9	6.2	7.5	2.1	–	8.5	23.7	31.1	34.6	61.8	39.3	213.3
STA3	53.4	150.7	253.4	367.0	157.1	221.9	166.1	255.6	327.6	304.6	315.7	385.7	2 354.4
STA4	34.2	–	72.1	69.7	–	–	7.5	–	–	–	–	–	182.6
STA5	874.6	859.0	1 144.1	1 108.9	1 185.8	1 101.6	1 193.4	1 092.4	1 113.3	689.1	1 083.7	668.4	4 559.4
STA7	678.3	652.1	824.2	769.5	583.7	615.7	582.4	633.0	874.2	889.2	695.4	789.8	5 775.6
TAR1	3 810.3	4 022.9	3 394.5	3 337.4	3 340.7	2 624.7	3 376.3	3 610.4	3 710.7	4 418.6	3 764.8	2 840.9	19 022.1
TAR2	5 446.1	5 537.1	5 212.0	4 889.6	4 089.2	4 237.0	4 678.6	4 548.0	4 003.3	4 063.3	4 096.9	3 305.3	15 414.6
TAR3	1 557.6	2 029.9	2 271.5	2 215.8	1 546.7	1 763.1	2 362.6	2 493.4	1 817.4	2 360.8	2 211.6	1 733.7	12 391.1
TAR4	713.9	353.6	743.0	328.9	17.8	–	762.7	522.8	93.2	287.8	60.1	566.5	2 216.8
TAR5	21.9	16.3	86.1	154.8	124.2	140.3	79.3	93.7	119.2	90.3	60.9	47.4	817.3
TAR7	3 303.8	3 856.4	3 853.3	4 129.1	4 358.3	4 461.7	4 455.9	3 512.8	3 979.5	3 939.3	3 351.3	3 360.5	23 114.3
TAR8	464.8	759.9	817.5	769.8	867.5	781.5	816.3	706.4	706.3	543.3	597.8	514.6	5 006.2
TRE1	1 115.0	1 085.2	1 188.4	1 508.1	945.1	864.5	1 028.0	815.0	1 090.0	1 516.2	1 328.5	1 402.6	6 908.8
TRE2	61.6	104.2	78.9	21.6	7.1	65.3	60.7	68.1	108.6	53.6	12.4	27.5	642.6
TRE7	3 027.3	3 313.1	2 578.2	2 656.7	2 579.6	2756.1	2 397.0	2 273.6	2 544.1	2 369.9	2 220.0	1 937.3	11 289.1
WAR2	283.0	211.2	195.6	123.2	138.5	121.5	126.2	96.3	152.0	192.1	164.5	95.5	1 260.1
WAR3	503.3	434.2	594.9	659.1	897.8	627.6	609.1	655.6	633.9	607.8	415.9	596.4	3 807.7
WAR7	827.5	879.7	763.6	960.1	764.3	884.7	840.3	1 090.5	943.9	714.4	890.4	329.5	6 211.9
WAR8	9.2	–	2.4	12.3	38.8	9.4	49.4	17.1	72.4	31.1	33.9	25.4	279.9
Total	43 638.7	45 714.8	46 787.4	44 815.4	43 334.4	43 076.5	45 261.4	42 426.8	41 315.7	42 650.3	42 117.1	37 929.5	146 223.8

Table E7: The aggregate area (km^2) estimated for inshore fishstocks in FMAs 1–3 and 4–8/9, for fishing years 2008–2019.

Fishing	FMA1	FMA2	FMA3	FMA5	FMA7	FMA8/9	Total
2008	9 582.7	14 635.8	12 172.6	3 584.8	18 428.9	10 584.1	68 989.0
2009	10 041.5	15 236.7	14 133.9	3 356.3	19 521.9	10 813.3	73 103.4
2010	10 054.6	16 074.8	16 702.1	3 762.9	20 762.3	8 391.6	75 748.3
2011	9 518.1	14 590.4	15 597.5	3 562.9	18 095.6	7 879.0	69 243.4
2012	8 254.6	12 327.1	14 471.5	4 565.7	18 715.7	9 616.0	67 950.5
2013	7 201.1	11 986.4	15 986.5	4 636.1	18 528.7	9 395.3	67 734.0
2014	7 904.7	13 771.9	17 023.7	4 633.4	17 503.9	8 963.8	69 801.5
2015	7 425.0	12 572.9	14 266.3	4 121.7	16 599.9	9 092.3	64 078.1
2016	8 017.1	11 645.8	13 474.7	4 362.2	17 259.3	8 468.5	63 227.5
2017	8 867.7	11 673.1	14 717.1	4 071.4	18 084.5	8 522.2	65 936.0
2018	8 553.7	11 114.3	15 137.5	3 784.6	15 969.8	8 362.5	62 922.3
2019	7 255.8	9 380.2	12 205.2	3 171.8	15 841.9	7 875.0	55 729.8
All	102 676.5	155 009.2	175 888.5	47 613.6	215 312.3	107 963.6	804 463.8

Table E8: The footprint (km^2) estimated for inshore fishstocks in FMAs 1–3 and 4–9, for fishing years 2008–2019.

Fishing	FMA1	FMA2	FMA3	FMA5	FMA7	FMA8/9	Total
2008	6 864.0	8 466.6	7 997.8	2 029.7	10 597.9	7 567.7	43 523.8
2009	6 965.8	8 556.8	9 061.2	2 009.9	11 498.3	7 907.5	45 999.5
2010	7 056.0	8 685.8	10 219.1	2 280.9	11 924.7	6 321.1	46 487.7
2011	6 760.8	8 422.2	9 835.7	2 317.8	11 438.0	6 079.4	44 854.0
2012	6 104.5	7 130.0	9 099.5	2 626.5	11 595.7	7 092.9	43 649.0
2013	5 234.9	7 210.5	9 638.6	2 667.1	11 937.5	6 866.6	43 555.1
2014	5 835.2	8 061.8	10 250.5	2 682.3	11 270.0	6 840.1	44 939.9
2015	5 640.0	7 551.9	9 243.9	2 700.7	10 512.5	6 685.6	42 334.7
2016	6 033.2	7 345.0	8 369.1	2 545.5	10 960.7	6 439.4	41 692.8
2017	6 744.9	7 510.8	9 131.5	2 276.1	11 004.0	6 386.8	43 054.2
2018	6 388.4	7 352.3	9 656.2	2 312.2	10 629.6	6 243.1	42 581.9
2019	5 320.8	6 129.3	8 037.8	1 934.5	10 404.7	5 782.7	37 609.9
All	22 423.5	20 172.2	30 642.0	8 446.8	37 746.3	28 152.4	145 884.7

Table E9: Summary data for the number of tows, the aggregate area, and the footprint for the main bottom-contacting inshore fishstocks per 25-km^2 cell, for 2008–2019. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year.

Main	No. of tows per cell (minimum=1)					Aggregate area (minimum < 0.003)					Footprint (minimum < 0.003)				
fishstock	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
FLA2	1	3	87.9	14	5 037	0.3	0.6	17.5	2.6	994.3	0.3	0.6	3.2	2.3	25.0
FLA3	1	5	176.0	59	4 601	0.4	1.0	35.8	10.8	1 245.2	0.4	1.0	5.5	7.4	25.0
FLA7	2	6	180.9	55	4 794	0.4	1.5	41.4	10.5	911.7	0.4	1.4	5.6	7.2	25.0
GUR1	1	4	38.1	29	1 802	0.4	0.9	9.4	6.4	460.5	0.4	0.9	4.2	5.2	25.0
GUR2	2	15	168.1	141	1 971	0.5	2.7	39.7	29.4	480.1	0.4	2.4	7.6	14.0	25.0
GUR3	1	6	27.7	33	313	0.4	1.3	6.5	7.1	69.6	0.4	1.3	4.1	5.9	22.3
GUR7	1	7	46.1	54	477	0.4	1.5	11.5	12.6	133.6	0.4	1.4	5.5	9.1	24.9
GUR8	2	6	34.9	36	483	0.4	1.5	9.1	8.6	166.7	0.4	1.5	4.8	6.7	24.7
JDO1	1	4	42.5	23	917	0.4	0.9	9.0	4.6	220.4	0.3	0.9	3.8	4.0	25.0
JDO2	1	3.5	16.0	16	308	0.3	0.8	3.8	3.4	91.6	0.3	0.8	2.6	3.1	23.3
JDO7	2	5	15.5	14	317	0.4	1.1	3.8	3.5	91.2	0.4	1.1	2.8	3.3	24.0
RCO3	2	12	45.7	42	1 854	0.5	2.7	11.1	9.8	524.2	0.5	2.4	5.1	7.9	25.0
RCO7	1	6	33.0	32	499	0.4	1.2	8.8	7.4	166.3	0.4	1.2	4.5	6.0	25.0
SNA1	2	16	97.0	113	1 303	0.5	3.2	22.6	27.8	352.9	0.5	2.8	7.5	14.7	25.0
SNA2	1	5	21.8	24	271	0.4	1.1	6.9	5.7	146.1	0.4	1.0	3.8	4.9	24.6
SNA7	1	6	33.2	23	765	0.4	1.2	7.2	5.1	191.6	0.4	1.1	3.6	4.4	24.9
SNA8	1	5	17.9	19	201	0.4	1.4	6.2	5.9	67.5	0.4	1.3	4.0	5.2	23.1
TAR1	2	10	61.6	56	970	0.5	2.5	17.3	15.2	286.3	0.5	2.3	6.3	10.4	25.0
TAR2	4	21	181.0	187	2 900	0.7	4.3	47.3	45.8	846.2	0.7	3.8	8.8	18.5	25.0
TAR3	2	11	63.2	66	831	0.5	2.4	15.3	15.8	265.0	0.5	2.3	6.5	11.3	25.0
TAR4	1	3	36.2	30	473	0.4	0.9	16.0	11.3	255.0	0.4	0.9	5.2	7.8	25.0
TAR7	2	13	61.1	73	1 408	0.6	3.2	17.2	19.9	422.3	0.5	3.0	7.1	13.2	25.0
TAR8	1	4	26.0	17	466	0.4	1.1	7.3	4.4	146.2	0.4	1.1	3.7	3.9	24.8
TRE1	2	10	54.0	48	1 096	0.4	2.0	13.4	10.8	345.3	0.4	1.7	5.5	8.0	25.0
TRE7	2	6	55.9	37	832	0.4	1.6	19.9	9.9	378.2	0.4	1.5	5.6	7.4	25.0

Table E10: Summary data for the number of tows, the aggregate area, and the footprint for the main bottom-contacting inshore fishstocks per 25-km^2 cell, for 2019. Data show the value at the first quartile and third quartile, and the median, mean, and maximum per cell per year.

Main	No. of tows per cell (minium=1)					Aggregate area (minimum < 0.003)					Footprint (minimum < 0.003)				
fishstock	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.	1st Qu.	Median	Mean	3rd Qu.	Max.
FLA2	1	2	16.5	8.25	306	0.2	0.4	3.2	1.4	67.6	0.2	0.4	1.7	1.2	19.3
FLA3	1	5	28.3	23	425	0.3	0.9	5.7	4.5	103.3	0.3	0.9	3.2	3.8	24.1
FLA7	1	4	22.1	25	224	0.4	0.9	5.2	4.9	72.6	0.3	0.8	3.3	4.3	23.4
GUR1	1	3	9.3	7	195	0.3	0.8	2.6	2.0	48.0	0.3	0.8	2.0	1.9	20.6
GUR2	2	7	21.1	32	186	0.4	1.5	4.9	7.0	46.9	0.4	1.4	3.6	5.7	20.7
GUR3	1	3	7.4	10	89	0.3	0.7	1.7	2.1	24.5	0.3	0.7	1.5	1.9	14.8
GUR7	1	5	12.1	16	100	0.4	1.1	3.2	4.1	32.9	0.4	1.1	2.6	3.7	18.0
GUR8	1	3	7.6	8	74	0.3	0.6	1.9	1.8	21.7	0.3	0.6	1.6	1.7	14.0
JDO1	1	2	6.1	7	51	0.2	0.5	1.4	1.3	12.2	0.2	0.5	1.2	1.3	9.6
JDO2	1	1	3.0	3	24	0.2	0.4	0.7	0.8	7.6	0.2	0.4	0.6	0.7	6.2
JDO7	1	2	4.2	5	30	0.3	0.6	1.1	1.3	8.9	0.3	0.6	1.0	1.3	6.6
RCO3	1	2	6.4	5	155	0.2	0.5	1.4	1.0	43.9	0.2	0.5	1.1	1.0	16.7
RCO7	1	3	5.9	7	73	0.3	0.8	1.6	2.0	22.0	0.3	0.8	1.4	1.9	14.3
SNA1	2	7	14.4	18	116	0.4	1.7	3.8	4.9	38.8	0.4	1.6	3.0	4.4	19.3
SNA2	1	1	4.6	3	44	0.2	0.4	1.9	1.0	30.1	0.2	0.4	1.2	0.8	13.6
SNA7	1	3	6.7	8	41	0.2	0.6	1.4	1.6	9.9	0.2	0.6	1.2	1.5	7.6
SNA8	1	2	3.2	3	28	0.2	0.5	1.1	1.1	11.1	0.2	0.5	1.0	1.1	7.5
TAR1	1	4	8.4	11	80	0.4	1.2	2.8	3.6	44.1	0.4	1.2	2.3	3.3	14.1
TAR2	2	7	18.9	32	158	0.4	1.4	4.9	7.3	46.4	0.4	1.3	3.5	6.0	20.8
TAR3	1	3	10.5	12	118	0.3	0.7	2.5	2.5	36.2	0.3	0.7	2.0	2.4	17.4
TAR4	1	3	9.4	10	77	0.3	0.8	3.7	3.3	40.3	0.3	0.8	2.4	2.9	17.4
TAR7	2	5	9.2	12	104	0.4	1.2	2.7	3.4	38.0	0.4	1.2	2.2	3.0	18.3
TAR8	1	3	6.8	8	75	0.3	0.7	2.0	2.0	41.9	0.3	0.7	1.4	1.8	14.3
TRE1	1	5	11.4	14	103	0.3	1.0	2.9	3.6	32.6	0.3	1.0	2.3	3.2	17.3
TRE7	1	3	9.2	12	71	0.4	1.1	3.5	4.4	28.6	0.4	1.1	2.8	3.8	17.5

Table E11: The number of 25-km^2 cells contacted by inshore fishstocks, by 50-m depth zone, for fishing years 2008–2019.

Fishing	50-m depth zone						
year	0–50	50–100	100–150	150–200	200–250	over 250	All
2008	2 301	2 198	1 734	752	326	2 148	9 459
2009	2 306	2 261	1 861	739	317	1 916	9 400
2010	2 322	2 257	1 855	769	334	1 942	9 479
2011	2 330	2 238	1 853	762	349	2 050	9 582
2012	2 351	2 250	1 863	725	319	1 791	9 299
2013	2 300	2 255	1 867	728	301	1 738	9 189
2014	2 307	2 300	1 934	784	332	1 921	9 578
2015	2 293	2 248	2 023	745	331	1 848	9 488
2016	2 265	2 243	1 941	748	299	1 870	9 366
2017	2 245	2 249	1 950	760	330	1 942	9 476
2018	2 255	2 198	1 888	739	298	1 871	9 249
2019	2 159	2 207	1 804	736	332	1 448	8 686
All	2 564	2 545	2 613	933	483	6 061	15 199

Table E12: The aggregate area (km^2) estimated for inshore fishstocks, by 50-m depth zone, for fishing years 2008–2019.

Fishing	50-m depth zone						
year	0–50	50–100	100–150	150–200	200–250	over 250	All
2008	29 634.0	20 402.8	11 155.9	4 633.2	1 525.0	3 006.5	70 357.5
2009	30 791.3	22 541.3	10 765.3	4 585.6	1 789.1	3 150.5	73 623.1
2010	34 306.4	22 700.7	10 773.0	4 360.0	1 540.6	3 158.5	76 839.1
2011	28 500.2	21 253.8	11 438.8	4 048.9	1 569.0	3 090.6	69 901.3
2012	29 682.0	20 536.2	10 019.4	3 710.7	1 250.6	2 776.5	67 975.4
2013	29 016.3	22 394.3	9 457.3	3 258.2	1 025.8	2 584.0	67 735.9
2014	29 195.9	21 561.2	11 811.9	4 107.9	1 432.1	2 944.1	71 053.1
2015	24 197.1	21 803.1	11 003.5	3 709.8	1 294.8	2 794.9	64 803.2
2016	25 291.8	20 229.5	9 679.2	3 618.0	1 406.9	3 109.2	63 334.7
2017	25 717.9	20 606.9	11 470.5	3 873.7	1 494.9	3 210.9	66 374.8
2018	22 713.0	20 385.4	11 478.3	3 856.1	1 393.2	3 159.5	62 985.5
2019	21 071.3	19 638.8	9 893.0	3 063.4	1 097.8	1 847.1	56 611.4
All	330 117.3	254 054.0	128 946.1	46 825.4	16 819.8	34 832.3	811 595.0

Table E13: The footprint (km^2) estimated for inshore fishstocks, by 50-m depth zone, for fishing years 2008–2019.

Fishing	50-m depth zone						
year	0–50	50–100	100–150	150–200	200–250	over 250	All
2008	15 678.8	13 508.4	7 883.2	3 525.7	1 185.7	2 455.5	44 237.2
2009	16 554.2	14 787.8	7 791.7	3 418.0	1 316.5	2 453.6	46 321.7
2010	17 504.3	14 939.8	7 832.4	3 296.5	1 158.1	2 488.1	47 219.3
2011	15 815.4	14 496.7	8 094.4	3 100.9	1 194.2	2 451.1	45 152.7
2012	16 206.7	14 019.8	7 394.2	2 870.4	945.9	2 135.8	43 572.7
2013	16 048.6	14 835.8	7 053.0	2 590.2	826.0	2 111.8	43 465.4
2014	15 811.8	14 425.8	8 708.6	3 206.8	1 110.6	2 344.6	45 608.2
2015	14 131.7	14 163.7	8 168.8	2 988.1	1 041.8	2 271.6	42 765.7
2016	14 100.6	13 617.5	7 528.0	2 886.3	1 098.3	2 487.8	41 718.4
2017	13 765.4	14 025.7	8 614.9	3 074.7	1 168.4	2 617.6	43 266.8
2018	13 295.5	14 108.3	8 428.2	3 041.0	1 123.9	2 588.4	42 585.4
2019	12 685.3	13 369.4	7 274.9	2 408.4	854.8	1 538.7	38 131.5
All	37 422.2	43 789.0	32 659.7	13 593.6	5 129.2	15 682.5	148 276.2

Table E14: The number of cells contacted by the inshore fishstocks during 2008–2019 and 2019, by the BOMEC classes.

Fishing		BOMEC class														
year	Out	A	B	C	D	E	G	H	I	J	K	L	M	N	O	All
2008	39	1 076	545	2 674	1 077	926	242	1 448	127	940	7	10	91	246	11	9 459
2009	40	1 076	540	2 880	1 079	910	234	1 370	105	821	1	18	96	221	9	9 400
2010	54	1 078	544	2 828	1 076	960	247	1 466	118	766			81	252	9	9 479
2011	45	1 071	550	2 882	1 097	875	250	1 478	127	836	1		86	272	12	9 582
2012	43	1 088	543	2 889	1 103	893	251	1 307	83	787	1	2	70	235	4	9 299
2013	44	1 058	550	2 904	1 085	889	254	1 305	98	708		1	55	226	12	9 189
2014	41	1 052	542	2 997	1 103	917	249	1 465	103	817	7		46	233	6	9 578
2015	42	1 025	546	2 923	1 109	998	250	1 463	125	770	10	2	65	154	6	9 488
2016	41	1 022	539	2 947	1 087	908	232	1 354	121	804	12	6	95	187	11	9 366
2017	40	1 031	538	2 960	1 064	917	232	1 461	111	831	11		53	219	8	9 476
2018	39	1 003	547	2 911	1 095	830	245	1 436	105	784	13		51	186	4	9 249
2019	34	953	538	2 782	1 067	906	226	1 359	89	521	1	5	45	156	4	8 686
All	75	1 176	554	3 495	1 181	1 396	262	2 362	321	2 788	19	40	280	1 188	62	15 199

Table E15: The estimated aggregate area (km^2) for the inshore fishstocks during 2008–2019 and 2019, by the BOMEC classes. For 2008–2019, 'Out' had a total of 104.5 km^2; class K had 25.1 km^2; class L had 17.9 km^2; and class O had 10.6 km^2.

Fishing	BOMEC class											
year	A	B	C	D	E	G	H	I	J	M	N	All
2008	12 951.0	8 801.0	23 371.4	12 272.7	4 366.9	1 516.7	6 173.8	110.7	655.5	29.0	94.9	70 357.5
2009	13 006.1	8 325.4	25 346.7	13 683.5	4 541.1	1 719.6	6 063.5	182.1	611.2	42.3	85.4	73 623.1
2010	14 188.6	10 079.6	22 635.4	15 600.4	5 936.2	1 791.0	5 715.6	190.1	554.0	32.4	104.3	76 839.1
2011	12 409.4	7 946.1	21 314.1	13 842.7	5 897.7	2 136.9	5 539.5	104.4	569.5	35.8	95.6	69 901.3
2012	12 788.5	9 261.8	19 351.5	14 211.2	5 077.8	1 935.8	4 583.6	88.0	553.7	23.4	88.1	67 975.4
2013	11 552.5	9 060.0	19 501.8	15 462.9	5 348.9	1 805.3	4 208.8	109.8	568.8	16.2	86.4	67 735.9
2014	11 808.9	9 178.4	19 249.8	15 603.4	6 922.9	1 952.6	5 474.2	89.7	655.2	13.2	91.9	71 053.1
2015	10 067.6	8 717.6	19 636.9	12 931.1	5 886.8	1 641.3	5 178.9	82.0	572.1	20.7	53.9	64 803.2
2016	10 386.1	8 697.4	18 499.9	13 164.9	4 899.6	1 537.8	5 306.7	125.0	581.6	49.2	68.6	63 334.7
2017	9 516.2	9 575.3	20 053.3	13 059.4	6 040.9	1 403.2	5 811.1	115.9	687.1	19.8	78.5	66 374.8
2018	8 694.6	7 700.4	19 944.7	12 308.9	6 087.2	1 307.8	6 080.6	81.6	672.9	19.9	74.9	62 985.5
2019	8 145.6	8 694.1	18 326.5	11 463.7	4 312.8	1 135.8	4 082.3	51.2	327.6	14.3	48.5	56 611.4
All	135 515.2	106 037.0	247 232.0	163 604.8	65 318.6	19 883.8	64 218.6	1 330.5	7 009.1	3 16.3	9 71.0	811 595.0

Table E16: The estimated footprint (km^2) for the inshore fishstocks during 2008–2019 and 2019, by the BOMEC classes. For 2008–2019, 'Out' contacted 35.4 km^2; class K had 23.5 km^2; class L had 17.8 km^2; and class O had 10.3 km^2.

Fishing	BOMEC class											
year	A	B	C	D	E	G	H	I	J	M	N	All
2008	7 358.6	4 298.8	15 853.7	6 932.1	3 128.4	1 034.7	4 779.0	96.0	621.1	28.8	92.5	44 237.2
2009	7 459.5	4 534.9	16 596.9	7 691.1	3 415.2	1 157.0	4 645.9	124.6	558.2	40.4	83.3	46 321.7
2010	7 799.2	5 143.5	15 242.2	8 373.8	4 225.5	1 258.1	4 378.9	134.0	522.7	30.3	102.0	47 219.3
2011	7 142.8	4 637.4	14 940.7	7 713.6	4 282.2	1 407.4	4 264.7	92.2	535.1	35.4	93.0	45 152.7
2012	7 396.4	5 057.8	13 984.5	7 822.2	3 684.0	1 269.2	3 649.2	72.2	518.8	22.7	85.2	43 572.7
2013	6 887.4	5 170.4	13 985.4	8 220.8	3 813.7	1 246.4	3 413.5	86.3	529.5	15.9	84.3	43 465.4
2014	6 844.9	5 073.9	14 099.3	8 337.5	4 774.1	1 272.0	4 406.6	76.9	611.0	13.0	87.6	45 608.2
2015	6 121.4	4 787.7	13 966.1	7 533.7	4 322.9	1 152.8	4 186.4	77.6	531.5	20.6	52.3	42 765.7
2016	6 338.8	4 883.9	13 746.4	7 073.2	3 612.5	1 087.9	4 209.8	95.5	542.9	43.9	67.0	41 718.4
2017	5 905.0	4 972.6	14 717.6	6 960.0	4 217.0	995.4	4 674.7	86.3	630.4	19.0	76.1	43 266.8
2018	5 542.4	4 497.5	14 672.8	7 251.9	4 116.4	939.1	4 775.3	76.2	611.7	19.5	72.0	42 585.4
2019	5 215.9	5 129.6	13 214.0	6 855.7	3 191.1	787.9	3 310.2	49.1	307.6	14.3	47.7	38 131.5
All	16 233.8	11 184.2	52 087.3	20 498.2	15 634.4	4 288.2	21 452.2	718.8	4 935.4	289.2	867.4	148 276.2

Table E17: The estimated inshore footprint (km^2) for inshore fishstocks during 2008–2019 ad 2019 by the surficial layers representing the percent of carbonate, gravel mud, and sand. 'unk' is where there was no overlap.

	2008–2019 footprint (km^2)					2019 footprint (km^2)			
Sediment (%)	Carbonate	Gravel	Mud	Sand	Sediment (%)	Carbonate	Gravel	Mud	Sand
0–20	42 924.1	119765.5	48 364.1	13 402.3	0–20	12 770.9	31 419.5	11 892.0	3 228.4
20–40	66 981.8	20353.4	36 127.5	32 387.1	20–40	16 665.7	4 925.2	8 583.5	9 238.5
40–60	28 857.0	4958.6	28 748.4	41 029.6	40–60	7 158.2	1 163.2	8 209.3	10 808.4
60–80	6 476.0	724.7	23 414.5	40 562.7	60–80	960.4	142.4	6 981.3	9 851.7
80–100	638.4	76.2	9 225.7	18 495.0	80–100	102.7	7.8	1 992.1	4 531.0
unk	2 399.0	2397.8	2 396.0	2 399.6	unk	473.5	473.3	473.3	473.5
Total	148 276.2	148 276.2	148 276.2	148 276.2	Grand Total	38 131.5	38 131.5	38 131.5	38 131.5

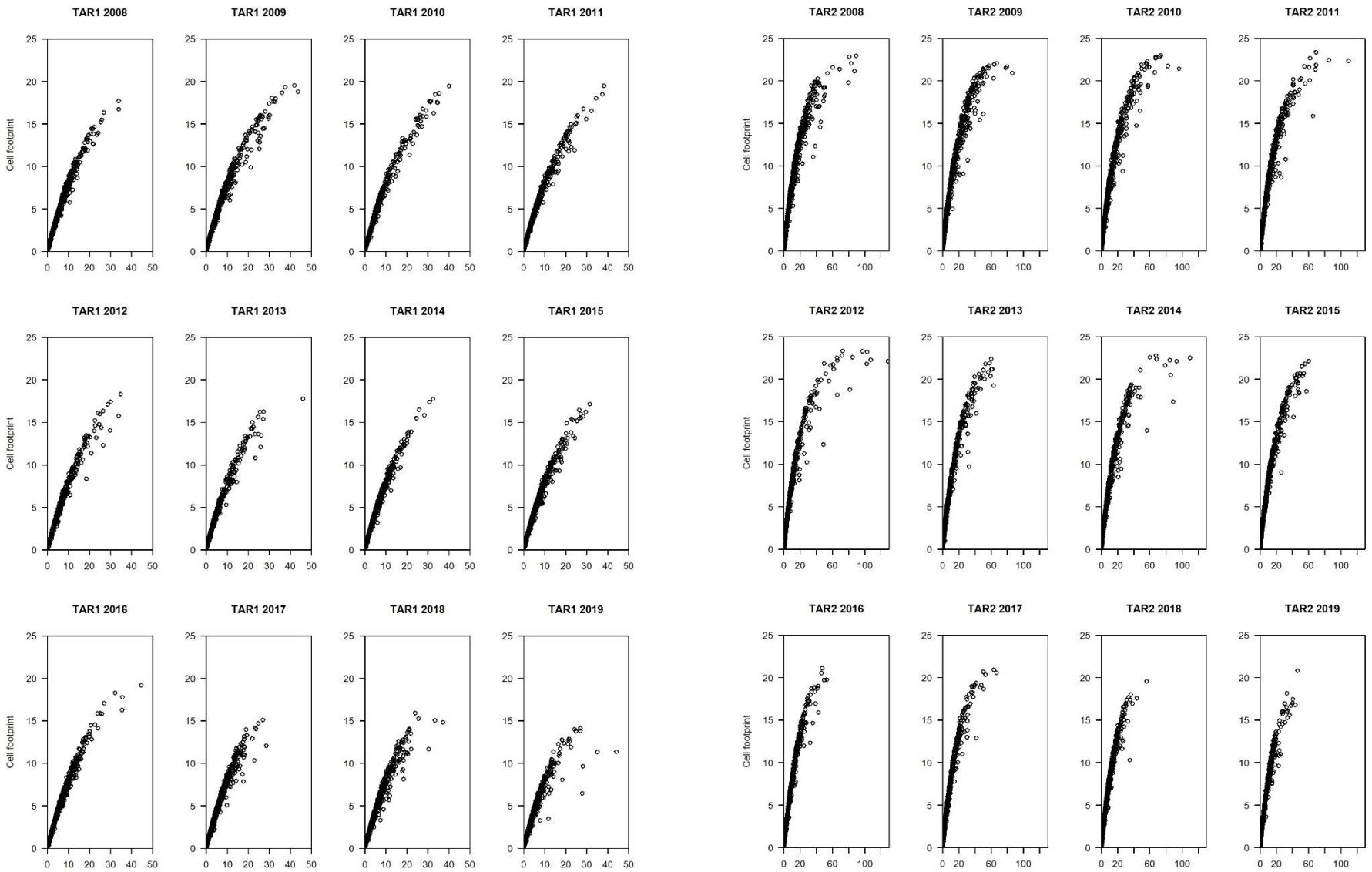
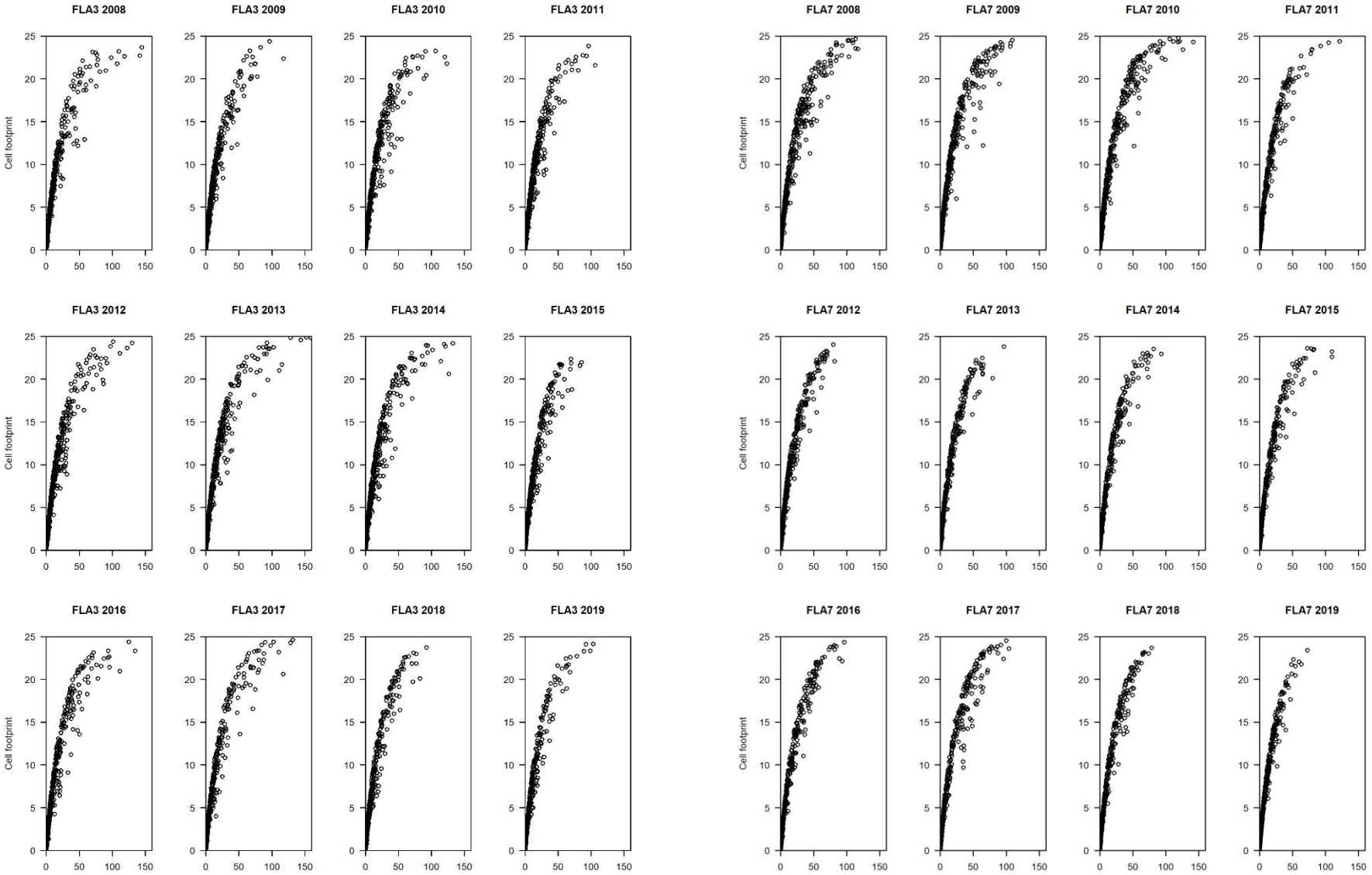


Figure E1: Relationship between the aggregate area and footprint of cells each fishing year for tarakihi fishstocks, 2008–2019.


FLA3 2008
FLA3 2009
FLA3 2010
FLA3 2011
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FLA3 2019
FLA7 2016
FLA7 2017
FLA7 2018
FLA7 2019
Cell footprint
0
5
10
15
20
25
0
50
100
150

APPENDIX F: ERS DATA

Table F1: Comparison of the groomed ERS data (unchanged resolution of position data) and the rounded-coordinate ERS data: 2018 and 2019 number of contacted cells, aggregate area (km^2), and footprint (km^2) for deepwater Tier 1 and deepwater Tier 2 targets.

	Unchanged ERS data			Rounded-coordinate ERS data		
Tier 1	No. cells	Aggregate	Footprint	No. cells	Aggregate	Footprint
HAK	288	899.4	745.5	289	888.8	751.1
HOK	4 636	105 235.7	37 409.6	4 691	105 658.0	38 518.0
JMA	1 466	6 458.7	4 823.3	1 474	6 459.1	4 850.3
LIN	862	3 652.2	2 089.7	876	3 680.8	2 178.9
OEO	601	818.2	602.1	653	876.3	712.3
ORH	1 934	7 101.6	5 053.7	1 959	7 290.1	5 403.0
SBW	558	1 667.9	1 456.9	557	1 675.6	1 469.2
SCI	646	5 683.3	3 154.6	679	5 704.4	3 287.7
SQU	967	23 850.9	5 034.4	1011	23 973.9	5 520.6
Tier 1	10 317	155 368.0	58 457.1	10 518	156 207.0	60 634.4
Tier 2	No. cells	Aggregate	Footprint	No. cells	Aggregate	Footprint
BAR	807	3 928.6	2 093.0	825	3 925.9	2 157.7
BYX	418	587.3	391.8	411	615.2	453.8
CDL	111	138.4	98.4	112	144.7	117.2
EMA	34	24.7	24.4	34	24.9	24.4
FRO	61	79.0	72.3	60	78.9	73.8
LDO	23	15.9	15.2	25	16.2	16.0
RBT	43	22.0	21.9	41	22.3	22.2
RBY	66	49.0	43.9	65	50.4	46.7
SPE	51	112.5	78.2	51	112.9	85.5
SWA	1 028	2 569.3	1 945.2	1 051	2 576.6	2 042.5
WWA	212	280.8	229.1	219	281.5	241.5
t2	2 518	7 807.6	4 939.5	2 550	7 849.5	5 206.6

Table F2: Comparison of the groomed ERS data (unchanged resolution of position data) and the rounded-coordinate ERS data: 2019 number of contacted cells, aggregate area (km^2), and footprint (km^2) for the main inshore fishstock targets. (Continued on next page.)

	Unchanged ERS data			Rounded-coordinate ERS data		
Inshore	No. cells	Aggregate	Footprint	No. cells	Aggregate	Footprint
BAR1	834	2 126.5	1 394.0	845	2 118.0	1 430.5
ELE3	321	229.8	221.5	317	229.1	221.7
ELE5	87	44.5	43.6	79	45.2	44.5
ELE7	8	2.0	2.0	8	1.9	1.9
FLA2	30	22.3	19.8	31	23.1	20.4
FLA3	356	842.0	598.4	362	844.5	617.5
FLA7	544	1 248.9	1 033.5	549	1 250.6	1 058.7
GSH3	16	3.5	3.5	17	3.6	3.6
GSH7	55	26.9	25.4	54	25.7	25.0
GSH8	11	4.0	4.0	12	4.0	4.0
GUR1	305	691.3	578.9	312	689.4	581.8
GUR2	384	727.1	645.4	394	725.7	654.2
GUR3	249	344.1	301.3	254	345.3	307.8
GUR7	559	800.7	693.0	573	802.0	729.0
GUR8	216	245.0	222.5	214	243.4	221.9

Table F2: continued.

	Unchanged ERS data			Rounded-coordinate ERS data		
Inshore	No. cells	Aggregate	Footprint	No. cells	Aggregate	Footprint
JDO1	67	41.9	41.2	63	42.8	42.4
JDO2	91	58.8	53.7	92	59.1	55.0
JDO7	65	21.8	21.4	67	22.2	21.9
LEA3	17	9.7	9.7	16	9.6	9.6
MOK1	225	237.1	221.5	233	234.0	221.7
RCO3	277	317.6	243.6	285	316.7	252.4
RCO7	239	149.8	134.6	234	150.1	142.5
RSK3	58	16.6	16.4	60	17.1	16.9
SCH1	122	131.1	118.9	125	130.9	126.3
SCH3	7	1.5	1.5	7	1.4	1.4
SCH7	45	14.2	14.1	43	13.8	13.8
SCH8	98	87.2	81.0	97	86.8	83.7
SKI1	58	55.7	54.6	59	55.1	53.6
SKI2	12	12.7	6.5	13	13.1	11.5
SNA1	586	1 683.9	1 384.3	599	1 682.4	1 413.2
SNA2	89	390.0	187.6	92	385.6	213.9
SNA7	29	25.0	19.3	31	24.9	23.4
SNA8	249	414.8	381.2	249	414.3	380.4
SPO3	67	44.2	42.7	71	44.0	42.7
SPO8	28	25.0	20.7	31	25.0	22.3
STA3	141	78.5	74.2	140	78.8	76.5
STA5	164	414.0	301.5	171	412.4	314.6
STA7	178	148.5	140.4	187	147.9	139.1
TAR1	938	2 970.8	2 142.1	959	2 963.9	2 229.2
TAR2	566	2 052.4	1 486.7	585	2 040.7	1 563.3
TAR3	425	743.9	629.6	438	740.6	641.0
TAR4	147	594.8	351.4	149	594.4	391.8
TAR5	45	67.2	57.9	45	67.3	60.8
TAR7	764	1 586.4	1 182.8	771	1 578.3	1 317.1
TAR8	166	616.7	318.7	182	618.3	376.4
TRE1	432	595.1	540.7	438	595.5	549.5
TRE2	11	2.7	2.7	11	2.9	2.9
TRE7	553	3 647.0	2 535.4	561	3 625.5	2 560.5
WAR2	71	83.7	77.2	72	84.7	77.9
WAR3	146	374.1	319.2	149	373.9	328.9
WAR7	108	124.0	100.3	118	124.7	107.4
WAR8	21	8.9	8.2	22	9.0	8.9
All	5 776	25 205.6	17 619.4	5 873	25 138.6	18 368.6

APPENDIX G: SHELLFISH DREDGE FISHERIES

Most commercial dredging for shellfish in New Zealand targets scallops (*Pecten novaezelandiae*) and oysters (*Ostrea chilensis*).

Scallop dredge fisheries

Five main scallop dredge fisheries have operated in the New Zealand coastal waters during the 1990–2019 fishing years: the three northern fisheries in the Auckland and Kermadec Areas (Northland, West Coast, Coromandel) and two southern fisheries (Nelson-Marlborough (Challenger) and Chatham Islands) (Figure G1). Scallops inhabit substrates of shell, gravel, and silt in waters to about 60 m (85 m at Chatham Islands) and are most common at depths of 10–45 m (Cryer 2001). Dredges are designed to dig into the seafloor. The substrate generally dictates the type of dredge used. Fishers in the northern fisheries generally use the self-tipping "box" dredge which is more effective on the harder substrate encountered in the northern fisheries (Cryer 2001), whereas fishers in the southern fisheries use ring bag dredges. Commercial Fishing Regulations define the dredge design and operation of these fisheries, and management closures have occurred in some areas.

Tables of groomed numbers of tows (after Baird et al. 2011) are given in Tables G1–G5.

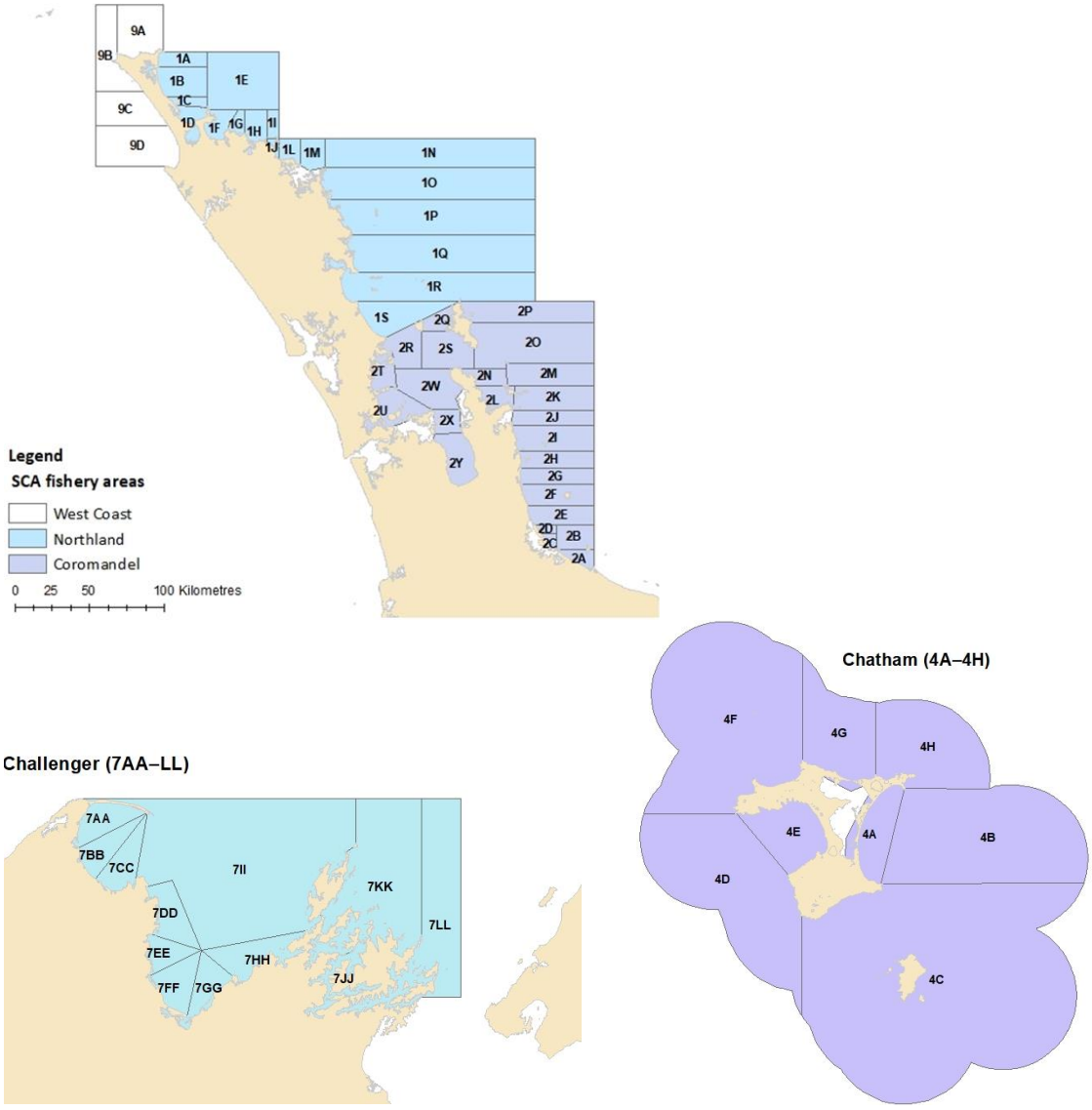

Figure G1: The five scallop fishery areas with effort during 1990–2019: the three northern areas (top) and the two southern areas (bottom).

Historically, most effort has been in the Challenger, Coromandel, and Northland fishery areas (Tables G1 & G2). However, these fisheries have been subject to multiple closures (see Fisheries New Zealand 2019, Hartill & Williams 2014 for Northland, and Williams et al. 2014 for Challenger). There has been no effort in the Challenger fishery which has been closed since 2017 in an attempt to re-build the stock (see https://www.mpi.govt.nz/fishing-aquaculture/sustainable-fisheries/the-southern-scallop-fishery-sca-7). Scallop dredging ceased in the CHAT fishery 2005 and after 2010 in the WCNI fishery.

During 1990–2019, the annual number of daily records has dropped from a peak of over 7000 in the mid-1990s to under 1000 since 2012, with less than 500 in 2019 (Table G1). The number of dredge tows has decreased from over 100 000 tows a year during most years between 1991 and 1996, about 49 000–82 000 tows during 1997–2003, about 23 000–53 500 tows during 2004–2010 (Table G2). Effort then dropped to under 20 000 tows until 2017, when the lowest number of tows per year were reported (6252), followed by a small increase to about 9000 tows in 2018 and 2019 (from the two fisheries still operating — Coromandel and Northland).

Table G1: Number of scallop records by area and year, 1990–2019. Data are from CELR forms which record daily effort in a fishery statistical area. See Figure G1 for areas. UNK is unknown location.

	Scallop fishery areas						
Fishing year	CHAL	CHAT	CORO	NOR	WCNI	UNK	Total
1990	901	113	760	1 593	0	1 328	4 695
1991	1 655	126	1636	2 173	0	749	6 339
1992	1 580	80	1761	2 883	0	1 198	7 502
1993	2 170	79	578	2 019	0	627	5 473
1994	4 182	1	761	2 700	2	128	7 774
1995	1 395	103	842	2 984	164	155	5 643
1996	3 245	134	822	1 350	1 041	677	7 269
1997	1 394	240	837	1 029	655	532	4 687
1998	1 222	150	693	759	630	598	4 052
1999	2 633	54	360	417	146	918	4 528
2000	1 916	36	158	273	168	531	3 082
2001	2 640	3	372	441	31	14	3 501
2002	3 240	12	365	407	286	10	4 320
2003	2 738	19	429	350	81	32	3 649
2004	1 675	0	597	447	112	28	2 859
2005	1 008	7	639	365	1	8	2 028
2006	1 401	0	640	417	0	27	2 485
2007	501	0	683	409	0	8	1 601
2008	345	0	544	349	42	9	1 289
2009	1 009	0	458	518	42	2	2 029
2010	461	0	398	233	1	5	1 098
2011	203	0	538	47	0	11	799
2012	385	0	525	45	0	8	963
2013	228	0	687	4	0	12	931
2014	260	0	614	11	0	17	902
2015	51	0	320	196	0	13	580
2016	109	0	350	174	0	6	639
2017	0	0	310	122	0	0	432
2018	0	0	392	197	0	3	592
2019	0	0	250	190	0	0	440
Total	38 547	1 157	18319	23 102	3 402	7 654	92 181
% by area	41.8	1.3	19.9	25.1	3.7	8.3	100.0

Table G2: Number of scallop tows by area and year, 1990–2019.

	Scallop fishery areas					
Fishing year	CHAL	CHAT	CORO	NOR	WCNI	Total
1990	11 996	1 093	18 100	35 319	0	66 508
1991	15 542	1 092	38 115	45 307	0	100 056
1992	22 334	695	44 626	62 218	0	129 873
1993	31 211	721	14 639	43 917	0	90 488
1994	68 080	16	17 716	51 937	23	137 772
1995	22 994	1 238	21 245	56 178	2 945	104 600
1996	59 141	1 422	19 833	25 679	12 921	118 996
1997	25 320	2 429	21 998	19 829	11 781	81 357
1998	23 085	1 197	18 098	15 630	12 298	70 308
1999	47 392	273	9 237	8 398	2 954	68 254
2000	35 394	179	4 470	5 757	3 276	49 076
2001	47 700	6	8 200	8 430	590	64 926
2002	60 723	43	9 552	7 666	3 998	81 982
2003	56 709	266	8 708	6 333	1 496	73 512
2004	32 019	0	11 200	8 271	2 076	53 566
2005	20 852	51	13 299	5 792	22	40 016
2006	30 843	0	14 486	6 240	0	51 569
2007	9 305	0	16 670	9 199	0	35 174
2008	6 292	0	14 941	7 290	824	29 347
2009	20 486	0	11 435	8 595	801	41 317
2010	9 374	0	9 667	4 300	2	23 343
2011	4 107	0	10 700	902	0	15 709
2012	7 507	0	7 449	847	0	15 803
2013	5 130	0	11 527	58	0	16 715
2014	4 837	0	14 280	178	0	19 295
2015	908	0	6 322	4 690	0	11 920
2016	1 657	0	6 140	3 187	0	10 984
2017	0	0	3 937	2 315	0	6 252
2018	0	0	5 988	3 028	0	9 016
2019	0	0	5 195	3 758	0	8 953
Total	680 938	10 721	417 773	461 248	56 007	1 626 687
% by area	41.9	0.7	25.7	28.4	3.4	100.0

For the years when the WCNI fishery was operating, 98% of the effort was in area 9A, off the northern-most coast of North Island (Table G3). At the Chatham Islands, 85% of the effort was in areas 4G and 4H, to the north and northeast of Chatham Island.

Dredging for scallops in the Northland fishery was mainly in area 1D (50% of tows during 1990–2019), though there was no effort reported during 2013–2018. Effort in area 1D in 2019 (at about 1000 tows) was less than 10% of annual effort in the 1990s (see Table G3 and Figure G1). The second most important fishery area was area 1R further south (34% of the 30-year effort). This area was fished mainly during the 1990s, at a much-reduced amount in 2005–2007 and from 2015.

In the Coromandel fishery, areas 2L (62% of all dredge tows), 2R (12%), and 2W (9%) accounted for most of the tows and effort was reported in all years for 2R, and every year but one year in 2L. Before the Challenger fishery was closed, the main areas were 7BB (24% tows) and 7CC (17%) in Golden Bay; 7EE (6%), 7FF (11%), and 7GG (5%) in Tasman Bay, and 7KK (16%) in Marlborough Sounds. Area 7KK was fished in most years after the early 1990s; effort in areas other than those listed above was very low after the 1990s, except for 7AA which was fished sporadically after 2007.

Table G3: Number of scallop tows by scallop fishery statistical areas (see Figure G1), by fishing year. Areas are shown in Figure G1.

West Coast North Island (WCNI)

Fishing year	9A	9B	9C	9D	Total
1994	23	0	0	0	23
1995	2 945	0	0	0	2 945
1996	11 897	0	0	1 024	12 921
1997	11 779	2	0	0	11 781
1998	12 223	0	75	0	12 298
1999	2 954	0	0	0	2 954
2000	3 276	0	0	0	3 276
2001	590	0	0	0	590
2002	3 961	19	18	0	3 998
2003	1 484	0	0	12	1 496
2004	2 076	0	0	0	2 076
2005	22	0	0	0	22
2008	824	0	0	0	824
2009	801	0	0	0	801
2010	2	0	0	0	2
Total	54 857	21	93	1 036	56 007

Chatham Islands (CHAT)

Fishing year	4A	4B	4C	4E	4F	4G	4H	Total
1990	501	337	0	0	0	22	233	1093
1991	183	20	12	0	6	379	492	1092
1992	0	0	0	0	0	385	310	695
1993	13	0	0	0	0	708	0	721
1994	0	0	0	16	0	0	0	16
1995	64	12	0	0	0	671	491	1238
1996	15	0	0	0	3	934	470	1422
1997	54	0	183	0	0	2190	2	2429
1998	130	68	125	0	0	808	66	1197
1999	12	0	0	0	0	142	119	273
2000	0	0	0	0	0	179	0	179
2001	0	0	0	0	0	6	0	6
2002	0	0	0	0	0	43	0	43
2003	0	0	0	0	0	220	46	266
2005	0	0	0	0	0	0	51	51
Total	972	437	320	16	9	6687	2280	10721

Table G3: *continued.* Northland. Areas are shown in Figure G1.

Fishing year	1A	1B	1C	1D	1E	1F	1G	1H	1I	1J	1K	1L	1O	1P	1Q	1R	1S	Total
1990	1 623	206	1 735	15 084	0	344	0	504	0	349	0	0	0	0	156	14 312	1 006	35 319
1991	1 204	1011	76	8 212	56	426	0	581	0	431	0	0	0	0	0	30 611	2 699	45 307
1992	1 418	25	0	15 904	0	1 025	0	1 087	0	1 231	0	27	0	0	0	38 029	3 472	62 218
1993	0	84	0	24 323	95	2 970	30	7 327	0	1 025	0	540	0	0	0	7 431	92	43 917
1994	352	53	0	34 676	0	2 435	20	6 754	0	1 731	69	297	10	30	0	5 510	0	51 937
1995	282	4446	593	26 921	0	658	12	3 589	438	1 530	0	62	0	0	0	17 629	18	56 178
1996	226	2379	407	13 724	0	873	0	2 187	383	974	0	0	0	0	0	4 256	270	25 679
1997	413	1283	96	14 074	0	228	0	352	0	360	0	0	0	0	0	2 942	81	19 829
1998	155	0	0	14 080	0	0	0	295	0	153	0	0	0	0	0	947	0	15 630
1999	46	10	0	8 342	0	0	0	0	0	0	0	0	0	0	0	0	0	8 398
2000	98	0	0	5 546	0	0	0	0	0	0	0	0	0	0	0	113	0	5 757
2001	0	0	0	7 657	0	186	0	0	0	0	0	0	0	0	0	563	24	8 430
2002	8	0	0	6 469	0	0	0	0	0	0	0	0	0	428	0	706	55	7 666
2003	44	0	0	4 887	700	0	0	0	0	0	0	0	0	111	0	493	98	6 333
2004	0	0	0	7 954	84	0	0	3	0	0	0	0	0	42	0	185	3	8 271
2005	0	0	0	590	0	0	0	0	0	0	0	0	0	0	3	5 199	0	5 792
2006	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	6 217	19	6 240
2007	21	0	0	1 888	0	0	0	0	146	0	31	0	0	0	256	6 856	1	9 199
2008	0	0	0	7 060	0	0	0	0	15	0	0	0	0	0	63	152	0	7 290
2009	21	0	0	8 566	0	0	0	0	8	0	0	0	0	0	0	0	0	8 595
2010	0	0	0	4 275	0	0	0	0	0	0	0	0	0	0	0	25	0	4 300
2011	0	0	0	853	0	0	0	0	0	0	0	0	0	0	0	6	43	902
2012	0	0	0	817	0	0	0	0	0	0	0	0	0	0	0	30	0	847
2013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	0	58
2014	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	162	0	178
2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4 690	0	4 690
2016	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	3 169	0	3 187
2017	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	1 231	1 056	2 315
2018	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 920	1 108	3 028
2019	0	0	0	1 122	0	0	0	0	0	0	0	0	0	0	0	2 636	0	3 758
All	5 911	9 515	2 907	233 028	935	9 161	90	22 679	990	7 784	100	926	10	611	478	156 078	10 045	461 248

Table G3: *continued.* Coromandel fishery. Annual totals are provided in Table G2. Areas 2J, 2M, 2P, 2Q, 2T, 2U, and 2Y had less than 75 tows during 1990–2019 and are not shown here (total of 232 tows). Areas are shown in Figure G1.

Year	2A	2B	2C	2D	2E	2F	2G	2H	2I	2K	2L	2N	2R	2S	2W	2X
1990	0	0	0	0	0	0	0	0	0	0	12 771	0	1 399	57	786	3 087
1991	30	0	21	0	0	0	0	0	0	0	27 481	30	3 224	54	2 554	4 721
1992	103	0	0	0	668	35	0	70	0	232	23 361	228	4 190	0	3 172	12 567
1993	793	144	0	0	1 574	204	0	999	24	44	8 266	18	2 290	90	190	1
1994	2 363	0	111	580	1 911	417	0	1 098	227	68	10 171	369	152	125	124	0
1995	3 628	0	0	0	1 035	90	0	522	35	417	10 434	0	4 142	151	743	0
1996	406	0	56	0	0	0	80	593	138	0	12 314	0	3 653	815	1778	0
1997	31	0	481	0	0	0	0	76	151	0	16 770	0	3 563	48	696	142
1998	0	0	290	0	0	0	0	132	0	0	16 545	0	933	0	160	0
1999	242	0	90	0	0	0	0	0	0	0	7 376	0	910	35	95	477
2000	2 185	0	219	0	0	0	105	0	0	0	1 657	0	304	0	0	0
2001	2 359	0	0	0	0	0	0	0	0	0	3 806	0	1 995	0	0	40
2002	3 216	0	387	0	161	51	0	0	0	0	4 566	0	1 124	27	0	20
2003	44	0	0	0	2 128	512	0	0	0	0	3 858	0	337	2	1 330	497
2004	591	0	0	671	3 215	380	53	0	0	0	5 671	0	619	0	0	0
2005	517	0	0	1 161	2 507	40	601	163	0	0	7 122	0	566	0	468	101
2006	0	0	0	0	0	0	0	0	0	17	12 309	0	1 423	0	726	0
2007	0	0	28	0	0	0	0	0	0	0	15 507	0	673	0	451	0
2008	38	0	224	0	6	0	0	7	0	1 020	11 451	0	879	36	1 234	46
2009	0	0	673	0	0	24	0	0	0	0	8 829	0	1 767	25	117	0
2010	0	0	0	0	0	0	0	0	0	313	7 853	0	1 088	0	413	0
2011	32	0	0	0	0	0	0	0	0	131	6 609	0	2 757	58	1 097	16
2012	0	0	0	0	0	0	0	0	0	0	0	0	14	14	7 400	0
2013	0	8	0	0	0	0	0	0	0	25	3 623	0	1 441	118	6 312	0
2014	0	0	152	0	0	0	0	0	0	0	5 651	0	874	111	7 492	0
2015	0	0	0	0	0	0	0	0	0	0	3 124	0	1 867	0	244	1 087
2016	0	0	0	0	0	0	0	0	0	0	4 704	0	1 157	0	279	0
2017	0	0	0	0	0	0	0	0	0	0	1 361	0	2 576	0	0	0
2018	0	0	0	0	0	0	0	0	0	0	3 927	0	1 174	0	887	0
2019	0	0	0	0	0	0	0	0	0	0	3 770	0	1 425	0	0	0
Total	16 578	152	2 732	2 412	13 205	1 753	839	3 660	575	2 267	260 887	645	48 516	1 766	38 748	22 802

Table G3: *continued.* Challenger fishery. Note: areas were reported as, for example, 7A and 7AA up to about 2000, with 7AA notation starting from about 1993. The data are combined for each letter in the table below.

Year	7AA	7BB	7CC	7DD	7EE	7FF	7GG	7HH	7II	7JJ	7KK	7LL	7MM	All
1990	7 221	2 177	0	201	0	0	1 237	350	225	345	0	0	240	11 996
1991	3 123	8 196	3 502	107	0	51	354	209	0	0	0	0	0	15 542
1992	54	13 400	4 057	0	0	0	325	12	870	3 602	14	0	0	22 334
1993	3 068	4 859	0	152	13	16 904	1 981	958	209	2 537	530	0	0	31 211
1994	11 649	27	12 161	20	15 011	17 425	0	93	0	3 161	7 961	572	0	68 080
1995	204	1 718	15 566	0	2 099	84	1 058	604	15	728	802	116	0	22 994
1996	8 796	5 272	10 916	1 677	3 166	7 839	5 368	434	0	6 758	8 335	580	0	59 141
1997	1 589	1 282	12 643	2 047	0	2 240	40	0	0	1 850	3 045	584	0	25 320
1998	4 361	8 939	3 310	58	1 695	0	0	18	10	860	3 470	364	0	23 085
1999	4 115	8 913	3 573	280	2 260	1 151	7 201	3 297	5 493	1 395	9 297	398	19	47 392
2000	0	3 395	19 389	3 055	6 028	1 098	274	96	38	40	354	1 627	0	35 394
2001	4 299	23 637	10 961	1 080	4 127	17	111	593	722	44	1 737	372	0	47 700
2002	5 478	41 342	4 554	916	79	1 023	3 187	0	719	0	3 372	53	0	60 723
2003	11 801	19 321	6 272	69	145	2 511	7 088	47	864	108	7 646	837	0	56 709
2004	3 977	42	9	151	4	15 735	2 820	23	310	88	7 969	890	1	32 019
2005	704	3 038	5	70	3 679	5 366	1 307	0	6	420	6 257	0	0	20 852
2006	2 847	4 777	20	1	109	1 315	277	0	0	616	18 964	1 917	0	30 843
2007	1 672	1 212	5 526	0	0	0	0	0	12	186	621	76	0	9 305
2008	0	0	5 243	0	0	6	0	0	0	0	0	1 043	0	6 292
2009	88	11 042	186	0	0	20	37	0	4	0	9 042	30	37	20 486
2010	297	1 505	421	32	0	0	0	0	0	0	6 076	1 043	0	9 374
2011	0	1 018	26	0	0	0	0	0	70	0	2 417	576	0	4 107
2012	0	96	50	0	0	0	0	0	0	0	4 508	2 853	0	7 507
2013	97	0	0	0	0	0	0	0	0	0	4 084	949	0	5 130
2014	0	0	0	0	0	0	0	0	0	0	3 917	920	0	4 837
2015	0	0	0	0	0	0	0	217	30	0	455	206	0	908
2016	0	0	0	0	14	0	0	32	0	0	1 095	516	0	1 657
All	75 440	165 208	118 390	9 916	38 429	72 785	32 665	6 983	9 597	22 738	111 968	16 522	297	680 938

Oyster dredge fisheries

The main dredge oyster fisheries are in Foveaux Strait (Figure G4) and in the Challenger area (see Figure G1). Regulations define the dredge design and use, and the fisheries have been subject to restrictions on minimum size and catch and closures (primarily due to the *Bonamia* parasite infections (Fisheries New Zealand 2019). Heavy double ring bag dredges are used in the Foveaux Strait oyster fishery (OYU 5), whereas, historically, the Challenger (Nelson-Marlborough) fishery dredges were of lighter construction than those used in Foveaux Strait. The number of records and numbers of tows in each main fishery are given in Table G4. The Challenger fishery peaked at about 31 500 tows in 1995 during a period of sustained effort in 1993–1999 (> 20 000), dropped to under 15 000 tows during 2001–2007, with little reported effort in subsequent years. The Foveaux Strait fishery is currently the only one being fished. The highest level of effort in the Foveaux Strait fishery, for 1990–2019, was in 1990 and 1991. This was followed by a steady period of lower annual effort during 1996–2013 (16 500–19 300 tows), before a gradual increase to over 30 000 tows a year during 2017–2019.

Table G4: The number of records and number of tows reported for the Challenger (CHAL) oyster fishery and the Foveaux Strait (FOV, OYU 5) oyster fishery.

	No. of records				No. of tows			
Fishing year	CHAL	FOV	other	total	CHAL	FOV	other	Total
1990	723	1 020	9	1 752	8 548	39 013	101	47 662
1991	1 096	1 585	12	2 693	13 530	64 496	131	78 157
1992	1 163	344	101	1 608	15 565	12 541	1 841	29 947
1993	1 664	110	53	1 827	24 362	3 498	652	28 512
1994	1 986	157	9	2 152	29 969	4 464	318	34 751
1995	2 195	147	44	2 386	31 457	4 227	662	36 346
1996	1 775	633	243	2 651	27 977	19 299	3 614	50 890
1997	1 587	650	123	2 360	24 735	16 504	2 086	43 325
1998	1 641	652	55	2 348	27 655	16 730	1 008	45 393
1999	1 445	605	29	2 079	25 727	15 927	545	42 199
2000	927	703	19	1 649	14 828	17 951	310	33 089
2001	618	582	1	1 201	10 565	17 596	56	28 217
2002	8	982	1	991	164	32 462	2	32 628
2003	937	622	0	1 559	14 674	19 164	0	33 838
2004	493	664	0	1 157	8 448	17 565	0	26 013
2005	697	841	0	1 538	10 980	25 446	0	36 426
2006	743	737	0	1 480	11 041	19 789	0	30 830
2007	584	644	0	1 228	9 775	16 225	0	26 000
2008	124	549	0	673	2 329	16 028	0	18 357
2009	38	616	0	654	658	17 610	0	18 268
2010	77	614	0	691	1 235	16 669	0	17 904
2011	112	720	1	833	1 965	16 771	13	18 749
2012	53	847	1	901	935	19 391	18	20 344
2013	14	835	7	856	276	18 996	46	19 318
2014	5	852	5	862	81	24 369	29	24 479
2015	9	711	1	721	99	23 109	11	23 219
2016	10	726	0	736	135	23 865	0	24 000
2017	1	863	0	864	16	32 448	0	32 464
2018	1	1 011	0	1 012	2	39 013	0	39 015
2019	0	1 117	4	1 121	0	31 590	95	31 685
All	20 726	21 139	718	42 583	317 731	642 756	11 538	972 025

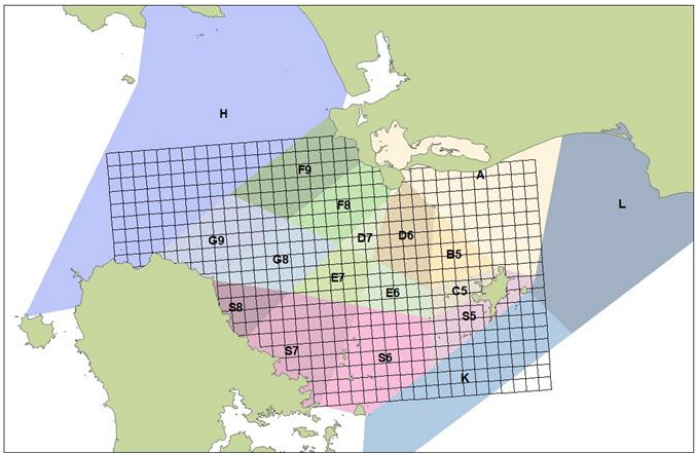

Figure G4: Foveaux Strait (OYU 5) fishery areas (coloured and labelled) with the 1 nm grid used by fishers to report fine-scale data.

Foveaux Strait oyster fishery (OYU 5), based on 2019 ERS data

During the 2019 oyster fishery, the ERS reporting was instigated gradually through the fleet of 12 vessels throughout the season. For ten vessels the fishing effort was reported on CELRs and ERS and for the remaining two vessels, data collection was via CELRs. In total, there were 681 CELR records and 438 ERS records for the 2019 season (Table G5).

Table G5: Number of oyster effort records in the 2019 OYU 5 season, by form type and OYU5 fishery area code. There are 18 fishery-specific areas (shown in Figure G4): in 2019 there was no reported effort in areas K and L.

Form	A	B5	C5	D6	D7	E6	E7	F8	F9	G8	G9	H	S5	S6	S7	S8	Unk
CEL	20	56	22	16	4	20	185	17	0	203	9	0	1	5	121	0	2
ERS	28	101	36	10	1	15	33	12	17	113	60	5	3	1	2	1	1
Total	48	157	58	26	5	35	218	29	17	316	69	5	4	6	123	1	3

These forms collect effort data in different ways: the CELR form collects daily data in the fishery-specific areas given in Tab and each record (*FishingEventKey*) represents daily effort in that area and the *EffortCount* in the data represent the number of dredge tows completed that day and area times the number of dredges used (two in this fishery). So, a record with *EffortCount*=30 as the reported effort represents 15 tows, each of two dredges.

The ERS data are collected on a 1-nm grid that overlays the fishery-specific areas (see Figure G4). For each *FishingEventKey* each start position reported by the fishers via ERS indicates the start of the first tow in a cell in a day and the end position gives the end position of the last tow in that cell for that day. Thus, data are collected at the level of a cell, and a fisher must create a new fishing event record when the next tow starts in a neighbouring cell. This effectively gives a cell-based number of tows and allows for a finer resolution for analysis than is provided by the larger fishery-specific areas. The industry provided a shapefile of the 1-nm grid to be used for analysis of these data – a grid that has been used by the fishers for industry reporting for the past 15 years. ERS data were assigned to the 1-nm grid (in GIS) based on each record's start position.

To develop an ERS 'swept area' measure per record, the following data are required: number of tows, number of dredges used (always 2), width of combined dredges (usually 6.6.m, see below), and fishing duration and tow speed (to develop a distance fished in that cell for a day). However, the duration data

is for a day's effort and is recorded as the time from the start of the first tow in a grid cell to the end of the last tow in that grid cell. Thus, duration would over-estimate the time that the gear is actually fishing.

Instead, a standardised swept area for each tow was developed:

*Standardised distance of 385 m * standard two-dredge width => 2541 m^2 swept area per tow*

where the standardised distance was calculated from a 5-minute duration for one tow at a tow speed of 2.5 kn. The swept area per tow was multiplied by the number of tows per record (per grid cell). It appeared that for some ERS data the number of tows was incorrect. A tow usually takes 15–20 minutes for the deployment, bottom-contact (fishing), and hauling and steaming back to start position (K. Michael, NIWA, pers. comm.). This means about 4 tows an hour is sensible. The numbers of tows per hour in the ERS data were looked at relative to the catch and duration and it was apparent that some records had 'number of tows' data that had been reported as if completing a CELR (that is, the CELR 'number of tows' actually reports 2 tows for each fishing event because it records the number of dredges fished per record for OYU 5, and thus CELR data would report twice the ERS 'number of tows' data per record). The spread of the estimated swept area for the OYU 5 2019 season is shown in Figure G5.

A total of 20.7 km^2 of seafloor was estimated as contacted by the 2019 ERS data; 100 grid cells had effort and of those, 3 cells had 1.25–1.3 km^2 of contact (maximum number of tows was 513), 6 had 0.5–0.9 km^2, 23 had 0.25–0.5 km^2, 19 cells had 0.1–0.24 km^2, and the remaining cells had under 0.1 km^2 of contact.

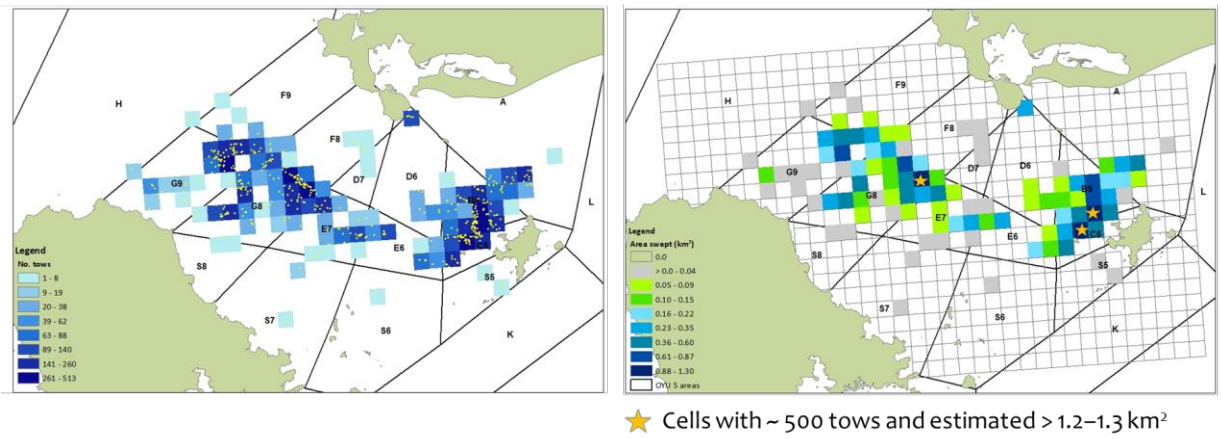

Figure G5: Number of tows (each with two dredges) per contacted 1-n. mile grid cells for 2019 (left), where tow starts are shown as small yellow dots, and the estimated swept area for the 2019 data per grid cell (right). These data represent 39% of the 436 daily records (CELR and ERS) from 10 vessels that fished in the 2019 season.