Fisheries New Zealand

Tini a Tangaroa

Inshore trawl survey off the west coast North Island, February-March 2025 (KHR2502)

New Zealand Fisheries Assessment Report 2026/09

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PLAIN LANGUAGE SUMMARY

This report presents the results from the first inshore trawl survey onboard the new research vessel *Kaharoa II*.

The survey extended from Scott Point on Ninety Mile Beach to Airedale Reef, to the north of New Plymouth, covering a depth range from 10–200 m, and was conducted from 13 February to 04 March 2025. There was no sampling within 2–4 nautical miles of the coast between Maunganui Bluff and the Waiwhakaiho River, New Plymouth, in the no-trawl area established to protect the Māui dolphin. The target species for the survey were snapper, red gurnard, John dory, and tarakihi.

All 67 planned Phase 1 stations were completed, followed by three Phase 2 tows for improving the coefficient of variation for tarakihi. Everything that is caught in the trawl is sorted, identified, and weighed. Length and maturity data are collected for selected species and otoliths (fish ear stones) are removed for ageing from the four target species. The trawl survey provides relative abundance estimates and age, length, and maturity stage information used for stock assessments and fisheries management advice for key inshore species.

Snapper catches were much smaller and concentrated much closer inshore than in previous west coast North Island surveys, which had been carried out in October-November. The results suggested that in late summer a significant proportion of the population, particularly older adults, remained in very shallow coastal areas that are largely closed to trawling and therefore not fully covered by the survey. As such, the February timing is not optimal for a snapper survey, although younger age classes (< 30 cm) were still sampled reasonably well. Catches were also low for the three other target species and some other QMS species also.

Based on these results, it was recommended by the Inshore Working Group that future surveys are carried out in autumn, starting in 2026.

EXECUTIVE SUMMARY

Jones, E.G.[1]; Bian, R.[1]; Walsh, C.[2]; Underwood, M.J.[1] (2026). Inshore trawl survey off the west coast North Island February-March 2025 (KHR2502).

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The 2025 trawl survey of the west coast North Island was the first trawl survey onboard the new vessel, RV *Kaharoa II* with a new trawl design, and the first to be carried out in February-March. The survey extended from Scott Point on Ninety Mile Beach to Airedale Reef, to the north of New Plymouth, covering a depth range from 10–200 m. There was no sampling within 2–4 nautical miles of the coast between Maunganui Bluff and the Waiwhakaiho River, New Plymouth, in the no-trawl area established to protect the Māui dolphin. The target species for the survey were snapper, red gurnard, John dory, and tarakihi.

The 2025 survey was carried out between 13 February to 4 March and used a stratified two-phase design. All 67 planned Phase 1 stations were completed, along with three Phase 2 tows to improve the coefficient of variation (CV) for tarakihi. There were 58 species recorded in total, with snapper by far the most abundant. Biomass estimates (in tonnes) for the key species across the whole survey were: snapper, 2871 t (CV 12.6%); red gurnard, 184 t (19.6%); tarakihi, 242 t (29%); John dory, 147 t (14.1%). Comparison of the 2025 relative biomass estimates with those from the previous spring (October–November) time series for the core and extended core (including deep strata) areas, along with catch distributions, population length frequencies, and summary information on reproductive status for the four target species, are presented.

Catch rates for snapper in February were much lower than previous spring surveys, with a more inshore, shallower spatial distribution. The 2025 survey results suggest that a large proportion of the snapper population remain closer inshore in February and early March, within the Maui dolphin no trawl zone, and therefore largely outside the survey area except for strata to the north of Maunganui Bluff. This was particularly apparent for the larger, older adults (> 5 years), and this survey most likely still monitors the younger age cohorts (3+, 4+ and 5+ year classes) that have previously been utilised in the stock assessment.

Low catch rates were also observed for the three other target species, particularly red gurnard, for which the very low relative biomass estimate also had a high CV compared to previous surveys. There was also an apparent change in tarakihi distribution, with very few fish caught in areas other than the three key strata, A200 and F150 and F20M. Lower catch rates and biomass estimates were also recorded for barracouta, school shark, and spiny dogfish, compared to recent spring surveys, whilst higher or similar catch rates and biomass estimates were recorded for trevally, rig, and kahawai. Changes in catch rates and abundance are confounded by changes to the survey vessel and gear so were not comparable to those from previous surveys.

Good weather for much of the survey enabled some opportunistic gear trials to be completed, which informed a decision to extend sweep lengths from 55 m to 110 m for the west coast South Island intercalibration and future surveys.

Based on the 2025 survey results, a recommendation was made by the Inshore Working Group to move the timing of the next west coast North Island survey in 2026 to autumn (April).

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1. INTRODUCTION

1.1 Background

The west coast of the North Island (WCNI) is the second largest fishery for snapper (*Chrysophrys auratus)* (SNA 8), and a key area for tarakihi (*Nemadactylus macropterus)* (TAR 1 & 8), red gurnard (*Chelidonichthys kumu)* (GUR 1 & 8) and John dory (*Zeus faber)* (JDO 1 & 2). These fisheries have provided a combined average of $12.2 million in direct annual landing revenue over the last 5 years for the west coast North Island (WCNI). Standardised trawl surveys in this area were first carried out in 1986, continuing until 1999 (Jones et al. 2022). The survey was reinstated in 2018, using the same stratification (subsequently adjusted to account for trawl exclusion zones to protect Maui dolphin), timing, vessel, and gear specification to enable comparison with the historical surveys. This provided a fishery-independent way to validate the SNA 8 CPUE index which has been unable to fully account for changes in the fishing fleet and fishing operational changes, as well as providing valuable information on other key quota management system (QMS) species (Jones at al. 2022). A series of four surveys were completed between 2018 and 2022, with a core area defined and compared to five of the seven historical surveys, extending the time series back to 1989 (Jones et al. 2022, 2023, 2024). This series provided indices of abundance for juvenile and adult snapper, red gurnard, John dory, and tarakihi, as well as useful information on other species such as rig (*Mustelus lenticulatus*), trevally (*Pseudocaranx georgianus*), barracouta (*Thyrsites atun*), school shark *(Galeorhinus galeus)*, and spiny dogfish (*Squalus acanthias*). (Jones et al. 2023). The survey data also supports a number of fisheries management objectives such as maintaining biodiversity; the National Plan of Action for Sharks (New Zealand Government 2022); and other aspects of ecosystem-based management plans. The wider trawl survey data may also be of value to research in support of Principle 2 (ecosystem impacts) through provision of broader fish community composition data and records of benthic invertebrate diversity.

For snapper, the 2, 3, 4 and 5 year-class strength indices have been used in the most recent SNA 8 stock assessments (Langley 2020, 2021, 2024), which have indicated that fishing mortality is at or below the target and that biomass is likely to continue to increase over the next 5 years, assuming 2023 catch levels (Langley 2024). However, the utility of the survey-derived adult snapper biomass indices in the stock assessment has been limited due to variability in catchability. This was driven largely by the variation in the extent to which snapper were aggregating and moving into shallow water to spawn. This was most apparent in the later timed 2018 survey (November–December) but remained an issue even with the earlier timed surveys, which is likely to be due to interannual variation in water temperatures and other environmental factors that influence snapper maturation and spawning movements during the October period (Jones et al. 2024).

A change to the timing of the survey to be carried out in the summer period when availability of snapper was presumed to be less variable was recommended by the Inshore Working Group in 2024. This also allowed sampling in the South Taranaki Bight and Kapiti Coast strata to align more closely with the survey of the west coast of the South Island, enabling joint monitoring of snapper in both SNA 8 and SNA 7 during the summer/autumn period of the same year. This alignment with the west coast South Island survey has resulted in the "southern strata" (those to the south of New Plymouth) being taken out of the west coast North Island survey from 2025 onwards (Underwood et al. 2026). In order to complete the west coast North Island, the South Taranaki Bight "southern strata" (renamed west coast central) and then carry on to start the west coast South Island survey, the WCNI survey was planned to start in mid-February to early March, followed by the strata south of New Plymouth surveyed immediately before the start of the west coast South Island survey in late March and April.

The change in timing occurred at the same time as the RV *Kaharoa* was being replaced with a new research vessel (*Kaharoa II*), which has necessitated an intercalibration of the two vessels and provided an opportunity to change other aspects to standardise survey gear and protocols across all inshore trawl surveys. A new trawl net design has been adopted that uses more modern materials along with newer, more efficient trawl doors. The design process included a series of discussions with input from inshore fishers, NIWA scientists involved in the inshore surveys, NIWA vessel skippers, and net makers (Motueka Nets). The key objectives were to design a trawl that was suitable for the range of target species and sea floor conditions of all the ongoing inshore trawl surveys as well as being more aligned with modern commercial trawl net design and materials. As part of this process, the majority decision was to prioritise a design closer to the 2-panel South Island trawl survey rather than the 4-panel high-opening bottom trawl (HOBT) trawl net used in the North Island surveys. This alignment has also resulted in the codend mesh size being increased to match to the South Island trawl survey. Additional changes adopted include reducing tow lengths in all surveys to 1.5 n. mile, and an increase of tow speed to 3.4 knots. This speed is measured as speed through water (STW), rather than speed over ground (SOG). Standardising the towing speed in this way reduces variation in efficiency of the trawl under different tidal conditions since fish swimming performance is also affected by whether they are swimming into or with water flow. These changes were agreed by majority decision at a meeting of the Inshore Working Group on 14 October 2024. Whilst an intercalibration exercise was required for the South Island surveys to continue their time series, the change in timing for the west coast North Island survey negated the need for an intercalibration and the 2025 survey was intended as the start of a new time series for this area covering the core and extended core (out to 200 m) strata north of New Plymouth only.

1.2 Project objectives

This research was carried out for Fisheries New Zealand research project INT2024-01: Inshore trawl surveys (WCNI, WCSI, ECSI).

Overall objective

To determine the relative abundance and distribution of inshore finfish species off the west coast of the North Island in the 2024–25, 2025–26, 2026–27 and 2028–29 fishing years; focusing on snapper (*Chrysophrys auratus*), tarakihi (*Nemadactylus macropterus*), red gurnard (*Chelidonichthys kumu*), and John Dory (*Zeus faber*).

Specific project objectives

1. To determine the relative abundance and distribution of snapper, tarakihi, red gurnard and John dory off the west coast of the North Island in summer (February) in 2025, 2026, 2027, and 2029 by carrying out trawl surveys over the depth range 10 to 200 m. The target coefficients of variation (CVs) of the biomass estimates for these species are as follows: snapper (20%), tarakihi (20–25%), red gurnard (20%), and John dory (20%).
2. To collect the necessary data and determine the length frequency, length-weight relationship and reproductive condition of snapper, tarakihi, red gurnard and John dory.
3. To collect otoliths from snapper, tarakihi, red gurnard, and John dory.
4. To age snapper and tarakihi otoliths collected on the surveys.
5. To collect the data to determine the catch weight of all species caught and the length frequencies and spawning condition of all other Quota Management System (QMS) species.
6. To identify benthic macro-invertebrates collected during the trawl survey.
7. Broader Outcomes.

2. METHODS

2.1 Survey area, design and timing

The survey area extended from Scott Point in Northland to Airedale Reef just to the north of New Plymouth (Figure 1). The depth range covered by the survey is 10–200 m, but between Maunganui Bluff and Airedale Reef, many of the shallower inshore strata have been reduced or removed as they are inside areas where commercial trawling is now prohibited to protect Māui dolphin and where the survey no longer samples (Jones et al. 2023). A core area has previously been defined for the purposes of the snapper stock assessment, between Airedale Reef and Scott Point out to 100 m, for which there is a time series of nine previous surveys across 33 years.

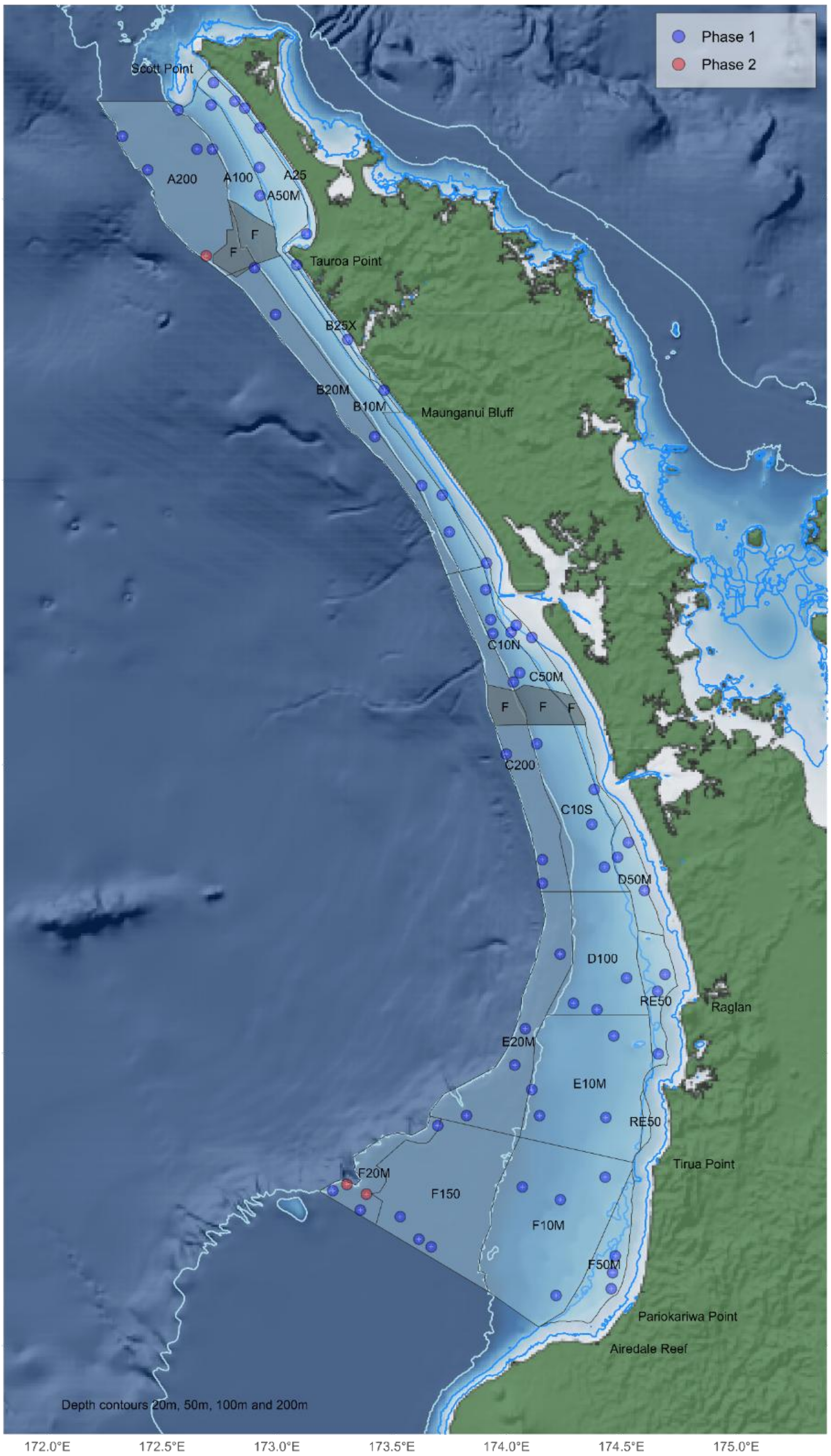

Figure 1: The 2025 west coast North Island (WCNI) survey area showing strata boundaries, with foul or excluded areas withing the survey area in grey. The depth contours of 20 m, 50 m, 100 m and 200 m are shown. The location of 2025 successful trawl stations are shown: Phase 1 stations are indicated in blue; Phase 2 stations in red.

For the start of the new series, there was an opportunity to review the stratification of the northern strata and consider any improvements that could be made. Two of the previous 18 strata have been split into two parts, agreed at the Inshore Working Group on 29 January 2025. Stratum C100 was divided into two strata separated by the cable zone, effectively separating the areas offshore from the Kaipara and Manukau Harbours where high abundance and variability of snapper catches have been observed in previous spring surveys. The large deepwater stratum, F200, has also been an area of highly variable tarakihi catches, which are typically found in the deeper part of the stratum. At the recommendation of the Inshore Working Group, this stratum was split into two strata along the 150 m depth contour. These changes are shown in Figure 1, with updated stratum areas in Table 1. The total area covered by the 2025 survey was 20 977 km^2.

Table 1: Details of stratum depth range and area, with numbers of planned and completed Phase 1 and Phase 2 stations for the 2025 WCNI survey. Stratum locations are shown in Figure 1. Blue shaded rows indicate the core strata.

Stratum	Depth (m)	Area (km^2)	Phase 1 stations Planned	Phase 1 stations Completed	Phase 2 Completed	Total Completed
A25	10–25	253	3	3		3
A50M	25–50	968	3	3		3
A100	50–100	621	3	3		3
B25X	10–25	127	3	3		3
B10M	50–100	1 234	3	3		3
C50M	25–50	462	4	4		4
C10N	50–100	461	4	4		4
C10S	50–100	1265	4	4		4
D50M	25–50	372	3	3		3
RE50	25–50	489	3	3		3
D100	50–100	1 308	3	3		3
E10M	50–100	2 292	4	4		4
F50M	25–50	592	3	3		3
F10M	50–100	2 637	4	4		4
A200	100–200	1 812	4	4	1	5
B20M	100–200	1030	3	3		3
C200	100–200	1 039	3	3		3
E20M	100–200	1 465	4	4		4
F150	100–150	2075	3	3		3
F20M	150–200	477	3	3	2	5
Total		**20 977**	**67**	**67**	3	**70**

The survey design was a two-phase stratified random sampling design (Francis 1981, 1984). Without any trawl survey data for the new time of year, three or four Phase 1 stations were allocated to each stratum, informed by a qualitative review of commercial catches in the survey area for February and March from recent years (2022–24), giving a total of 67 Phase 1 stations. This is within the range of stations previously required (64–83) to achieve target CVs for snapper, red gurnard, and John dory (the target CV for tarakihi has not always been achieved) during the most recent spring WCNI surveys in this northern area and allowed scope for Phase 2 stations if needed. The total number of stations completed in the 2022 survey in this northern area was 75 with some time lost to poor weather (Jones et al. 2024), and this was estimated to be the maximum number of stations likely to be achieved if a similar number of stations per day with the new vessel and trawl net were assumed.

Station positions were randomly generated using Earth Sciences NZ's custom software '*RandomStation*' (Doonan & Rasmussen 2017). The stations were required to be a minimum of 2 n. miles (3.7 km) apart with a boundary exclusion of 0.5 n. miles. Non-trawlable (foul) areas were excluded from the station generation program. Enough stations to cover both the first and second phases of the survey were generated.

Once Phase 1 stations were completed, provisional relative biomass estimates and CVs were calculated for the four target species using the Earth Sciences NZ's *SurvCalc* program (Francis & Fu 2012) and the area-swept method described by Francis (1981, 1989) to determine whether any Phase 2 stations were required. Phase 2 stations were allocated to strata with the highest variance for the target species where the CV was higher than the specified target in order of species priority (snapper, tarakihi, gurnard, and John dory). Given the remote location of some strata in this survey, there is a precedent that pre-emptive Phase 2 stations may be carried out if there is cause to believe those strata may attract Phase 2 stations and be difficult to return to at a later stage in the survey.

The 2025 survey took place from 13 February to 4 March. This timing allowed the strata to the south of New Plymouth to be surveyed immediately afterwards, followed by the west coast South Island survey in mid-March, as per previous years. Phase 1 stations were carried out in the most practical way to limit steaming distance and/or as dictated by weather conditions and fish offload requirements. Where feasible, the hours of darkness were used for steaming between sites and surveying new tows (i.e., mapping areas of the seafloor immediately surrounding the trawl stations).

2.2 Vessel, gear, and trawling procedure

The new research vessel *Kaharoa II* (36 m stern trawler, beam of 9.5 m, gross tonnage 499 t, engine power of 956 kW) and the newly designed two-panel wing trawl (Motueka Nets) were used for the 2025 survey (see Appendix 1 for net plan). The trawl has a headline length of 25.6 m and a fishing line length of 32.4 m, with mesh sizes of 150 mm in the wings and body of the trawl and 120 mm in the taper. The codend mesh was 60 mm, with a twine thickness of 6 mm and chaffing gear on the bottom panel. This is a larger mesh with thicker twine compared to the previous North Island survey trawl codend (40 mm mesh size with 2.5 mm twine). The net was fished with 55 m long sweeps and bridles and 4.41 m^2 (883 kg) Thyboron trawl doors.

All tows were conducted during daylight hours (generally between 06:00 and 19:00 NZST) at the stratified randomly allocated station positions. The direction of the tow was determined by a combination of factors, including weather conditions, tides, depth contours, but was usually in the direction of the next planned station. Where untrawlable ground was encountered, the area within a 2 n. mile (3.7 km) radius of the station was searched for suitable ground. If no suitable ground was found, the next alternative station from the random station list was selected.

A Marport net monitor on the headline provided headline height measurements, Marport doorspread sensors provided distance measurements between the trawl doors, and a bottom contact sensor (Zebratech) was mounted in the centre of the ground rope. Additional depth sensors were mounted on the headline and the footrope during selected tows to allow an alternative estimation of the opening height of the net. An RBR turbidity sensor was also mounted behind the headline. As part of the Māui dolphin mitigation plan put in place for this survey, a Dolphin Dissuader Device (DDD) was also mounted on the headline of the net. The plan also included keeping a look out for Māui's dolphins prior to and during trawling activity, and a move-on rule of at least 5 n. mile if a Māui dolphin was sighted. On completion of each tow, a Secchi disc was lowered overboard to provide an estimate of surface water transparency. Fisheries echosounder data were collected continuously during the survey.

Standard tows were of 1.5 n. mile distance measured by GPS, with a minimum acceptable tow distance of 0.8 n. mile. The tow was deemed to have started when the net monitor indicated that the net was stable on the bottom and was completed when hauling began. A warp length of 200 m was used for all tows less than 70 m depth with a warp to depth ratio of 3:1 thereafter, with some allowance to adjust warp length if needed to achieve expected door spread. The target tow speed was 3.4 knots (faster than the 3.0–3.2 knots used on the previous survey), measured as speed through water (STW) rather than speed over ground (SOG). Tow speed was measured using the vessel's acoustic doppler log. Tow speed, doorspread, and headline height were recorded manually at 5-minute intervals, as well as through the *Kaharoa II* DAS system to provide average values over the tow with station data captured electronically in the "Trawl Coordinator" program.

2.3 Catch and biological sampling

The catch from each tow was sorted into species and weighed on electronic motion-compensating Marel scales to the nearest 0.1 kg. Length frequency sampling procedures followed those described by Stevenson & Hanchet (1999). Sample sizes were either the whole catch or a randomly selected subsample of up to 100–200 fish, depending on species, for each of the target species and any other Quota Management System (QMS) species, and, where time allowed, for commercially important non-QMS species. Individual fish length was measured to the nearest centimetre below the actual length using electronic measuring boards and the appropriate measurement method for each species (e.g., fork length, total length, pelvic fin length).

For the target species (snapper, tarakihi, red gurnard, and John dory), more detailed biological data were collected on a random sub-sample on each tow. For red gurnard and snapper, the biological sub-sample size was up to 20 fish. For tarakihi, and John dory, the sub-sample size was up to 30 fish. Information collected included length to the nearest millimetre (mm), sex, weight (to nearest 10 g), otoliths and gonad stage. Additional biological information was collected for all other QMS species, when time allowed. The reproductive condition of finfish was assessed by recording macroscopic gonad stages using the middle depths 'MD' seven-stage scale for teleosts and using the sharks and skates 'SS' staging guide for elasmobranchs (Appendix 2).

The otoliths that were collected for the four target species from the random sample selected for additional biological information, were dried, and stored in suitably labelled envelopes at sea for further processing and storage ashore. For snapper, additional targeted sampling of larger (> 45 cm) individuals from the length frequency sample was carried out to ensure that sufficient otoliths were collected in these less common size classes.

All catch and biological sampling data were captured electronically in the "Trawl Coordinator" program, allowing for error checking routines using an Earth Sciences NZ custom R-shiny application.

2.4 Trawl survey data analysis

Following completion of the voyage, all data were further error-checked using standard routines and entered into Fisheries New Zealand's *trawl* database. Catch rates (kg km^{-2}) by station and stratum, relative biomass estimates, and population scaled length frequency distributions and their associated CVs were estimated by the area-swept method (Francis 1981, 1989) using *R-SurvCalc* in R (R Core Team, 2025), an updated version of the C++ trawl survey analysis program *SurvCalc* (Francis & Fu 2012) for the four target species and selected non-target QMS species where sufficient data had been collected. The selection criteria for these additional species were based on those used in the previous review of the historical surveys, which was a minimum of 200 kg caught in at least half of all surveys and at least 100 kg catch in the remaining surveys (Morrison et al. 2001).

The following assumptions were made for calculating biomass estimates:

1. Area swept during each tow equalled the distance between the doors multiplied by distance towed.
2. All fish within the swept area were caught and there was no escapement; vulnerability was 1.0.
3. All fish in the water column were below the headline height and available to the net; vertical availability was 1.0.

4. The fishstock being sampled was entirely within the area at the time of the survey; areal availability was 1.0.
5. Within the survey area, fish were evenly distributed over both trawlable and non-trawlable ground.

It is unlikely that all of these assumptions are correct, but they have been adopted for other previous and current trawl surveys of relative biomass (Stevenson & Hanchet 1999) and have been applied consistently to the previous trawl survey time series. Assumption 5 refers only to occasional foul ground encountered within the strata as some areas of foul have been excluded from the survey area. This exclusion differs to some other survey time series, such as the South Island inshore trawl series, where the areas of foul are included in the stratum areas and used for scaling up biomass. Given the above conditions, the biomass estimates generated are classed as relative indices of abundance.

Relative biomass estimates were calculated for each individual stratum as defined for the current survey. These were then combined to produce a survey biomass estimate for the 2025 survey. With the strata south of Airedale Reef (previously referred to as the "southern strata") excluded from the new time series, results are presented for two areas only.

- the core northern area (strata north of Airedale Reef, 10–100 m);
- the extended core: core + deeper northern area (strata north of Airedale Reef, 10–200 m depth).

Length frequencies for target and selected QMS species were scaled by the percentage of the catch sampled, area swept, and stratum area (Francis 1981, 1989) and are presented by sex for the whole survey and some or all sub-areas, where relevant. The geometric mean functional relationship was used to calculate the survey-specific length-weight coefficients for species where sufficient data were collected. For species where insufficient length-weight data were collected, coefficients were determined from the combined WCNI survey series, or by combining with the WCSI survey data. (Appendix 3). Sex ratios were calculated using scaled population numbers and were expressed as the ratio of males to females.

For the purposes of calculating recruited sub-population biomass estimates, recruited lengths were determined from either minimum commercial legal size, the size at which 50% of fish mature (sourced from the literature), or minimum lengths considered desirable for sale. For instance, there is no minimum legal size for rig and school shark, but a recruited length of 90 cm is used based on previous conversations with South Island Industry sources (Dan MacGibbon, Earth Sciences NZ, pers. comm.). Recruited lengths for jack mackerel species were 25 cm based on information available on the mesh size of the midwater trawl fishery in JMA 7 (Peter Horn, formerly NIWA, pers. comm.) and for kahawai, 40 cm was used (Bruce Hartill, Fisheries New Zealand, pers. comm.). For red gurnard, the recruited length was 30 cm to be consistent with the South Island trawl survey time series (MacGibbon et al. 2022, Beentjes et al. 2022). For John dory, the minimum legal size of 25 cm was used.

The reproductive state data collected were summarised by length category (10-cm intervals) for each of the target species and additional species where enough data were collected. For target species, numbers by 1 cm length class have also been presented.

2.5 Ageing of snapper and tarakihi

Snapper age determination

A subsample of the snapper otoliths collected at sea were selected and aged. A sample size of 600 otoliths (including deep strata) was considered consistent with historical surveys, with a target mean weighted CV of less than 20% across all age classes. Otoliths were randomly selected from 1-cm length bins with samples proportional to the scaled population length frequency for the survey. This was then adjusted to under-sample younger year classes with clear age modes (e.g., 0+ and 1+) and allow the supplementary selection of otoliths in larger size classes known to be highly variable in age.

The selected otoliths were prepared and aged using standardised protocols, outlined by Walsh et al. (2014). Preparation followed the break and burn technique (Chugunova 1963) and sectioned otoliths were then viewed under a low power stereomicroscope to count the zones on the surface. The forced margin method was implemented to anticipate the otolith margin type (wide, line, narrow) *a priori* based on the month in which the fish was sampled to provide guidance in determining age; 'wide' readings are increased by 1 year (e.g., 3W is aged as a 4 year old) whereas 'line' and 'narrow' readings remain the same as the zone count. The theoretical birthdate for ageing snapper is 1 January, following Paul (1976), and, to be consistent with past trawl survey snapper ageing, otoliths for this survey are aged as plus groups (i.e., 0+, 1+) as of the collection date (February–March 2025).

In a change to previous surveys, otoliths were read using a single reader method but incorporating an audit of the primary reader by a second experienced reader. Both readers read a random 20% sub-set of otoliths from the full set, each having no prior knowledge of the other's obtained zone count. For otoliths where both readers agreed on the zone count, the age was determined from this count. When readers disagreed, the otolith was re-examined to determine the likely source of disagreement and a final count agreed upon. A target of 90% match between primary reader initial and final-agreed ages as derived from a double-reading-conferring process was used to determine whether or not the audit sample should be expanded to include more otoliths.

Tarakihi age determination

The numbers of tarakihi sampled during west coast North Island surveys is not high enough to warrant sub-sampling and all otoliths collected were aged. Otoliths were prepared and read in accordance with the age determination protocol for tarakihi (Walsh et al. 2016). This included thin-section preparation of the otoliths and application of the forced margin method to anticipate the otolith margin type (wide, line, narrow) *a priori*, based on the month in which the fish were sampled, to provide guidance in determining age. Determining the maximum dorsal-ventral width of the year one zone was used to ensure accurate counts of successive opaque zones. The theoretical "birthday" for tarakihi is 1 May (Walsh et al. 2016).

As for snapper, otoliths were read by a single primary reader along with an audit by a second experienced otolith reader with the same target of 90% match between primary reader initial and final-agreed zone counts.

Once read, both snapper and tarakihi otoliths, along with those collected (but not aged) from the two other target species, were inventoried on the Fisheries New Zealand *age* database and archived at ESNZ, Wellington.

Catch-at-length-and-age analysis

The final snapper and tarakihi age and length data were used to form age-length keys (ALKs) using Earth Sciences NZ catch-at-length-and-age analysis software tool CALA (Francis & Bian 2011), which has been implemented in the R-programming language, instead of the C++ version used previously. The age-length key was assumed to be representative of the February and March period. The main assumption of an age-length key is that the sample was taken randomly with respect to age from within each length interval (Southward 1976) and this assumption was met. The ALKs were then applied to the population-scaled length frequency distributions. The coefficient of variation for each length and age class and overall mean weighted CV (MWCV) for each distribution was estimated in CALA using a bootstrapping routine where fish length records are resampled within each catch, catches are resampled within each stratum, and the age-length data are resampled, all with replacement. The bootstrap length-and age-frequency distributions were computed for each resample, and MWCVs computed from the bootstrap distributions. Age frequency distributions were generated for the core area for snapper and the extended core area for both species using the age-length keys.

Otolith reading precision was quantified by carrying out within and between-reader comparison tests, after Campana et al. (1995), on the subset of otoliths read by both readers, including those between each reader and the final agreed age. The Index of Average Percentage Error, IAPE (Beamish & Fournier 1981), and mean CV (Chang 1982) were calculated for each test.

2.6 Benthic macro-invertebrate collection and identification

Benthic invertebrates were weighed and identified at sea to phylum or species level if known, with unidentified specimens retained for later identification ashore. Specimens were placed in sealed plastic bags with a label noting the trip code and station number and frozen and, on return, were held in the appropriate facilities depending on the location of capture; frozen samples collected outside 12 n. miles were required to be listed under a biosecurity permit and stored at an approved biosecure freezer once landed. These samples were processed by Earth Sciences New Zealand's National Invertebrate Collection team, with all specimens recorded in the SPECIFY database and distributed to specialist taxonomists for identification to species, where possible (certain groups do not have specialist taxonomists in New Zealand). On completion, both SPECIFY and *trawl* (where feasible) databases were updated with identifications.

2.7 Broader outcomes and additional data collection

The project committed to supporting women in science through their inclusion in all parts of the project and building capacity and capability in the research sector through mentoring and training. Data collection and collaboration that was in addition to the specific objectives was also undertaken as part of our commitment to broader outcomes:

- Physical data (temperature and salinity) using a net-mounted Seabird Microcat CTD datalogger.
- Water clarity data collected using a Secchi disc deployed after each trawl station.
- Turbidity data collected from the first trial of using a net-mounted turbidity sensor.
- Fisheries acoustic data recorded on *Kaharoa II's* hull-mounted Simrad EK80 multifrequency echosounder.
- Tissue samples and otoliths for ecological and genetic-based population studies of kingfish (*Seriola lalandi lalandi*) and John dory being carried out by PhD students at Victoria University of Wellington.
- Collection of prey species of Māui dolphins to investigate the presence of *Toxoplasma* parasite eggs in gills and gut (Massey University).
- Tarakihi tissue samples for a genetic study (University of Tasmania).
- Educational resources for outreach programmes in a local New Zealand school.

Environmental data

The Seabird Microcat CTD (conductivity, temperature, depth) recorded water temperature and salinity profiles at 5 s intervals for the duration of each tow, but only single values for surface and bottom temperatures were stored in the *trawl* database. Surface temperatures were taken at a depth of 5 m below the surface. Bottom temperatures were taken at about 4.5 m above the sea floor because that is the approximate headline height of the trawl where the CTD is mounted. Full temperature profiles are stored in the *ctd* database and uploaded to the World Ocean Database hosted by NOAA.

Acoustic data

Acoustic data were continuously collected from the surface to the seabed using the *Kaharoa II* Simrad EK80 multifrequency (18, 38, 70, 120, and 200 kHz) echosounders. All 38 kHz data were collected with a transducer power output of 2000 W. Transmitted pulse length was 1.024 s with a ping interval of 0.5 s (i.e., ping rate of 2 pings per second). A logbook was used to keep record of acoustic files and related activities, enabling the acoustic data to be partitioned into data collected during steaming and trawling activities. All acoustic data were uploaded to the Fisheries New Zealand *acoustic* database on completion of the survey. The echosounder system was calibrated after this voyage, on the WCSI survey in April 2025 following standard procedures (Demer et al. 2015).

Gear performance trials

The 2025 WCNI trawl survey was the first to use the newly designed trawl net following initial gear trials completed in January 2025. The performance of the new trawl net was established during those gear trials, however, trials on species catchability were not feasible. During the WCNI survey and the west coast central survey, further trial tows were undertaken with prior agreement from Fisheries New Zealand. Where possible, these tows were carried out when insufficient time was available to reach the next survey station before the end of a day. In addition, two days (26–27 February) were dedicated to a comparison of the effect of using longer sweeps of 110 m on gear performance metrics including sweep angle, and on catch rates. For these trials, an alternate paired tow approach was used at the station position, with the second tow conducted along a track parallel with the first tow, and in the same direction, with an initial tow distance of 0.5 km, which was extended to 0.8 km later during the survey. Wingspread sensors were placed at the upper wing tips on the headrope to calculate the sweep angle. Aside from this, all aspects of the towing procedure were kept the same except for the length of sweeps used, with the order systematically alternated (i.e. short sweeps vs long sweeps, followed by long sweeps vs short sweeps). Some of these paired tows consisted of a valid survey tow paired with a subsequent trial tow with longer sweeps. Where longer sweeps were trialled first, both tows were considered as gear trials.

3. RESULTS

3.1 Timetable

RV *Kaharoa II* departed Wellington on 12 February 2025 steaming overnight to reach the southern end of the survey area the following day, with a stop-over in New Plymouth to collect fish bins and ice. The survey began on the afternoon of the 13 February with Phase 1 stations being carried out until a port call on 20 February to discharge fish, take on ice, allow repair of some engineering issues and science staff to join the vessel to support the new Wetlab operation. *Kaharoa II* departed in the afternoon and steamed overnight and the following day to reach the most northerly ‘A’ strata on the 22 February where Phase 1 stations were re-commenced off Te Oneroa a Tohe (Ninety Mile Beach). Unlike in previous surveys, where core strata were completed first, both core and deeper stations were carried out as the 2025 survey progressed, with a pre-emptive Phase 2 station completed in A200 due to highly variable tarakihi catches. *Kaharoa II* continued Phase 1 sampling as she steamed back down the coast coming alongside in New Plymouth on 28 February for a third port call to discharge fish, take on ice and undertake repairs to safety boat winch. The vessel departed later that afternoon, completing all Phase 1 stations on 3 March with F150 and F200 being the last strata sampled.

Provisional relative biomass estimates for both the core and total survey areas were calculated for the four target species and indicated that the tarakihi CV was well above target, and the CV for gurnard in the core area was also just above target. Four Phase 2 stations in F200 were allocated to reduce the tarakihi CV and two Phase 2 stations in D100 to reduce the red gurnard core area CV. Two of the planned Phase 2 stations were undertaken on the 4 March before worsening weather and winch issues resulted in the decision to finish the survey. *Kaharoa II* arrived outside New Plymouth later that evening but was unable to come alongside due to weather and had to dodge outside the harbour until the following morning. The survey ended with the vessel coming alongside on the morning of 5 March.

During the survey, two and half days (on 13, 20 and 28 February) were needed for taking ice onboard, unloading fish and carrying out essential vessel equipment repairs. A day and a half of sampling time was lost due to poor weather conditions on 4 and 5 March.

3.2 Station and tow data

A total of 83 trawl stations were carried out during the voyage (Appendix 4). All 67 planned Phase 1 stations and three Phase 2 stations were completed, covering all 20 strata in the survey (Table 2). One Phase 2 station was completed in stratumA200 and two in F20M (Figure 1). Four stations were classed as foul and not suitable for biomass estimation and were replaced with substitutes. These stations were fouled due to hauling early, issues with the CTD and/or Marport sensors fouling the headline, or a trawl door lifting off the seafloor during the tow. A further nine stations were gear performance trial tows.

Trawl performance
The performance of the trawl was monitored on every tow. A summary of gear and tow parameters by stratum depth range are given in Table 2 and individual station data are given in Appendix 4. The average headline heights ranged from 3.4–7.0 m during the survey. This was a wider range than recorded during the January 2025 gear trials, and the later west coast central and South Island surveys, where the ranges were between 4 and 5 m. Three stations recorded headline heights of less than 4 m. These prompted a trial tow to assess the effect of increasing layback (part of the net to bridle assembly) by 60 cm on the headline height. An increase of around 20 cm in headline height was estimated, although this adjustment to the trawl configuration was not retained.

The small number of higher headline heights (> 6 m) recorded by the Marport sensor occurred during tows in shallow water (< 25 m) and are thought to be likely spurious when compared to the estimates of net mouth opening calculated from paired depth sensors also mounted on some of those tows. Estimates made from these depth readings suggested a headline height of 5.5 m or less. The readings could have been caused by the way in which the Marport sensor was orientated, leading to interference from multiple reflections in shallower waters, and warrants further investigation in future survey work. In strata deeper than 50 m the average headline height ranged from 4.3 to 4.5 m

Trawl door spread ranged from 82–126 m. The values less than 90 m were in shallow depths less than 30 m and tended to be associated with tows that were conducted in the same direction as the prevailing tidal current. The new Marport sensor enables monitoring of trawl door heights and indicated that one tow was fouled due to one trawl door lifting off the seafloor during the tow. On several other occasions, additional wire was paid out to increase door spread and/or ensure that trawl doors maintained contact with the seafloor. Other trawl performance metrics included assessing the polish on the base of the trawl door and ground gear components and evaluating the measurements from the bottom contact sensor placed in the centre of the groundgear. These all indicated that the trawl doors and groundgear were in contact with the seafloor.

A series of paired tows was carried out to quantify the effect of increasing sweep length on the estimated sweep angle, door spreads and resulting catches. Increasing the sweep lengths to 110 m resulted in an average 11 m increase in door spread and a reduction in sweep angles by 4–7° to values below 20° and indicated that catches of some sweep-herded species such as red gurnard were likely to be increased (see Appendix 14 for further details).

Table 2: Gear parameters for valid biomass stations by depth range for the survey area (n, number of stations; s.d., standard deviation).

KHR2502		n	Mean	s.d.	Range
All stations					
	Headline height (m)	69	4.6	0.59	3.4–7.0
	Doorspread (m)	69	103.2	11.5	81.6–126.5
	Distance (n. mile)	70	1.5	0.03	1.44–1.62
	Warp:depth ratio	70	4	1.58	2.95–8.33
	Speed (knots)	70	3.4	0.06	3.1–3.5
10–25 m					
	Headline height (m)	6	6.1	1.02	4.3–7.0
	Door spread (m)	6	89.6	4.92	81.6–95.2
	Distance (n. mile)	6	1.5	0.04	1.48–1.58
	Warp:depth ratio	6	7.6	0.6	6.73–8.33
	Speed (knots)	6	3.4	0.14	3.1–3.5
25–50 m					
	Headline height (m)	15	4.4	0.22	3.9–4.7
	Door spread (m)	16	94.4	1.2	92.4–96
	Distance (n. mile)	16	1.5	0.03	1.44–1.55
	Warp:depth ratio	16	5.3	1.31	3.77–8.33
	Speed (knots)	16	3.4	0.04	3.3–3.5
50–100 m					
	Headline height (m)	25	4.5	0.23	3.9–5.0
	Door spread (m)	25	99	5.39	91.6–108.2
	Distance (n. mile)	25	1.5	0.03	1.48–1.62
	Warp:depth ratio	25	3.2	0.21	2.95–3.77
	Speed (knots)	25	3.4	0.06	3.3–3.5
100–200 m					
	Headline height (m)	23	4.3	0.26	3.4–4.7
	Door spread (m)	22	118.1	4.63	111.0–126.5
	Distance (n. mile)	23	1.5	0.02	1.49–1.58
	Warp:depth ratio	23	3.1	0.06	2.96–3.24
	Speed (knots)	23	3.4	0.05	3.3–3.5

3.3 Catch composition

A total of 10 595 kg of fish, invertebrates and debris (lost fishing gear, wood) were caught during the survey, of which 9381.5 kg was from survey tows used for biomass estimation. The average catch was 135 kg per tow. There were 58 species of finfish identified: 14 elasmobranchs and 44 teleosts. Snapper was the dominant species, accounting for 51.4% of the total survey catch by weight, followed by trevally (*Pseudocaranx georgiaunus)* making up 15.5% and porcupine fish (*Allomycterus jaculiferus*) making up 8.1%. Note that the latter is an overestimate of fish weight as it includes water retained by inflated porcupine fish. Tarakihi accounted for 4.0% of the total catch (376 kg), with red gurnard (213 kg) and John dory (145 kg) accounting for around 2.3% and 1.5% respectively. Other top 10 species included rig (*Mustelus lenticulatus*), eagle ray (*Myliobatis tenuicaudatus*), and yellowtail jack mackerel (*Trachurus novaezelandiae*). These same nine species were also in the top 10 most abundant in the 2022 spring survey, albeit with lower catches. A number of unusual fish species caught were retained for Te Papa including specimens of foxfish (*Bodianus flavipinnis)*, southern splendid perch (*Callanthias allporti*) and a juvenile dealfish (*Trachipterus trachypterus*). Species codes, common names, scientific names, and catch weights of all species caught during the survey are given in Appendix 5.

A variety of both pelagic and benthic macroinvertebrates also formed part of the catch. The number of invertebrate species does not necessarily reflect biodiversity in the survey area because the gear is not designed to collect them. Pelagic species included jellyfish and salps. A total of 26 macroinvertebrate ITUs (Individual Taxonomic Units) were recorded in the *trawl* database; most were not identified to species onboard, with 92 invertebrate samples retained and registered in Earth Sciences New Zealand's SPECIFY for expert taxonomists to identify. A list of identified invertebrates from the survey is provided in Appendix 6.

3.4 Biological sampling

Length data were collected from 46 species, with 8636 fish measured, by sex, where possible. Additional biological information collected from all QMS and many non-QMS species included 3200 individual fish weight, and 1634 reproductive state records. (see Appendix 7). Reproductive status information is summarised in Appendix 8 by 10 cm length class for the four target species (snapper, red gurnard, tarakihi, John dory) and eight other key species (trevally, two species of jack mackerel, kahawai, barracouta, school shark, rig, spiny dogfish).

Pairs of sagittal otoliths were collected from 1633 specimens: snapper (n = 886), red gurnard (n = 341), John dory (n = 176) and tarakihi (n = 230). A subsample of the snapper otoliths and all tarakihi otoliths were prepared for ageing as part of this project.

3.5 Snapper

As with spring surveys, snapper was the most abundant species in the 2025 summer survey, making up over half of the total catch by weight (Appendix 5). However, catch rates were markedly lower than in spring surveys and whereas previously caught in all stations, snapper was absent from over 20% of stations in the February survey. Snapper were found from 22 m to 187 m, but in contrast to spring surveys, where the highest catch rates and largest contribution to biomass were from the central 50–100 m strata, in February, the highest catch rates were recorded in the shallower strata less than 50 m depth off Ninety Mile Beach (A25, A50M), the Kaipara Harbour (C50M), and just north of Airedale Reef (F50M) (see Figure 2 and Appendix 9).

Relative biomass estimates and CVs by stratum for the 2025 survey are given in Appendix 10; almost 80% of the snapper biomass was found in the shallow strata, with just 16% of biomass from the 50–100 m strata and the remaining 5% found in the deeper strata.

Figure 3 shows the differences in stratum level biomass for the four most recent spring surveys compared to the 2025 February/March timed survey. Whilst biomass estimates in the shallow (< 50 m) strata are similar or greater, there are markedly reduced biomass estimates in the 50–100 m strata, particularly in the combined C10N and C10S strata compared to C100 in previous spring surveys. The pattern of lower biomass in strata deeper than 50 m was also apparent in the 2018 survey, which occurred closer to summer, in late November and December.

SNA, Snapper (khr2502)

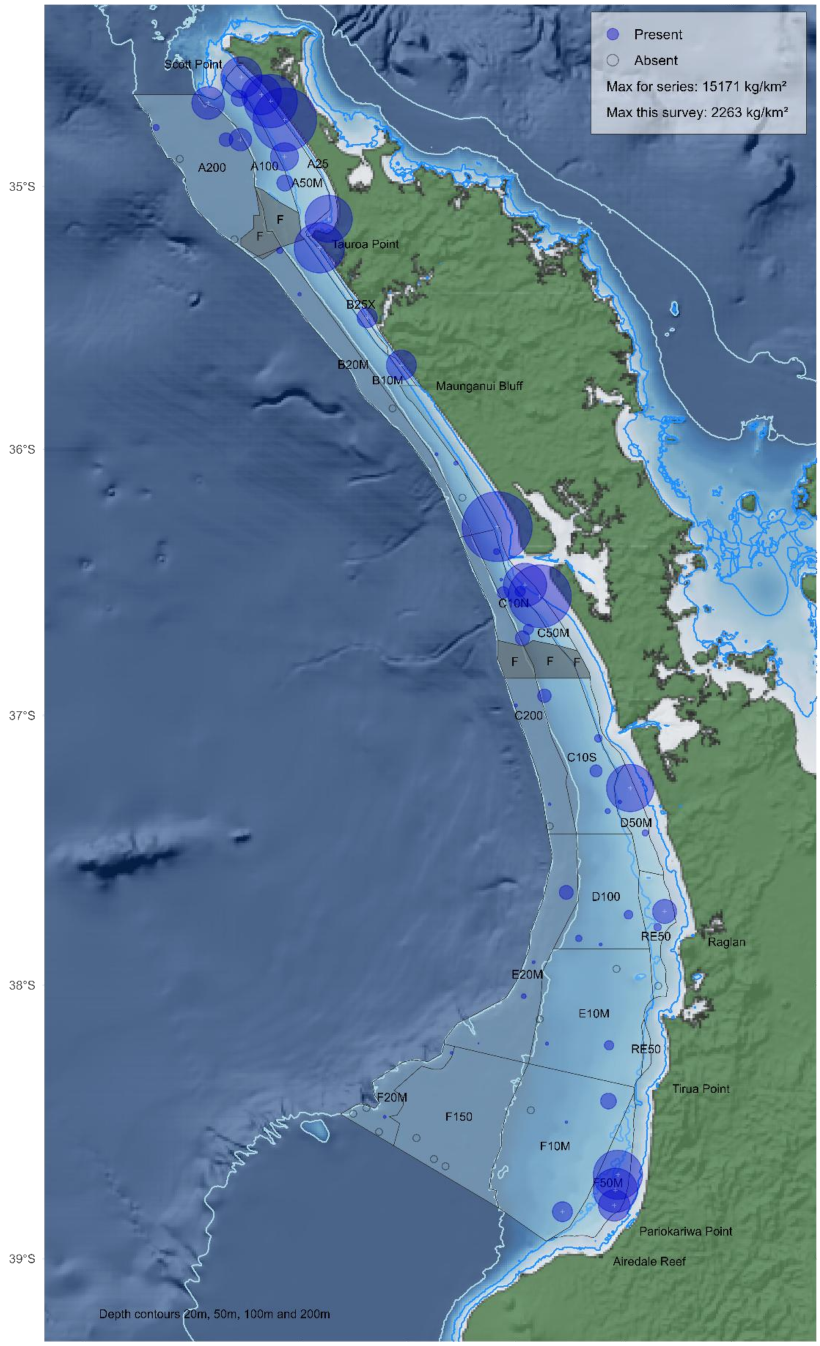

Figure 2: Spatial distribution of catch rates (kg km^{-2}) of snapper in the 2025 west coast North Island survey, scaled to the largest catch. Foul and excluded areas shaded grey. The depth contours indicate 20, 50, 100 and 200 m.

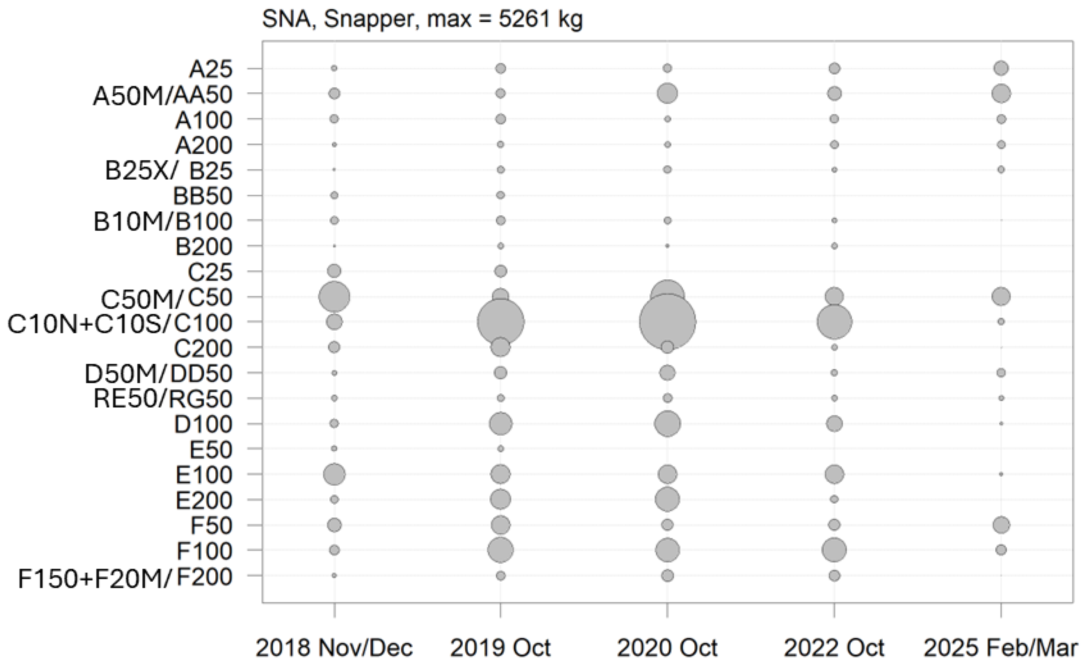

Figure 3: Relative snapper biomass estimates by stratum for the recent west coast North Island trawl surveys completed since 2018. Where a stratum has had boundaries modified during the time series, both names are given.

The combined relative snapper biomass estimate for the core 2025 survey was 2711.6 t (CV = 13.0%), and 2871.4 t (CV = 12.6%) when the deeper stations were included. The previous time series of snapper relative biomass estimates are provided in Table 3 and Figure 4, updated with the latest survey point. The 2025 estimates are only around a half of the 2022 snapper biomass estimate, and much lower than any of the other recent spring surveys. The CV was the lowest for both series.

Table 3: Relative biomass estimates (t) and CVs (%) of snapper for the core and extended core areas of the west coast North Island survey. The deeper strata of the extended core were not sampled in the 1989 and 1994 surveys.

Survey	Month	Core biomass (t)	Core CV %	Extended core biomass (t)	Extended core CV%
KAH8918	Nov/December	1 234.01	27.8		
KAH9111	Nov/December	576.5	30.5	597.6	29.4
KAH9410	October	371.0	25.0		
KAH9615	October	844.7	29.9	923.0	27.6
KAH9915	October	853.8	14.1	907.7	13.4
KAH1806	Nov/December	3 869.4	22.1	4 298.5	20.2
KAH1906	October	7 999.0	19.7	9 625.7	16.5
KAH2005	October	11 796.7	20.3	13 389.9	18.8
KAH2205	October	5 751.6	16.1	6 301.3	14.9
KHR2502	Feb/March	2 711.6	13.0	2 871.4	12.6

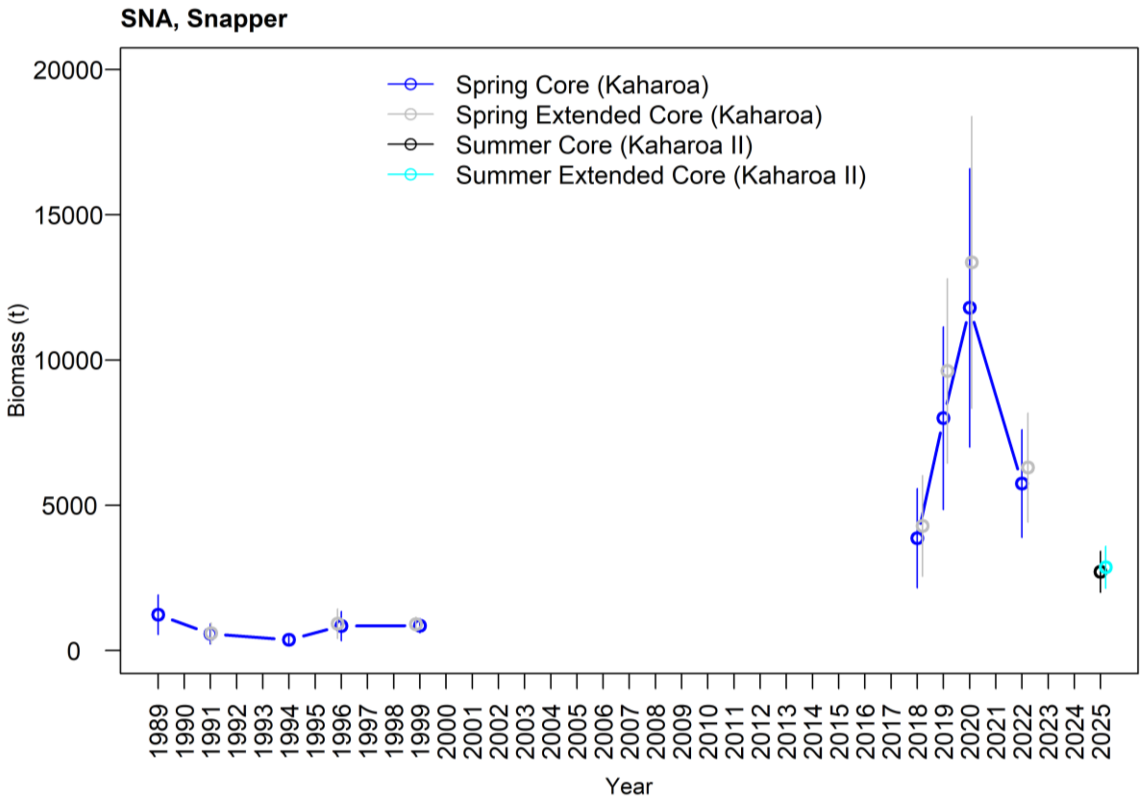

Figure 4 West coast North Island total relative biomass estimates and 95% confidence intervals for snapper for the core and extended core area (including deeper > 100 m strata). The Springtime series is shown from 1989 up until 2022, with the 2025 Summer survey estimates indicated in different colours. Note that each set of annual points is displaced slightly from each other for clarity.

Length measurements of 4936 snapper were taken during the 2025 survey, 4261 from stations used in the biomass estimates, with individual weight data collected from 918 snapper and pairs of otoliths from 886 fish (Appendix 7). Reproductive condition was assessed for 953 snapper (Appendix 8).

The length range of snapper caught across the whole survey was 13–73 cm, with one main modal peak at around 30 cm, and a much smaller mode at around 20 cm (Figure 5). Most fish sampled (almost 70%) were between 25–35 cm, with only 7% being of pre-recruit size (< 25 cm), and 12.6% 40 cm and above. Snapper of all sizes were most numerous in the shallow strata less than 50 m, including both the 20 cm mode, representing the 1+ year class, and larger fish 40 cm and greater. In deeper strata the size range was more restricted, mainly between 30–50 cm.

The overall survey sex ratio was roughly even but slightly favoured males in all depths except over 100 m where, similar to previous years, females outnumbered males (1.41:1).

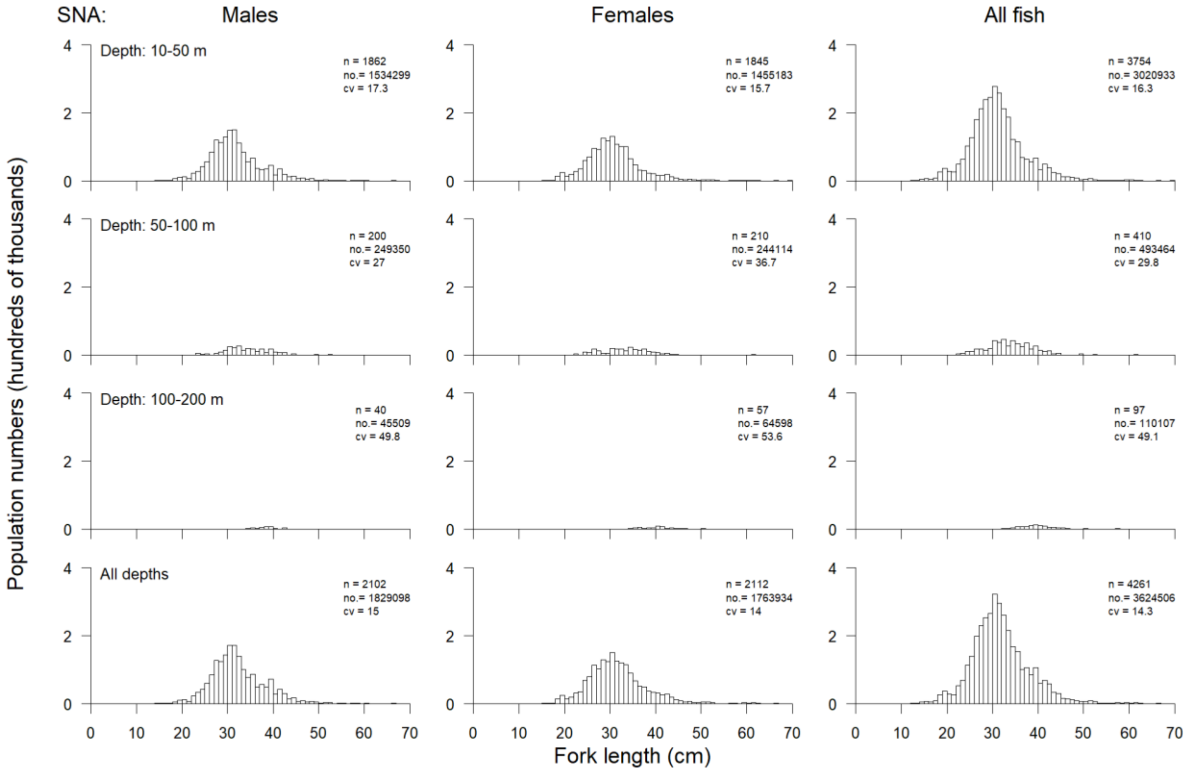

Figure 5: Comparative scaled length frequency distributions for males, females, and all snapper by depth range for the 2025 west coast North Island survey. n = number of fish measured, no. = scaled population number, and cv = coefficient of variation. 'All fish' includes unsexed fish.

The number of snapper at each reproductive stage by 1-cm size class are shown in Figure 6. The majority of snapper sampled, 87% of females and 90% of males, were classed as resting with a smaller number of ripening and ripe, partially spent and spent individuals, reflecting February being the end of the spawning period for this species. There were no reproductively active female snapper under 30 cm.

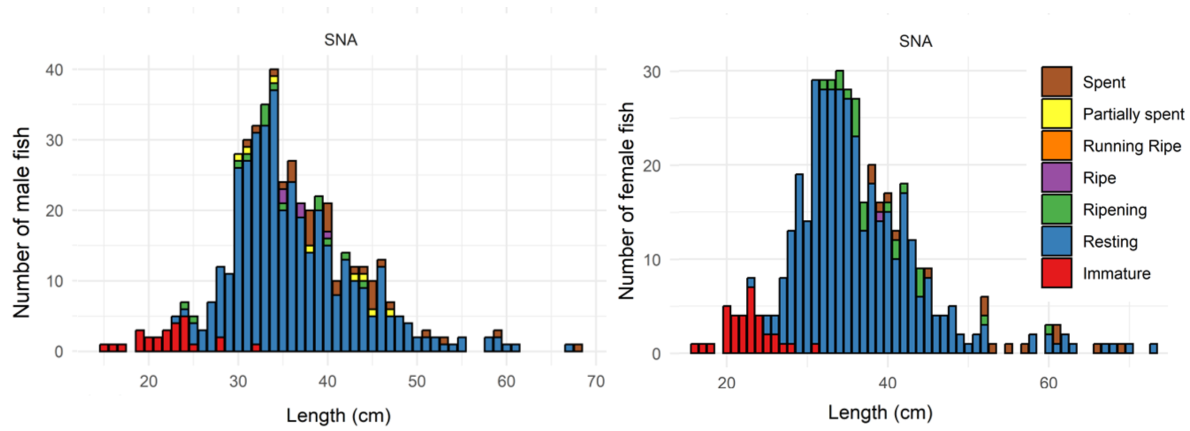

Figure 6: Number of female (left) and male (right) snapper at each reproductive stage by 1-cm size class. Note that the axis scales are different. See Appendix 2 for reproductive stage descriptions.

The time series of population scaled length frequencies is shown in Figure 7 for both the core (<100 m) and extended core areas. The lack of pre-recruit sizes compared to previous spring surveys was noticeable, as well as a less prominent right-hand tail of larger fish.

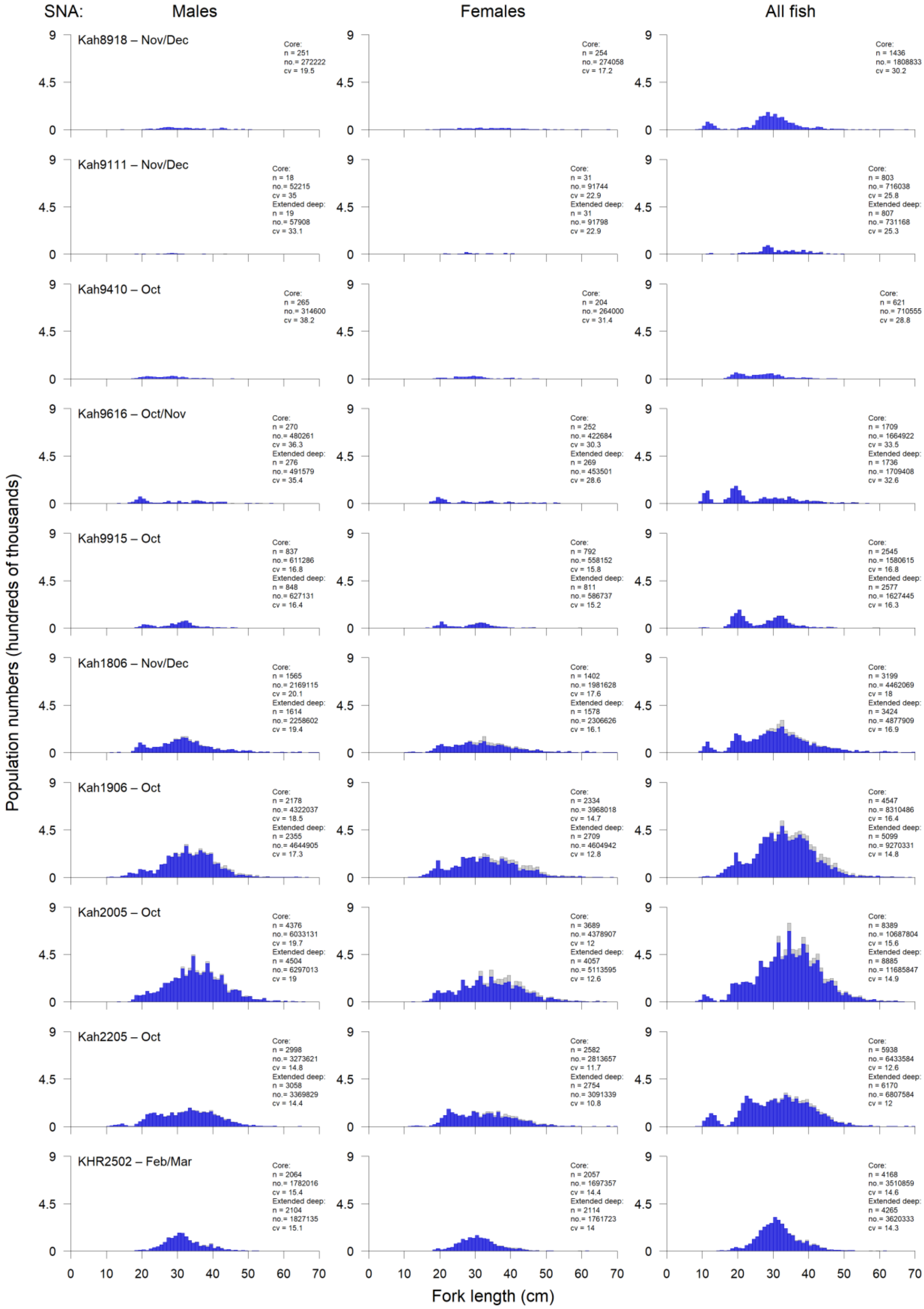

Figure 7: Comparative scaled length frequency distributions for males, females, and all snapper in the core strata (blue) and extended deep strata (grey) for the time series of the west coast North Island survey. Deep strata were not sampled in 1989 or 1994. n = number of fish measured, no. = scaled population number, cv = coefficient of variation. 'All fish' includes unsexed fish. The month sampling occurred is noted for each survey.

3.6 Snapper age composition

From the 886 pairs of otoliths collected during the survey, a sub sample of 600 otoliths were randomly selected with numbers per centimetre size class approximating the population scaled length distribution with small sizes undersampled and fish larger than 43 cm oversampled. The selected otoliths were prepared and read using a single reader method with audit by a second experienced reader.

The audit showed a good level of consistency between readers (Appendix 13). The percentage agreement was 77%, with between-reader CV and Indices of average percentage error (IAPE) scores of less than 5%. Comparisons of age-bias plots for primary and secondary readers with the agreed age show that agreement was high, particularly for the primary reader, who only differed from the final agreed age in one instance, and precision was also high, with CV and IAPE scores of less than 1% for the primary reader and less than 5% for the secondary reader.

The size distribution of snapper aged in the 2025 west coast North Island trawl survey is shown in the Age Length Key (ALK) provided in Appendix 11. With a February timing, 0+ snapper are not sampled in the trawl as they are too small, so 1+ snapper (2024-year class) between 13–19 cm were the youngest age class. The numbers-at-age distribution produced by applying the ALK to the population scaled length frequencies for snapper by depth range are given in Figure 8. The overall age composition was dominated by 3+, 4+ and 5+ year classes (2020, 2021 and 2022 cohorts), with a smaller number of younger and older ages present, mainly in shallow strata, with much lower numbers of older (> 5 years) fish in depths greater than 50 m.

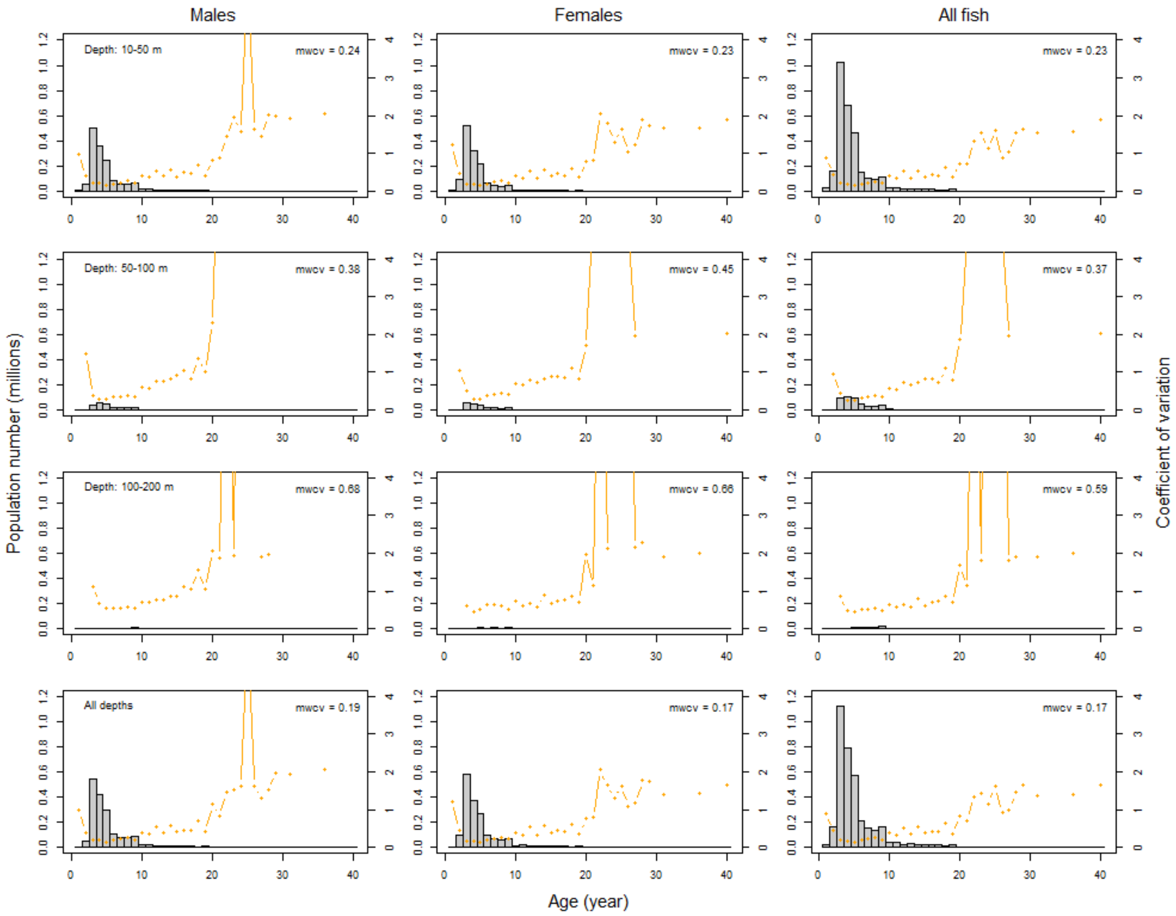

Figure 8: Numbers-at-age distributions (histogram) and CVs (line) by depth range and for all depths combined for males, females, and all snapper caught on the 2025 west coast North Island trawl survey. (mwcv = mean weighted coefficient of variation).

The 2022-year class made up an estimated one third of the overall population numbers in the survey area at that time (YCS of 1.19 million fish, CV = 0.19). This year class was observed in the spring 2022 survey as one of the most numerous 0+ cohorts sampled in recent surveys (Figure 9). The much lower numbers of older fish in the 2025 survey compared to previous spring survey is also shown in Figure 9, with 6–10 year old snapper making up just 18% of sampled fish, compared to the 30% in the most recent 2022 spring survey. The strong 2016-year class, which was tracked through the 2018–2020 surveys was still visible as slightly elevated numbers of the 9+ year class. The oldest fish aged was 62 cm and 40 years old, whilst the largest snapper, at 70 and 73 cm were aged at 26 and 24 years old.

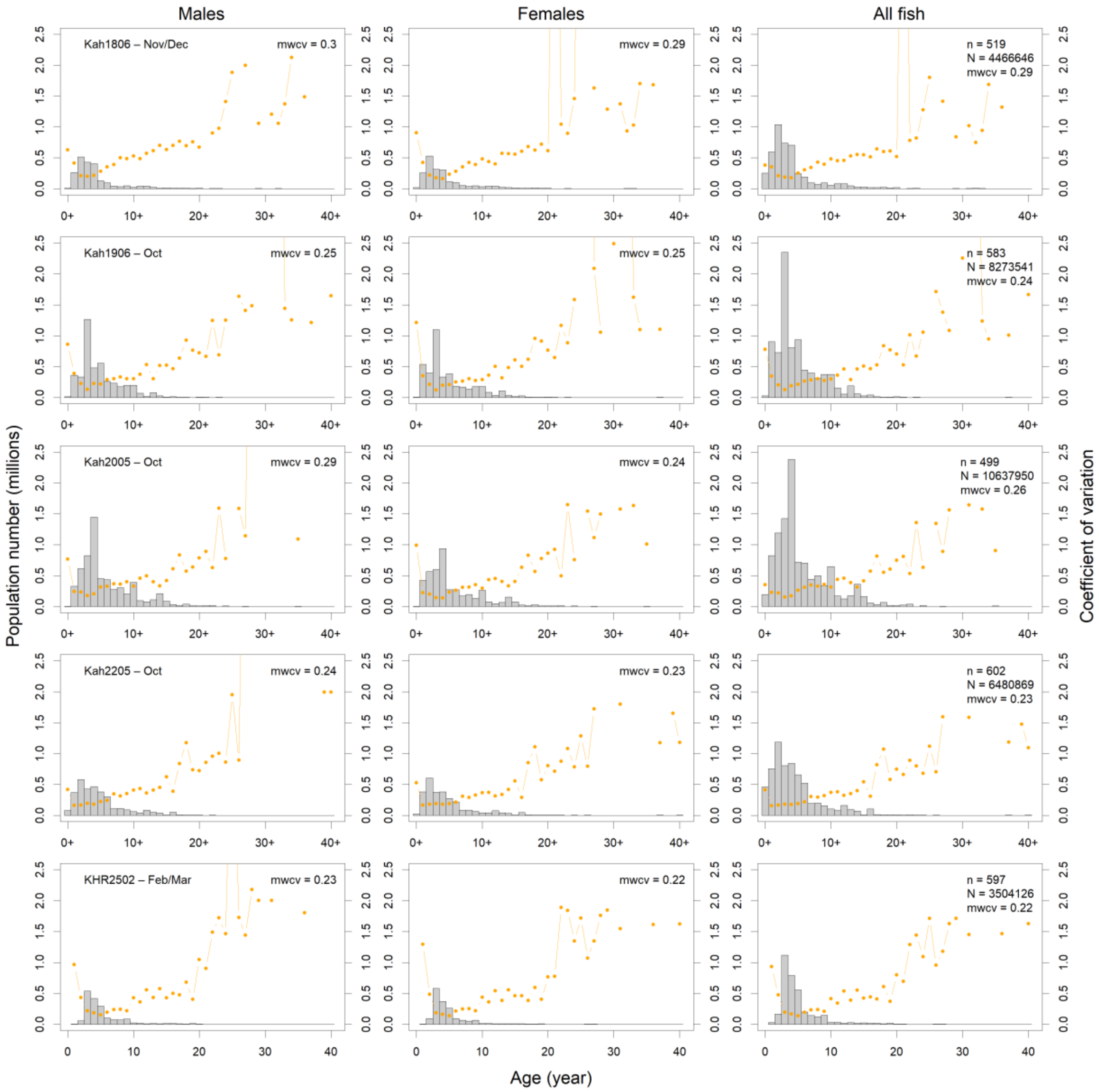

Figure 9: Time series of numbers-at-age (histogram) and CVs (line) for male, female, and all snapper caught from the core area on west coast North Island surveys from 2018 to 2025 (mwcv=mean weighted coefficient of variation; n=sample size; N=scaled population number). The month sampling occurred is noted for each survey.

3.7 Red gurnard

Red gurnard was the seventh most abundant species by weight, caught in 73% of stations and accounting for 2.3% of the total catch, all of which are lower than previous spring surveys (Appendix 5). It was found throughout the survey and at all depths, from 22 to 187 m, with highest catch rates in depths less than 100 m, particularly off Ninety Mile Beach, the Kaipara, Raglan and Kawhia harbours (Figure 10, Appendix 9).

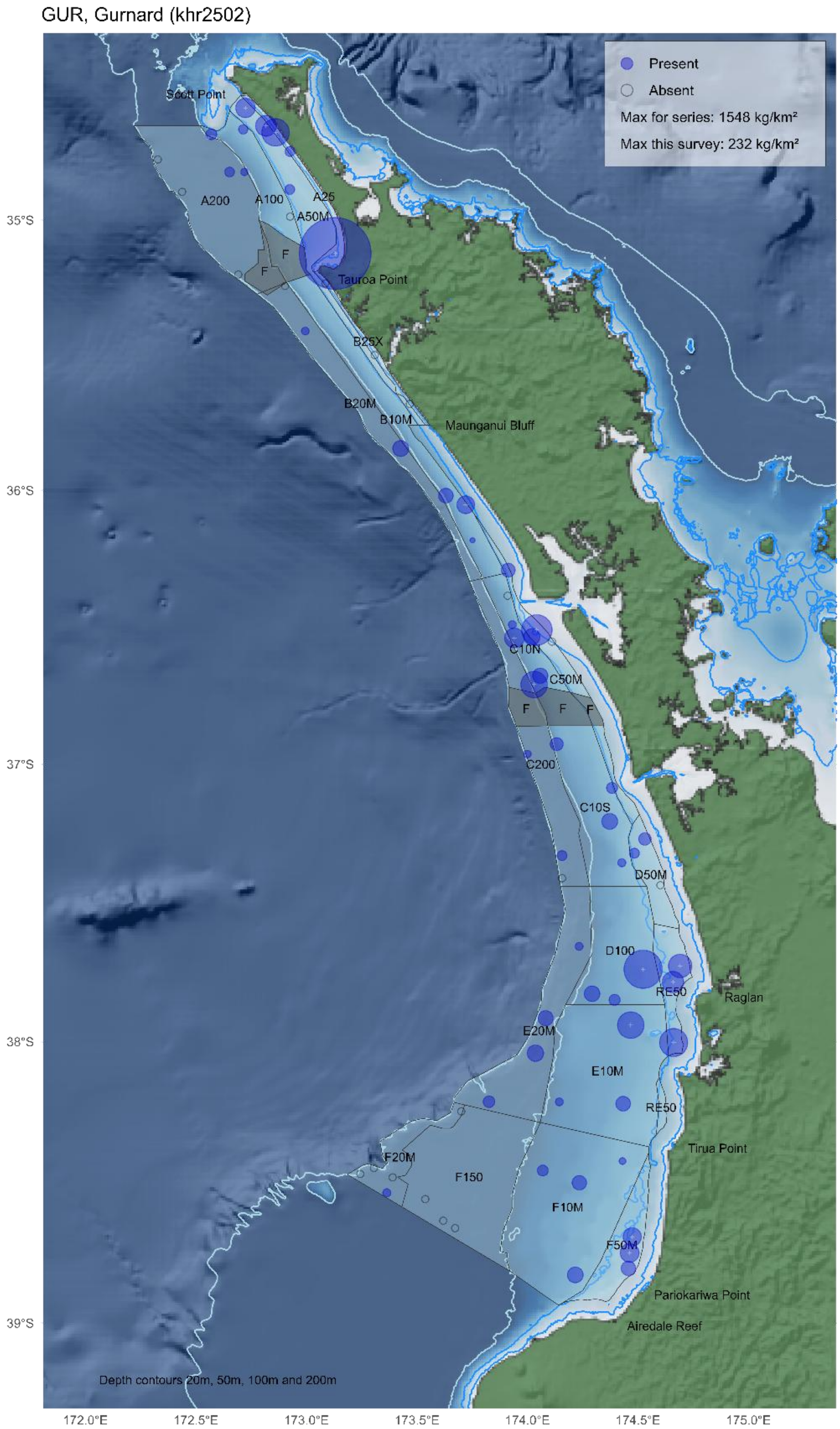

Figure 10: Spatial distribution of catch rates (kg km^{-2}) of red gurnard in the 2025 west coast North Island survey, scaled to the largest catch. Foul and excluded areas shaded grey. The depth contours indicate 20, 50, 100 and 200 m.

Figure 11 shows the differences in stratum level biomass for the four most recent spring surveys compared to the 2025 survey (also see Appendix 10). The shallow spatial distribution of red gurnard found in 2025 was similar to that in spring surveys but catch rates and estimated relative biomass was much reduced across most strata.

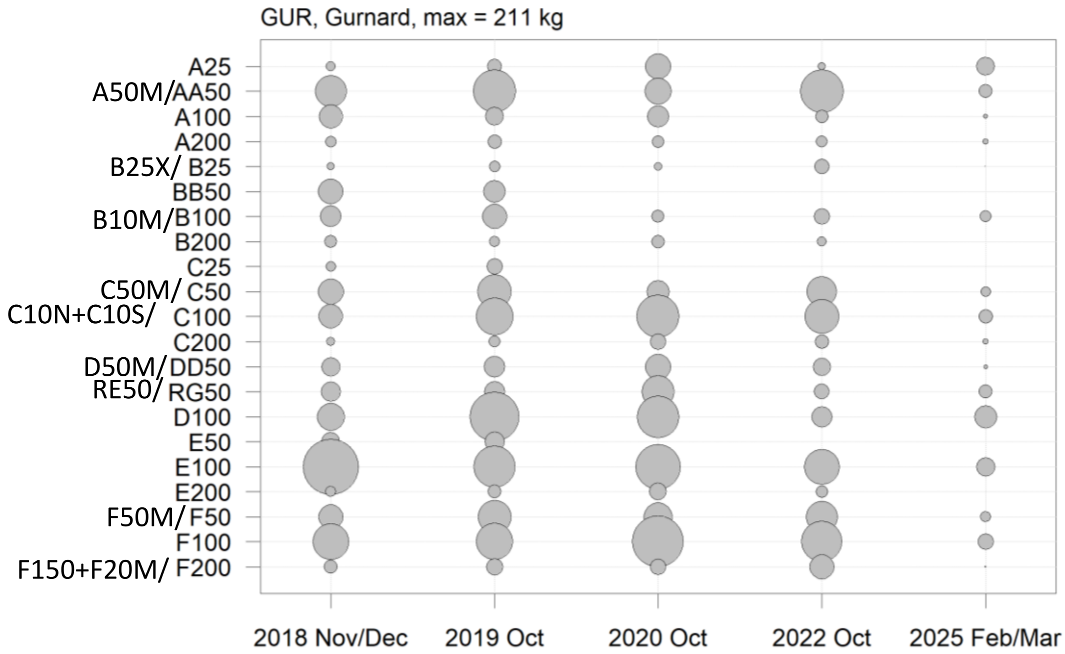

Figure 11: Relative red gurnard biomass estimates by stratum for the recent west coast North Island trawl surveys completed since 2018. Where a stratum has had boundaries modified during the time series, both names are given.

The relative biomass estimates for red gurnard in the core area was 163.3 t (CV = 21.9%), and 184.2 t (CV = 19.6%) when the deeper stations were included. The previous spring time series (October and Nov/December) of red gurnard relative biomass estimates are provided in Table 4 and Figure 12, updated with the 2025 summer survey point (February/March). The 2025 estimates are lower than any of the previous spring survey estimates, at around one third of the most recent estimate in 2022. The CVs for both the core and extended core areas were higher than recent previous surveys, with the core CV higher than target.

Table 4: Relative biomass estimates (t) and CVs (%) of red gurnard for the core and extended core areas of the west coast North Island survey. The deeper strata of the extended core were not sampled in the 1989 and 1994 surveys.

Survey	Month	Core biomass (t)	Core CV %	Extended core biomass (t)	Extended core CV %
KAH8918	Nov/December	1 754.5	16.2		
KAH9111	Nov/December	3 404.6	15.4	3 491.1	15.0
KAH9410	October	3 312.9	28.9		
KAH9615	October	2 452.3	12.5	2 541.0	12.1
KAH9915	October	1 693.4	16.3	1 730.7	16.0
KAH1806	Nov/December	643.7	17.0	687.9	16.0
KAH1906	October	884.7	13.4	946.7	12.7
KAH2005	October	919.4	12.7	994.6	11.8
KAH2205	October	643.9	11.7	724.2	10.6
KHR2502	February / March	163.3	21.9	184.3	19.6

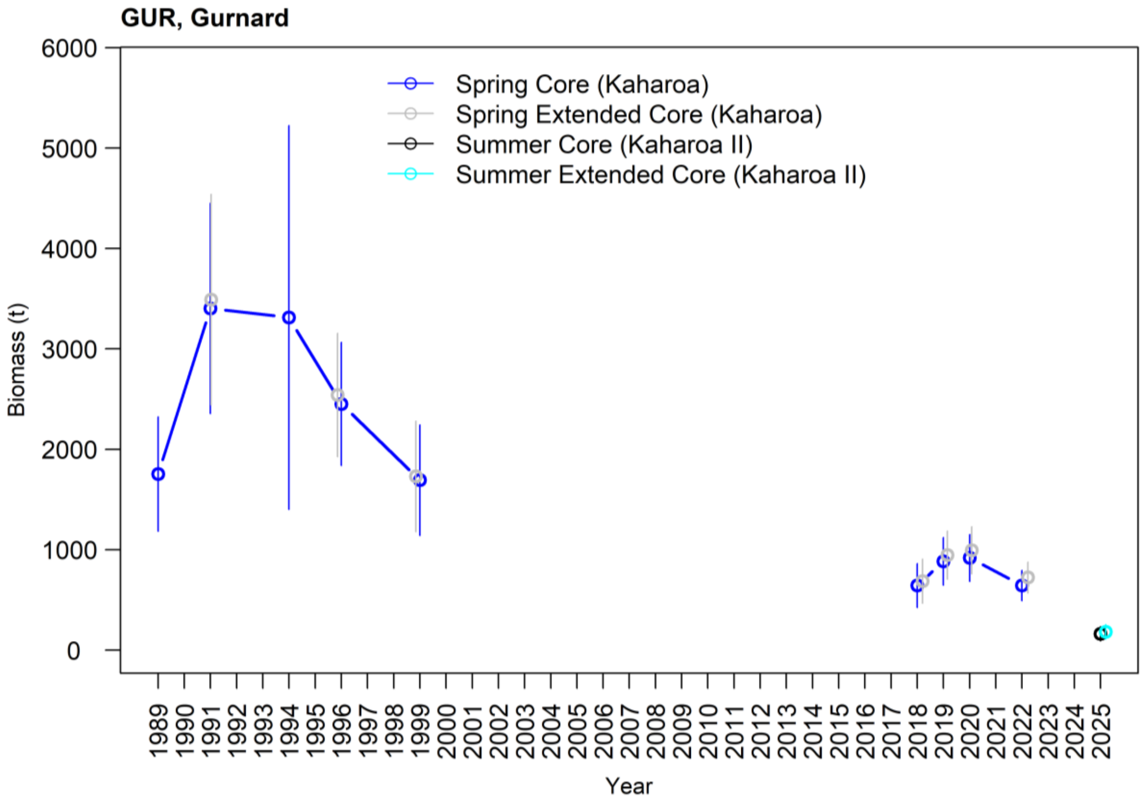

Figure 12: West coast North Island total relative biomass estimates and 95% confidence intervals for red gurnard for the core and extended core (including deeper > 100 m strata) areas. The Spring time series is shown from 1989 until 2022, with the 2025 Summer survey estimates indicated in different colours. Note that each set of annual points is displaced slightly from each other for clarity.

Length measurements of 415 red gurnard were taken during the 2025 survey, including 359 from stations used to estimate biomass, along with individual weight data from 344 red gurnard and 341 pairs of otoliths (Appendix 7). Reproductive condition was assessed for 362 gurnard (Appendix 8).

The population scaled length frequency distribution for the 2025 survey is shown in Figure 13. The overall size ranged from 14–50 cm although there were very few fish less than 20 cm. Similar to spring surveys, males were scarce in depths less than 50 m, with a male to female sex ratio of 1:18. At these depths, there were few pre-recruits (< 30 cm), with the main female length mode between 35 and 40 cm. The sex ratio was close to even in 50–100 m, but with more pre-recruit males than females observed, along with an adult mode in both sexes. A smaller number of mainly larger (> 35 cm) individuals were found in depths greater than 100 m. There was a wider size range of females than males at all depths, with a larger maximum size and more females measuring larger than 40 cm.

The reproductive status of red gurnard by 1-cm size class is shown in Figure 14. All stages of reproductive status were observed. Almost all gurnard under 30 cm were immature or resting, with larger gurnard mainly ripening and ripe (73% of females and 59% of males), with some resting and spent individuals also present in both sexes.

The core and extended core time series of scaled length frequency distributions is shown in Figure 15 alongside the frequency distribution from the 2025 summer survey. The historical surveys (prior to 2018) had modal peaks at around 22–25 cm for males and 25–29 cm for females with over 70% of the scaled numbers measuring between 20–30 cm. In the more recent spring surveys (2018 onwards), this component of the population was much reduced in catches, and this pattern has continued in the summer-timed 2025 survey, where this size range accounted for only 20% with modal peaks shifted to the right, particularly for females.

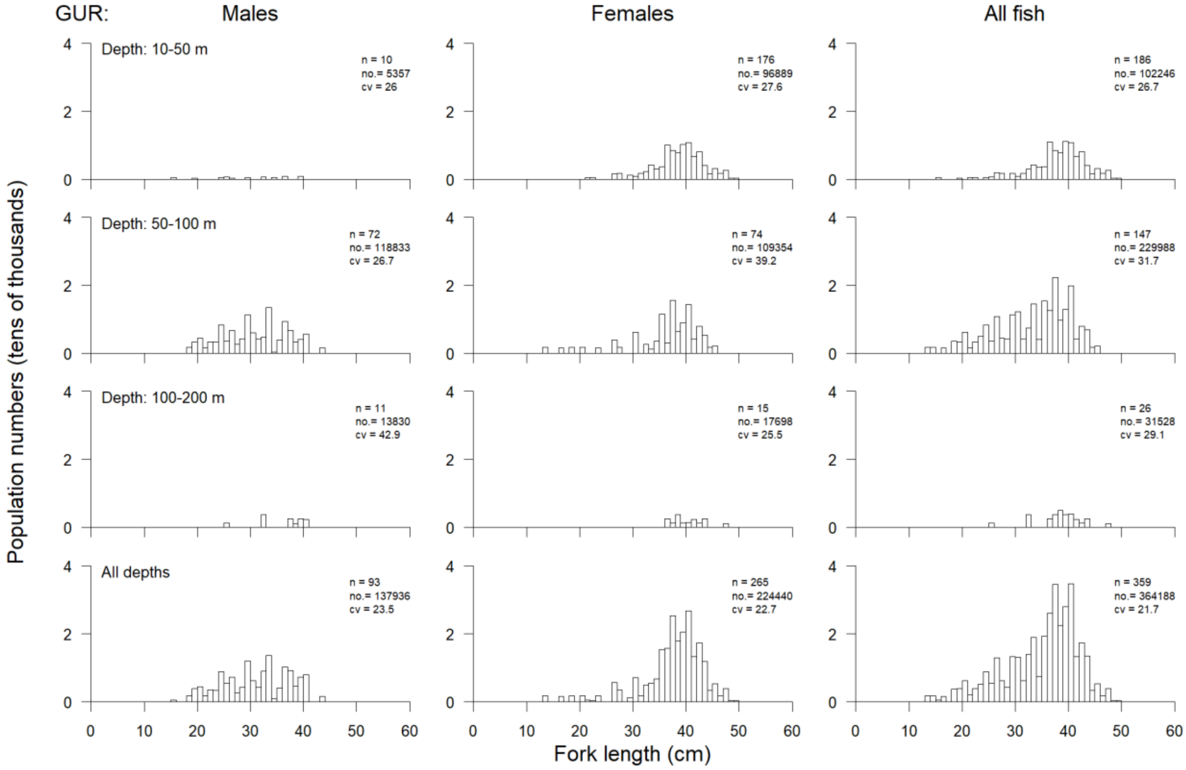

Figure 13: Comparative scaled length frequency distributions for males, females, and all red gurnard at different depths for the 2025 west coast North Island survey. n=number of fish measured, no.=scaled population number, and cv=coefficient of variation. 'All fish' includes unsexed fish.

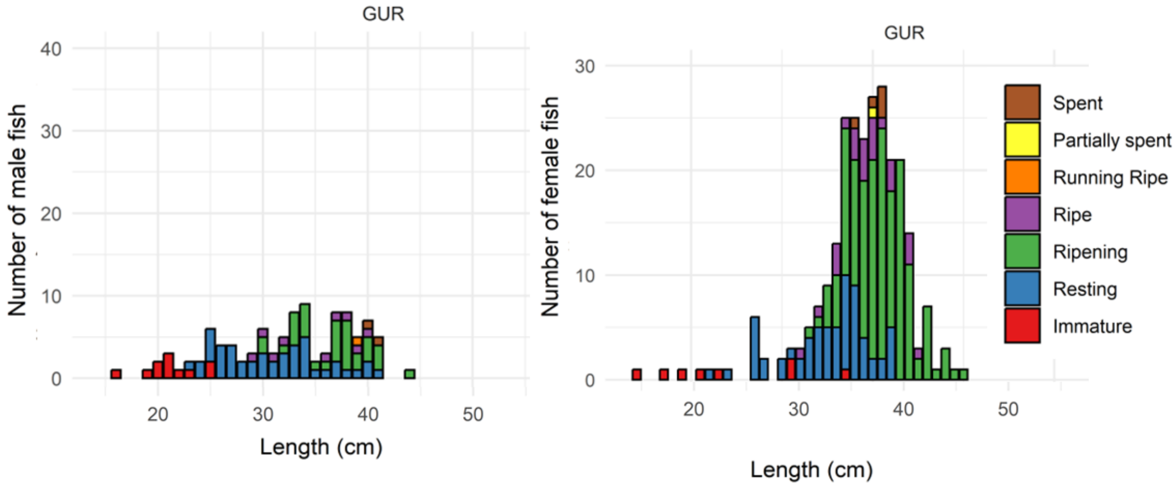

Figure 14: Number of female (left) and male (right) red gurnard at each reproductive stage by 1-cm size class. Note that the axis scales are different. See Appendix 2 for reproductive stage descriptions.

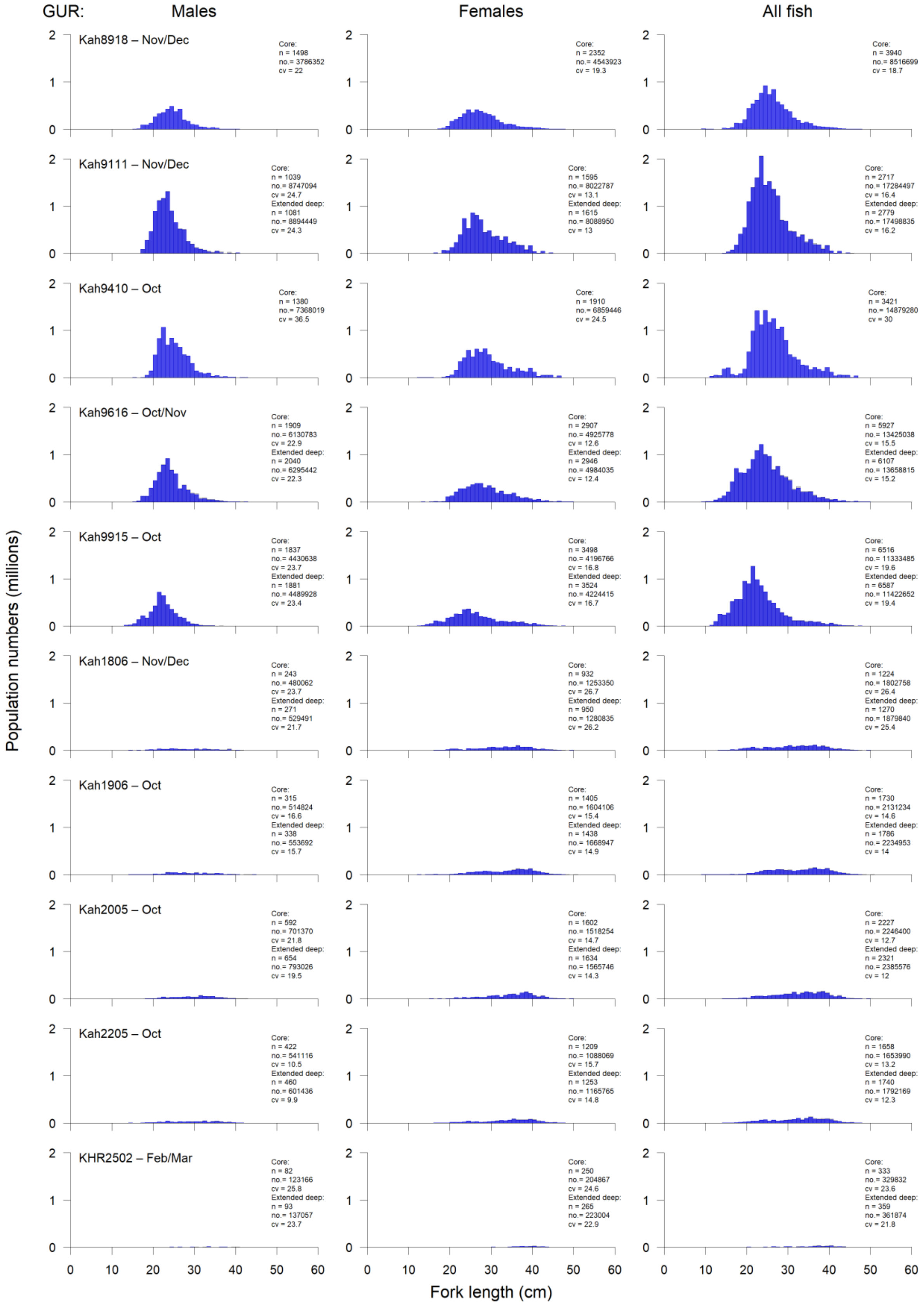

Figure 15: Comparative scaled length frequency distributions for males, females, and all red gurnard in the core strata (blue) and extended deep strata (grey) for the time series of the west coast North Island survey. Deep strata were not sampled in 1989 or 1994. n = number of fish measured, no. = scaled population number, cv = coefficient of variation. 'All fish' includes unsexed fish. The month sampling occurred is noted for each survey.

3.8 Tarakihi

Tarakihi was the fourth most abundant species by weight, making up 4% of the catch, but caught in only 31% of stations (Appendix 5). Catches were confined mainly to A200 off Ninety Mile Beach, and along the shelf edge of the North Taranaki Bight, with highest catch rates in F20M and A200 and low or zero catches in depths less than 100 m (Figure 16 Appendix 9).

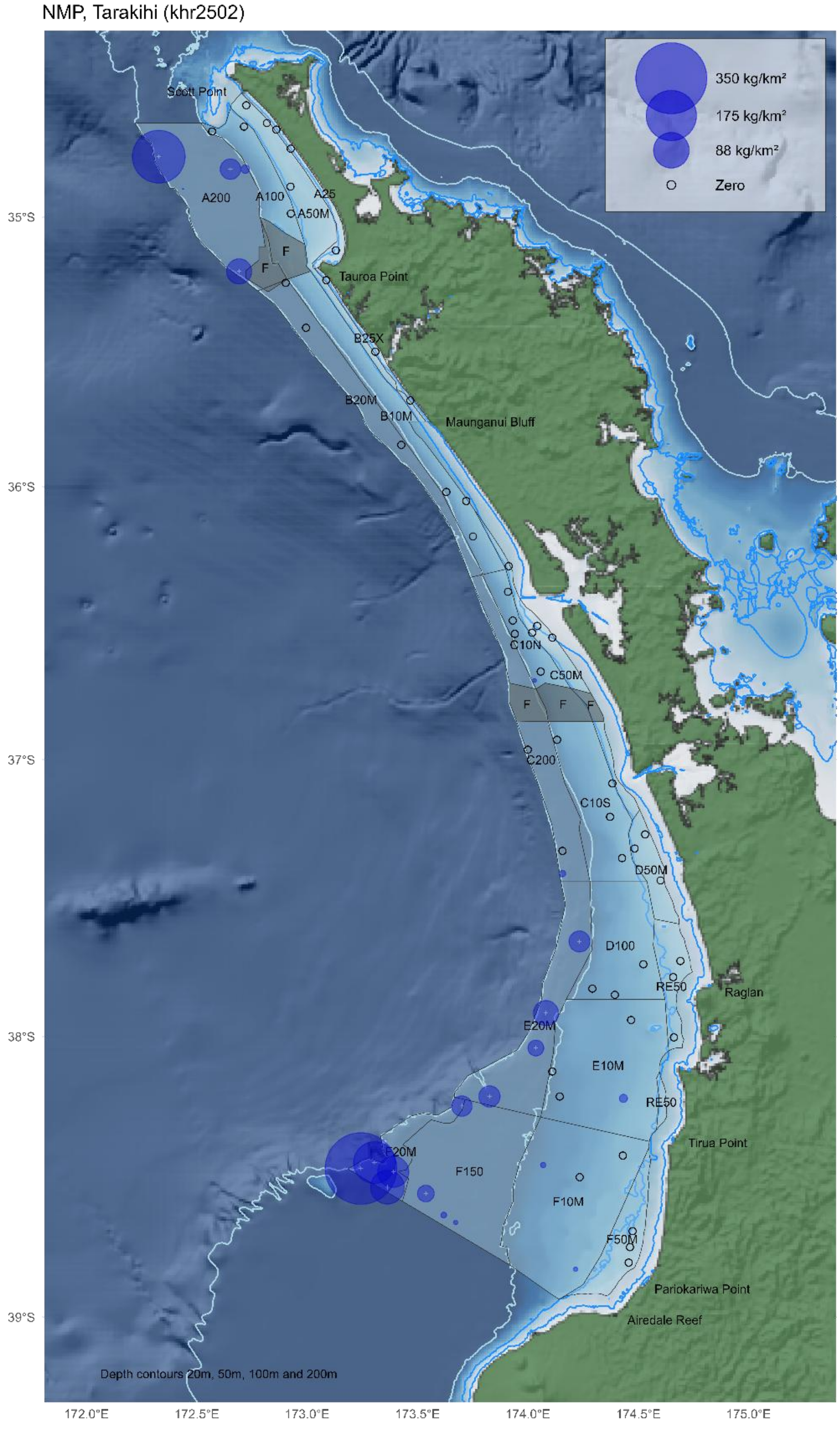

Figure 16: Spatial distribution of catch rates (kg km^{-2}) of tarakihi in the 2025 west coast North Island survey, scaled to the largest catch. Foul and excluded areas shaded grey. The depth contours indicate 20, 50, 100 and 200 m.

Figure 17 shows the patterns in stratum level biomass for the four most recent spring surveys compared to the 2025 survey. Whilst the biomass estimate in A200 is similar to previous years, the combined estimate of F150 and F200 is lower than the previous F200 estimates, but possibly more accurate given the concentration of tarakihi along the shelf-edge that is now contained within a more discreet stratum. Biomass in the central and shallower strata, was lower than previous surveys or zero.

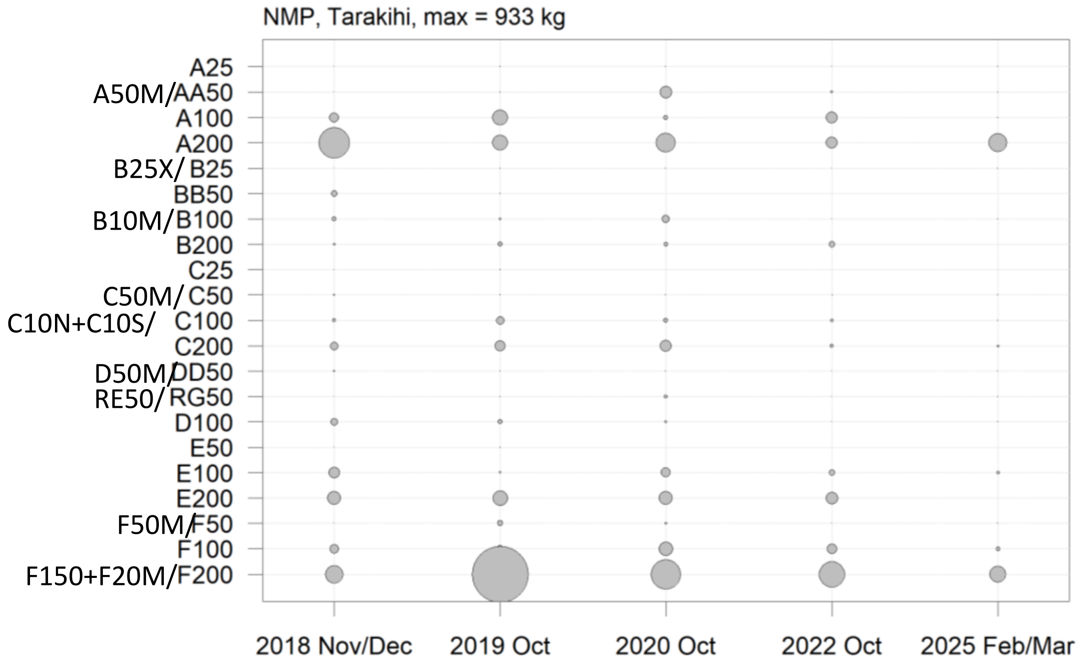

Figure 17: Relative tarakihi biomass estimates by stratum for the recent west coast North Island trawl surveys completed since 2018. Where a stratum has had boundaries modified during the time series, both names are given.

The combined relative biomass estimate for the extended core was 241.5 t with a CV of 29.4%. This is the lowest value recorded for this species in this survey (see Table 5 and Figure 18). The biomass for the core area is also provided. The shallow core, which excludes stations over 100 m is not appropriate for tarakihi, but the extremely low value compared to previous spring surveys reflects the notable absence of tarakihi from many core strata.

Table 5: Relative biomass estimates (t) and CVs (%) for tarakihi in the core and extended core areas of the west coast North Island survey. The deeper strata of the extended core were not sampled in the 1989 and 1994 surveys.

Survey	Month	Core biomass (t)	Core CV (%)	Extended core biomass	Extended core CV
KAH8918	Nov/December	160.5	36.4		
KAH9111	Nov/December	272.1	83.0	541.0	44.4
KAH9410	October	111.4	26.8		
KAH9615	October	248.3	57.9	654.6	23.9
KAH9915	October	51.1	27.2	511.4	12.6
KAH1806	Nov/December	115.7	28.5	539.8	36.3
KAH1906	October	125.9	32.2	1 237.1	43.1
KAH2005	October	170.6	30.5	649.6	13.6
KAH2205	October	86.8	38.3	389.8	23.0
KHR2502	February / March	9.7	51.4	241.5	29.4

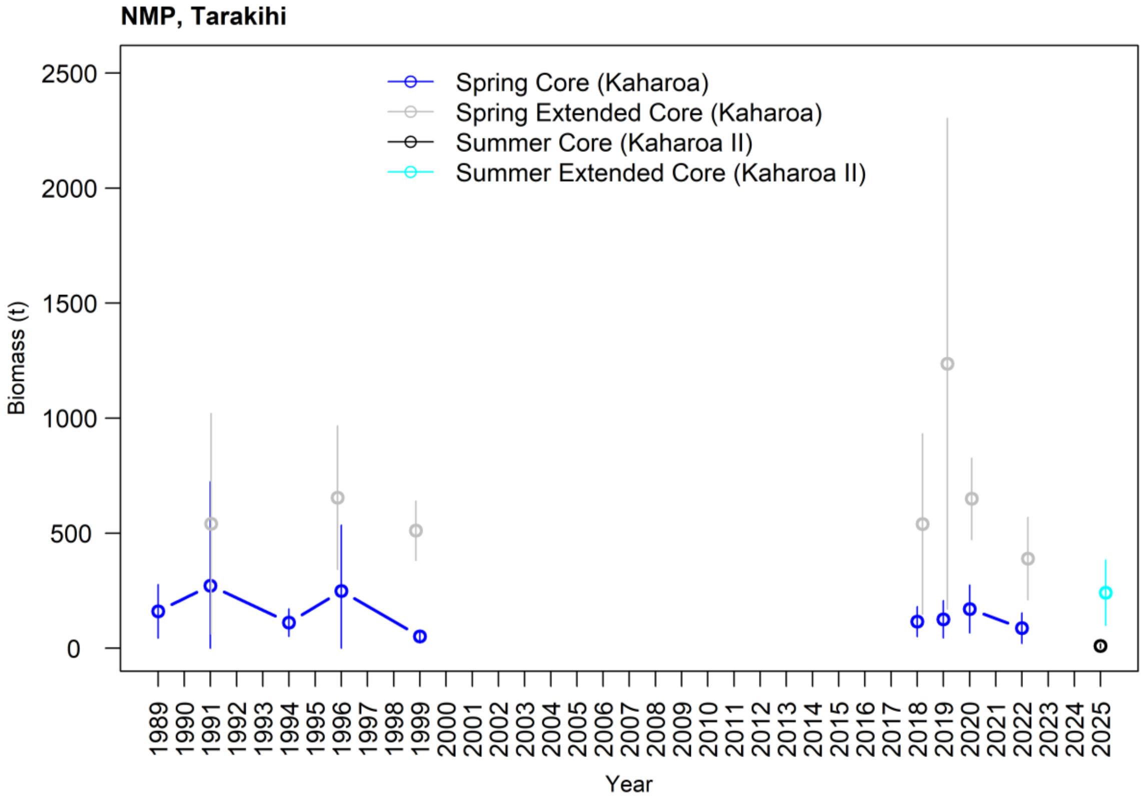

Figure 18: West coast North Island total relative biomass estimates and 95% confidence intervals for tarakihi for the core and extended core (including deeper > 100 m strata) areas. The Spring time series is shown from 1989 until 2022, with the 2025 Summer survey estimates indicated in different colours. Note that each set of annual points is displaced slightly from each other for clarity.

Length measurements of 332 tarakihi were taken during the 2025 survey, all from stations used to estimate biomass, along with individual weight data from 230 tarakihi for which reproductive condition and pairs of otoliths were also collected (Appendix 7).

The population scaled length frequency distributions by depth band for the 2025 survey are shown in Figure 19. The reproductive status of tarakihi by size is shown in Figure 20 and summarised in Appendix 8.

Given the size range, few immature fish were observed. Male tarakihi ranged from 18–47 cm, with a main mode at around 38 cm. Females ranged from 21–47 cm with a main peak between 41–44 cm. There were few fish caught under 30 cm and only five fish were sampled in depths under 100 m, which differs from the previous spring surveys as shown in the time series of population scaled length frequencies for both the core and extended core area (Figure 21). Similar to previous surveys, the population scaled sex ratio favoured females (female: male ratio = 1.15:1).

Females were mainly resting (58%) or ripening (27%), along with some spent individuals. Over half of the males sampled were partially or fully spent, with 39% ripening or ripe and a small number of resting individuals.

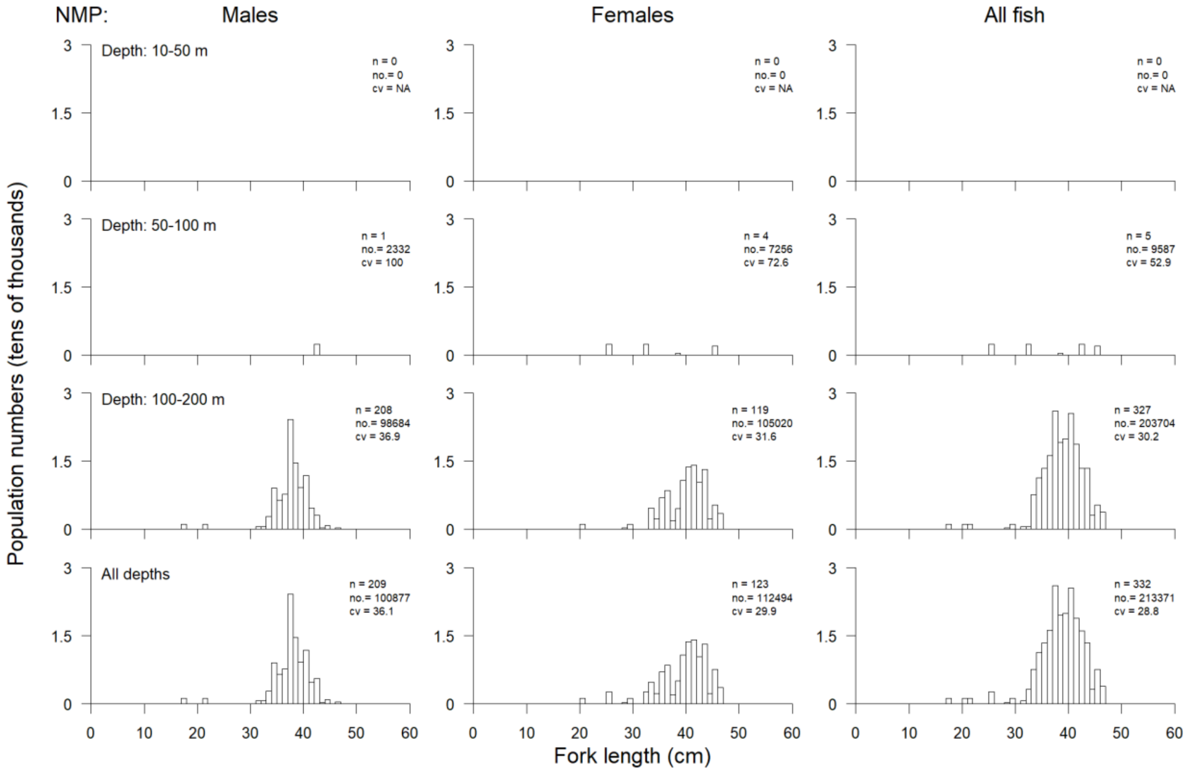

Figure 19: Comparative scaled length frequency distributions for males, females, and all tarakihi at different depths for the 2025 west coast North Island survey. n=number of fish measured, no.=scaled population number and cv=coefficient of variation. 'All fish' includes unsexed fish.

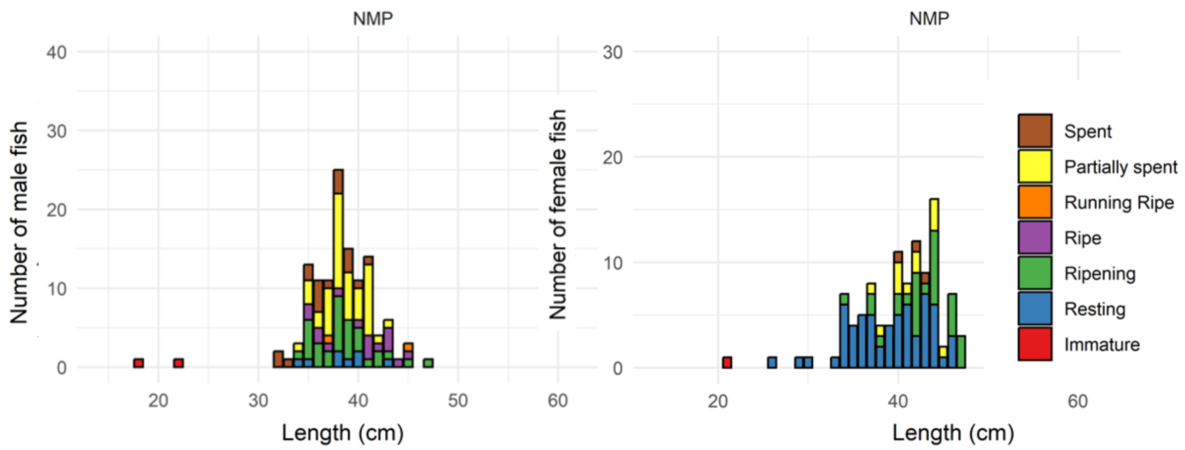

Figure 20: Number of female (left) and male (right) tarakihi at each reproductive stage by 1-cm size class. Note that the axis scales are different. See Appendix 2 for reproductive stage descriptions.

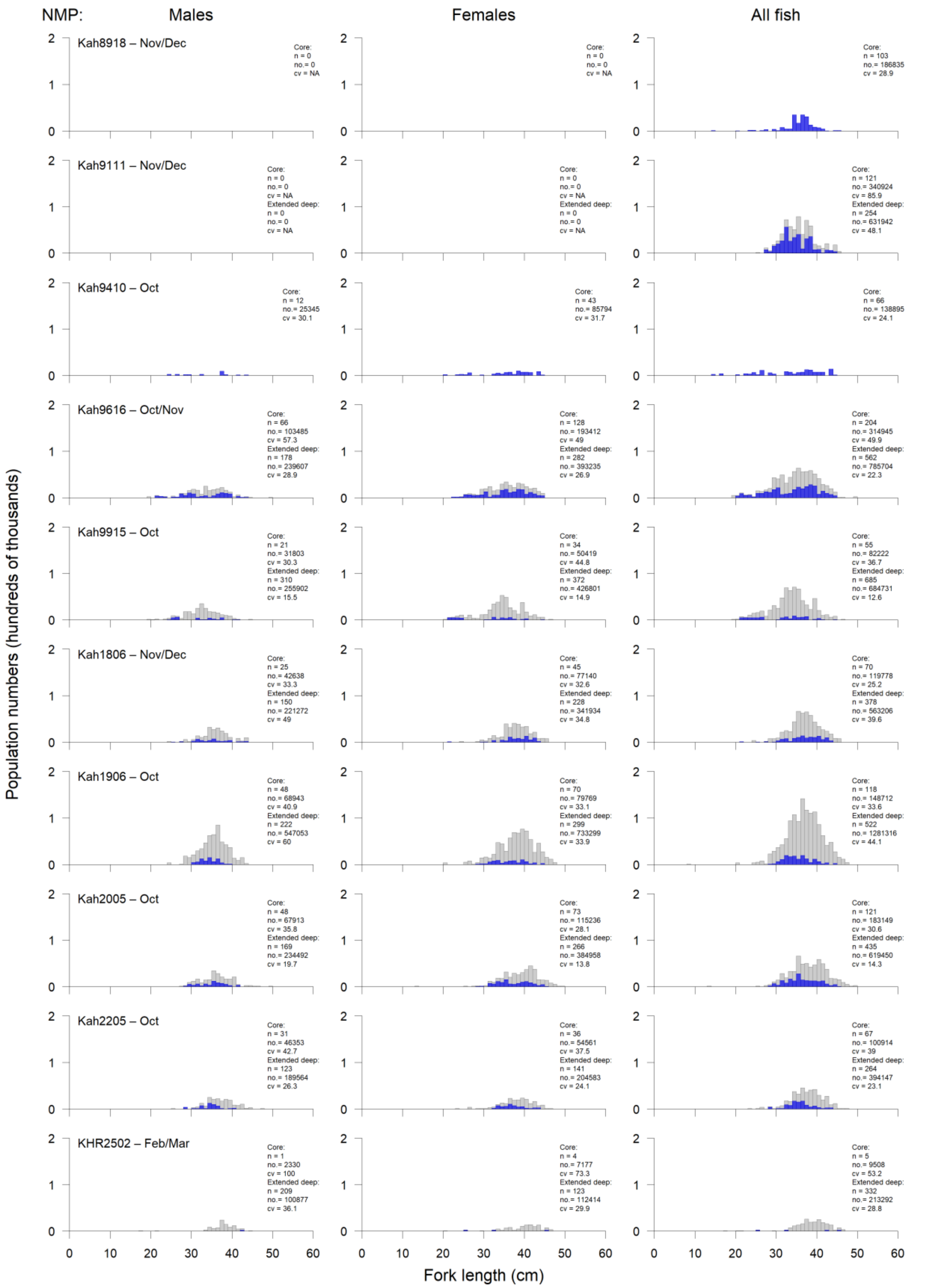

Figure 21: Comparative scaled length frequency distributions for males, females, and all tarakihi in the core strata (blue) and extended deep strata (grey) for the time series of the west coast North Island surveys. Deep strata were not sampled in 1989 or 1994. n = number of fish measured, no. = scaled population number and cv = coefficient of variation. 'All fish' includes unsexed fish. Extended deep numbers represent all northern strata combined. The month sampling occurred is noted for each survey.

3.9 Tarakihi age composition

One of each of the 230 pairs of otoliths collected during the survey were prepared and read using the single reader method with an audit of the first 46 otoliths by a second experienced reader.

The between-reader audit showed a good level of consistency (Appendix 13). The percentage agreement between readers for the initial reads was 87%, with between-reader CV and IAPE scores of less than 2%. Comparisons of age-bias plots for the primary and secondary readers with the final agreed age show that agreement and precision was high, with CV and IAPE scores of less than 1% for both readers. The percentage agreement of the primary reader with the final agreed age was 91%.

The age composition observed in the 2025 survey ranged from 3 up to 31 years, but most fish sampled were between 10 and 20 years old (Figure 22). The overall mean weight CV for all fish was 0.46. The age frequency was relatively similar between males and females, with both being dominated by 10- and 11-year-old fish (2014 and 2015 year classes) with a slightly higher proportion of male tarakihi under 10 years old (28% of numbers compared to 20%). Less prominent year classes visible include 7- and 8-year-olds, as well as 14-, 17- and 18-year-olds. This pattern contrasts with the age composition off the west coast of the South Island where there are much higher numbers of younger fish, along with 7-, 8-, 10- and 11-year-old adults also prominent in this area (MacGibbon et al. 2026).

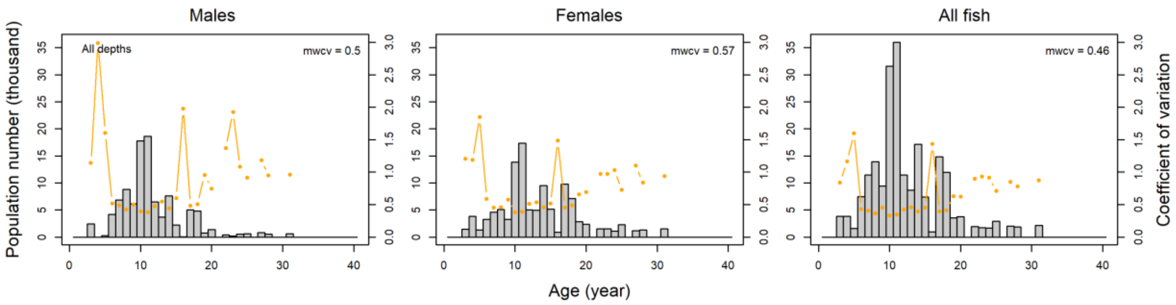

Figure 22: Numbers-at-age distributions (histogram) and CVs (line) across all depths for males, females, and all tarakihi caught on the 2025 west coast North Island trawl survey. (mwcv = mean weighted coefficient of variation).

3.10 John dory

John dory was the 10th most commonly caught species, making up only 1.5% of the catch by weight and caught in 69% of the stations ranging from 22 to 176 m. The highest catch rates were found off Ninety Mile Beach in A100, off the Kaipara and Manukau in C10N, C10S, and D50M (Figure 23). Stratum level catch rates are given in Appendix 8 and ranged from zero to 24.2 kg per km^2.

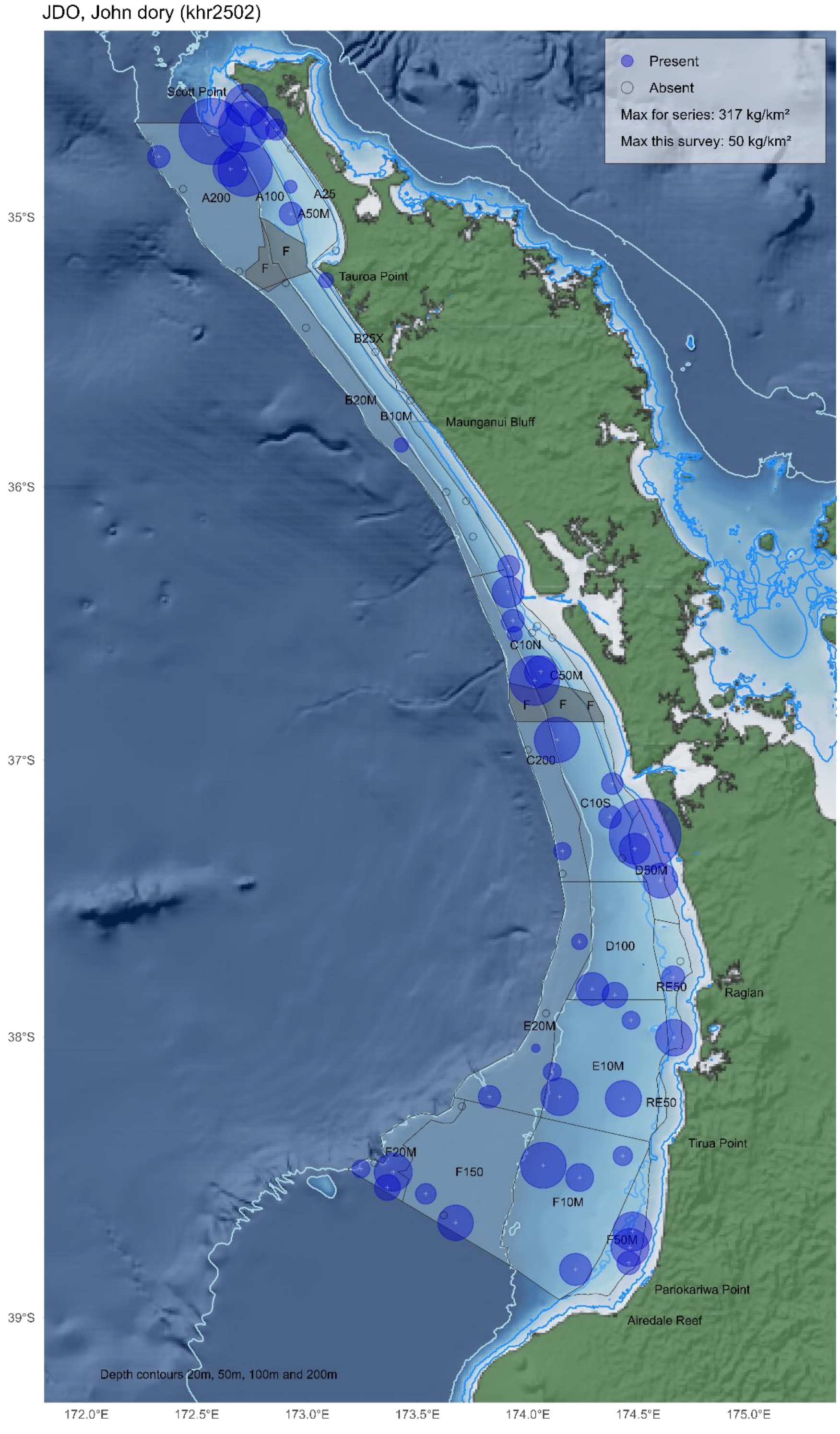

Figure 23: Spatial distribution of catch rates (kg km^{-2}) of John dory in the 2025 west coast North Island survey, scaled to the largest catch. Foul and excluded areas shaded grey. The depth contours indicate 20, 50, 100 and 200 m.

The relative biomass estimates and CVs by stratum for the 2025 survey are given in Appendix 9 and plotted in Figure 24 alongside the four most recent spring surveys. Estimated biomass is similar in some strata such the A strata off Ninety Mile Beach (A25, A50M, A100 and A200), and F50/F50M, but lower in other areas such as the B and C strata and F200/F150, F20M.

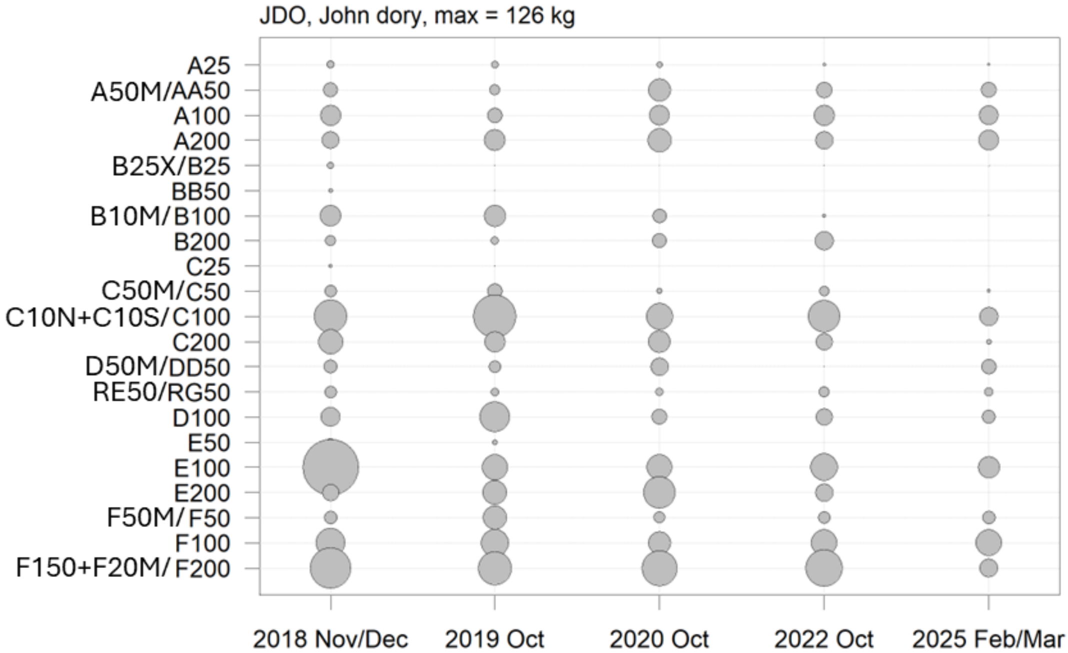

Figure 24: Relative John dory biomass estimates by stratum for the recent west coast North Island trawl surveys completed since 2018. Where a stratum has had boundaries modified during the time series, both names are given.

The combined relative biomass estimate for the 2025 survey core area was 111.9 t (CV = 14.8%) and 146.7 t (CV= 14.1%) when the deeper stations were included (see Table 6 and Figure 25). Similar to the other target species, these estimates were lower than any of the previous spring surveys.

Table 6: Relative biomass estimates (t) and CVs (%) for John dory in the core and extended core areas of the west coast North Island survey. The deeper strata of the extended core were not sampled in the 1989 and 1994 surveys.

Survey	Month	Core biomass (t)	Core CV (%)	Extended core biomass (t)	Extended core CV (%)
KAH8918	Nov/December	242.2	12.2		
KAH9111	Nov/December	466.2	28.5	692.6	23.9
KAH9410	October	127.4	31.0		
KAH9615	October	328.9	15.7	497.2	11.5
KAH9915	October	192.6	10.0	354.5	9.7
KAH1806	Nov/December	285.2	27.5	403.4	22.1
KAH1906	October	231.0	19.5	337.0	14.5
KAH2005	October	158.7	18.4	305.6	12.5
KAH2205	October	152.3	15.6	258.7	11.8
KHR2502	February / March	111.9	14.8	146.7	14.1

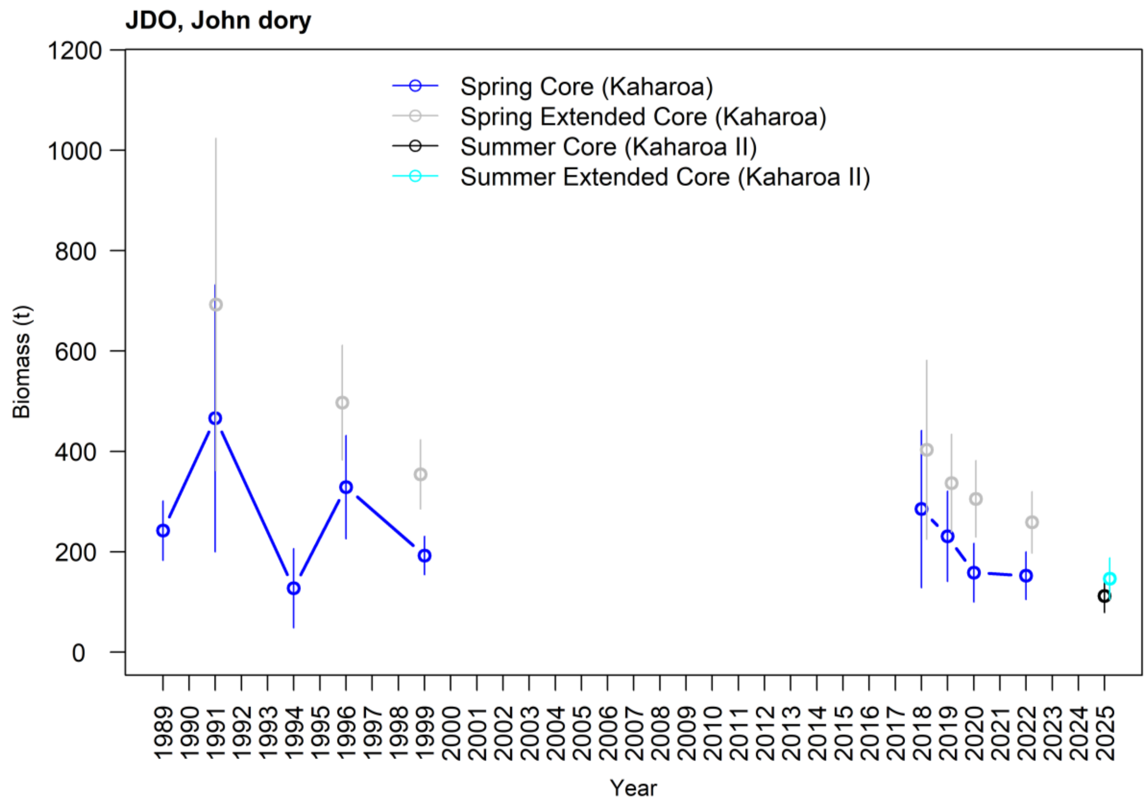

Figure 25: West coast North Island total relative biomass estimates and 95% confidence intervals for John dory for the core and extended core (including deeper > 100 m strata) areas. The Spring time series is shown from 1989 until 2022, with the 2025 Summer survey estimates indicated in different colours. Note that each set of annual points is displaced slightly from each other for clarity.

Length measurements of 179 John dory were taken during the 2025 survey, 154 from stations used to estimate biomass. Individual weight data, reproductive condition and pairs of otoliths were collected from176 individuals (Appendix 7).

The population scaled length frequency distribution for the whole survey is shown in Figure 26. Males ranged from 23–42 cm and females from 24–48 cm with more larger individuals over 40 cm observed compared to males. A small juvenile, mainly male mode between 20–30 cm was present, with larger adult modes at around 34 cm for males and 40 cm for females. Females were more numerous in shallow strata under 50 m depth, with numbers similar in deeper strata and an overall sex ratio favouring females (1.1: 1).

The reproductive status of John dory by size is shown in Figure 27 (also see Appendix 8). Females under 30 cm were either resting or immature, and above 30 cm around 80% were ripening and ripe, with a small number of running ripe and partially spent/spent individuals, Male John dory larger than 30 cm were a mix of ripening, ripe and running ripe fish. This predominance of reproductive active fish is similar to the spring timed surveys.

When compared to the previous spring time series of population scaled length distributions, the absence of very small (< 20 cm) 0+ juveniles in 2025 is apparent, along with fewer fish in the deeper strata (Figure 28).

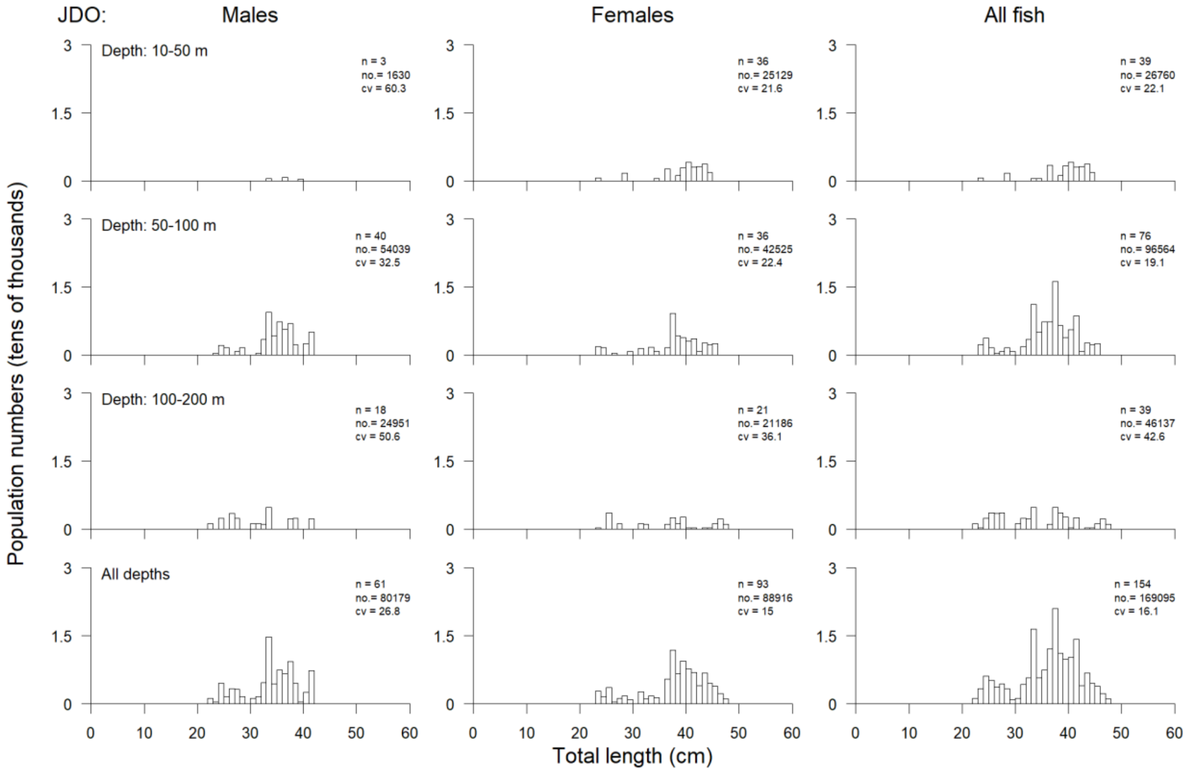

Figure 26: Comparative scaled length frequency distributions for males, females, and all John dory at different depths for the 2025 west coast North Island survey. n = number of fish measured, no.=scaled population number and cv = coefficient of variation. 'All fish' includes unsexed fish.

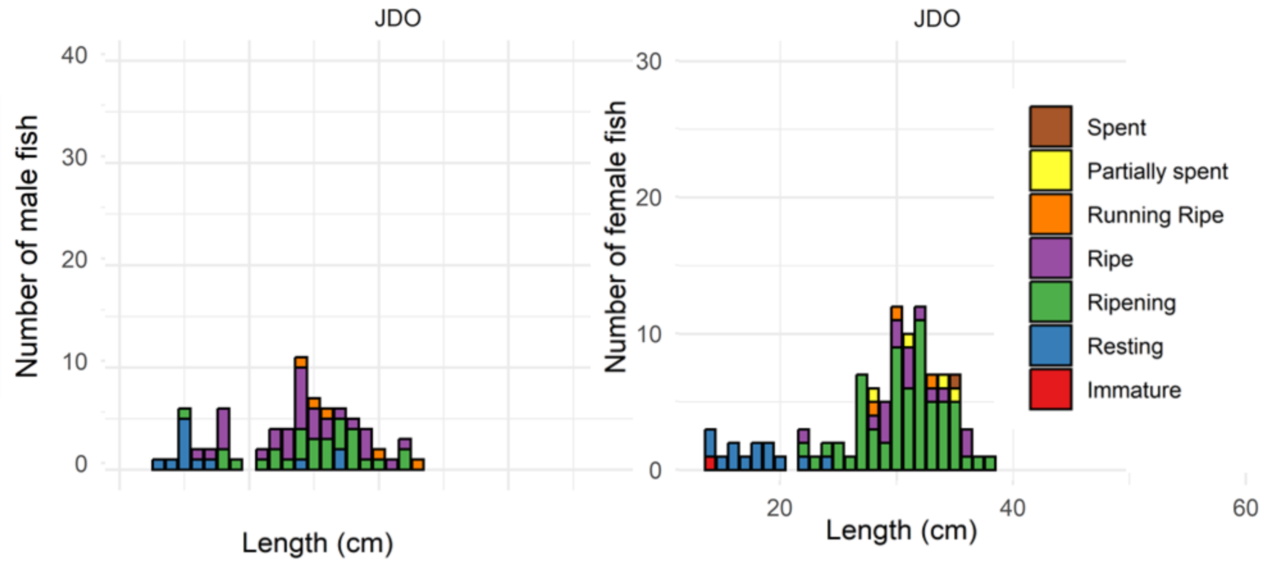

Figure 27: Number of female (left) and male (right) John dory at each reproductive stage by 1-cm size class. Note that the axis scales are different. See Appendix 2 for reproductive stage descriptions.

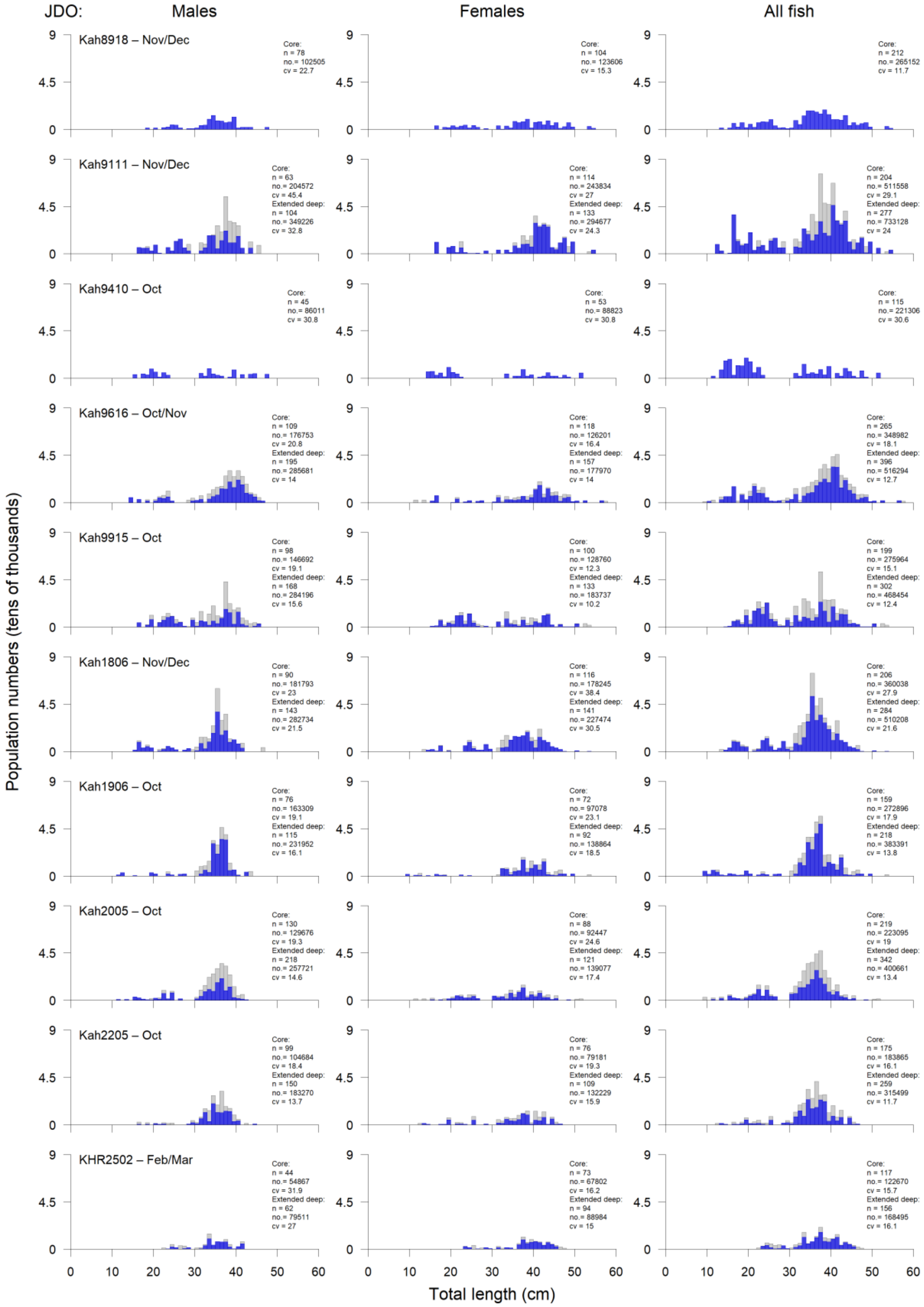

Figure 28: Comparative scaled length frequency distributions for males, females, and all John dory in the core strata (blue) and extended deep strata (grey) for the time series of the west coast North Island surveys. Deep strata were not sampled in 1989 or 1994. n = number of fish measured, no. = scaled population number and cv = coefficient of variation. 'All fish' includes unsexed fish. Extended deep numbers represent all northern strata combined. The month sampling occurred is noted for each survey.

3.11 Other Species

The distribution, catch rates, relative biomass and length distribution of a number of other key QMS species have previously also been reported from this survey, including trevally, kahawai (*Arripis trutta*), barracouta, rig, school shark and spiny dogfish. In a review of the survey, the information for some of these species, such as trevally and rig was considered to have some utility (Jones et al. 2023). Catch rates of kahawai, trevally, and barracouta in 2025 are shown in Figure 29. Catch rates of rig, school shark, and spiny dogfish are shown in Figure 30. Biomass estimates for these six species are plotted in Figure 31.

In the 2025 summer survey, trevally was the second most important species by weight, being caught in just under half of the stations and making up 15.5% of the catch weight (Appendix 5). The summer distribution of this species, similar to spring surveys was concentrated inshore, with highest catch rates in the shallow strata outside of the Kaipara (C50M), off Ninety Mile Beach (A25) and in the North Taranaki Bight (F50M) (see Figure 29 and Appendix 9). The combined relative biomass estimate for trevally was 1031 t (CV = 29.9%,), higher than in the previous spring surveys (Figure 31) - one of only two species with overall higher catches. The size of trevally caught ranged from 18–56 cm with the majority of fish being between 30–40 cm, and of those sampled for reproductive status, most females (>70%) were ripening whilst most males were already ripe (22%) or running ripe (61%) (Appendix 8).

Rig is another QMS species that the survey is considered to provide some useful information for, and with comparable catches to the spring surveys. Highest catch rates were northern inshore strata off Northland and the Kaipara Harbour (see Figure 30 and Appendix 9) and the combined relative biomass estimate was 146 t (CV = 23.6%) (Figure 31). The size range caught was from 45–109 cm, with most being between 70 and 100 cm. Most individuals of both sexes that were staged were mature, with many females being gravid (Appendix 8). Kahawai also had an inshore and more northern distribution with highest catch rates in the shallow (<25 m) northern strata off Northland (see Figure 29 and Appendix 9) and a combined relative biomass estimate within the range of the previous spring surveys (Figure 31). The size of kahawai ranged from 18–57 cm. All fish sampled for reproductive status over 30 cm were mature, with males being mainly ripe or running ripe and females mainly ripening (Appendix 8).

In contrast to the above species, barracouta was only found south of Kawhia harbour (see Figure 29 and Appendix 9) with lower catch rates and combined relative biomass estimate (Figure 31) compared to previous spring surveys. The majority of barracouta were 70 cm or greater and not reproductively active (Appendix 8). The distribution of spiny dogfish in the southern strata was similar to previous surveys (see Figure 30), with males examined for reproductive status being mature, along with both maturing through to gravid females observed. Only three school shark were caught in the 2025 survey.

Further information on these and all other non-target species are available in the Trawl Survey Information Portal online, at https://tsip.niwa.co.nz/home.

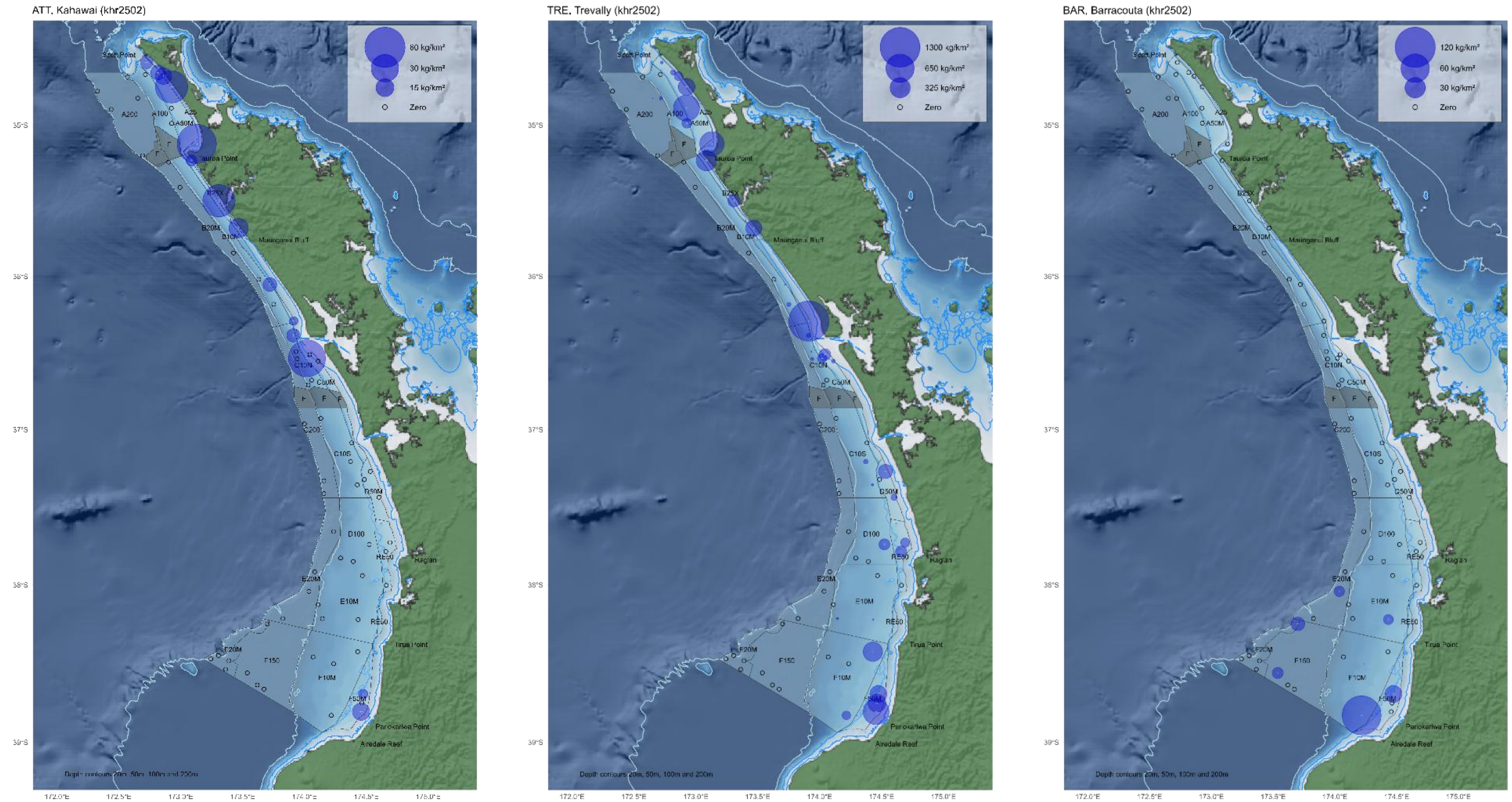

Figure 29: Spatial distribution of catch rates (kg km^{-2}) of key QMS species (left, kahawai; centre, trevally; and right, barracouta) in the 2025 west coast North Island survey, scaled to the largest catch. Foul and excluded areas shaded grey. The depth contours indicate 20, 50, 100 and 200 m.

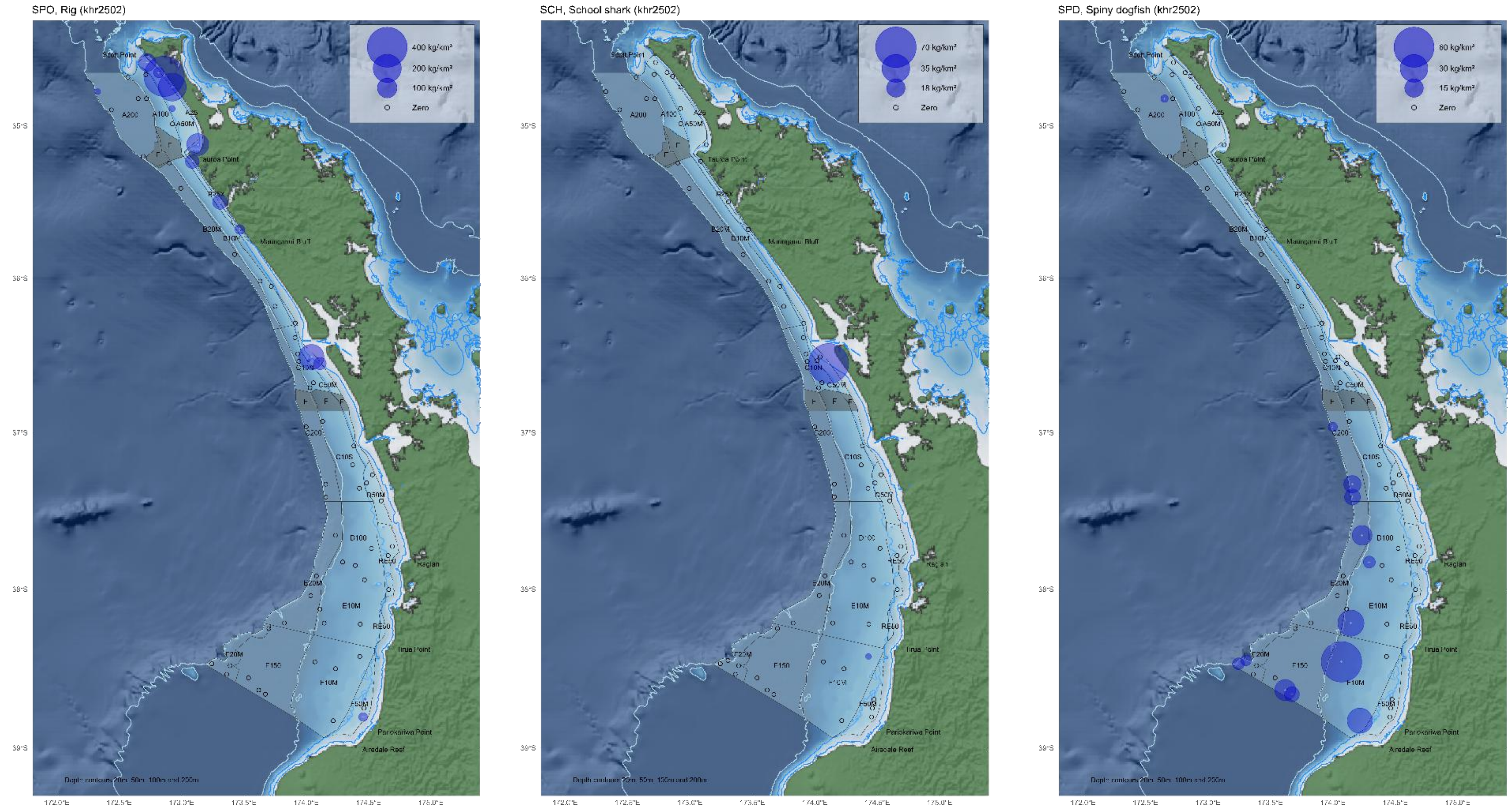

Figure 30: Spatial distribution of catch rates (kg km^{-2}) of key QMS species (left, rig; centre, school shark; and right, spiny dogfish) in the 2025 west coast North Island survey, scaled to the largest catch. Foul and excluded areas shaded grey. The depth contours indicate 20, 50, 100 and 200 m.

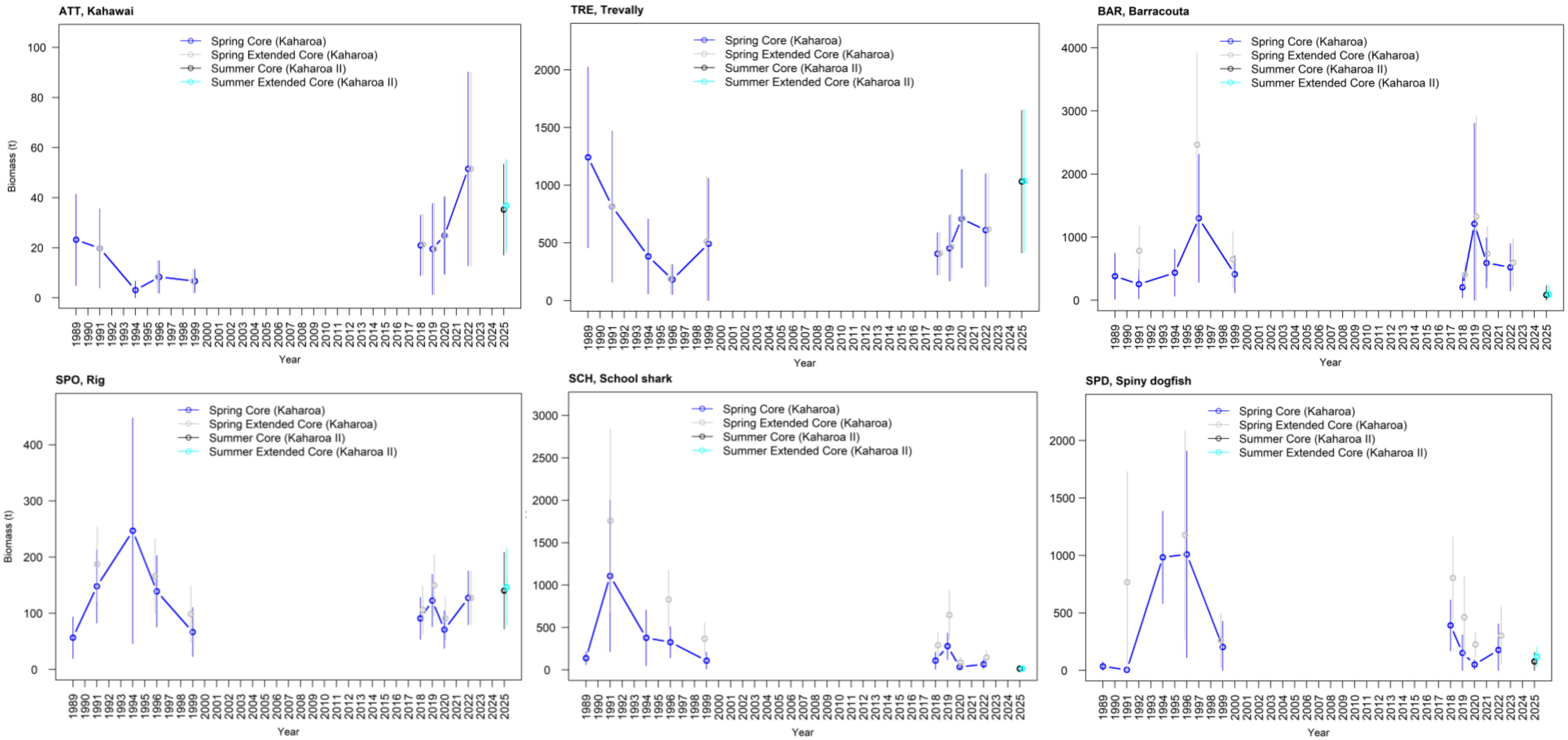

Figure 31: West coast North Island total relative biomass estimates and 95% confidence intervals for key QMS species for the core and extended core (including deeper > 100 m strata) areas. The Spring time series is shown from 1989 until 2022, with the 2025 Summer survey estimates indicated in different colours. Note that each set of annual points is displaced slightly from each other for clarity.

3.12 Identification of benthic macroinvertebrates

The survey is not designed to sample benthic or pelagic invertebrates. Nevertheless, given the limited scientific sampling of benthic communities across large areas of the New Zealand continental shelf, reliably identified trawl survey collections can contribute valuable information on the distribution of invertebrate species (e.g., Stephenson et al. 2022).

The most common benthic invertebrates sampled in the trawl were sponges (14 stations), hydroids (10 stations) and sea pens (9 stations). A total of 92 invertebrate samples were retained and registered in Earth Sciences New Zealand's SPECIFY for expert taxonomists to identify (Appendix 6). From the samples of hydroids collected, 15 different species were identified. From the sponge samples collected there were 5 similar *Callyspongia* species, the most common being the thin, soft spaghetti sponge *Callyspongia* sp. 19 (NIWA 139362, Cape Maria van Diemen), but also including two new species not found before. Other species identified were *Crella incrustans* (Carter, 1885), *Callyspongia latituba* (Dendy, 1924) sensu strictu, *Homaxinella erecta* (Brøndsted, 1924), *Taonura marginalis* (Lendenfeld, 1888), and *Dysidea hirciniformis* (Carter, 1885) sensu Dendy (1924), the latter three being considered unusual for the area (Michelle Kelly pers. comm.)

4. SUMMARY

The 2025 *Kaharoa II* trawl survey of the west coast North Island was the first trawl survey onboard the new vessel, with the new trawl net, and the first to be carried out in February–March. The survey was completed successfully with all 67 planned Phase 1 stations completed and three Phase 2 tows improving the CV for tarakihi and bringing it down to < 30%.

Catch rates for snapper in February were much lower than recent spring surveys, with a much shallower spatial distribution. Comparison of the size composition with previous surveys indicated that this was particularly evident for larger snapper. Changes in catch rates and abundance are confounded by changes to the survey vessel and gear, and without an intercalibration of the old and new west coast North Island surveys, interpretation of the 2025 survey results is limited, however there are other sources of information. The intercalibration results (Devine et al. 2026), between the old west coast South Island vessel and gear and the new vessel and trawl set-up suggested that catch rates of snapper were not significantly different. A recent spatio-temporal modelling (VAST) of snapper commercial catch by time of year (Arnaud Gruss, Earth Sciences NZ, unpublished), confirmed a more inshore distribution of snapper in summer/autumn (January-April) compared to spring (October-December) and autumn/winter (May-September) As such, the 2025 survey results are most likely indicative of a large proportion of the snapper population remaining closer inshore in February and early March, within the Māui dolphin no trawl zone and therefore largely outside the survey area, except for strata to the north of Maunganui Bluff. This is particularly apparent for the larger, older adults (> 5 years), so this survey most likely still monitors the younger age cohorts (3+, 4+ and 5+ year classes) that have previously been utilised in the stock assessment.

Low catch rates were also observed for the three other target species, particularly red gurnard, for which the very low relative biomass estimate also had a high CV compared to previous surveys. In contrast to snapper, the new vessel and trawl set-up was found to have a significantly lower catchability for red gurnard compared to the old west coast South Island vessel and gear (Devine et al. 2026). There was also an apparent change in tarakihi distribution, with very few fish caught in areas other than the two key strata, A200 and F200 (F150 & F20m). Lower catch rates and relative biomass estimates were also recorded for barracouta, school shark, and spiny dogfish, whilst higher or similar catch rates and relative biomass estimates were recorded for trevally, rig, and kahawai.

Good weather for much of the survey enabled some opportunistic gear trials to be completed with approval from Fisheries New Zealand to assess the impacts of increasing the sweep lengths on trawl performance and catch rates (see Appendix 14 for details). Longer sweeps (110 versus 55 m) produced sweep angles between 15–18.7°, which are within a range more favourable for effective herding of demersal species, such as red gurnard. Following discussion with Fisheries New Zealand, the longer length was adopted for the west coast central survey and west coast South Island intercalibration and will be used on future surveys including this one.

Following the presentation of these results at the Inshore Working Group in July 2025, a more fine-scale analysis of snapper CPUE was undertaken (Adam Langley, Trophia, unpublished) along with some informal consultation of commercial and recreational fishers, and a recommendation has been made to move the timing of the next survey in 2026 to an autumn (April) timing.

5. FULFILMENT OF BROADER OUTCOMES

Project specific commitments to the "Broader Outcomes" included collection of data and samples which were in addition to the main survey objectives, building capacity, capability and supporting gender diversity in the research sector, and outreach activities that were organised with a local school following the survey (Goodwood primary school, Cambridge).

5.1 Environmental data collection

Profiles of water temperature, salinity, and conductivity were collected at every station using the net-mounted CTD. Water temperature at the sea surface (SST) ranged from 19.3 to 21.9 °C during the survey period with a median temperature of 21.3 °C. Figure 32 compares the 2025 SST from within the core strata with previous spring surveys. Water temperature at the seafloor varied more widely, between 12.7 and 21.3°C, with the coolest temperatures found in the deepwater stratum A200. These data are stored in the Fisheries New Zealand *CTD* database.

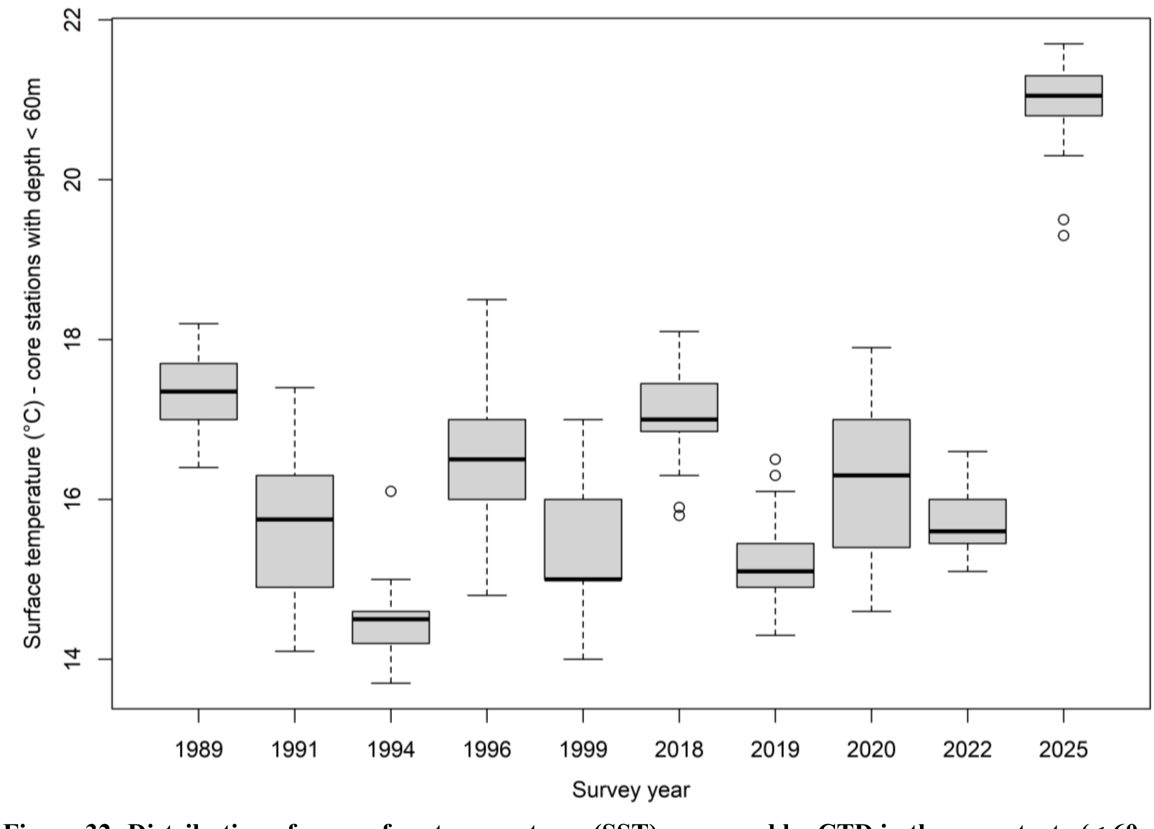

Figure 32: Distribution of sea surface temperatures (SST) measured by CTD in the core strata (< 60 m depth) during the WCNI surveys from 1989 to 2025. Grey boxes indicate the lower and upper

quartiles, the thick black line indicates the median value, the whiskers 1.5 interquartile range, and points are outliers.

Measurements of surface water clarity by Secchi disc ranged from 3 to 27 m, with most stations deeper than 30 m having water clarity of greater than 10 m. The most turbid waters were outside the Kaipara and Hokianga harbours. A new turbidity sensor was also deployed on the trawl for the first time. Some adjustments were needed to the housing and mounting, but turbidity was measured on 47 stations and ranged from 0–21 NTU (Nephelometric Turbidity Unit).

5.2 Acoustic data collection

Acoustic data were continuously collected by RV *Kaharoa II* on the Simrad EK80 multifrequency echosounder during the survey with a detailed log delineating between fishing activities and steaming between stations. The quality of these data was generally high given the favourable weather conditions during most of the survey. These data are archived in the Fisheries New Zealand *acoustic* database.

5.3 Gear trials

Gear trials to assess the performance of the new trawl with longer (110 m versus 55 m) sweeps were carried out opportunistically during the survey. The results have been summarised and presented at the Inshore Working Group. The results of these and further paired tows carried out onboard KHR2503 are presented in Appendix 14.

5.4 Building capacity and supporting gender diversity in the research sector

This trawl survey had two female staff as part of the seagoing team; voyage leader, and a junior member of ESNZ's Te Kuwaha team. The wider inshore trawl survey project (INT2024-01) and improved facilities onboard the new RV *Kaharoa II* has supported female participation and leadership of inshore trawl surveys with three out of four voyage leads in the 2025 survey series being women.

In support of building capacity and collaboration in the wider research sector, the survey team undertook extensive sampling for multiple additional projects. This included:

- Collection of tissue samples from 164 John dory and 16 kingfish from 65 stations for two Victoria University of Wellington PhD genetics projects;
- Collection of Māui dolphin prey species from 43 stations for a Massey University study to detect the occurrence and transmission of toxoplasma oocysts in the marine ecosystem;
- Collection of 45 tarakihi tissue samples for the University of Tasmania;
- Samples for shark reproductive studies;
- Collection of otoliths from rare species for the continued construction of the otolith identification atlas for educational and research purposes;
- Educational resources collected during the survey were utilised for outreach activities in a local New Zealand school (Goodwood School, Cambridge) to help young students discover more about science. Information on trawl survey methods, fish identification, and fish ageing were included in the outreach activities.

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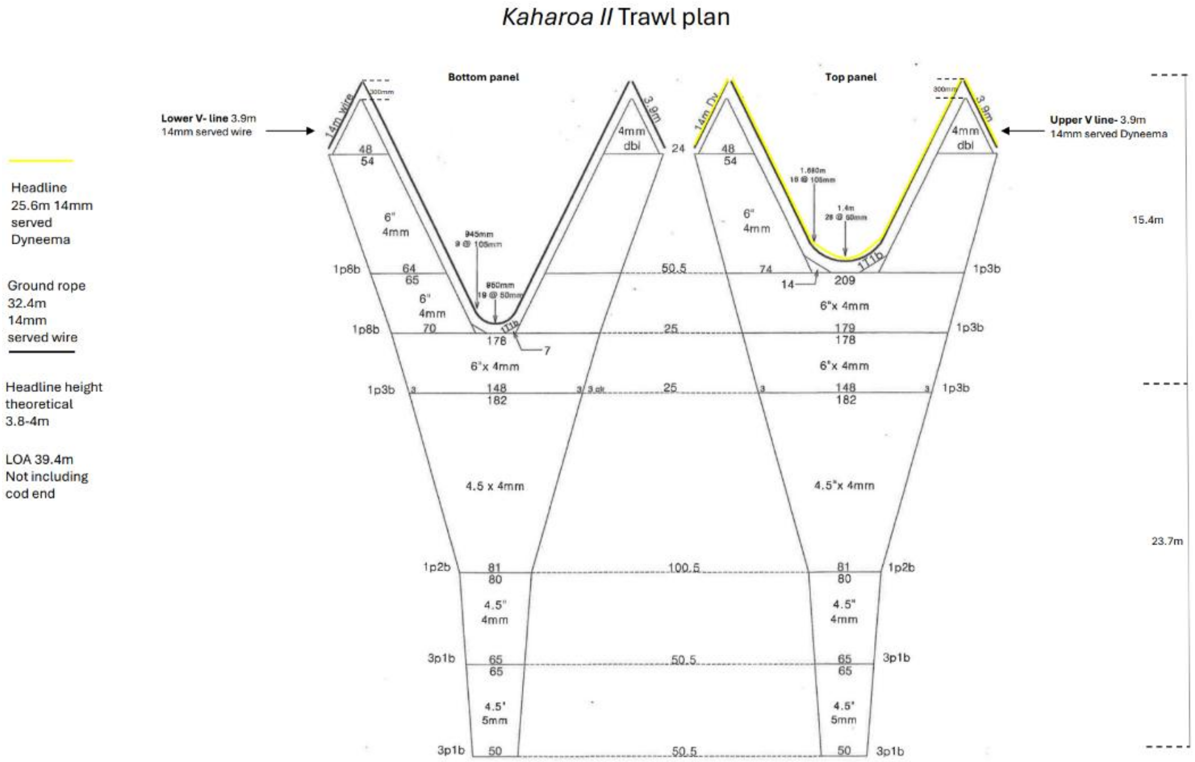
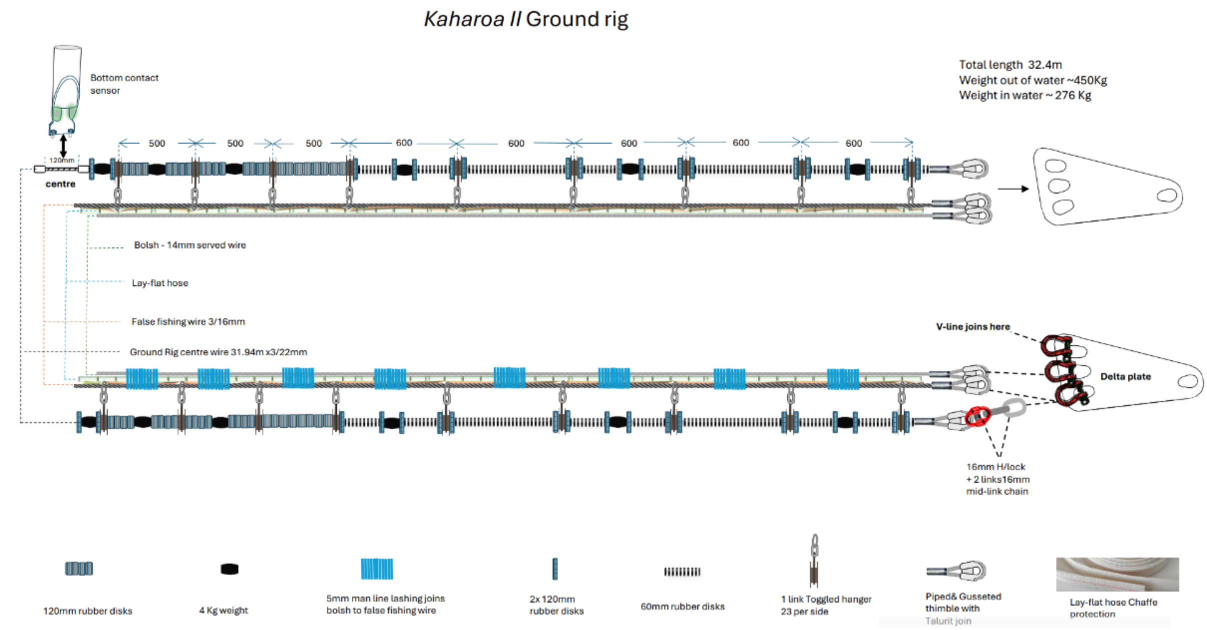
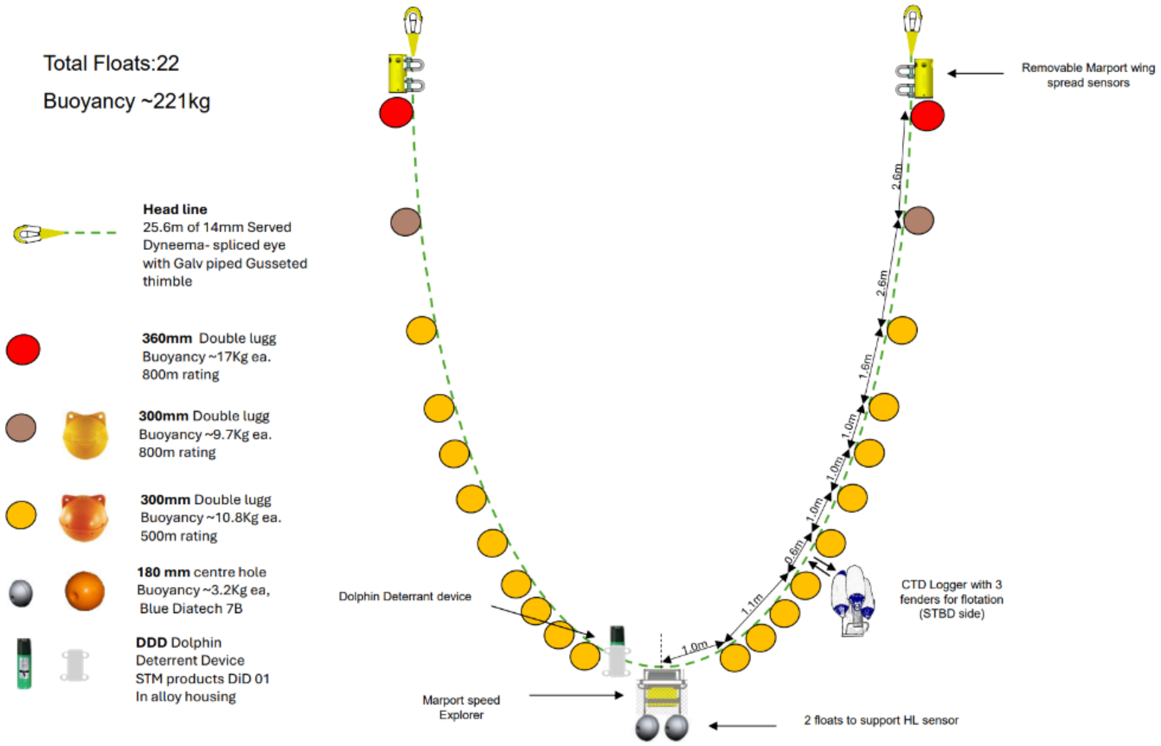
APPENDIX 1: *Kaharoa II* trawl net plan





R.V. *Kaharoa II* Trawl float plan



APPENDIX 2: Maturity stages for teleosts and chondrichthyans

Teleost Middle Depths Stage Scale

Gonad stage		Males	Females
1	Immature	Testes small and translucent; threadlike or narrow membranes.	Ovaries small and translucent. No developing oocytes.
2	Resting	Testes thin and flabby; white or transparent.	Ovaries developed, but no developing eggs visible.
3	Ripening	Testes firm and well developed, but milt is present.	Ovaries contain visible developing eggs, but no hyaline eggs present.
4	Ripe	Testes large, well developed; milt is present and flows when testis is cut, but not when body is squeezed.	Some or all eggs hyaline, but eggs not extruded when body is squeezed.
5	Running ripe	Testis is large, well formed; milt flows easily under pressure on the body.	Eggs flow freely from the ovary when cut or the body is pressed.
6	Partially spent	Testis somewhat flabby and may be slightly bloodshot, but milt still flows freely under pressure on the body.	Ovary partially deflated, often bloodshot. Some hyaline and ovulated eggs present and flowing from a cut ovary or when the body is squeezed.
7	Spent	Testis is flabby and bloodshot. No milt in most of testes, but there may be some remaining near the lumen. Milt not easily expressed, even when present.	Ovary bloodshot; ovary wall may appear thick and white. Some residual ovulated eggs may be present but will not flow when body is squeezed.

Shark and Skate Stage Scale

Males

1. Immature (claspers shorter than the pelvic fins)
2. Maturing (claspers at least as long as the pelvic fins but soft)
3. Mature (claspers longer than the pelvic fins and hard and firm)

Females

1. Immature (no eggs visible in the ovary larger than about 2 mm in diameter)
2. Maturing (ovary contains eggs greater than 2 mm in diameter but no yolk apparent)
3. Mature (yolked eggs in the ovary, uterus small and firm)
4. Ripe (‘candle’ of eggs in the uterus, no embryos visible)
5. Running Ripe (embryos visible in the uterus)
6. Spent (no embryos in the ovary, ovary flabby and may be bloodshot. Yolked eggs may be present in the ovary)

APPENDIX 3: Length-weight relationship parameters

Parameters used to scale length frequencies and calculate length class biomass estimates for the survey.
n = sample size. Data source: "WCNI" refers to all *Kaharoa* WCNI surveys combined; "WCNI & WCSI" refers to all WCNI and west coast South Island *Kaharoa* surveys combined**.**

				Length range (cm)		
Species	***a***	***b***	**n**	**Min**	**Max**	**Data source**
Snapper	0.0417	2.8077	913	13.2	73.9	KHR2502
Red gurnard	0.0109	2.9812	343	15.7	50.3	KHR2502
John dory	0.0134	3.0549	174	23.7	48.0	KHR2502
Tarakihi	0.0151	3.0492	229	18.7	47.4	KHR2502
Trevally	0.0373	2.8036	457	19.9	52.0	KHR2502
Kahawai	0.0196	2.9076	338	15.1	57.3	WCNI
Yellowtail jack mackerel	0.0198	2.8454	229	5.3	37.2	KHR2502
Greenback jack mackerel	0.0168	2.9034	1261	6.0	52.4	WCNI
Barracouta	0.0065	2.9009	349	10.6	100.5	WCNI
Rig	0.0023	3.1335	2360	29.0	147.0	WCNI & WCSI
School shark	0.0021	3.1854	4374	29.7	179.0	WCNI & WCSI
Spiny dogfish	0.0004	3.5277	8897	27.0	98.9	WCNI & WCSI
Rough skate	0.0306	2.8965	1261	14.7	66.0	WCNI & WCSI

APPENDIX 4: KHR2502 station details.

Note: * = stations not suitable for biomass estimation (i.e., gear performance > 3 or extra stations). GT = gear trial

Station no.	Date	Stratum	Time	Start of tow Latitude (° ' S)	Start of tow Longitude (° ' E)	End of tow Latitude (° ' S)	End of tow Longitude (° ' E)	Gear depth (m) Min	Gear depth (m) Max	Distance towed (n. mile)	Headline height (m)	Door spread (m)	Surface temp (°C)	Bottom temp (°C)	Warp length (m)
1*	13-Feb-25	F50M	12:26	38 52.97	174 18.05	38 52.63	174 19.10	41	41	0.88	4.4	96.2	21.1	17	200
2	13-Feb-25	F50M	14:37	38 45.10	174 27.76	38 46.32	174 26.60	38	40	1.51	3.9	95.0	21.7	17.2	200
3	13-Feb-25	F50M	16:28	38 41.69	174 28.46	38 43.13	174 27.94	40	42	1.49	4.1	95.9	20.9	17.9	200
4	14-Feb-25	F10M	6:23	38 49.77	174 12.98	38 51.08	174 11.98	64	65	1.52	4.4	92.5	20.8	15.7	200
5*	14-Feb-25	F10M	8:45	38 44.25	174 01.56	38 43.14	174 02.87	84	88	1.50	5.0	102.3	21	15.2	270
6	14-Feb-25	F10M	11:48	38 27.56	174 04.16	38 28.73	174 02.99	95	96	1.48	5.0	98.7	21.4	15.2	280
7	14-Feb-25	F10M	14:04	38 30.16	174 14.09	38 31.51	174 13.23	80	81	1.50	4.6	99.9	21.3	15.3	243
8*	14-Feb-25	F10M	16:37	38 26.54	174 24.80	38 26.50	174 24.94	60	60	0.11	–	–	21.8	15.8	–
9	15-Feb-25	F10M	6:13	38 25.54	174 25.81	38 27.07	174 25.83	58	59	1.53	4.1	93.8	21.6	16	200
10	15-Feb-25	E10M	8:58	38 13.27	174 25.98	38 11.74	174 25.62	69	73	1.55	4.7	93.6	21.5	15.6	220
11	15-Feb-25	E10M	11:42	38 12.89	174 08.66	38 11.35	174 09.33	95	96	1.62	4.4	108.0	21.5	15.2	300
12	15-Feb-25	E10M	13:13	38 07.51	174 06.64	38 05.97	174 06.95	99	102	1.55	3.9	106.0	21.5	15.3	300
13	15-Feb-25	E20M	15:15	38 02.45	174 02.17	38 03.87	174 01.49	127	127	1.51	4.3	114.3	21.8	15	390
14_{GT}	15-Feb-25	E20M	17:00	38 02.99	174 01.23	38 04.48	174 01.23	125	126	1.49	4.5	115.9	21.9	15	390
15	16-Feb-25	RE50	6:14	38 00.16	174 39.69	37 58.68	174 39.99	47	47	1.49	4.4	95.5	21.4	17.6	200
16	16-Feb-25	E10M	8:24	37 56.42	174 28.05	37 57.52	174 26.72	70	75	1.51	4.6	99.0	21.3	15.9	240
17	16-Feb-25	D100	10:30	37 50.99	174 23.66	37 49.52	174 24.15	80	81	1.52	4.8	100	21.3	16.2	260
18	16-Feb-25	D100	12:18	37 49.66	174 17.53	37 50.91	174 16.35	90	90	1.55	4.8	99.9	21.5	15.7	270
19	16-Feb-25	D100	15:05	37 44.40	174 31.40	37 42.94	174 31.92	61	63	1.51	4.6	91.6	21.4	16.7	200
20	16-Feb-25	RE50	17:20	37 47.17	174 39.51	37 48.50	174 38.60	45	46	1.51	4.5	95.2	21.2	17.4	200
21	17-Feb-25	RE50	6:13	37 43.69	174 41.46	37 42.17	174 41.63	37	38	1.52	4.6	93.7	20.8	17.7	200
22	17-Feb-25	D50M	9:01	37 26.24	174 36.07	37 24.74	174 35.86	36	36	1.50	4.5	95.2	21.3	17.7	200
23	17-Feb-25	D50M	10:52	37 19.31	174 29.03	37 17.87	174 28.30	53	54	1.55	4.6	94.5	21.2	17.5	200
24	17-Feb-25	D50M	12:33	37 16.22	174 31.88	37 14.86	174 30.98	40	40	1.53	4.4	95.2	21	17.8	200

25	17-Feb-25	C10S	14:26	37 12.41	174 22.34	37 11.06	174 21.52	64	65	1.49	4.5	93.4	21.6	17.4	200
26	17-Feb-25	C10S	16:46	37 21.38	174 25.61	37 22.82	174 26.20	64	64	1.51	4.4	95.5	21.3	17.9	210
27	18-Feb-25	C10S	6:11	37 05.14	174 22.97	37 03.68	174 22.53	52	53	1.50	4.6	94.5	21.5	18.2	200
28	18-Feb-25	C10S	8:50	36 55.60	174 07.95	36 54.19	174 07.18	98	99	1.53	4.4	107.8	21.4	16.3	300
29	18-Feb-25	C200	10:58	36 57.77	173 59.99	36 59.22	174 00.58	183	187	1.52	4.2	123.7	21.7	14.2	555
30	18-Feb-25	C200	14:27	37 19.83	174 09.40	37 21.33	174 09.66	136	139	1.51	4.4	116.9	21.9	14.7	420
31	18-Feb-25	C200	16:04	37 24.74	174 09.42	37 26.19	174 09.96	161	164	1.51	4.0	124.4	21.8	14.4	510
32	19-Feb-25	E20M	7:07	37 39.46	174 14.04	37 40.96	174 13.75	116	117	1.51	4.3	113.1	21.6	15.8	360
33	19-Feb-25	E20M	10:32	37 54.93	174 04.93	37 53.43	174 05.27	141	145	1.52	4.4	116.2	21.4	15.3	435
34	19-Feb-25	E20M	15:01	38 12.86	173 49.57	38 11.59	173 50.68	140	142	1.54	4.5	114.0	21.4	14.7	420
35	19-Feb-25	F20M	17:29	38 14.93	173 42.05	38 13.50	173 42.64	146	148	1.50	4.4	116.9	21.2	14.4	450
36	22-Feb-25	A50M	6:16	34 34.88	172 43.47	34 36.03	172 44.68	38	39	1.52	4.7	93.5	20.9	19.0	200
37	22-Feb-25	A50M	7:59	34 38.89	172 49.06	34 40.15	172 50.08	36	38	1.51	4.5	92.6	20.7	19.2	200
38	22-Feb-25	A25	9:53	34 40.36	172 51.64	34 41.59	172 52.66	23	28	1.48	6.6	81.6	20.9	19.1	200
39	22-Feb-25	A25	11:45	34 44.65	172 55.56	34 43.30	172 54.54	23	24	1.58	6.7	93.1	20.9	19.1	200
40	22-Feb-25	A50M	14:41	34 53.16	172 55.47	34 51.75	172 54.68	45	47	1.55	4.2	96.0	21.1	18.7	200
41*	22-Feb-25	A100	16:39	34 46.91	172 48.41	34 47.13	172 48.55	65	65	0.24	1.5	109.0	–	–	200
42	23-Feb-25	A100	6:12	34 59.22	172 55.59	34 57.78	172 54.99	57	58	1.52	4.4	94.5	20.5	19.1	200
43	23-Feb-25	A200	8:37	34 49.25	172 43.18	34 48.00	172 41.99	109	111	1.58	4.4	111.0	21.0	14.8	330
44	23-Feb-25	A200	10:25	34 49.24	172 39.16	34 48.03	172 37.99	133	134	1.54	4.3	118.5	–	–	410
45	23-Feb-25	A100	12:29	34 40.78	172 34.19	34 41.19	172 35.97	89	93	1.52	4.6	102.9	21.1	15.3	280
46	23-Feb-25	A100	14:16	34 39.70	172 42.84	34 40.98	172 43.79	56	62	1.49	4.7	93.5	21.7	17.0	200
47$_{GT}$	23-Feb-25	A100	16:03	34 39.68	172 43.22	34 41.00	172 44.17	58	61	1.53	4.8	103.0	21.1	17.0	200
48	24-Feb-25	A200	6:23	34 46.44	172 19.67	34 47.88	172 20.24	173	176	1.51	4.2	125.0	20.9	13.0	540
49	24-Feb-25	A200	8:38	34 53.68	172 26.27	34 54.69	172 27.64	180	183	1.51	4.1	126.5	21.5	12.8	555
50	24-Feb-25	B20M	13:17	35 14.68	172 54.19	35 16.03	172 54.98	119	123	1.49	4.5	112.4	20.8	13.9	360
51	24-Feb-25	A25	16:00	35 07.44	173 07.80	35 08.42	173 06.43	22	26	1.48	5.4	86.5	20.7	18.6	175
52	25-Feb-25	A200	6:29	35 12.14	172 41.53	35 13.03	172 43.08	194	195	1.54	4.2	126.4	21.1	12.7	585
53	25-Feb-25	B25X	9:34	35 14.09	173 05.19	35 15.31	173 06.32	22	25	1.52	7.0	91.5	19.5	19.0	200
54	25-Feb-25	B20M	11:55	35 24.71	172 59.69	35 25.92	173 00.78	154	154	1.50	4.3	120.6	21.1	13.3	465
55	25-Feb-25	B25X	14:41	35 30.05	173 18.54	35 31.34	173 19.59	22	25	1.54	6.4	89.6	19.3	17.5	200

56	26-Feb-25	C50M	6:25	36 32.16	174 01.19	36 33.25	174 02.50	38	41	1.51	4.6	93.5	21.4	17.7	200
57_{GT}	26-Feb-25	C50M	8:06	36 32.10	174 01.42	36 33.16	174 02.83	36	38	1.55	5.1	102.1	21.5	19.9	200
58_{GT}	26-Feb-25	C50M	10:09	36 31.33	174 03.18	36 30.15	174 01.94	25	28	1.54	5.2	108.8	21.4	18.4	200
59_{GT}	26-Feb-25	C50M	11:50	36 31.34	174 02.63	36 30.13	174 01.44	26	26	1.54	4.5	96.5	21.5	18.4	200
60	26-Feb-25	C50M	13:54	36 33.24	174 06.66	36 32.45	174 05.03	22	24	1.52	4.4	92.7	21.6	19.7	200
61_{GT}	26-Feb-25	C50M	15:52	36 33.65	174 06.55	36 32.86	174 04.96	24	24	1.50	5.0	104.3	21.3	19.9	200
62_{GT}	27-Feb-25	C10N	6:27	36 31.86	173 56.68	36 33.13	173 57.71	90	92	1.51	4.5	123.3	21.4	17.1	285
63	27-Feb-25	C10N	8:19	36 32.41	173 56.45	36 33.64	173 57.55	98	100	1.51	4.5	108.2	21.5	16.8	300
64	27-Feb-25	C10N	10:38	36 40.69	174 03.48	36 42.07	174 04.33	79	81	1.53	4.4	102.9	–	–	255
65_{GT}	27-Feb-25	C10N	12:22	36 39.94	174 03.41	36 41.19	174 04.51	74	78	1.52	4.6	112.9	21.8	16.8	240
66	27-Feb-25	C10N	14:07	36 42.62	174 01.82	36 43.95	174 02.67	96	96	1.49	4.2	107.9	21.8	16.8	300
67	28-Feb-25	F50M	16:00	38 48.39	174 27.40	38 47.10	174 28.45	32	34	1.52	4.5	94.2	20.8	18.0	200
68	01-Mar-25	C10N	8:52	36 29.49	173 55.91	36 28.12	173 55.04	80	85	1.53	4.5	97.3	21.3	16.7	255
69	01-Mar-25	C50M	11:01	36 17.53	173 54.79	36 16.30	173 53.85	48	49	1.44	4.2	95.4	21.1	18.4	200
70	01-Mar-25	B10M	13:15	36 10.98	173 45.08	36 09.57	173 44.38	73	76	1.51	4.6	98.7	21.4	16.9	240
71	01-Mar-25	B10M	14:55	36 03.15	173 43.26	36 01.98	173 41.98	57	58	1.56	4.6	94.4	21.3	17.9	200
72	01-Mar-25	B10M	16:42	36 01.14	173 37.86	36 02.35	173 39.01	80	82	1.52	4.5	99.9	21.3	17.1	255
73	02-Mar-25	B25X	6:24	35 40.88	173 28.06	35 42.06	173 29.28	24	26	1.54	4.3	95.2	20.3	18.5	200
74	02-Mar-25	B20M	8:33	35 50.74	173 25.60	35 51.96	173 26.78	129	130	1.55	4.5	115.4	–	–	390
75_{GT}	02-Mar-25	C10N	14:09	36 23.16	173 54.61	36 24.71	173 54.86	69	74	1.56	4.4	95.0	21.0	18.0	230
76	02-Mar-25	C50M	16:10	36 30.67	174 02.55	36 31.75	174 03.86	22	24	1.50	4.3	92.4	21.3	21.3	200
77	03-Mar-25	F20M	7:40	38 28.31	173 14.64	38 29.12	173 12.94	156	160	1.55	4.5	120.0	20.8	14.1	480
78	03-Mar-25	F20M	9:52	38 32.30	173 21.83	38 31.54	173 23.54	158	162	1.53	4.3	118.2	20.8	14.1	480
79	03-Mar-25	F150	11:58	38 33.65	173 32.27	38 32.46	173 33.52	144	145	1.54	4.3	117.4	21.0	14.3	440
80	03-Mar-25	F150	13:52	38 38.25	173 37.14	38 39.78	173 37.06	135	136	1.53	4.6	120.5	21.2	14.5	420
81	03-Mar-25	F150	15:17	38 39.84	173 40.36	38 38.55	173 41.46	134	134	1.54	3.4	117.5	–	–	405
82	04-Mar-25	F20M	6:37	38 27.04	173 18.32	38 26.55	173 16.47	161	175	1.52	4.6	118.1	21.2	13.9	525
83	04-Mar-25	F20M	8:54	38 29.01	173 23.41	38 29.83	173 21.78	153	159	1.51	4.7	112.8	21.0	14.1	480

APPENDIX 5: Catch summary in descending order by weight

* = less than 0.1%.

Species code	Common name	Scientific name	Catch (kg)	% Catch	No.	% Occ.	Depth (m) Min	Max
SNA	Snapper	*Pagrus auratus*	4 814.2	51.5	55	78.6	22	187
TRE	Trevally	*Pseudocaranx georgianus*	1 448.0	15.5	34	48.6	22	134
POP	Porcupine fish	*Allomycterus jaculiferus*	742.7	7.9	43	61.4	45	187
NMP	Tarakihi	*Nemadactylus macropterus*	375.9	4.0	22	31.4	64	195
SPO	Rig	*Mustelus lenticulatus*	316.8	3.4	16	22.9	22	176
EGR	Eagle ray	*Myliobatis tenuicaudatus*	262.6	2.8	14	20.0	22	90
GUR	Gurnard	*Chelidonichthys kumu*	212.7	2.3	52	74.3	22	187
JMN	Yellowtail jack mackerel	*Trachurus novaezelandiae*	162.5	1.7	33	47.1	22	195
BWH	Bronze whaler shark	*Carcharhinus brachyurus*	155.3	1.7	3	4.3	23	93
JDO	John dory	*Zeus faber*	142.6	1.5	48	68.6	22	176
SSK	Smooth skate	*Dipturus innominatus*	76.2	0.8	3	4.3	156	175
ATT	Kahawai	*Arripis trutta*	75.3	0.8	14	20.0	22	111
SQU	Arrow squid	*Nototodarus sloanii & N. gouldi*	72.5	0.8	38	54.3	22	195
SPD	Spiny dogfish	*Squalus acanthias*	67.7	0.7	14	20.0	64	187
NSD	Northern spiny dogfish	*Squalus griffini*	62.0	0.7	10	14.3	109	195
BRA	Short-tailed black ray	*Dasyatis brevicaudata*	48.2	0.5	4	5.7	22	102
KIN	Kingfish	*Seriola lalandi*	47.8	0.5	6	8.6	22	76
BAR	Barracouta	*Thyrsites atun*	46.9	0.5	7	10.0	40	148
HPC	Sea perch	*Helicolenus percoides*	30.0	0.3	7	10.0	133	176
JGU	Spotted gurnard	*Pterygotrigla picta*	28.3	0.3	10	14.3	109	195
SCH	School shark	*Galeorhinus galeus*	20.9	0.2	3	4.3	22	99
RSK	Rough skate	*Zearaja nasuta*	17.2	0.2	5	7.1	89	160
JMD	Greenback jack mackerel	*Trachurus declivis*	10.7	0.1	12	17.1	40	195
RSO	Gemfish	*Rexea solandri*	10.4	0.1	3	4.3	135	175
LEA	Leatherjacket	*Meuschenia scaber*	9.8	0.1	11	15.7	32	176
FRO	Frostfish	*Lepidopus caudatus*	6.9	0.1	4	5.7	109	195
WRA	Longtailed stingray	*Dasyatis thetidis*	6.8	0.1	2	2.9	22	99
HHS	Hammerhead shark	*Sphyrna zygaena*	5.8	0.1	1	1.4	23	28
BOA	Sowfish	*Paristiopterus labiosus*	5.8	0.1	2	2.9	57	130
GIZ	Giant stargazer	*Kathetostoma giganteum*	5.5	0.1	1	1.4	116	117
LFB	Longfinned boarfish	*Zanclistius elevatus*	4.3	*	4	5.7	45	100
BRI	Brill	*Colistium guntheri*	4.0	*	1	1.4	40	40
BPE	Butterfly perch	*Caesioperca lepidoptera*	3.6	*	2	2.9	156	175
CUC	Cucumber fish	*Paraulopus nigripinnis*	2.9	*	12	17.1	119	164
GSH	Ghost shark	*Hydrolagus novaezealandiae*	2.4	*	1	1.4	134	134
SNI	Snipefish	*Macroramphosus scolopax*	2.0	*	9	12.9	80	164
LSO	Lemon sole	*Pelotretis flavilatus*	1.5	*	3	4.3	37	93
STT	Starry toado	*Arothron firmamentum*	1.5	*	1	1.4	64	65
ERA	Electric ray	*Torpedo fairchildi*	1.4	*	1	1.4	153	159
RCO	Red cod	*Pseudophycis bachus*	1.3	*	1	1.4	173	176
FOX	Fox fish	*Bodianus flavipinnis*	1.3	*	1	1.4	158	162
KOH	Koheru	*Decapterus koheru*	1.2	*	1	1.4	23	24
WAR	Common warehou	*Seriolella brama*	1.1	*	1	1.4	136	139
EMA	Blue mackerel	*Scomber australasicus*	0.8	*	6	8.6	40	111
CAR	Carpet shark	*Cephaloscyllium isabellum*	0.5	*	1	1.4	133	134
SCG	Scaly gurnard	*Lepidotrigla brachyoptera*	0.3	*	3	4.3	119	195
OPE	Orange perch	*Lepidoperca aurantia*	0.3	*	1	1.4	173	176
RHY	Common roughy	*Paratrachichthys trailli*	0.3	*	1	1.4	156	160
SPP	Splendid perch	*Callanthias spp.*	0.3	*	1	1.4	156	160
ANC	Anchovy	*Engraulis australis*	0.2	*	2	2.9	40	62
SDO	Silver dory	*Cyttus novaezealandiae*	0.2	*	1	1.4	146	148
NOF	Orange bellowsfish	*Notopogon fernandezianus*	0.1	*	1	1.4	173	176
SDP	Southern splendid perch	*Callanthias allporti*	0.1	*	1	1.4	173	176
WIT	Witch	*Arnoglossus scapha*	0.1	*	1	1.4	173	176
BRC	Northern bastard cod	*Pseudophycis breviuscula*	0.1	*	1	1.4	40	42
CEP	Red bandfish	*Cepola haastii*	0.1	*	1	1.4	127	127
SCA	Scallop	*Pecten novaezelandiae*	0.1	*	1	1.4	90	90
WHI	Whitebait	*Galaxiidae (juvenile)*	0.1	*	1	1.4	24	26

Species code	Common name	Scientific name	Catch (kg)	% Catch	No.	% Occ.	Depth (m) Min	Max
DEA	Dealfish	*Trachipterus trachypterus*	0.1	*	1	1.4	161	175
Pelagic								
JFI	Jellyfish		3.1	*	1	1.4	80	81
ZVA	*Thetys vagina*	*Thetys vagina*	0.5	*	1	1.4	95	96
SAL	Salps		0.4	*	3	4.3	73	195
Other								
ECK	Ecklonia	*Ecklonia*	2.4	*	1	1.4	89	93
RHO	Red seaweed	*Rhodophyta*	0.7	*	6	8.6	22	195
PHA	Brown seaweed	*Phaeophyta*	0.4	*	4	5.7	22	47
SEO	Seaweed		0.1	*	1	1.4	23	28
WOD	Wood		4.3	*	2	2.9	40	73
ZFO	Rubbish fishing other		2.2	*	1	1.4	173	176
Benthic invertebrates								
ONG	Sponges	*Porifera*	3	*	14	20.0	22	176
HDR	Hydroid	*Hydrozoa*	1.1	*	10	14.3	22	195
CCM	Eleven-arm seastar	*Coscinasterias muricata*	1.1	*	5	7.1	32	99
AGF	Flower sea pen	*Anthoptilum grandiflorum*	0.9	*	6	8.6	129	183
CRS	Airy finger sponge	*Callyspongia ramosa*	0.9	*	8	11.4	24	195
ALF	Long-leaf sea pen	*Acanthoptilum longifolium*	0.9	*	9	12.9	127	175
LMC	Carpet star	*Luidia maculata*	0.7	*	5	7.1	61	187
THO	Bottlebrush coral	*Thouarella spp.*	0.6	*	1	1.4	173	176
APC	Astropecten spp.	*Astropecten spp.*	0.5	*	5	7.1	36	64
EGC	Egg case		0.4	*	1	1.4	45	46
CRB	Crab		0.3	*	3	4.3	32	123
ASC	Sea squirt	*Ascidiacea*	0.3	*	3	4.3	23	62
GAS	Gastropods	*Gastropoda*	0.2	*	2	2.9	56	65
PAG	Hermit crab	*Paguroidea*	0.2	*	2	2.9	38	82
HCI	Pillbox crab	*Halicarcinus cookii*	0.2	*	2	2.9	70	93
PSI	Geometric star	*Psilaster acuminatus*	0.2	*	1	1.4	79	81
ANT	Anemones	*Anthozoa*	0.1	*	1	1.4	173	176
GOC	Gorgonian coral	*Gorgonacea*	0.1	*	1	1.4	180	183
OCP	Octopod		0.1	*	1	1.4	40	42
COU	Coral (unspecified)	*Alcyonacea,Gorgonacea,Scleractinia,Antipatharia (Orders) & Stylasteridae(Family)*	0.1	*	1	1.4	22	25
LEH	Leech - generic	*Hirudinea*	0.1	*	1	1.4	22	25
NTO	Masking crab	*Notomithrax spp.*	0.1	*	1	1.4	127	127
ISO	Isopod	*Isopoda*	0.1	*	1	1.4	70	75
NCB	Smooth red swimming crab	*Nectocarcinus bennetti*	0.1	*	1	1.4	70	75
OPH	Ophiuroid (brittle star)		0.1	*	1	1.4	89	93
KWH	Knobbed whelk	*Austrofucus glans*	0.1	*	1	1.4	73	76

APPENDIX 6: Benthic macro-invertebrates retained and identified ashore

Initial Code	Phylum: Class	Order	Family	Scientific name	Expert ID code	No. of stations
LEH	Annelida: Clitellata			*Hirudinea*	LEH	1
HDR	Annelida: Polychaeta	Terebellida	Terebellidae	*Terebellidae ?*	POL	1
CRB	Arthropoda: Malacostraca	Decapoda		*Brachyura MEGALOPA*	CRB	1
ALF	Arthropoda: Malacostraca	Decapoda	Chirostylidae	*Uroptychus yaldwyni cf.*	URP	1
PAG	Arthropoda: Malacostraca	Decapoda	Diogenidae	*Paguristes subpilosus*	PAG	1
CRB	Arthropoda: Malacostraca	Decapoda	Hymenosomatidae	*Halicarcinus tongi*	CRB	1
HCI	Arthropoda: Malacostraca	Decapoda	Hymenosomatidae	*Halicarcinus tongi*	CRB	2
CRB	Arthropoda: Malacostraca	Decapoda	Lyreididae	*Lyreidus tridentatus*	LYR	1
ISO	Arthropoda: Malacostraca	Isopoda	Sphaeromatidae	*Cymodoce n. sp. ?*	ISO	1
BRN	Arthropoda: Thecostraca	Calanticomorpha	Calanticidae	*Calantica spinilatera*	BRN	1
ASC	Chordata: Ascidiacea	Aplousobranchia	Holozoidae	*Sycozoa sigillinoides*	SYG	2
ANT	Cnidaria: Hexacorallia	Actiniaria		*Actiniaria*	ANT	1
HDR	Cnidaria: Hexacorallia	Antipatharia	Antipathidae	*Antipathes leptocrada*	ATP	1
COU	Cnidaria: Hexacorallia	Scleractinia	Flabellidae	*Monomyces rubrum*	CUP	1
HDR	Cnidaria: Hydrozoa	Anthoathecata	Solanderiidae	*Solanderia*	HDF	1
HDR	Cnidaria: Hydrozoa	Leptothecata	Aglaopheniidae	*Aglaophenia*	HDF	1
HDR	Cnidaria: Hydrozoa	Leptothecata	Aglaopheniidae	*Aglaophenia hystrix ?*	HDF	2
HDR	Cnidaria: Hydrozoa	Leptothecata	Aglaopheniidae	*Aglaophenia laxa*	HDF	2
HDR	Cnidaria: Hydrozoa	Leptothecata	Aglaopheniidae	*Aglaophenia sinuosa cf. ?*	HDF	1
HDR	Cnidaria: Hydrozoa	Leptothecata	Plumulariidae	*Nemertesia elongata*	NEE	3
HDR	Cnidaria: Hydrozoa	Leptothecata	Plumulariidae	*Plumularia*	HDF	2
HDR	Cnidaria: Hydrozoa	Leptothecata	Plumulariidae	*Plumularia setacea cf.*	HDF	4
HDR	Cnidaria: Hydrozoa	Leptothecata	Plumulariidae	*Plumulariidae*	HDF	2
HDR	Cnidaria: Hydrozoa	Leptothecata	Sertulariidae	*Amphisbetia bispinosa*	HDF	1
HDR	Cnidaria: Hydrozoa	Leptothecata	Sertulariidae	*Amphisbetia fasciculata*	HDF	1

Initial Code	Phylum: Class	Order	Family	Scientific name	Expert ID code	No. of stations
HDR	Cnidaria: Hydrozoa	Leptothecata	Sertulariidae	*Crateritheca*	HDF	3
HDR	Cnidaria: Hydrozoa	Leptothecata	Sertulariidae	*Diphasia subcarinata*	HDF	1
HDR	Cnidaria: Hydrozoa	Leptothecata	Sertulariidae	*Sertularella integra*	HDF	1
HDR	Cnidaria: Hydrozoa	Leptothecata	Syntheciidae	*Synthecium ?*	HDF	1
GOC	Cnidaria: Octocorallia	Malacalcyonacea	Alcyoniidae	*Anthothela*	ANB	1
ALF	Cnidaria: Octocorallia	Scleralcyonacea	Anthoptilidae	*Anthoptilum grandiflorum*	AGF	4
AGF	Cnidaria: Octocorallia	Scleralcyonacea	Funiculinidae	*Funiculina quadrangularis*	FQU	1
THO	Cnidaria: Octocorallia	Scleralcyonacea	Primnoidae	*Metafannyella*	MEF	1
OPH	Echinodermata: Ophiuroidea	Ophiacanthida	Ophiodermatidae	*Ophiopsammus assimilis ?*	OPH	1
EGC	Mollusca:			*Mollusca eggcase*	EGC	1
ONG	Porifera: Demospongiae	Dictyoceratida	Dysideidae	*Dysidea cf. sp. 2*	DSO	1
ONG	Porifera: Demospongiae	Dictyoceratida	Dysideidae	*Dysidea hirciniformis*	DSO	1
ONG	Porifera: Demospongiae	Dictyoceratida	Thorectidae	*Taonura marginalis ?*	DSO	1
CRS	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia cf. sp. 12*	DSO	1
ONG	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia cf. sp. 19*	DSO	3
CRS	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia cf. sp. 19*	DSO	1
ONG	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia cf. sp. 22*	DSO	1
ONG	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia latituba*	DSO	1
ONG	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia n. sp. 23*	DSO	1
ONG	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia sp. 19*	DSO	6
CRS	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia sp. 19*	DSO	2
CRS	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia sp. 22*	DSO	1
ONG	Porifera: Demospongiae	Haplosclerida	Callyspongiidae	*Callyspongia sp. 22*	DSO	2
ONG	Porifera: Demospongiae	Haplosclerida	Petrosiidae	*Xestospongia coralloides*	DSO	1
ONG	Porifera: Demospongiae	Poecilosclerida	Crellidae	*Crella incrustans*	CIC	1
ONG	Porifera: Demospongiae	Poecilosclerida	Microcionidae	*Clathria (Axosuberites) indet.*	DSO	1
ONG	Porifera: Demospongiae	Poecilosclerida	Microcionidae	*Microcionidae indet.*	DSO	1
ONG	Porifera: Demospongiae	Suberitida	Halichondriidae	*Halichondria cf. sp. 2*	DSO	1

Initial Code	Phylum: Class	Order	Family	Scientific name	Expert ID code	No. of stations
ONG	Porifera: Demospongiae	Suberitida	Suberitidae	*Homaxinella erecta*	DSO	2

APPENDIX 7: Number of length frequency and biological records

No. of samples refers to the number of stations on which fish were sampled. Measurement methods; 1 = fork length, 2 = total length, 4 = mantle length (squid), 5= pelvic length (skates and rays), G = Chimaera length (tip of snout to posterior end of dorsal fin). Biological records refers to the subsample of length records where biological data were collected including length and weight data and usually one of more of the following; gonad/maturity stage and / or otoliths. Additional gonad/maturity data were also collected for some species as part of staged length frequencies (i.e., individual weights not collected).

	Length frequency data			Biological samples		
Species code	Measurement method	No. of samples	No. of fish	No. of samples	No. of fish	No. of otoliths
ANC	1	1	1			
ATT	1	16	58	16	58	0
BAR	1	8	22	6	9	0
BOA	1	2	7	2	7	0
BPE	2	2	7	2	7	0
BRC	2	1	1			
BRI	2	1	1	1	1	0
BWH	2	3	3	2	2	0
CEP	2	1	1			
CUC	1	11	63	10	62	0
DEA	2	1	1			
EMA	1	8	28	7	27	0
FOX	1	1	1	1	1	0
FRO	1	4	4	4	4	0
GIZ	2	1	1	1	1	0
GSH	G	1	2	1	2	0
GUR	1	58	415	58	362	341
HHS	2	1	2	1	2	0
HPC	2	6	88	6	41	0
JDO	2	55	179	55	179	176
JGU	1	10	78	10	78	0
JMD	1	11	153	9	135	0
JMN	1	35	422	34	262	0
KIN	1	11	16	11	16	0
KOH	1	1	2	1	2	0
LEA	2	11	35	11	35	0
LSO	2	4	4	4	4	0
NMP	1	22	332	22	230	230
NOF	2	1	4	1	4	0
NSD	2	10	30	10	30	0
OPE	1	1	1	1	1	0
RCO	2	1	1	1	1	0
RHY	1	1	2	NA	NA	NA

	Length frequency data			Biological samples		
Species code	Measurement method	No. of samples	No. of fish	No. of samples	No. of fish	No. of otoliths
RSK	5	5	6	5	6	0
RSO	1	3	7	3	7	0
SCG	1	2	3	2	3	0
SCH	2	3	3	2	2	0
SDO	2	1	1	1	1	0
SDP	1	1	1	1	1	0
SNA	1	63	4 936	63	953	886
SPD	2	15	56	15	56	0
SPO	2	20	152	20	137	0
SPP	1	1	1	1	1	0
SSK	5	3	9	3	9	0
TRE	1	41	1 495	39	460	0
WAR	1	1	1	1	1	0
		460	8 636	444	3 200	1 633

APPENDIX 8: Gonad stage table

	Males gonad stages							Female gonad stages							
Length (cm)	1	2	3	4	5	6	7	1	2	3	4	5	6	7	Total
Snapper															
11–20	8							8							16
21–30	17	62	3			1		25	57						165
31–40	1	238	9	5		3	16	1	222	13	1			4	513
40–50		73	2			4	10		69	6				2	166
50–60		13					3		9	2				5	32
60–70		2					1		7					4	14
70–80									1						1
Total	**26**	**388**	**14**	**5**		**8**	**30**	**34**	**365**	**21**	**1**			**15**	**907**
Red gurnard															
11–20	4							3							7
21–30	7	22	2	2				2	12						47
31–40		22	27	7	1		1	3	46	71	17		1	2	198
40–50		1	4				1		7	82	8			3	106
Total	**11**	**45**	**33**	**9**	**1**		**2**	**8**	**65**	**153**	**25**		**1**	**5**	**358**
John dory															
11–20															
21–30		9	4	6				1	11						31
31–40		3	22	22	4				2	27	7	2	1		90
40–50			2	2	1					35	8	1	3	1	53
Total		**12**	**28**	**30**	**5**			**1**	**13**	**62**	**15**	**3**	**4**	**1**	**174**
Tarakihi															
1–10	1														1
21–30	1							1	3						5
31–40		7	26	7	1	34	17		32	6			5	1	136
40–50		1	6	9	1	11	1		26	22			7	2	86
50–60															
Total	**2**	**8**	**32**	**16**	**2**	**45**	**18**	**1**	**61**	**28**			**12**	**3**	**228**
Trevally															
11–20									2						2
21–30	4	2	6	6	19			2	21	7	1				68
31–40		1	22	43	115				22	126	5	3	1		338
40–50		2	2	3	12				7	19	1	1			47
50–60					1					1					2
Total	**4**	**5**	**30**	**52**	**147**			**2**	**52**	**153**	**7**	**4**	**1**		**457**
Kahawai															
11–20	1							2							3
21–30	2	1							1						4

	Males gonad stages							Female gonad stages							
Length (cm)	1	2	3	4	5	6	7	1	2	3	4	5	6	7	Total
31–40				2	2					2					6
40–50			2	4	13					13	1				33
50–60					4					7		1			12
Total	**3**	**1**	**2**	**6**	**19**			**2**	**1**	**22**	**1**	**1**			**58**
Yellowtail jack mackerel															
11–20	6	7	2					5	11	1					32
21–30		4	12	20	5			2	13	25					81
31–40			4	2	4					6					16
Total	**6**	**11**	**18**	**22**	**9**			**7**	**24**	**32**					**129**
Greenback jack mackerel															
11–20	5	5						2	4						16
21–30															
31–40															
40–50										1					1
Total	**5**	**5**						**2**	**4**	**1**					**17**
Barracouta															
31–40															
40–50															
50–60															
60–70									1						1
70–80		4	1		1				3						9
80–90		2	1		1				5	1					10
90–100															
Total		**6**	**2**		**2**				**9**	**1**					**20**
School shark															
60–70								1							1
70–80															
90–100															
Total								**1**							**1**
Rig															
50–60								4							4
60–70	1	7	3						1						12
70–80		2	24							4	2	12			44
80–90			2					1			6	12			21
90–100												6			6
100–110												1			
Total	**1**	**9**	**29**					**5**	**1**	**4**	**8**	**31**			**88**
Spiny dogfish															
50–60			4												4
60–70			35						3	2					40

	Males gonad stages							Female gonad stages							
Length (cm)	1	2	3	4	5	6	7	1	2	3	4	5	6	7	Total
70–80			2							2	2	4			10
Total			**41**						**3**	**4**	**2**	**4**			**54**

APPENDIX 9: Mean catch rate (kg km^{-2}) by stratum for the four target species and nine key QMS species

Species codes are given in Appendix 5

	Species code												
Stratum	SNA	GUR	JDO	NMP	TRE	ATT	JMN	JMD	BAR	SCH	SPO	SPD	RSK
A25	1 397.9	89.4	1.5	0.0	257.7	37.1	8.4	0.0	0.0	0.0	244.8	0.0	0.0
A50M	615.7	12.8	9.9	0.0	194.9	7.0	1.4	0.0	0.0	0.0	43.0	0.0	0.0
A100	234.9	2.8	24.2	0.0	24.4	0.0	9.2	0.0	0.0	0.0	0.0	0.0	7.1
A200	62.8	1.2	9.0	55.6	2.8	0.9	48.2	0.5	0.0	0.0	2.9	1.0	0.0
B25X	576.1	0.0	0.8	0.0	224.4	21.8	0.0	0.0	0.0	0.0	46.7	0.0	0.0
B10M	3.6	7.7	0.0	0.0	6.1	3.5	0.2	0.1	0.0	0.0	0.0	0.0	0.0
B20M	6.9	4.3	0.7	0.0	0.0	0.0	0.1	0.6	0.0	0.0	0.0	0.0	3.3
C50M	1 246.3	14.9	1.2	0.0	379.6	14.6	23.4	0.0	0.0	17.2	53.1	0.0	0.0
C10N	47.2	14.6	10.3	0.9	3.1	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
C10S	42.7	6.2	7.4	0.0	5.8	0.0	13.9	0.0	0.0	1.1	0.0	0.0	0.0
C200	2.6	2.1	1.0	1.7	0.0	0.0	22.1	0.0	0.0	0.0	0.0	10.4	0.0
D50M	348.9	3.5	23.7	0.0	65.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
RE50	92.6	25.7	6.1	0.0	54.9	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
D100	16.7	26.4	5.7	0.0	32.0	0.0	0.2	0.1	0.0	0.0	0.0	2.7	3.6
E10M	9.9	10.5	8.2	1.7	2.4	0.0	0.0	0.1	1.8	0.0	0.0	6.8	0.0
E20M	24.3	7.2	2.1	31.8	0.0	0.0	1.2	0.0	2.0	0.0	0.0	4.2	0.0
F50M	813.1	12.6	11.3	0.0	346.2	7.2	0.9	5.8	7.1	0.0	10.8	0.0	0.0
F10M	70.5	6.4	10.4	2.1	90.4	0.0	0.0	0.2	28.4	1.4	0.0	22.5	0.0
F150	0.0	0.0	5.5	9.7	0.0	0.0	0.6	1.3	2.9	0.0	0.0	9.7	0.0
F20M	1.5	0.5	4.7	131.1	0.0	0.0	0.8	1.7	2.7	0.0	1.5	3.0	2.8

APPENDIX 10: Estimated biomass (t) and (% CV) by stratum for the four target species and eight key QMS species

Stratum	SNA	GUR	JDO	NMP	TRE	ATT	JMD	JMN	BAR	SPO	SCH	SPD	RSK
A25	353.7 (17.9)	22.6 (80.0)	0.4 (100)	0	65.2 (47.9)	9.4 (34.5)	0	2.1 (44.1)	0	61.9 (35.3)	0	0	0
A50M	596 (21.6)	12.4 (34.9)	9.6 (45.7)	0	188.7 (92.5)	6.8 (50.7)	0	1.3 (100)	0	41.6 (46.3)	0	0	0
A100	145.8 (52.4)	1.7 (51.9)	15.0 (44.4)	0	15.2 (100)	0	0	5.7 (97.9)	0	0	0	0	4.4 (100)
A200	113.8 (66.9)	2.2 (65.2)	16.3 (59.3)	100.8 (63.3)	5.1 (72.6)	1.6 (100)	0.9 (100)	87.3 (92.5)	0	5.2 (100)	0	1.8 (100)	0
B25X	73.2 (51.3)	0	0.1 (100)	0	28.5 (28.1)	2.8 (44)	0	0	0	5.9 (19.6)	0	0	0
B10M	4.5 (55.6)	9.5 (45.9)	0	0	7.5 (69.4)	4.4 (100)	0.1 (100)	0.3 (50.0)	0	0	0	0	0
B20M	7.1 (68.2)	4.4 (74.1)	0.7 (100)	0	0	0	0.6 (100)	0.1 (100)	0	0	0	0	3.4 (100)
C50M	575.8 (40.0)	6.9 (59.6)	0.5 (100)	0	175.4 (83.7)	6.7 (85.4)	0	10.8 (100)	0	24.5 (69.8)	8 (100)	0	0
C10N	21.7 (36.5)	6.7 (40.3)	4.7 (46.5)	0.4 (100)	1.5 (65)	0	0	0.1 (100)	0	0	0	0	0
C10S	54 (35.9)	7.9 (26.7)	9.4 (58.7)	0	7.3 (68.3)	0	0	17.6 (66.8)	0	0	1.4 (100)	0	0
C200	2.7 (51.1)	2.2 (55.1)	1.1 (100)	1.8 (100)	0	0	0	23.0 (94.0)	0	0	0	10.8 (21.6)	0
D50M	129.8 (97.1)	1.3 (53.4)	8.8 (55.8)	0	24.2 (77.4)	0	0	0.3 (28.8)	0	0	0	0	0
RE50	45.3 (88.1)	12.6 (17.0)	3.0 (61.9)	0	26.9 (53.2)	0	0	0.1 (100)	0	0	0	0	0
D100	21.8 (45.3)	34.5 (71.6)	7.5 (50.9)	0	41.9 (100)	0	0.2 (100)	0.3 (100)	0	0	0	3.5 (100)	4.7 (100)
E10M	22.7 (86.1)	24.1 (65.2)	18.8 (34.8)	3.8 (100)	5.5 (59)	0	0.2 (100)	0	4.1 (100)	0	0	15.6 (100)	0
E20M	35.6 (79.4)	10.5 (27.3)	3.1 (51.3)	46.5 (16.4)	0	0	0	1.7 (100)	2.9 (100)	0	0	6.1 (100)	0
F50M	481.4 (24.2)	7.4 (15.7)	6.7 (26.7)	0	204.9 (28.8)	4.2 (57.7)	3.4 (100)	0.5 (79.5)	4.2 (100)	6.4 (66.8)	0	0	0
F10M	186 (59.7)	16.9 (29.7)	27.5 (34.1)	5.5 (58)	238.4 (80.2)	0	0.5 (57.8)	0	74.9 (99.6)	0	3.7 (100)	59.3 (62.8)	0

Stratum	SNA	GUR	JDO	NMP	TRE	ATT	JMD	JMN	BAR	SPO	SCH	SPD	RSK
	0	0	11.4	20.2	0	0	2.7	1.2	6.0	0	0	20.2	
F150			(65.6)	(56)			(65.9)	(76.4)	(100)			(55)	0
	0.7	0.3	2.3	62.5	0	0	0.8	0.4	1.3	0.7	0	1.4	1.3
F20M	(61.2)	(100)	(54.9)	(44.6)			(100)	(67.9)	(100)	(100)		(61.4)	(61.3)

APPENDIX 11: Snapper age-length key for the 2025 west coast North Island trawl survey

Length	Age (years)															No. aged
	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	>15+	
13	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
16	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
18	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
19	0.33	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
20	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
21	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
22	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
23	0	0.57	0.43	0	0	0	0	0	0	0	0	0	0	0	0	0	7
24	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	11
25	0	0.22	0.67	0.11	0	0	0	0	0	0	0	0	0	0	0	0	9
26	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	7
27	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	15
28	0	0	0.91	0.09	0	0	0	0	0	0	0	0	0	0	0	0	22
29	0	0	0.86	0.14	0	0	0	0	0	0	0	0	0	0	0	0	28
30	0	0	0.28	0.64	0.05	0	0	0.03	0	0	0	0	0	0	0	0	39
31	0	0	0.22	0.52	0.26	0	0	0	0	0	0	0	0	0	0	0	46
32	0	0	0.07	0.52	0.36	0	0	0.05	0	0	0	0	0	0	0	0	42
33	0	0	0.08	0.42	0.37	0.05	0.03	0.03	0.03	0	0	0	0	0	0	0	38
34	0	0	0.03	0.22	0.53	0.09	0.09	0	0.03	0	0	0	0	0	0	0	32
35	0	0	0.04	0.21	0.17	0.33	0.08	0.08	0.08	0	0	0	0	0	0	0	24
36	0	0	0	0.05	0.36	0.32	0.18	0.05	0	0	0	0.05	0	0	0	0	22

37	0	0	0	0.14	0.36	0.07	0.29	0.07	0	0	0	0.07	0	0	0	0	14
38	0	0	0	0.13	0.13	0.20	0.07	0.07	0.33	0	0	0	0	0	0.07	0	15
39	0	0	0	0	0	0.18	0.09	0.18	0.27	0.09	0.09	0	0	0.09	0	0	11
40	0	0	0	0	0.07	0.14	0.14	0.21	0.21	0.14	0	0	0.07	0	0	0	14
41	0	0	0	0	0.14	0.14	0.29	0.29	0.00	0	0	0	0	0.14	0	0	7
42	0	0	0	0	0	0.08	0.08	0.15	0.23	0.08	0.08	0	0	0	0	0.31	13
43	0	0	0	0	0.04	0	0	0.09	0.39	0	0.13	0.04	0.09	0.04	0.04	0.13	23
44	0	0	0	0	0	0	0	0	0.25	0.05	0.25	0.05	0.15	0.05	0.1	0.10	20
45	0	0	0	0	0	0	0.05	0	0.32	0.21	0.11	0	0.05	0.05	0	0.21	19
46	0	0	0	0	0	0	0	0	0	0.06	0.24	0.12	0.24	0.06	0.18	0.12	17
47	0	0	0	0	0	0	0	0	0.09	0.09	0.18	0.00	0.09	0	0.27	0.27	11
48	0	0	0	0	0	0	0	0	0	0.10	0.1	0.10	0.40	0	0.10	0.2	10
49	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.17	0.5	6
50	0	0	0	0	0	0	0	0	0	0	0.00	0	0	0	0	1	3
51	0	0	0	0	0	0	0	0	0	0	0.17	0	0	0	0.17	0.67	6
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.13	0.88	8
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.67	3
54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
58	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3
60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
61	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

65	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
66	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
																	597

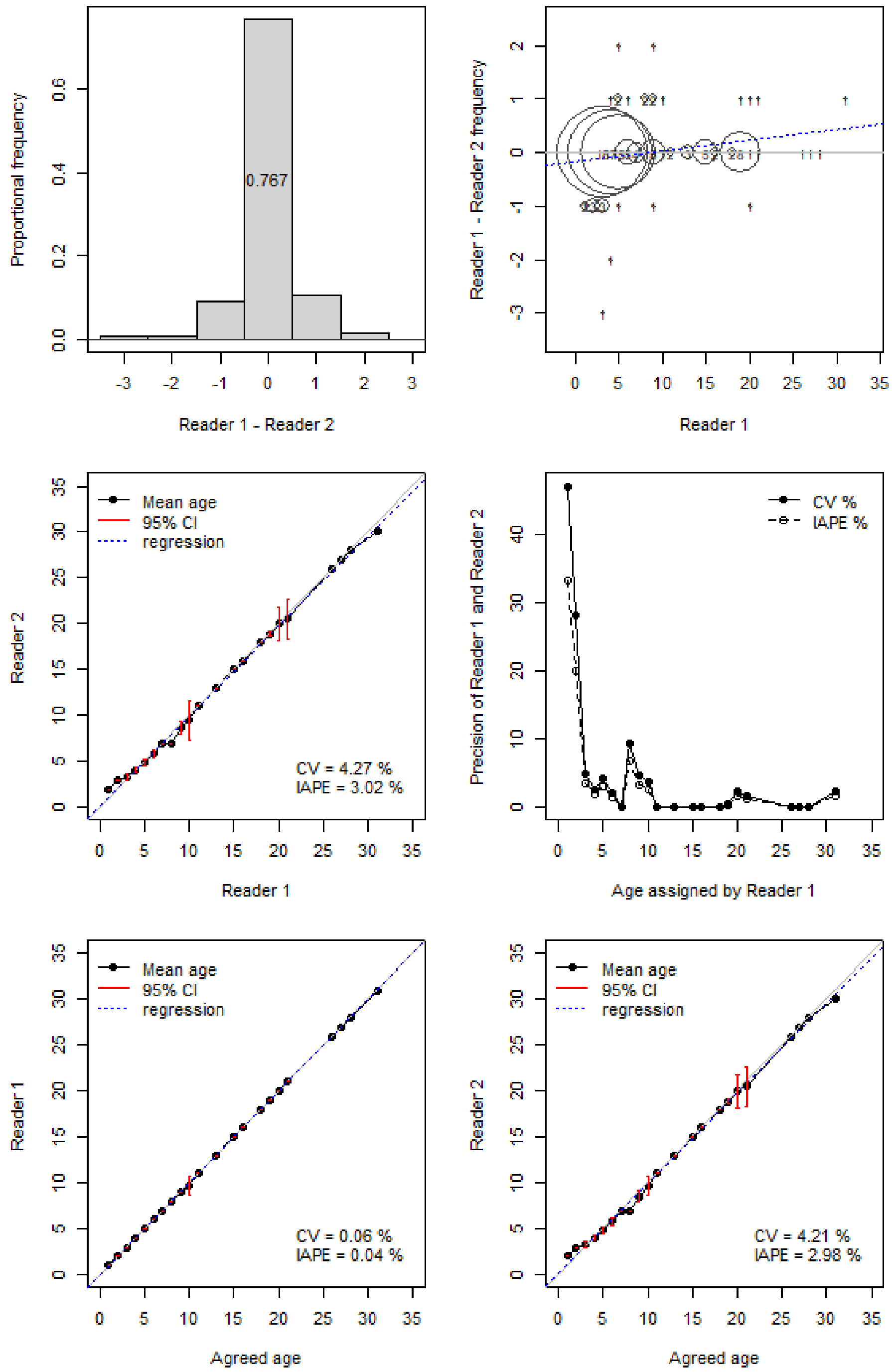
APPENDIX 12: Tarakihi age-length key for the 2025 west coast North Island trawl survey

Length (cm)	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+	11+	12+	13+	14+	15+	Age (years) >15+	No. aged
18	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
22	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
30	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0.5	0	0.5	0	0	0	0	0	0	0	0	2
33	0	0	0	0	0.5	0	0	0	0	0.5	0	0	0	0	0	0	2
34	0	0	0	0	0	0.5	0.1	0.1	0.1	0.1	0	0	0	0	0	0.1	10
35	0	0	0	0	0	0.24	0.06	0.18	0.12	0.29	0.12	0	0	0	0	0	17
36	0	0	0	0	0	0.06	0.19	0.31	0.00	0.25	0.13	0.06	0	0	0	0	16
37	0	0	0	0	0	0	0.11	0.11	0.11	0.37	0.05	0.05	0.00	0.00	0.00	0.21	19
38	0	0	0	0	0	0	0.10	0.10	0.07	0.17	0.28	0.07	0.03	0.07	0.00	0.10	29
39	0	0	0	0	0	0	0.05	0.05	0.16	0.16	0.11	0.16	0.11	0.05	0.05	0.11	19
40	0	0	0	0	0	0	0.05	0.00	0.00	0.18	0.27	0.09	0.05	0.18	0.05	0.14	22
41	0	0	0	0	0	0	0	0.05	0	0.14	0.27	0.05	0	0.18	0.05	0.27	22
42	0	0	0	0	0	0	0.06	0.00	0.00	0.06	0.24	0.06	0.12	0.06	0.00	0.41	17
43	0	0	0	0	0	0	0	0	0	0	0.20	0.00	0.07	0.20	0.07	0.47	15

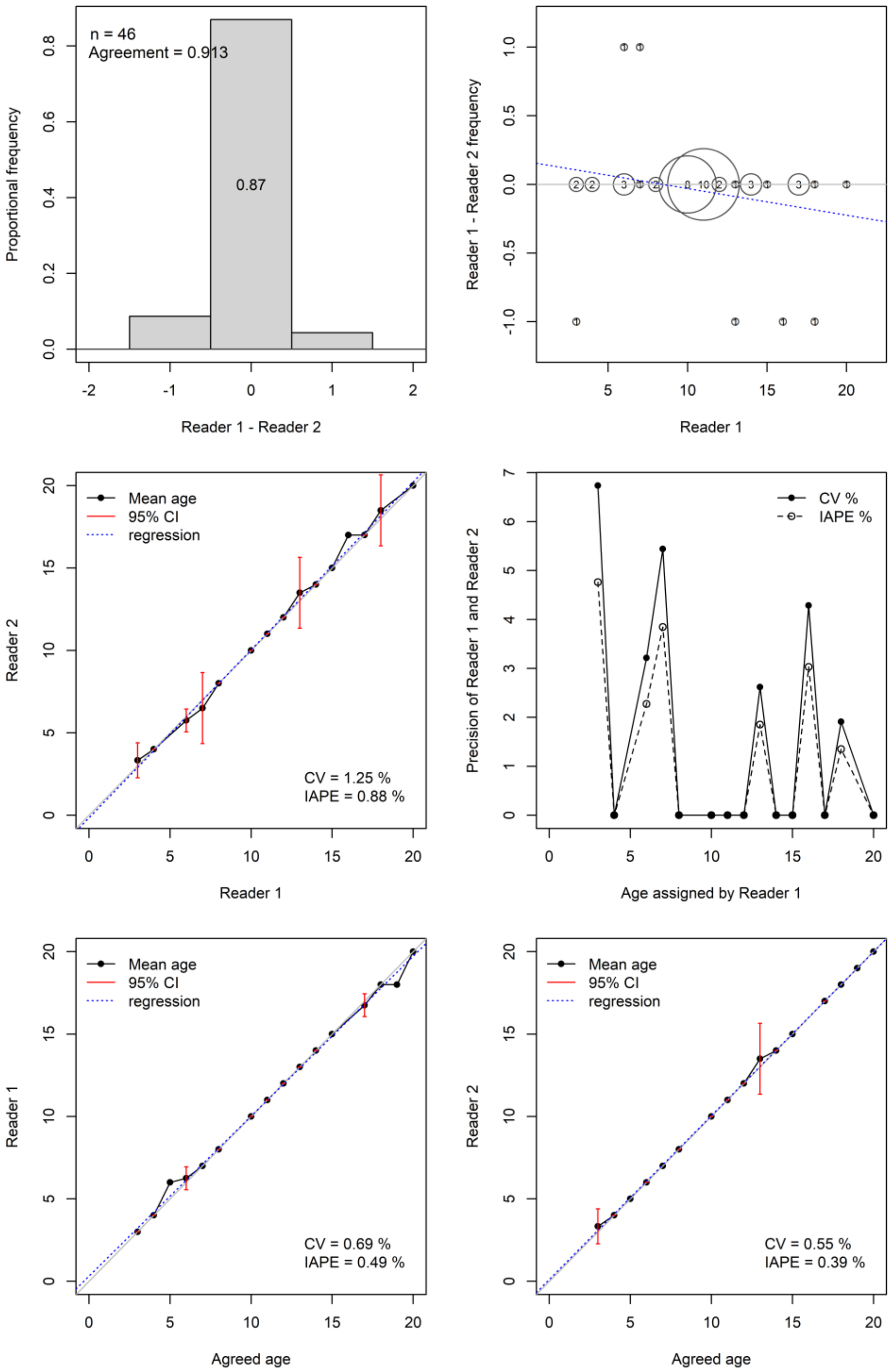
44	0	0	0	0	0	0	0	0	0.06	0.06	0.18	0.06	0.12	0.06	0.18	0.29	17
45	0	0	0	0	0	0	0	0	0	0	0.20	0	0	0	0	0.80	5
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0.14	0	0.86	7
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25	0.75	4
																	229

APPENDIX 13: Reader comparison tests for snapper and tarakihi otolith readings

Results of between-reader audit for snapper otoliths collected in 2025 (n =120): (top left) histogram of differences between readings for the same otolith; (top right) differences between readers for a given age assigned by reader 1; (middle left) bias plot between readers; (middle right) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (bottom left) bias plot between reader 1 and agreed age; and (bottom right) between reader 2 and agreed age.



Results of between-reader audit for tarakihi otoliths collected in 2025 (n = 46): (top left) histogram of differences between readings for the same otolith; (top right) differences between readers for a given age assigned by reader 1; (middle left) bias plot between readers; (middle right) CV and IAPE profiles (precision) relative to the age assigned by reader 1; (bottom left) bias plot between reader 1 and agreed age; and (bottom right) between reader 2 and agreed age.



APPENDIX 14: Gear performance trial results

Sweeps and bridles herd fish toward the trawl mouth by eliciting avoidance responses (Wardle 1986). The effectiveness of this process depends on sweep geometry, as larger sweep angles increase the distance fish must swim to enter the trawl path, potentially reducing herding efficiency (Wardle 1986; Engås & Godø, 1989). Pre-voyage gear trials indicated that the new trawl configuration resulted in greater doorspreads than the previous trawl, likely increasing sweep angles. During the 2025 west coast North Island survey, concern about low red gurnard catches prompted consideration of whether sweep angle could be reduced by increasing sweep length.

With approval from Fisheries New Zealand, opportunistic experimental tows were carried out during the west coast North Island and west coast central surveys with the aim of exploring the effect on sweep angle and catch rates of target species during the survey.

Methods

Experimental tows with longer (110 m) sweeps were opportunistically paired with survey tows with shorter (55 m) sweeps during the survey. Sequential paired tows were conducted in parallel, with tow separations ranging from 0.5 to 1.2 km and across depths of 24–99 m. Wing spread sensors were placed at the upper wing tips on the headrope to calculate the sweep angle. Sweep angle was calculated for a subset of tows using sensors deployed on the wing ends; usable sensor data were obtained from 16 tows. All aspects of the towing procedure were kept the same except for the length of sweeps used, with the order systematically alternated (i.e. short sweeps vs long sweeps, followed by long sweeps vs short sweeps). In total, 12 paired tows were available for analysis from the two surveys KHR2502 (WCNI) and KHR2503 (WCC).

Catch data for red gurnard and snapper were standardised by swept area and expressed as catch rates (kg km^{-2}). Given the opportunistic nature of the trials and relatively small number of paired tows, analyses are exploratory and descriptive.

Results

Gear geometry

The station data is presented in Table A11.1. Use of longer sweeps (110 m) resulted in greater door spreads by approximately 7–18% compared with shorter sweeps (55 m). Correspondingly, sweep angles were reduced by approximately 4–7°. Sweep angles associated with longer sweeps ranged from 15–18.7°, whereas shorter sweeps produced larger angles of 19.8–24.2°.

Table A11.1: Station data for the gear performance trials. Experimental stations (not used for biomass estimates) are in bold.

Pair No.	Trip code	Station	Treatment	Max depth (m)	Distance between pair (m)	Headline (m)	Door spread (m)	Door spread (m)	Wing spread (m)	Sweep angle (°)
						average	Range	average	average	
1	KHR2502	46	Short	62	500	4.7	92–95	93.5		
1	KHR2502	**47**	**Long**	**61**	**500**	**4.8**	**100–106**	**103.5**	**15.6**	**15.4**
2	KHR2502	56	Short	41	500	4.6	91–95	93.5	17.8	20.1
2	KHR2502	**57**	**Long**	**38**	**500**	**5.1**	**100–105**	**102.1**	**15.4**	**15.2**
3	KHR2502	**58**	**Long**	**27**	**500**	**5.2**	**98–113**	**108.8**	**15.5**	**16.4**
3	KHR2502	59	Short	26	500	4.5	96–99	96.5	16.9	21.2
4	KHR2502	60	Short	24	500	4.4	92–95	92.7	18.2	19.8
4	KHR2502	**61**	**Long**	**24**	**500**	**5**	**94–108**	**104.3**	**15.6**	**15.6**
5	KHR2502	**62**	**Long**	**92**	**800**	**4.5**	**120–128**	**123.3**	**17.3**	**18.7**
5	KHR2502	63	Short	99	800	4.5	105–109	108.2	18.1	24.2
6	KHR2502	64	Short	81	800	4.4	101–104	103	17.8	22.8
6	KHR2502	**65**	**Long**	**78**	**800**	**4.6**	**110–117**	**112.9**	**16.8**	**16.9**
7	KHR2503	**19**	**Long**	**33**	**1 200**	**4.3**	**110**	**110**		
7	KHR2503	20	Short	38	1 200	4.6	91–95	93.1		
8	KHR2503	21	Short	82	1 200	4.5	97–98	97.9		
8	KHR2503	**22**	**Long**	**77**	**1 200**	**4.5**	**105–107**	**106.3**		
9	KHR2503	**33**	**Long**	**63**	**1 200**	**4.8**	**110–114**	**105.7**		
9	KHR2503	34	Short	62	1 200	4.8	93–94	93.3		
10	KHR2503	**42**	**Long**	**71**	**1 200**	**4.9**	**89–93**	**89.2**		
10	KHR2503	43	Short	71	1 200	4.6	92–94	92.3	16.5	20.2
11	KHR2503	44	Short	71	1 200	4.7	89–99	94.4	17.3	20.5
11	KHR2503	**45**	**Long**	**70**	**1 200**	**4.6**	**100–103**	**100.8**	**15.3**	**15**
12	KHR2503	**46**	**Long**	**62**	**1 200**	**4.7**	**106–108**	**107**	**16.3**	**16**
12	KHR2503	47	Short	61	1 200	4.4	95–96	95.2	17.1	23

Red gurnard
Catches were generally low across all paired tows, ranging from 0 to 41 kg (Figure A11.1a). Despite this, catch rates (kg km^{-2}) were higher in tows using longer sweeps in 8 of the 12 paired comparisons. Higher catch rates were observed with shorter sweeps in two pairs, with the remaining pairs showing little difference between sweep configurations. Most red gurnard ranged in size from 25–44 cm with only a single small individual (< 25 cm) caught in each treatment (long and short sweeps; Figure A11.1b-c).

Snapper
Snapper catches were highly variable, ranging from 0 to 1448 kg per tow (Figure A11.2a). For paired tows conducted with separations of 0.5–0.8 km, higher catches were recorded in the first tow in 5 of the first 6 pairs, irrespective of sweep length, indicating that this separation distance was insufficient to remove order effects. When tow separation was increased to approximately 1.2 km, higher catches were recorded from tows using shorter sweeps in 4 of 6 paired comparisons. Snapper were mainly between 25–50 cm with few small (< 25 cm) individuals caught irrespective of the sweep length.

Summary and Discussion

These sweep-length trials indicate that increasing sweep length reduced sweep angle and increased doorspread, consistent with the understanding of trawl geometry and herding processes. Longer sweeps produced sweep angles within a range considered more favourable for effective herding, which is likely to have reduced the swimming distance required for fish to enter the trawl path. Although catches of red gurnard were low, the tendency for higher catch rates with longer sweeps in most paired tows is consistent with improved herding efficiency under reduced sweep angles. Interpretation of snapper results is more uncertain. The potential effects of the shorter distances between paired tows (0.5–0.8 km) suggest that the results from those comparisons may have been due to spatial or behavioural factors rather than gear configuration alone. This is supported by subsequent intercalibration analyses for snapper using long sweeps which showed little difference between the new and old vessel and gear combinations (Devine et al. 2026). Longer sweeps have been shown to reduce the number of smaller individuals caught in survey trawls (Engås & Godø 1989). This effect could not be tested in these trials due to the lack of small red gurnard or snapper (<25 cm) caught in both sweep configurations.

Following discussion with Fisheries New Zealand, 110 m sweeps were adopted for the 2025 west coast central survey and the west coast South Island intercalibration work.

References

Devine, J.; MacGibbon, D.; Underwood, M.; Jones, E.; O'Driscoll, R.; Beentjes, M.; Hamill, J. (2026). Intercalibration of research vessels, Kaharoa and Kaharoa II, for inshore bottom trawl surveys. *New Zealand Fisheries Assessment Report 2026/12*. 55 p.

Engås, A.; Godø, O.R. (1989). The effect of different sweep lengths on the length composition of bottom-sampling trawl catches. *ICES Journal of Marine Science, 45(3):* 263–268.

Wardle, C.S. (1986). Fish behaviour and fishing gear. In *The behaviour of teleost fishes* (pp. 463-495). Boston, MA: Springer US.

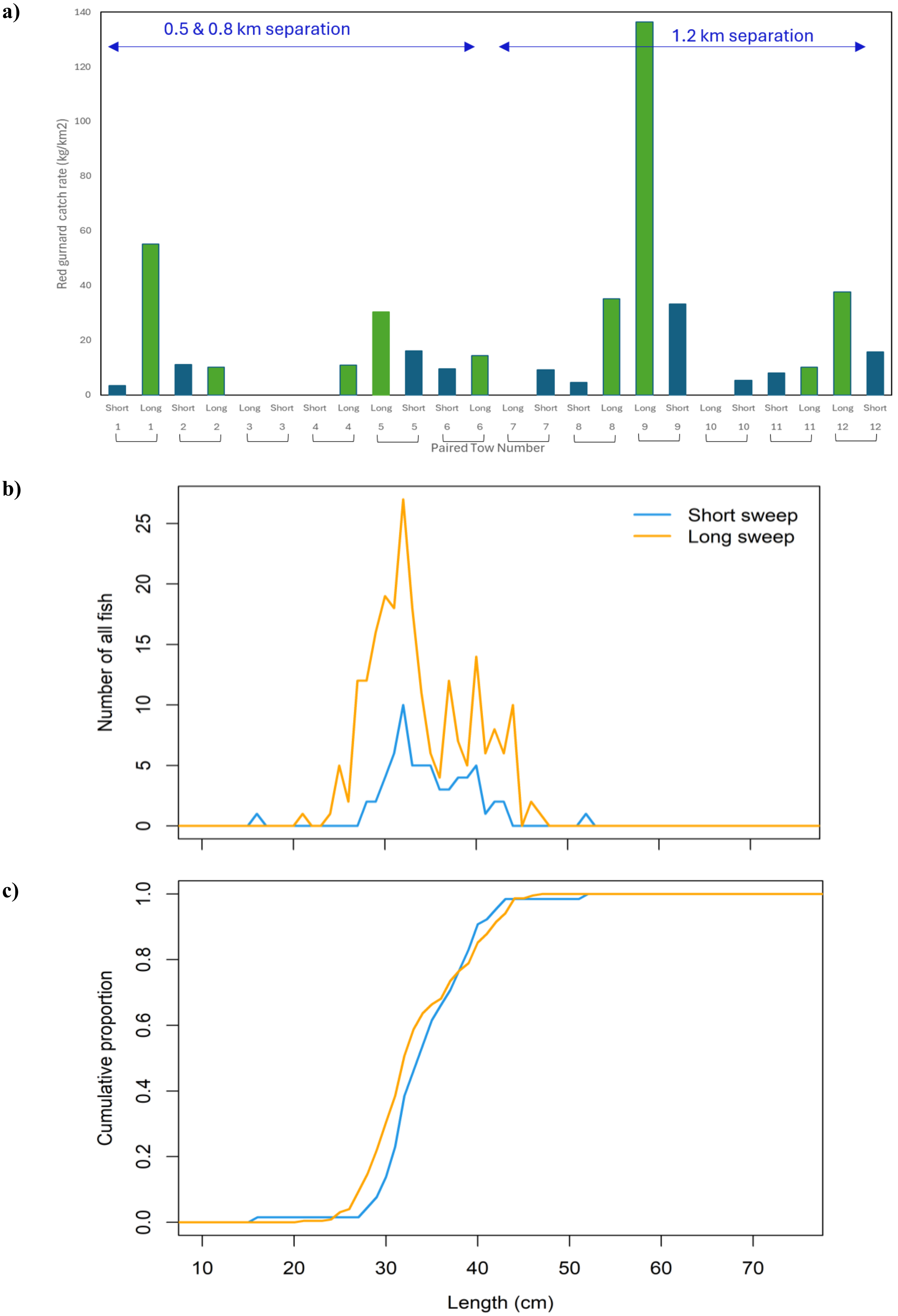
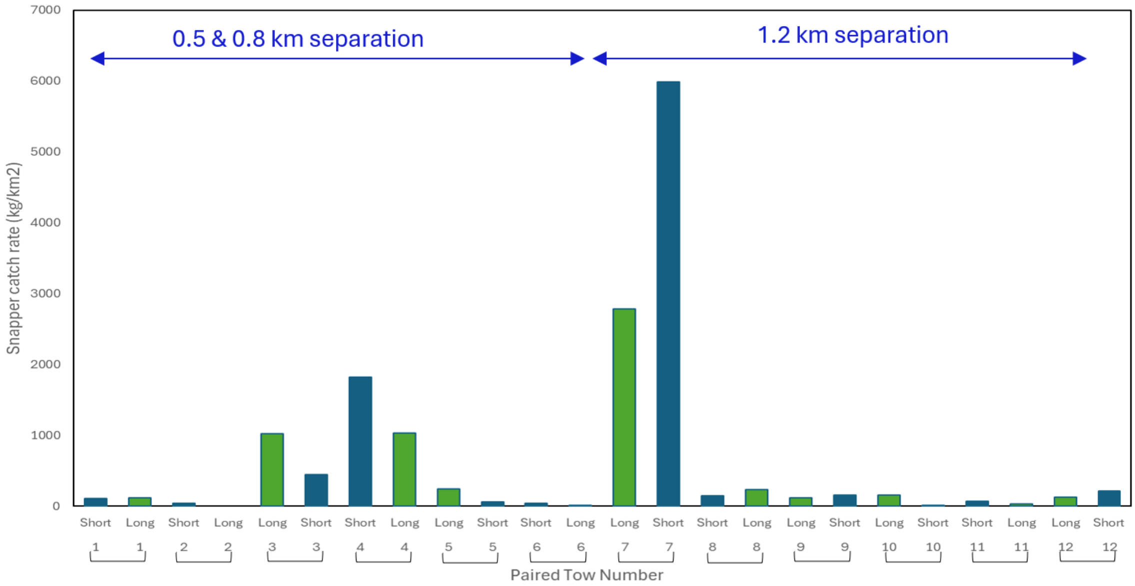
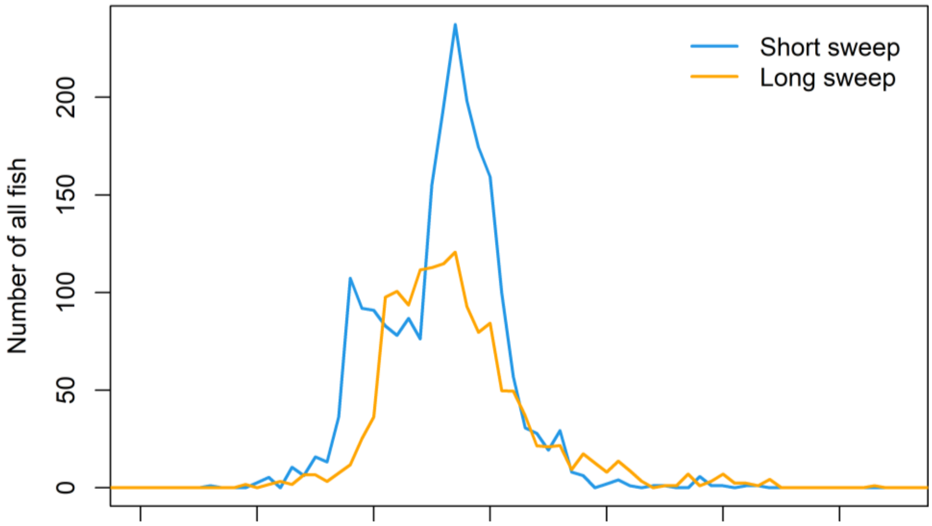


Figure A11.1: Comparison of: (a) catch rates; (b) number of fish and cumulative proportion of red gurnard, when trawling with short (55 m) and long (110 m) sweeps.

a)



b)



c)

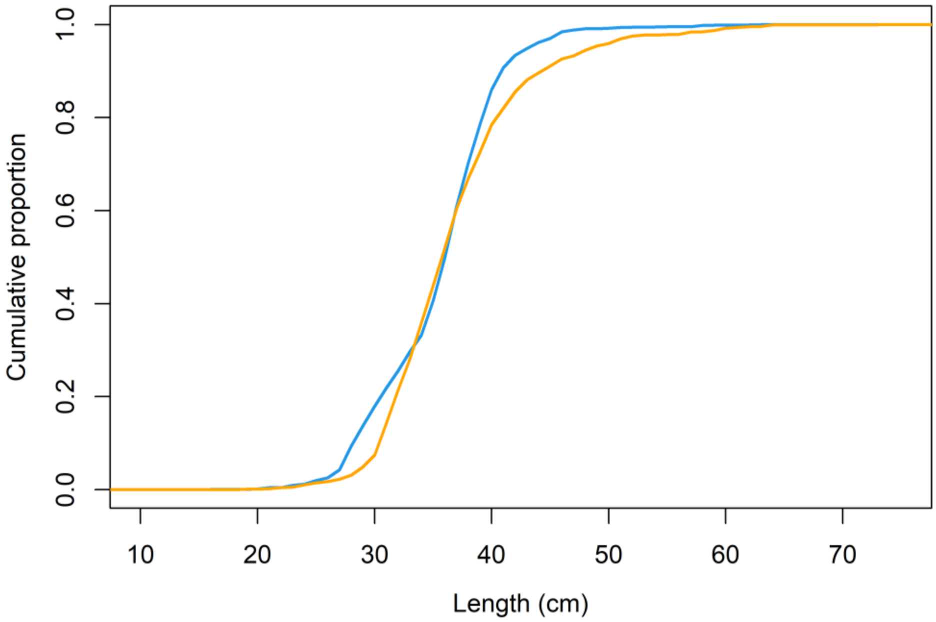


Figure A11.2: Comparison of: (a) catch rates; (b) number of fish and cumulative proportion of snapper, when trawling with short (55 m) and long (110 m) sweeps.