

PISCES
RESEARCH

Fisheries and fish populations in statistical area 025 (Foveaux Strait) in relation to a proposed finfish farm

Report for Sanford Ltd

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To be cited as:

Middleton, D. A. J. (03 March 2020). Fisheries and fish populations in statistical area 025 (Foveaux Strait) in relation to a proposed finfish farm, 30 pages. Report for Sanford Ltd.

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1. INTRODUCTION

Sanford Ltd wish to better understand the fish populations and wild-harvest fisheries in general statistical area 025, which comprises Foveaux Strait and adjacent waters (Figure 1). This report provides a characterisation of the fisheries in that area, primarily based on statutory catch, effort and landings data reported by commercial fishers to the Ministry for Primary Industries. Information on recreational fisheries, and other published information on fish distributions, is also summarised.

For a number of the fisheries of interest, statutory data have only been available at the resolution of the statistical area (noting that area definitions vary between species). However, all commercial fishers are currently transitioning to electronic reporting (ER) which will provide information at a finer spatial scale in future.

In this report the term Foveaux Strait is generally used to refer to statistical area 025. Sanford are particularly interested in fishing in the area of proposed marine farming areas that would lie to the south-east of Ruapuke Island (Figure 1).

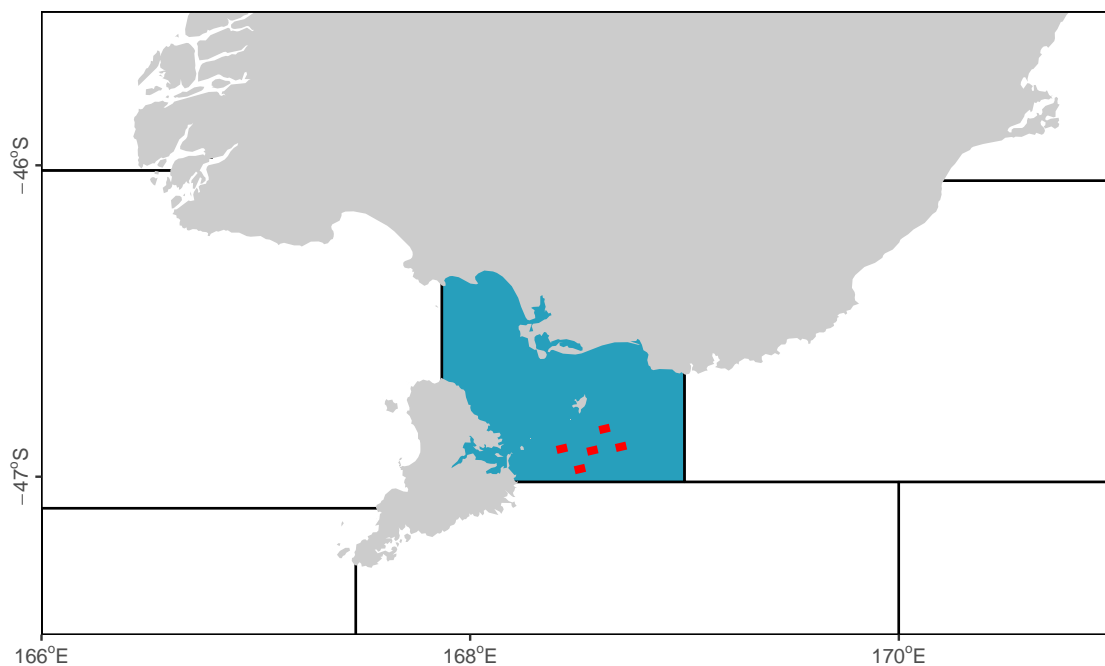


Figure 1: Foveaux Strait with statistical area 025 highlighted in blue and the location of the proposed farming areas indicated by red polygons. The polygons correspond to the Outer Farming Area Boundaries within which the pens and associated mooring structures would be located.

2. FINFISH FISHERIES

Finfish fisheries are identified here as those fisheries reporting fishing effort located in general statistical area 025. Although reporting using general statistical codes is not strictly limited to finfish, this approach conveniently separates out the major non-finfish fisheries (i.e. oysters, paua and rock lobsters) because these have species-specific statistical areas.

The cod potting fishery (method code CP) has had the greatest effort in statistical area 025 over the past decade (fishing years 2009/10 to 2018/19, where the fishing year is 1 October to the following 30 September), with bottom trawling and set netting as the other methods with significant effort (Figure 2).

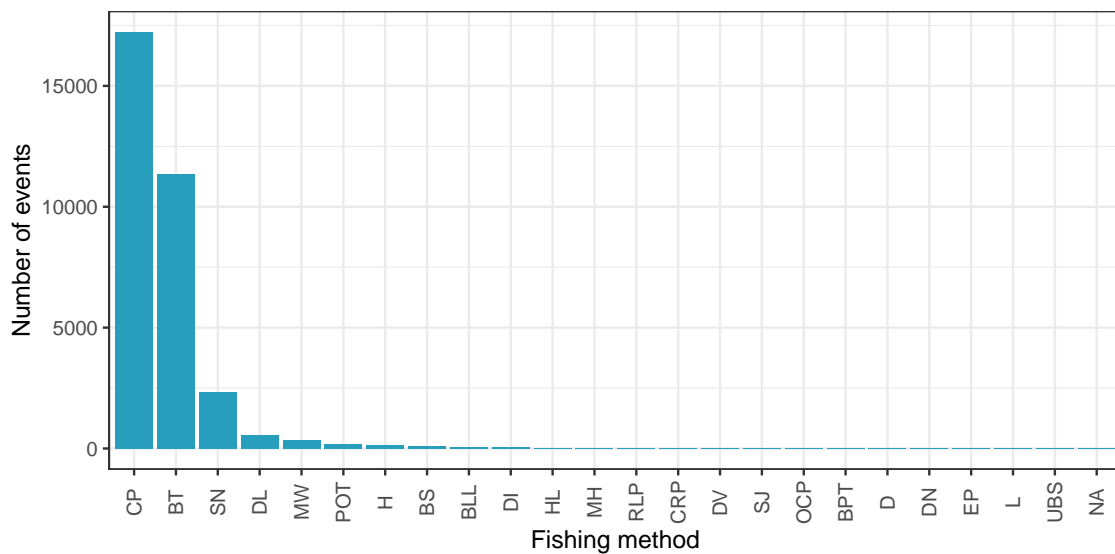


Figure 2: Fishing methods reported in area 025 from 2009/10 to 2018/19. Statutory reporting codes are defined in Table A-1. NA indicates that no code was reported. POT is a non-statutory code, assumed to indicate cod potting.

2.1 Cod potting

The cod pot fishery is a target blue cod (BCO) fishery, with only limited bycatch of other species (Figure 3). Cod potting is reported on the Catch, Effort and Landing Return (CELR) form, so fishing events are daily records of fishing per area/method/target.

Blue cod catch and effort in the pot fishery have declined somewhat over the last decade (Figure 4), although the number of vessels participating in the fishery has remained stable.

Because cod potting effort has been reported on the CELR form using the general statistical areas, no information on fishing locations within area 025 is currently available in the statutory data (although this will change as electronic reporting is introduced during 2019). However, effort location data is available from a subset of 18 vessels that participated in a diary programme from 2009 to 2011 (Figure 5; Pomarede

2013). Although these data are not necessarily representative of the whole cod fishery, they indicate that the proposed farming areas are largely outside, to the south east, of the main areas fished.

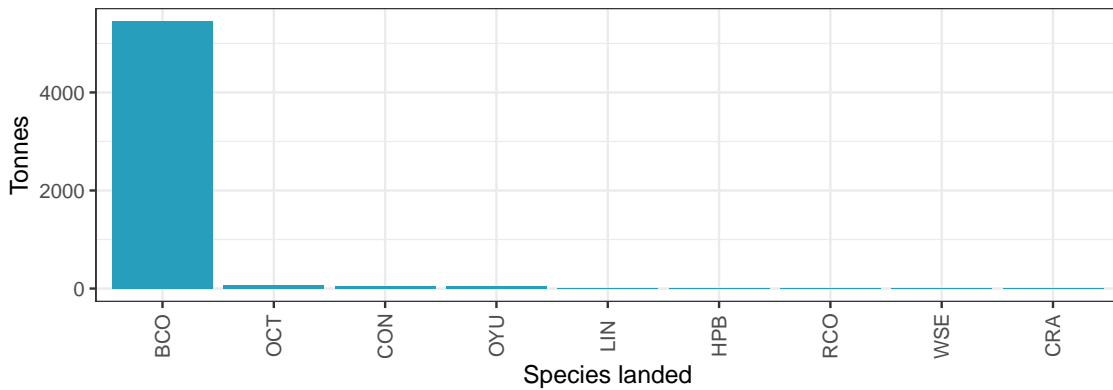


Figure 3: Catch by species by cod potting (method codes CP or POT) in statistical area 025 from 2009/10 to 2018/19, for species with aggregate landings of at least 5 tonnes in this period. Statutory reporting codes are defined in Table A-2.

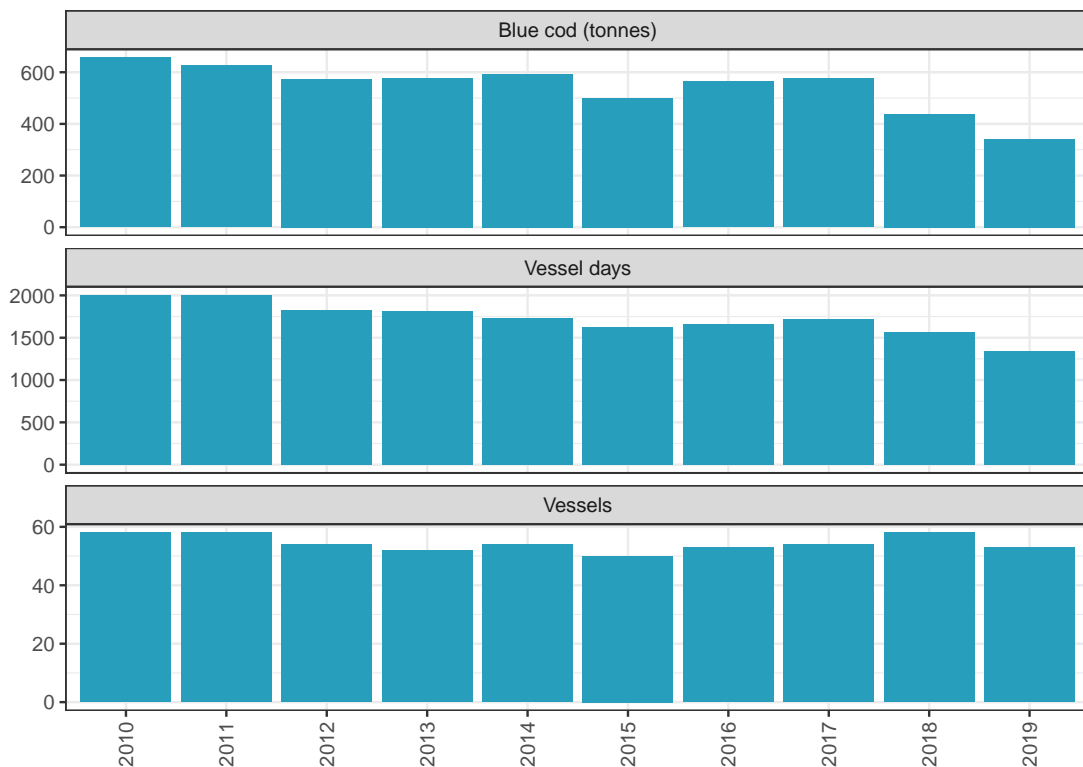


Figure 4: Annual blue cod catch and fishing days by cod potting (method codes CP or POT) in statistical area 025 from 2009/10 to 2018/19. Fishing years are indicated by the later year; for example 2010 represents the 2009/10 fishing year.

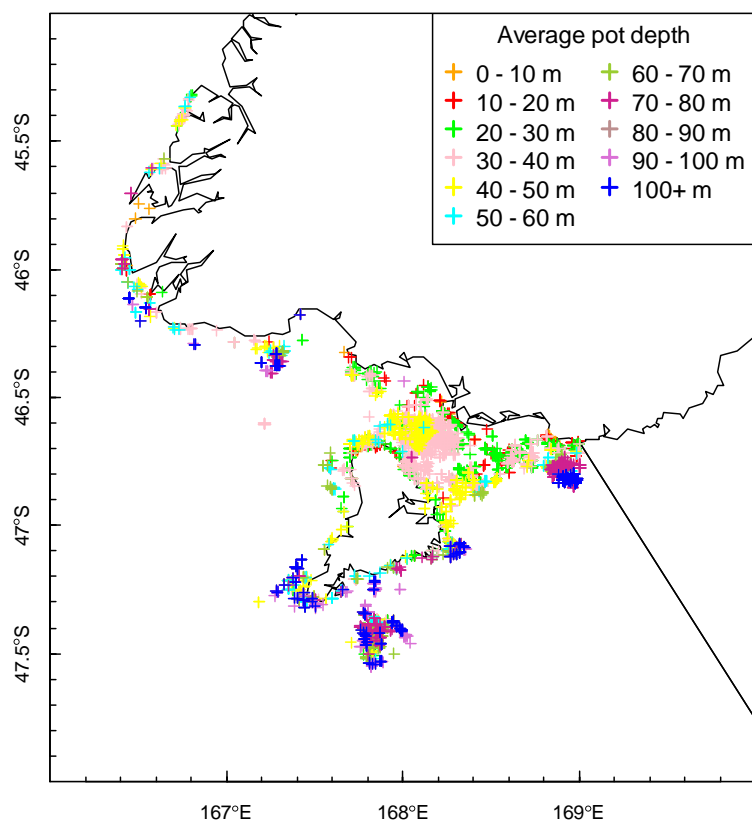


Figure 5: Fishing depth and location reported by 18 fishers participating in the BCO 5 diary programme, from Pomarede (2013).

2.2 Bottom trawling

The majority of bottom trawl effort in statistical area 025 is targeted at flatfish (Figure 6). Bottom trawling catches a range of species with barracouta the dominant species landed, followed by flatfish, blue warehou, gurnard, spiny dogfish and stargazer (Figure 7). The relatively large catch of barracouta primarily arises from non-flatfish target effort.

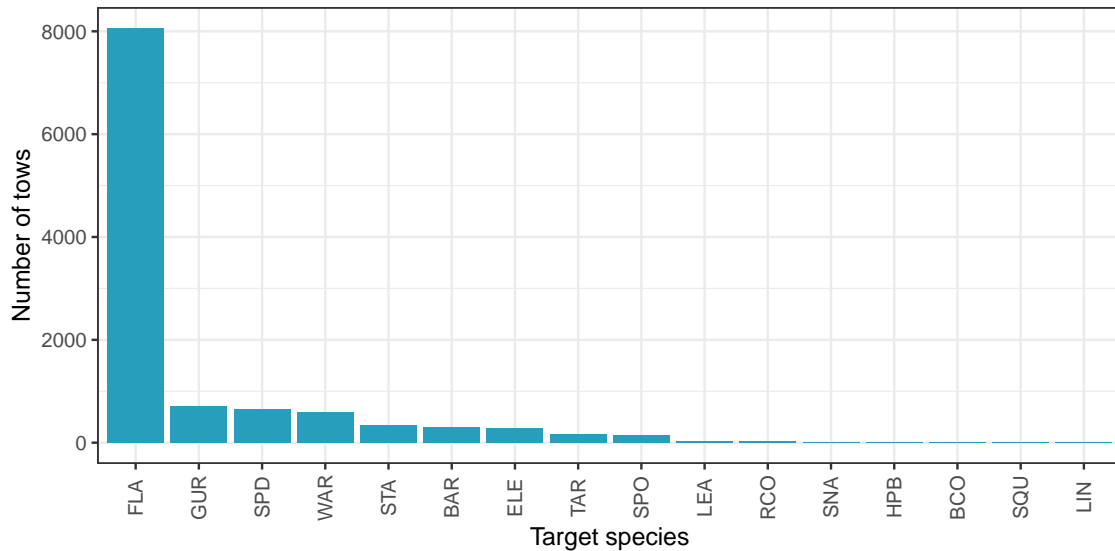


Figure 6: Target species for bottom trawling (method code BT) in statistical area 025 from 2009/10 to 2018/19. Statutory reporting codes are defined in Table A-2.

All bottom trawling in area 025 over the last decade has been reported on ‘high resolution’ forms (Figure 8), so all bottom trawl fishing events are individual tows and are reported with at least a start position. The highest catches of the key trawl-caught species occur in the south-east of area 025 (Figure 9).

The highest catches of barracouta (BAR) and spiny dogfish (SPD) are taken to the south-east of the proposed farming areas, while the greatest catches of elephant fish (ELE) are taken to the north of the proposed development. The highest catches of flatfish (FLA) and gurnard (GUR) are also taken to the north of the proposed development, but moderate catches of both these stocks are taken in cells that overlap with the proposed development. The greatest overlaps between standardised catch and the proposed farming areas occur for red cod (RCO) and stargazer (STA). Catches of blue warehou (WAR) are more patchy, but the proposed farming areas also overlap with the area where the greatest catches of this species have been taken.

The majority of trawling in area 025 occurs at depths of less than 100 m (Figure 10). Flatfish targeting is bimodal, with some effort less than 20 m but the majority around 50 m, at similar depths to gurnard target trawling. Spiny dogfish target trawling is generally shallower (around 30 m), although some targeting occurs around 75 m, while effort targeting barracouta, warehou and stargazer is deeper (mostly greater than 75 m).

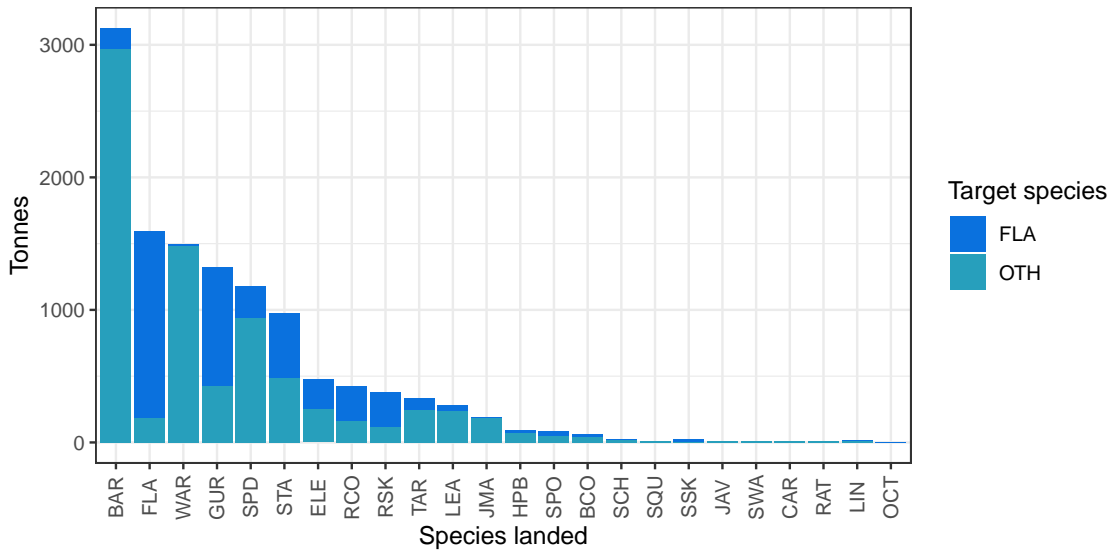


Figure 7: Catch by species by bottom trawling (method code BT) in statistical area 025 from 2009/10 to 2018/19, for species with aggregate landings of at least 5 tonnes in this period. Statutory reporting codes are defined in Table A-2. Catches are categorised according to whether the associated fishing event was targeting flatfish (FLA) or non-flatfish (OTH) species.

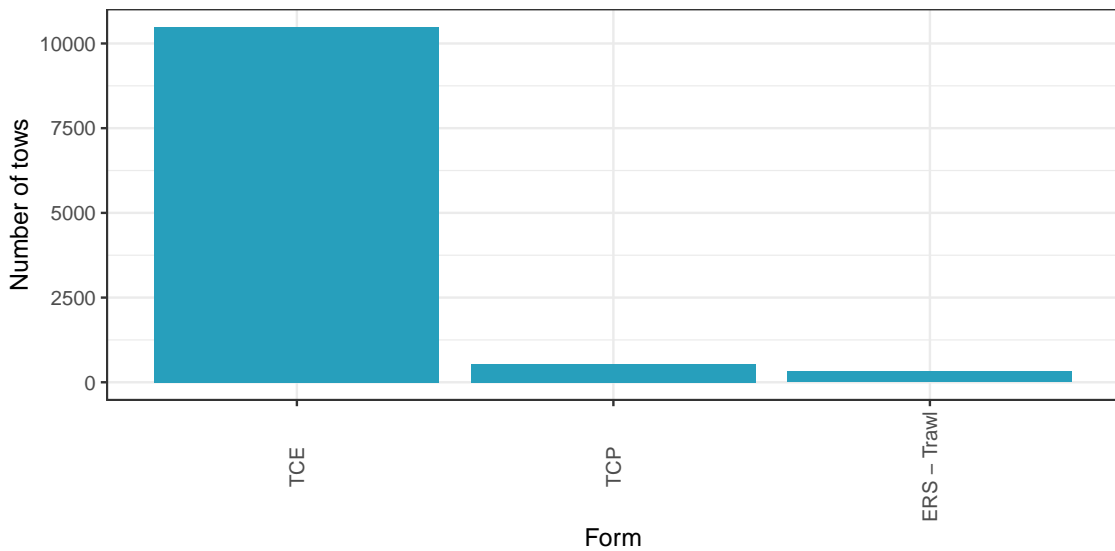


Figure 8: Reporting form for bottom trawling (method code BT) in statistical area 025 from 2009/10 to 2018/19. TCE = Trawl Catch Effort Return; TCP = Trawl Catch, Effort and Processing Return; ERS - Trawl = Electronic Reporting System.

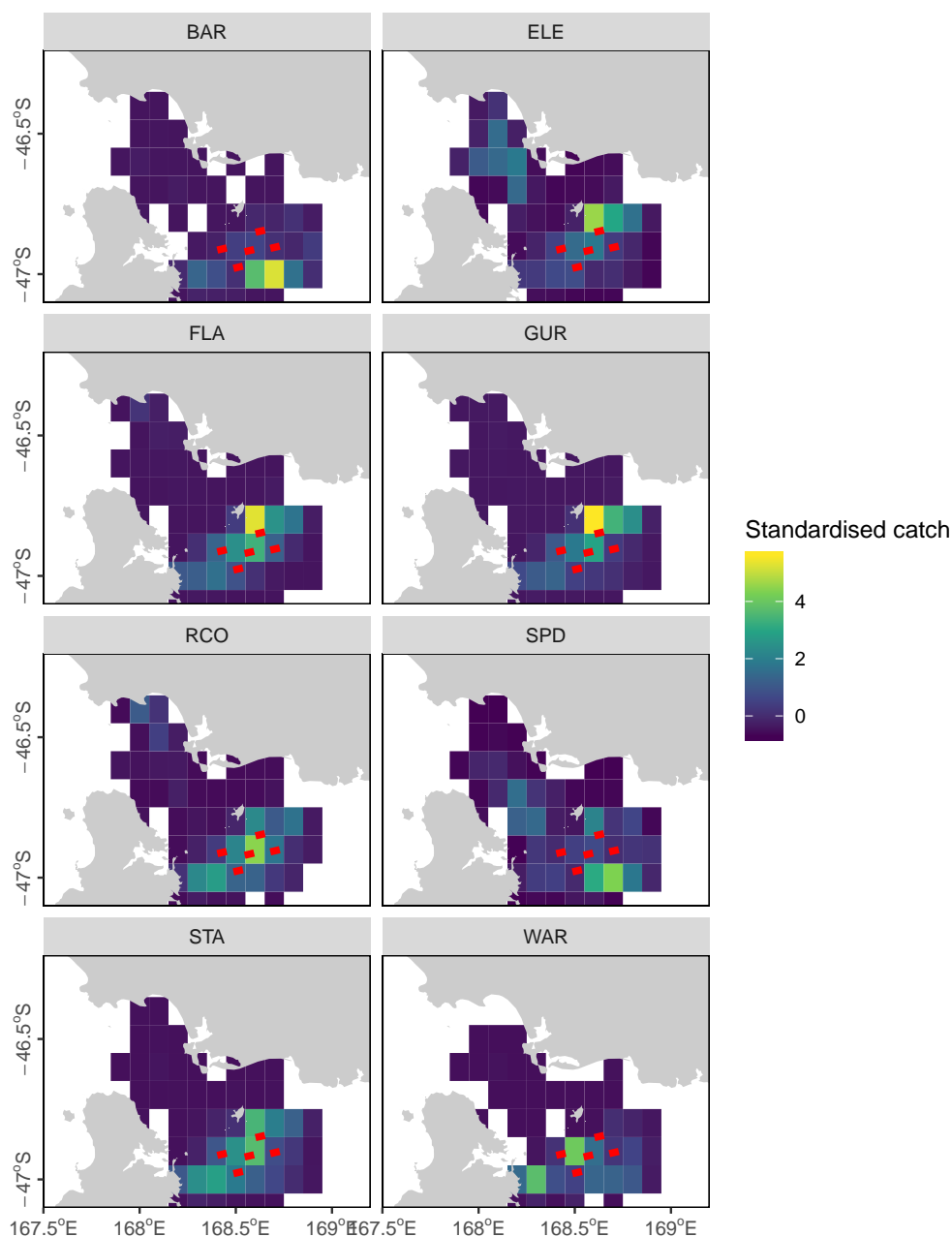


Figure 9: Standardised catch of key species taken by bottom trawl in statistical area 025, from 2009/10 to 2018/19. Zero cells with less than three vessels or permit holders represented are omitted. Catch totals are standardised to show the spatial variation of catch within a species; see Figure 7 for the relative magnitude of catches between species.

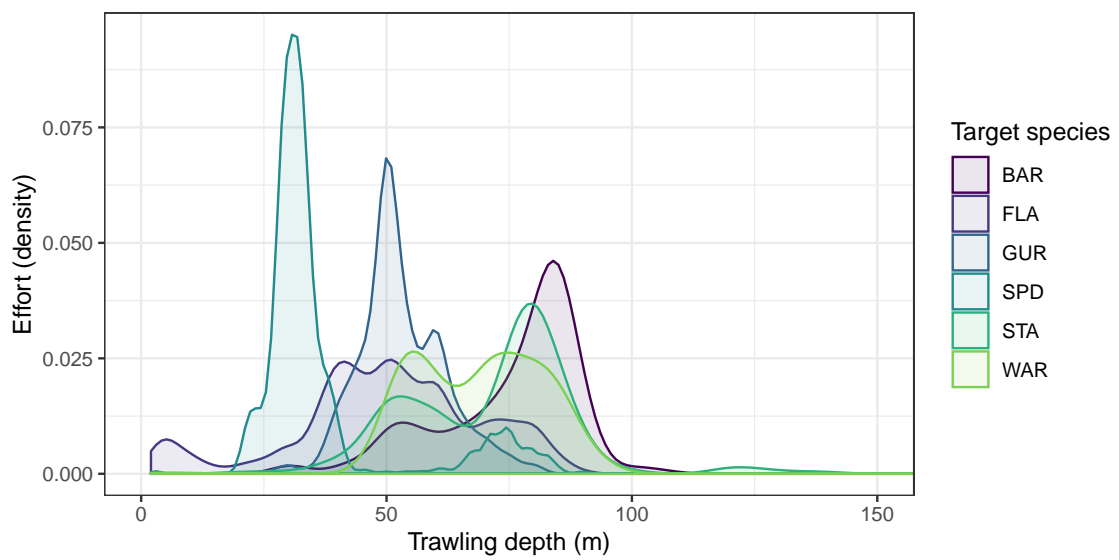


Figure 10: Trawl depth for key target species for bottom trawling in statistical area 025, from 2009/10 to 2018/19.

2.3 Potentially displaced bottom trawl effort

To assess the magnitude of bottom trawl effort that might be displaced by the proposed marine farming activity, trawls with a start or end point within the outer boundary of the farming areas were identified. The outer farming area boundary extends beyond the fish pen and mooring structures, providing a buffer around the farm structures that is almost seven times the area that would actually be occupied by farm structures. Thus, not all these tows would be displaced by farm structures. Conversely, some tows starting and ending outside the farming areas are likely to have towed through the areas.

Overall, 3.9% of tows in statistical area 025 started or ended within the farming areas, with trawling targeting stargazer and blue warehou showing the greatest overlap (Table 1). The impacted effort is carried out by a number of different vessels (Table 2), with a similar vessel size composition to vessels fishing throughout statistical area 025 (Figure 11).

Typical tow lengths in the Foveaux Strait trawl fisheries are estimated to be 10 km to 20 km (Figure 12). The arrangement of the farming areas and the gently sloping bathymetry in the area (Figure 13) suggest trawling activity should be able to continue around the proposed marine farm structures, although some established tow lines will inevitably be impacted.

Table 1: Number of tows in statistical area 025 from 2009/10 to 2018/19 lying inside and outside the proposed farming areas (a tow is classified as inside the farming area if its start or end position is within a farming area).

| Target species | Outside | Inside farming areas | | | | | Total | Percent inside |
|----------------|---------|----------------------|--------|--------|--------|--------|-------|----------------|
| | | Site A | Site B | Site C | Site D | Site E | | |
| BAR | 291 | 2 | 3 | 1 | 5 | 1 | 12 | 4.0 |
| ELE | 272 | 0 | 2 | 2 | 4 | 2 | 10 | 3.5 |
| FLA | 7768 | 115 | 11 | 48 | 109 | 7 | 290 | 3.6 |
| GUR | 666 | 22 | 0 | 3 | 19 | 1 | 45 | 6.3 |
| SPD | 635 | 0 | 1 | 7 | 1 | 0 | 9 | 1.4 |
| STA | 314 | 3 | 9 | 10 | 1 | 3 | 26 | 7.6 |
| TAR | 155 | 0 | 1 | 3 | 0 | 5 | 9 | 5.5 |
| WAR | 549 | 9 | 3 | 2 | 18 | 12 | 44 | 7.4 |
| Other | 250 | 1 | 1 | 0 | 0 | 0 | 2 | 0.8 |

Table 2: Number of vessels in statistical area 025 from 2009/10 to 2018/19 fishing inside and outside the proposed farming areas, noting that vessels may fish in multiple areas.

| Target species | Outside | Inside farming areas | | | | | Total |
|----------------|---------|----------------------|--------|--------|--------|--------|-------|
| | | Site A | Site B | Site C | Site D | Site E | |
| FLA | 39 | 18 | 8 | 13 | 19 | 4 | 27 |
| Other | 41 | 6 | 8 | 7 | 10 | 6 | 14 |

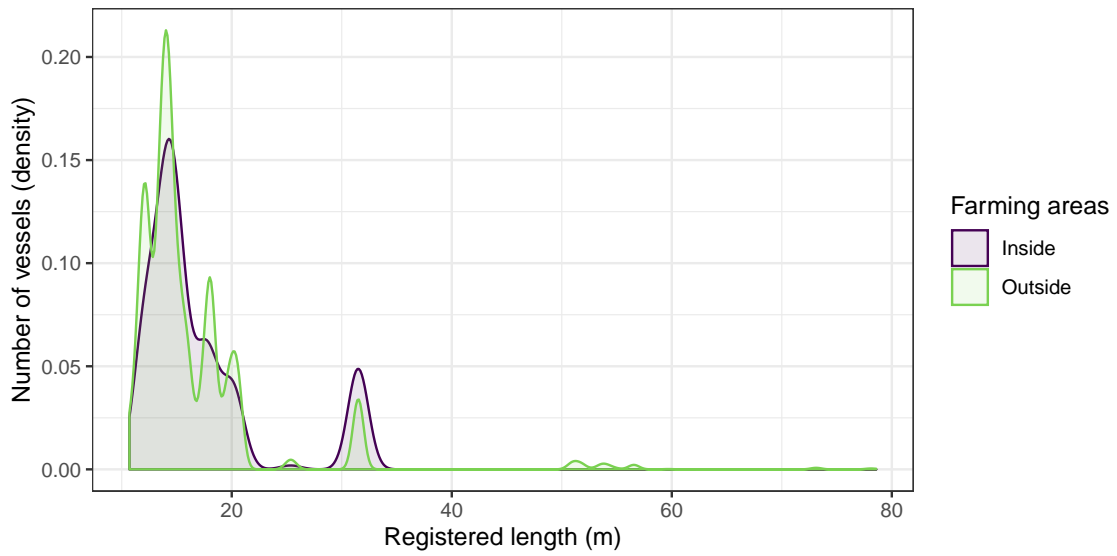


Figure 11: Registered length distributions for bottom trawl vessels operating inside and outside the farming areas from 2009/10 to 2018/19 (based on tow start/end positions). A vessel may be classified as operating both inside and outside the farming areas.

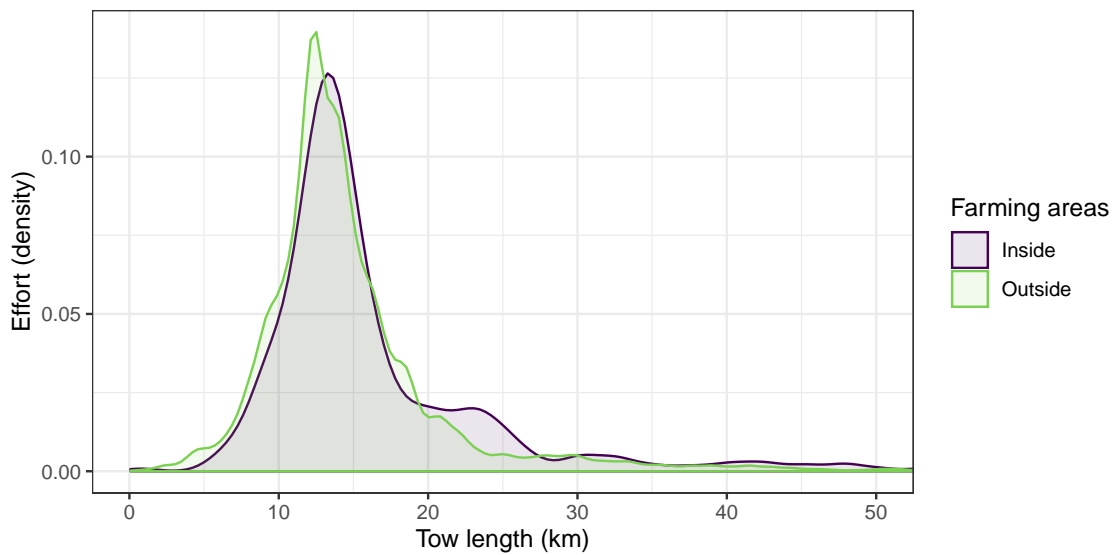


Figure 12: Trawl lengths (km), estimated from speed and duration, for tows beginning/ending inside and outside the farming areas from 2009/10 to 2018/19.

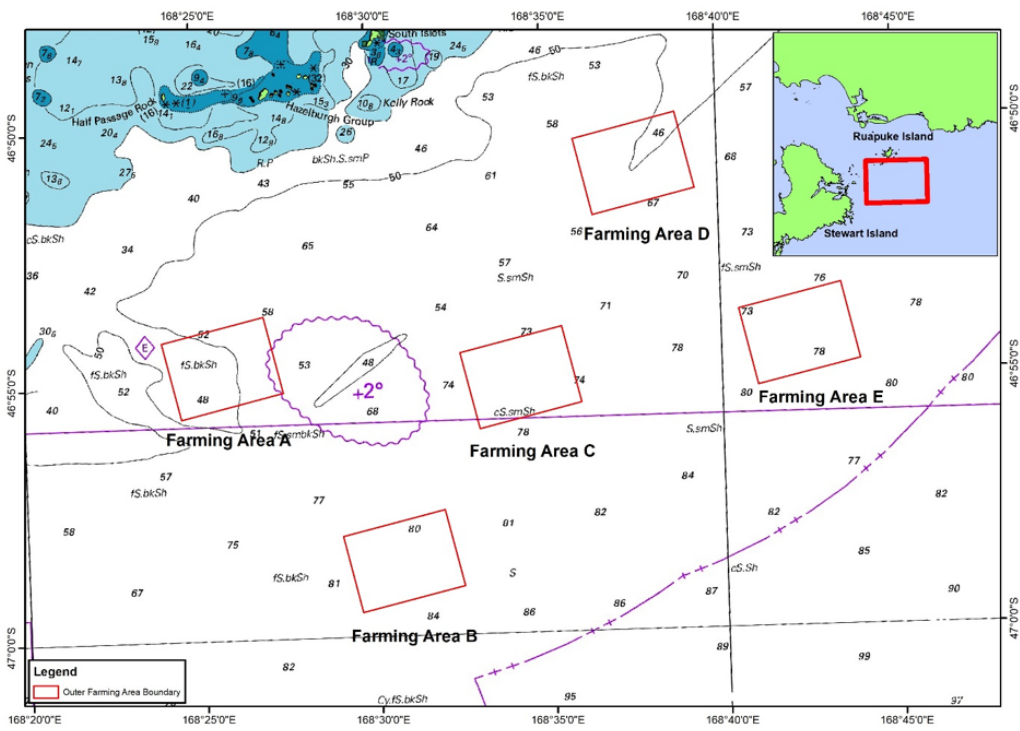


Figure 13: The proposed marine farming areas overlaid on a hydrographic chart. Provided by Mark James, Aquatic Environmental Sciences Ltd.

2.4 Set netting

Set net catches in statistical area 025 are dominated by inshore sharks: spiny dogfish, school shark and rig (Figure 14). Butterfish is the key non-shark species taken by set net.

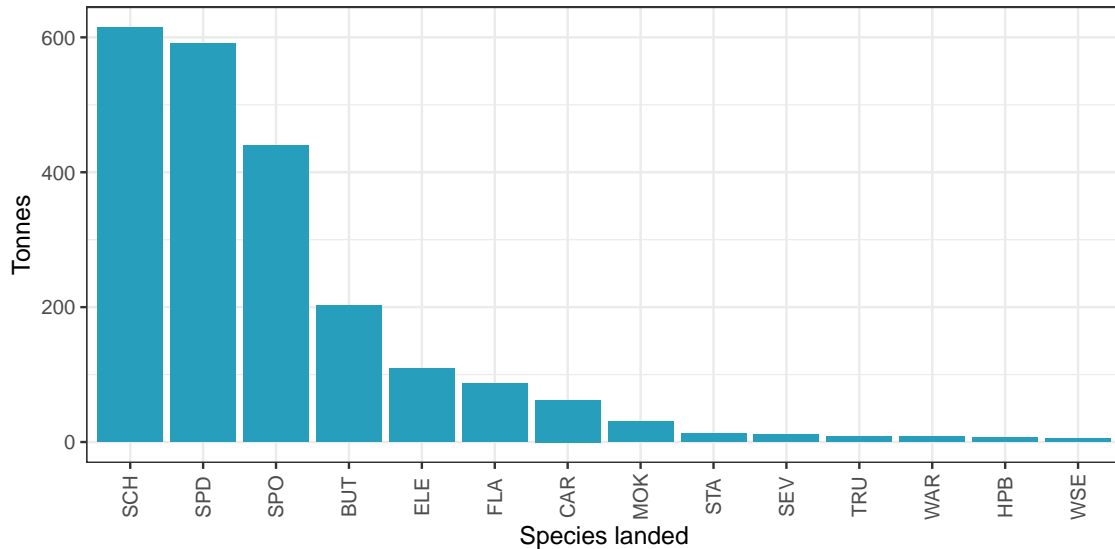


Figure 14: Catch by species by set netting (method code SN) in statistical area 025 from 2009/10 to 2018/19, for species with aggregate landings of at least 5 tonnes in this period. Statutory reporting codes are defined in Table A-2.

Set net effort targeting flatfish is the largest effort grouping, followed by targeting of rig and school shark, then butterfish (Figure 15). A significant proportion of set net effort – in particular all set net effort targeted at flatfish species – is reported on the CELR form (Figure 16) and therefore lacks fine scale spatial data. However, such effort will be coastal effort by vessels less than 6 m. Sets reported via the newer NCELR form have set position data available.

Based on set net effort where fine scale spatial data are available (i.e. the non-flatfish set net target fishing), shark catches occur in similar areas of statistical area 025, although spiny dogfish and rig dominate catches in the north-west of the area while the greatest catches of school shark occur in the east (Figure 17). Butterfish set net catches are localised in a small number of coastal areas. Set net catches show little overlap with the proposed farming areas.

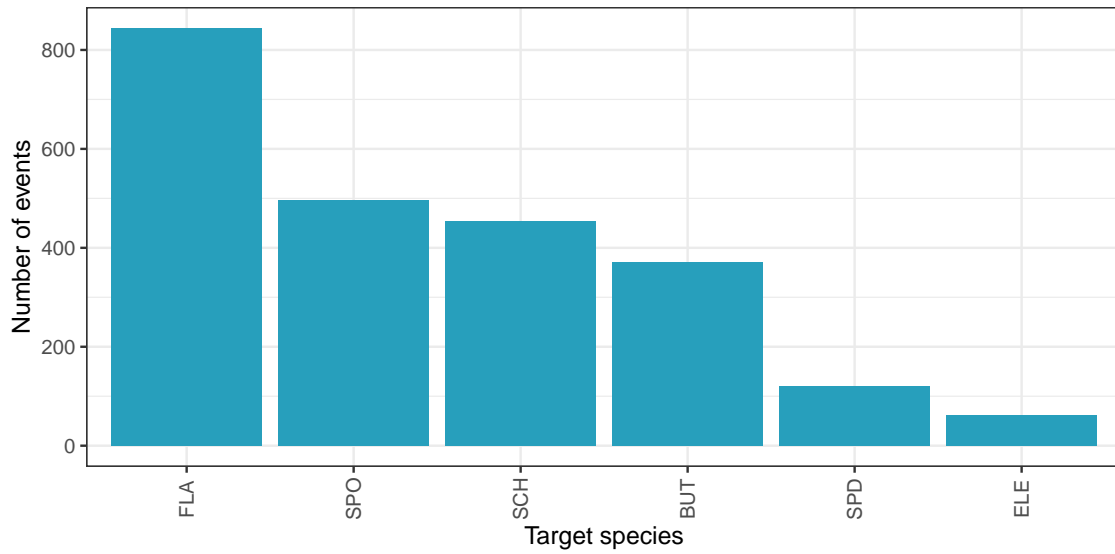


Figure 15: Target species for set netting (method code SN) in statistical area 025 from 2009/10 to 2018/19. Statutory reporting codes are defined in Table A-2.

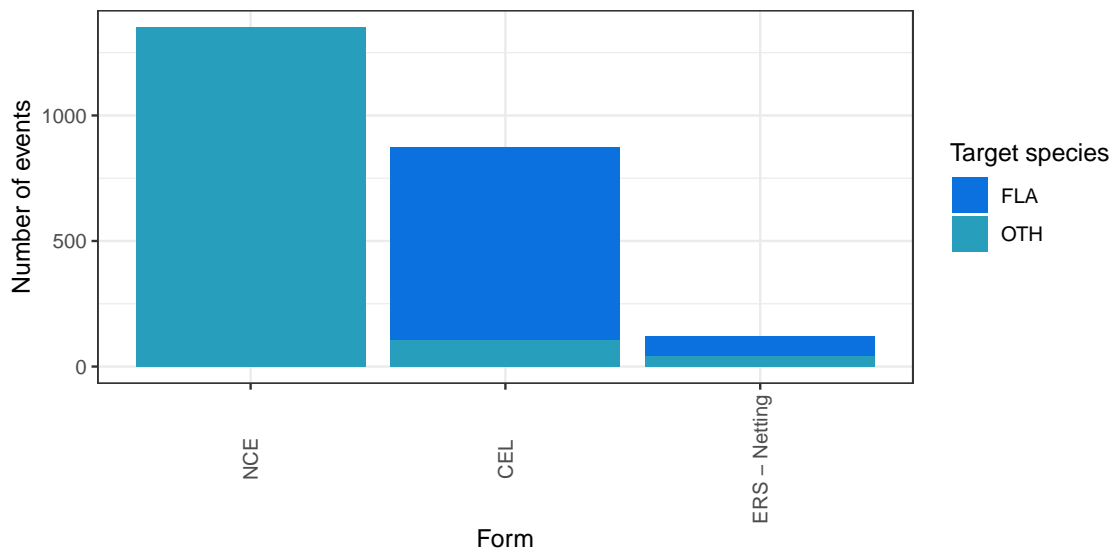


Figure 16: Reporting form for set netting (method code SN) in statistical area 025 from 2009/10 to 2018/19. NCE = Netting Catch, Effort and Landing Return; CEL: Catch, Effort and Landing Return. Form use is categorised according to whether the associated fishing event was targeting flatfish (FLA) or non-flatfish (OTH) species.

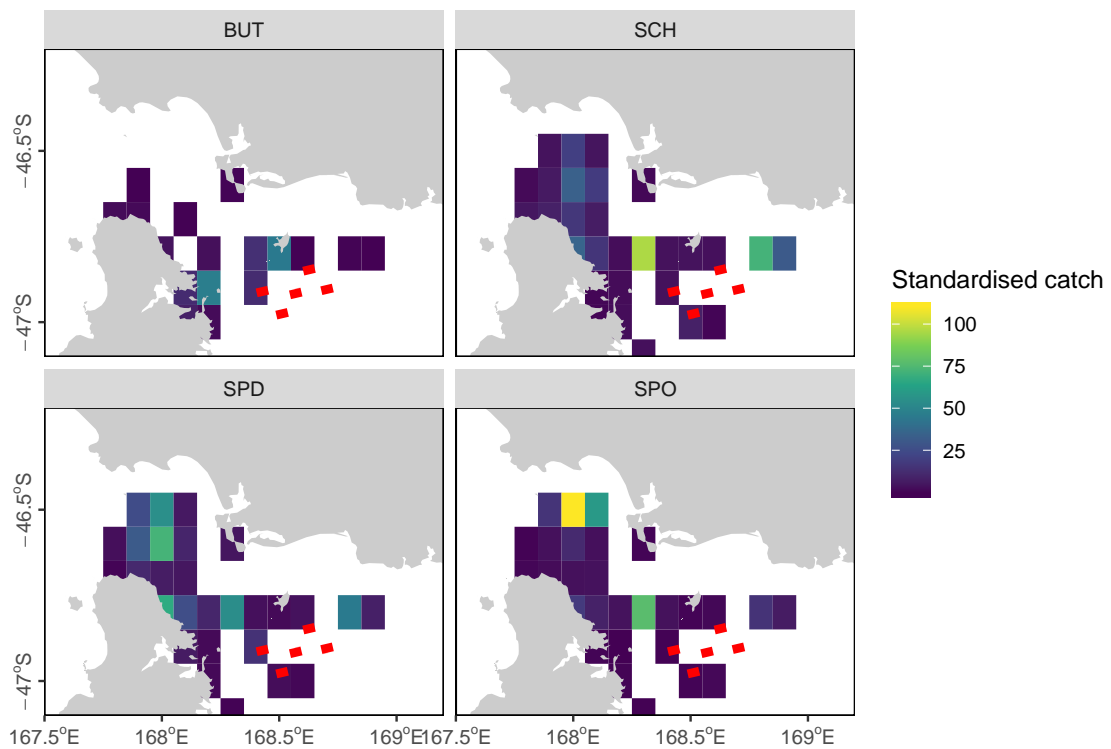


Figure 17: Standardised catch of key species taken by set net in statistical area 025, from 2009/10 to 2018/19. Four cells with less than three vessels or permit holders represented are omitted. Catch totals are standardised to show the spatial variation of catch within a species; see Figure 14 for the relative magnitude of catches between species.

3. THE OYSTER FISHERY

Oyster catch and effort have increased over the past decade, with the fleet size remaining stable (Figure 18). Foveaux Strait comprises a number of oyster statistical areas and the largest catches have come from the central part of the Strait between Stewart Island/Rakiura and Ruapuke Island (Figure 19). The proposed farming areas are outside the area where the oyster fishery operates. Surveys of the oyster fishery only consider the area to the west and north of Ruapuke Island (Michael et al. 2019).

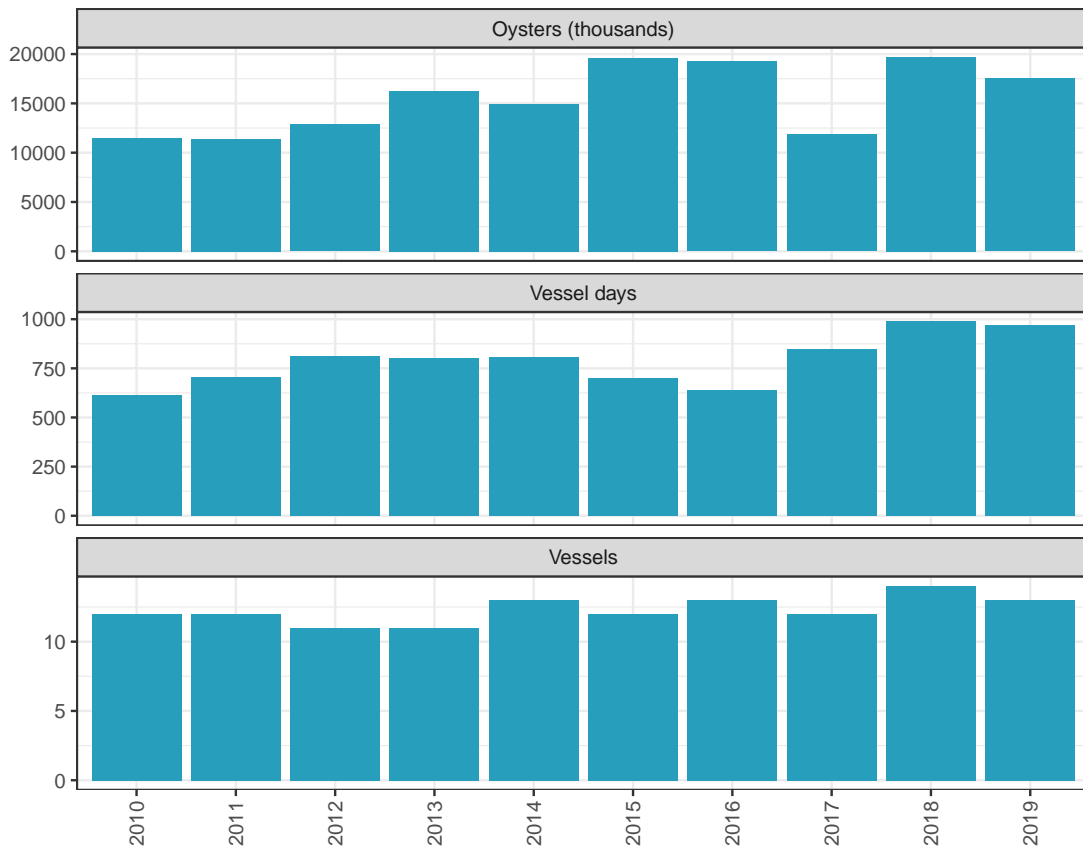


Figure 18: Annual oyster catch and fishing days by dredging (method code D) in Foveaux Strait from 2009/10 to 2018/19. Fishing years are indicated by the later year, for example 2008 represents the 2007/08 fishing year.

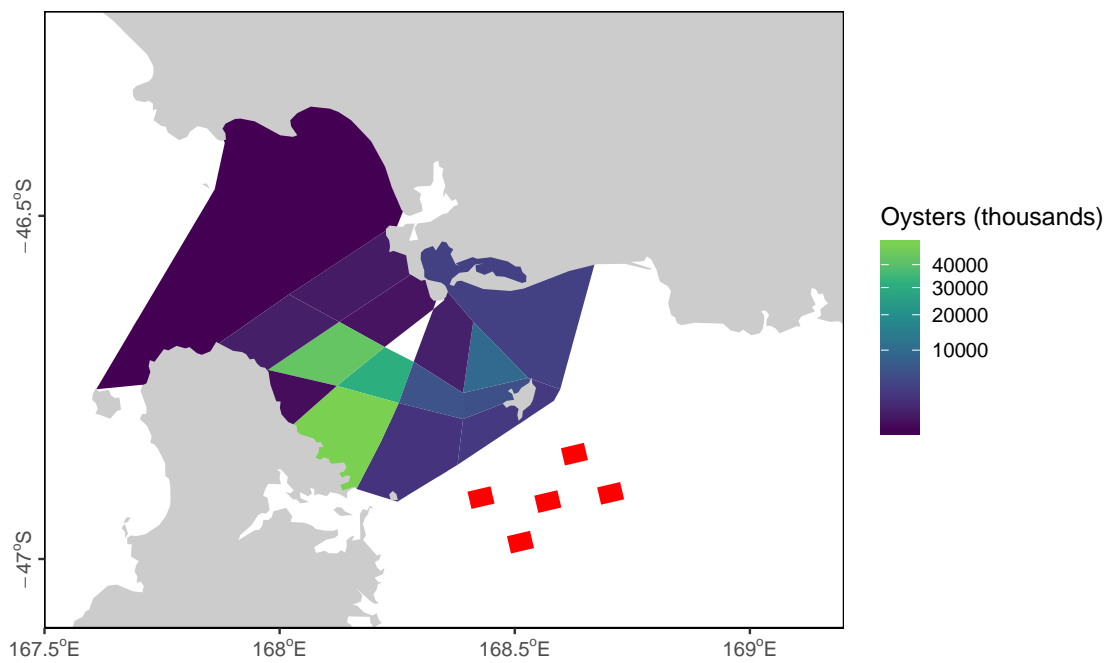


Figure 19: Oyster catch by statistical area in Foveaux Strait from 2009/10 to 2018/19. Six areas, with a maximum aggregate catch of 0.147 thousand oysters, are not shown as they included fishing by fewer than three vessels over the period.

4. THE PAUA FISHERY

Foveaux Strait comprises parts of PAU 5B and PAU 5D. Paua catch and effort from statistical areas within Foveaux Strait have been reasonably stable over the past decade (Figure 20). The largest catches have come from the northern paua statistical areas at the east and west of Foveaux Strait, with catches fairly evenly spread along the paua statistical areas off the coast of Stewart Island/Rakiura (Figure 21). While moderate catches of paua are reported from the statistical areas overlapping the proposed farming areas, these catches will have been taken by free diving on coastal reef areas only, implying no actual overlap between the paua fishery and the proposed farming areas.

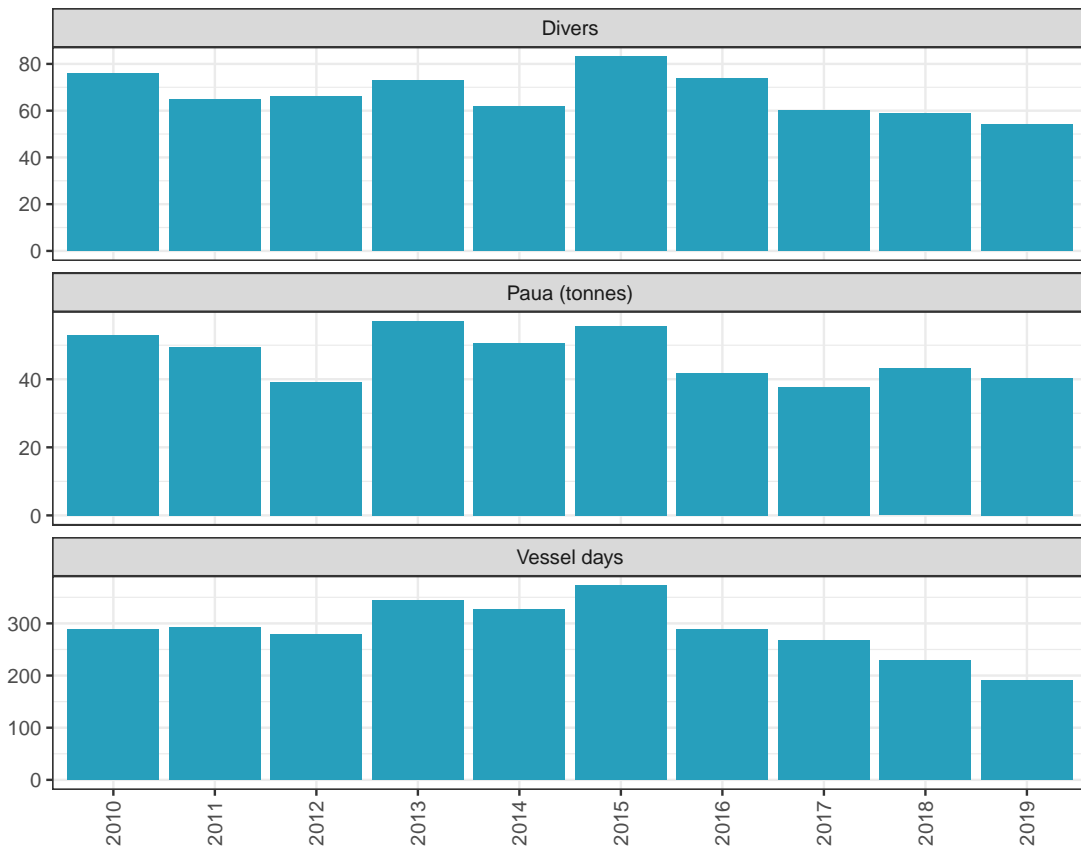


Figure 20: Annual paua catch and fishing days by diving (method code DI) in Foveaux Strait from 2009/10 to 2018/19. Fishing years are indicated by the later year, for example 2008 represents the 2007/08 fishing year.

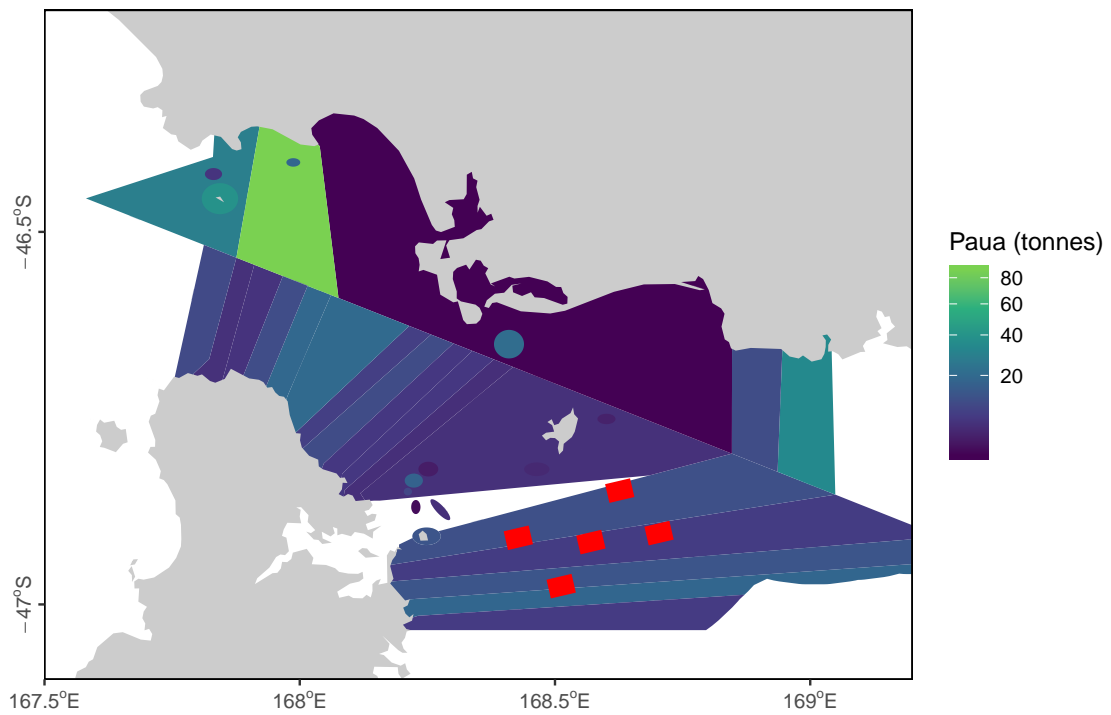


Figure 21: Paua catch by statistical area in Foveaux Strait from 2009/10 to 2018/19. Areas with fishing by less than three vessels, divers or permit holders are omitted.

5. THE LOBSTER FISHERY

The lobster fishery has been quite stable over the last decade, although an increase in catch is evident in the last three years (Figure 22). Foveaux Strait falls in just three lobster statistical areas with the greatest catches coming from rock lobster statistical area 925 which is off the north-east coast of Stewart Island/Rakiura (Figure 23). The proposed farming areas mostly lie within the lobster statistical area with intermediate catches, but this area is large and it is unclear how much catch is actually taken in the area of the proposed farm. Because there are trawl fisheries operating in vicinity of the proposed farming areas it is unlikely that there is significant potting activity in the same areas.

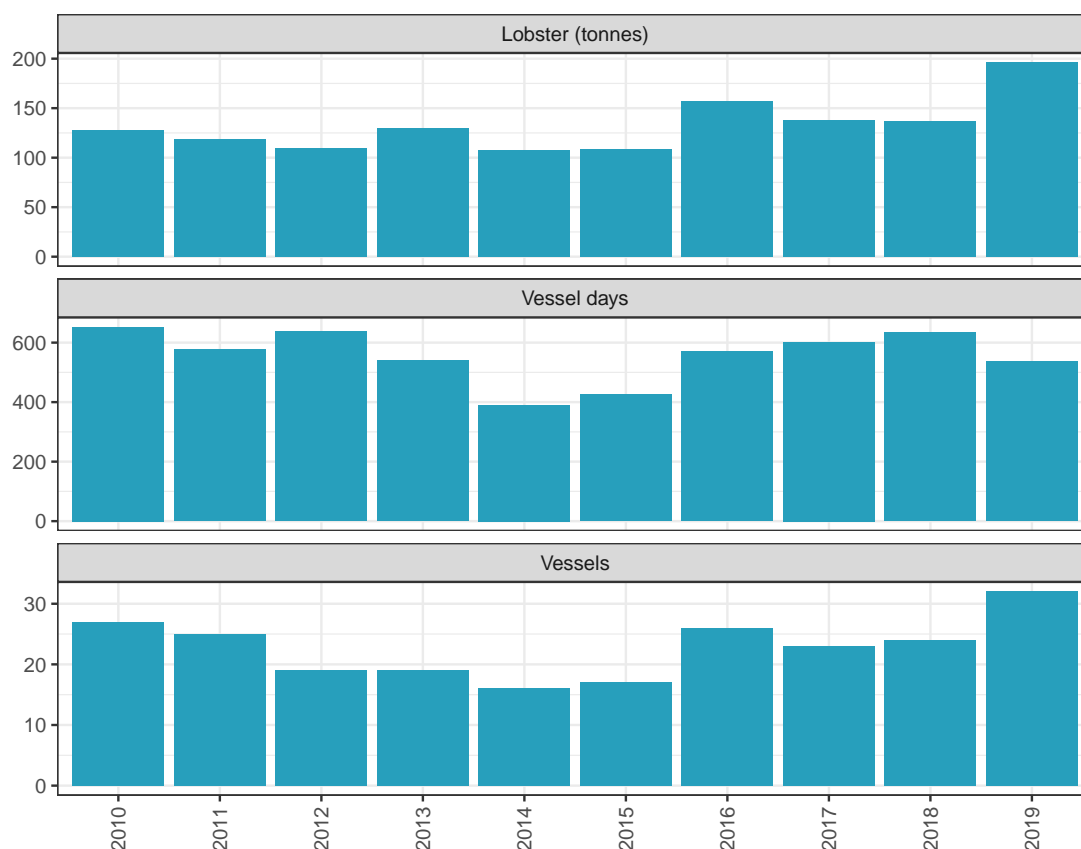


Figure 22: Annual lobster catch and fishing days by rock lobster potting (method code RLP) in Foveaux Strait from 2009/10 to 2018/19. Fishing years are indicated by the later year, for example 2008 represents the 2007/08 fishing year.

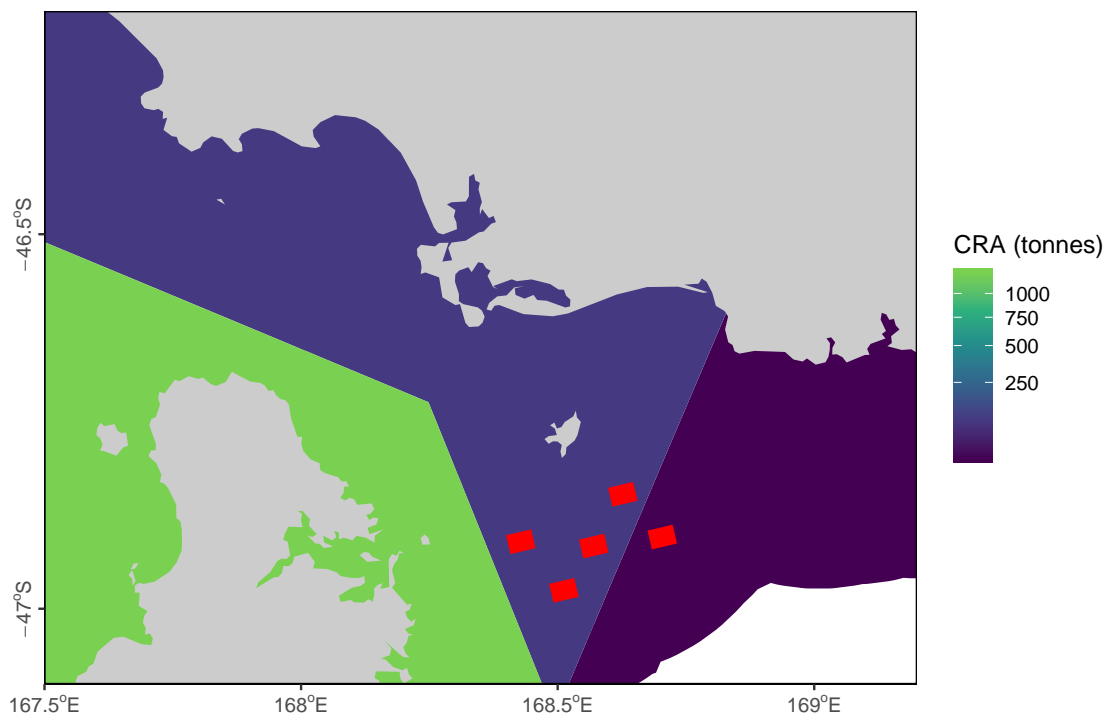


Figure 23: Lobster catch by statistical area in Foveaux Strait from 2009/10 to 2018/19.

6. RECREATIONAL FISHERIES

Foveaux Strait is within the Southland Fisheries Management Area, FMA 5. The 2017-18 National Panel Survey of Marine Recreational Fishers demonstrated that FMA 5 has the lowest number of fishers and recreational fishing trips of all the mainland New Zealand FMAs (FMA 4, the Chatham Islands, was not included in the survey), although it is one of only two areas where an increase in numbers of recreational fishers was estimated since the 2011-12 survey (Wynne-Jones et al. 2019, Tables 27, 30).

Key recreational fishing methods in FMA 5 are rod and line fishing and hand-gathering, especially by diving. While rod and line fishing is the dominant method used, net, pot and dredge fishing by recreational fishers are proportionally more important in FMA 5 than other areas. Of the finfish species harvested by recreational fishers, blue cod is the dominant species harvested (the 2017-18 estimate is 139 176 fish, or 66.86 tonnes), followed by sea perch (13.22 t) and trumpeter (over 27 000 fish), then flatfish, butterfish and blue moki (7000-9000 fish). Oysters and paua (approx. 30 t) are the key non-fish species harvested, followed by mussels and crayfish (40.96 t).

There is limited information available on the spatial distribution of recreational fishing within FMA 5. Ramp surveys within FMA 5 for the 2017-18 National Panel Survey were restricted to Bluff, and provided measurements of blue cod, rock lobster, paua, scallops and trumpeter (Davey et al. 2019). Finer scale spatial information may have been collected as part of this ramp survey but, as Stewart Island was excluded, it will not be representative of recreational fishing in Foveaux Strait.

Charter fishing for some species in FMA 5, including blue cod, hapuka/bass, bluenose and rock lobster must be reported by recreational charter operators and information on locations of charter fishing may be available in these data. However, no analyses of these data have been published, to date.

The nature of the recreational catches indicates that these are likely to be restricted to coastal areas and the central part of Foveaux Strait, and overlap with the proposed farming areas is unlikely.

7. OTHER INFORMATION ON FISH DISTRIBUTION

Trawl surveys have been carried out throughout much of New Zealand's coastal waters and Exclusive Economic Zone (EEZ). There has been relatively little trawl survey effort in Foveaux Strait (Figure 24), although dredge surveys are conducted for oysters (Michael et al. 2019). Models, fitted to the trawl survey dataset using environmental covariates, allow all areas of the New Zealand Extended Continental Shelf shallower than 2000 m to be assigned to a demersal fish classification (Leathwick et al. 2012).

A recently updated, 30-group classification (Stephenson et al. 2019) places Foveaux Strait in class 24, with the proposed farming areas lying at the boundary of this class and class 26. These are closely-related shallow depth groups that occur south of the Subtropical front, with the spatial extent of the groups extending up the east coast of the South Island where depths are similar, and also around the Chatham Islands (Figure 25).

Spiny dogfish and barracouta were key species in the classification of both groups 24 and 26, with group 24 containing red gurnard and having a higher occurrence of tarakihi, red cod and elephantfish while group 26 has a higher occurrence of hāpuka and also includes ling and witch (Stephenson et al. 2019, Table 6).

Kettles et al. (2017) describe surveys of the subtidal rocky reef communities, including reef fish, of the Foveaux Strait region, concluding that 'sites within the Foveaux Strait region are clustered in a distinct 'Stewart Island' biogeographic region' and that the rockwalls of the Foveaux Strait region have similar levels of diversity to Fiordland. Surveying extended to depths of 20 m only, so this information is limited to areas inshore from the proposed farming areas.

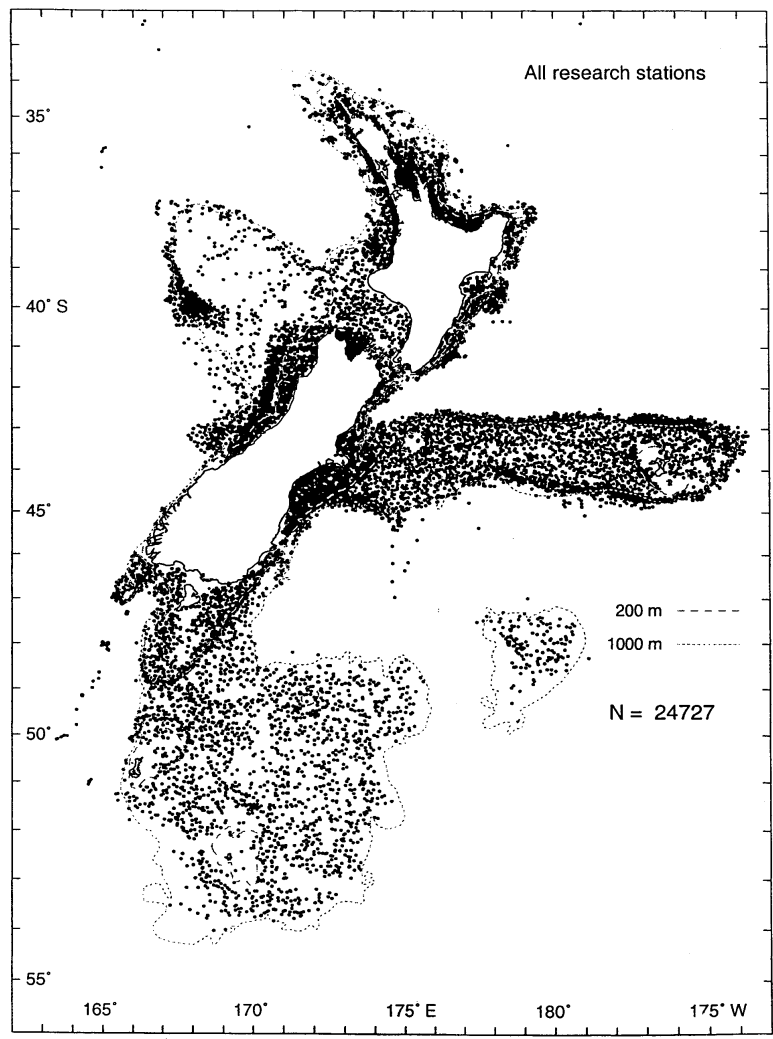


Figure 24: Positions of all research trawl stations in the Ministry for Primary Industries' trawl database as at 2003 (from O'Driscoll et al. 2003, Figure 1).

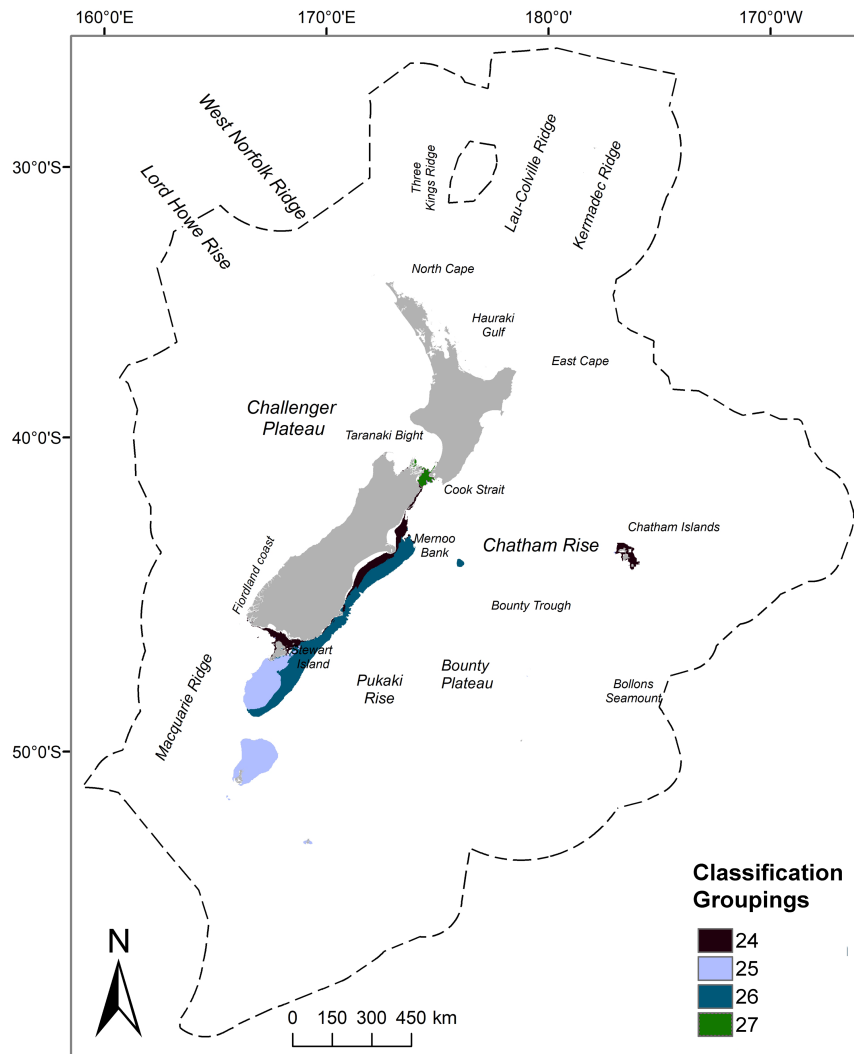


Figure 25: The geographic extents of groups 24–27 of a 30-group demersal fish classification of New Zealand waters shallower than 2000 m (from Stephenson et al. 2019, Figure 7).

7.1 White sharks

White sharks (*Carcharodon carcharias*) are found throughout New Zealand waters from the subtropical Kermadec Islands to the subantarctic waters of Campbell Island (Francis et al. 2015). Major aggregations of subadult and adult sharks occur around the Chatham Islands, and north-east of Stewart Island, associated with the feeding opportunities provided by fur seal rookeries and haulout areas.

White sharks are present in Foveaux Strait from late summer to early winter, particularly from March to June, and spend the rest of the year migrating to the tropics (Francis et al. 2015). The core aggregation site in Foveaux Strait is around the Titi Islands, but sharks do use the wider area including the waters around Ruapuke Island. White sharks are a protected species in New Zealand, but are incidentally caught in set net fisheries (Figure 26).

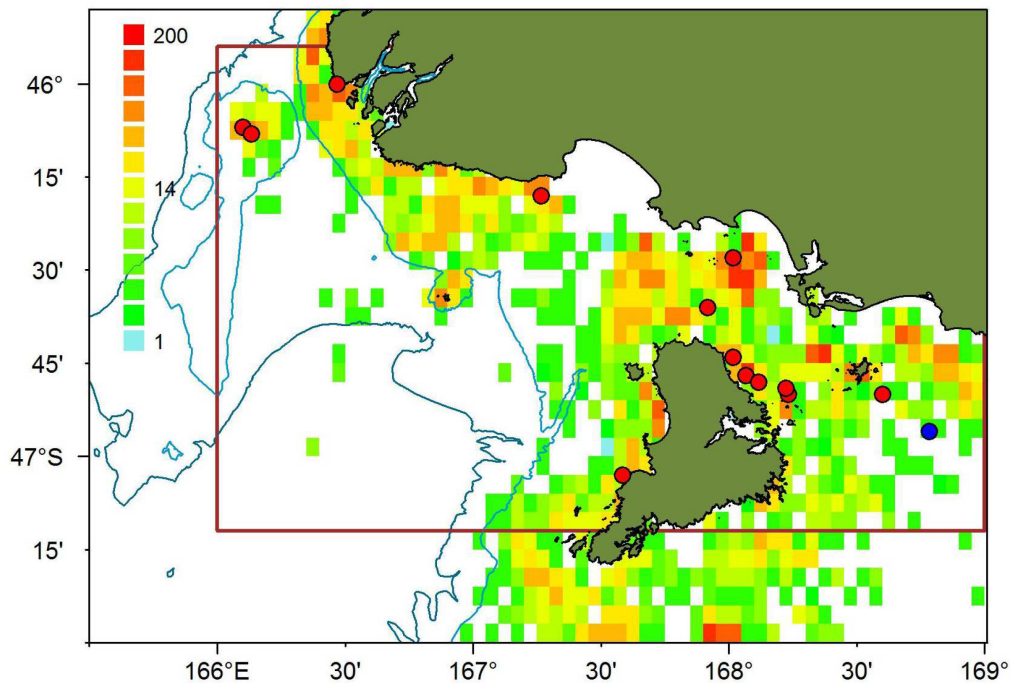


Figure 26: Set net fishing effort (colour scale, total length of net set from 2008–2016) with white shark captures in set net (red points) and trawl (blue points) (from Francis 2017, Figure 3).

8. CONCLUSIONS

The statutory catch effort data, although currently limited in spatial resolution for some methods, indicates that the only fishery which shows some overlap with the proposed marine farming areas is the bottom trawl fishery, with effort targeting red cod, stargazer and blue warehou showing the greatest overlap. The arrangement of the proposed farming areas potentially allows trawling to continue around and between the farm structures. It is likely that there is no significant overlap with the blue cod pot fishery, the Bluff oyster fishery, set net fisheries, the paua and lobster fisheries or recreational fishing.

A classification of demersal fish assemblages places the proposed farming areas within intermediate-shallow depth groups south of the Subtropical Front. The same assemblages extend up the east coast of the South Island. White sharks are known to aggregate in Foveaux Strait from late summer to early winter.

9. ACKNOWLEDGEMENTS

Kim George of the Ministry for Primary Industries reviewed the fisheries characterisation presented in this report for consistency with MPI Guidelines on the use of statutory fisheries data. MPI has not reviewed the conclusions relating to overlap of fishing and the proposed marine farming areas.

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APPENDIX A Reporting codes

Table A-1: Fishing method reporting codes used in this report.

| Code | Fishing method |
|------|------------------------------------------------------------------|
| BLL | Bottom longlining |
| BPT | Bottom trawl—pair |
| BS | Beach Seine/Drag nets |
| BT | Bottom trawl—single |
| CP | Cod potting |
| CRP | Crab potting |
| D | Dredging |
| DI | Diving |
| DL | Drop/dahn lines |
| DN | Inshore drift netting |
| EP | Eel potting (Hinaki) |
| H | Handgathering |
| HL | Handlining |
| L | Lampara |
| MH | Mechanical harvesting |
| MW | Midwater trawl—single |
| OCP | Octopus potting |
| RLP | Rock lobster potting |
| SJ | Squid jigging |
| SN | Set netting (including Gill nets) |
| UBS | Diving utilising surface-supplied underwater breathing apparatus |

Table A-2: Species reporting codes used in this report.

| Species code | Description |
|--------------|----------------------------------|
| BAR | Barracouta |
| BCO | Blue cod |
| BUT | Butterfish |
| CAR | Carpet shark |
| CON | Conger eel |
| CRA | Spiny red rock lobster |
| ELE | Elephant fish |
| FLA | Flatfish |
| GUR | Gurnard |
| HPB | Hapuku and bass |
| JAV | Javelinfish |
| JMA | Jack mackerel |
| LEA | Leatherjacket |
| LIN | Ling |
| MOK | Blue moki |
| OCT | Octopus |
| OYU | Oysters, dredge (Foveaux Strait) |
| PAU | Blackpaua & yellowfoot paua |
| RAT | Rattails |
| RCO | Red cod |
| RSK | Rough skate |
| SCH | School shark |
| SEV | Broadnose sevengill shark |
| SNA | Snapper |
| SPD | Spiny dogfish |
| SPO | Rig |
| SQU | Arrow squid |
| SSK | Smooth skate |
| STA | Giant stargazer |
| SWA | Silver warehou |
| TAR | Tarakihi |
| TRU | Trumpeter |
| WAR | Common warehou |
| WSE | Wrasses |