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Stock assessment of eastern tarakihi for 2026

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PLAIN LANGUAGE SUMMARY

The report updates the assessment for the eastern stock of tarakihi, including TAR 2, TAR 3 and the eastern portions of TAR 1 and TAR 7. The assessment estimated that the stock had declined to about 20% of the reference biomass level (*SB0*) by the mid-1970s. Since then, biomass continued to slowly decline to 7.7% of the reference biomass level in 2024–25. Under current catch levels biomass is predicted to decline slightly over the next five years, due in part to low recruitment.

EXECUTIVE SUMMARY

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Tarakihi (*Nemadactylus macropterus*) are distributed throughout the coastal waters around the North Island and South Island. There are two separate stocks of tarakihi within this area: 1) an eastern stock encompassing Quota Management Areas (QMAs) TAR 3, TAR 2 and the eastern portions of TAR 1 and TAR 7, and 2) a western stock including TAR 8 and the western portions of TAR 1 and TAR 7 QMAs. The stock units are discriminated based on differential trends in abundance indices (CPUE and trawl surveys), persistent differences in the age structure (year class strengths) and differences in growth rates.

The tarakihi catch is predominantly taken by the inshore trawl fleet. The eastern tarakihi fishery developed from the 1930s and catches reached a peak in the 1960s and 1970s, with the largest proportion of the catch taken from off the central North Island (TAR 2). During the 1970s, the overall catch from the eastern tarakihi stock declined.

For the eastern stock six main fisheries are defined: trawl fisheries in east Northland (ENLD) (eastern TAR 1), Bay of Plenty (BPLE) (eastern TAR 1), central North Island (TAR 2), eastern Cook Strait (eastern TAR 7) and east coast South Island (ECSI) (TAR 3); and the Kaikoura set net fishery. Standardised CPUE indices were derived for each fishery. For the TAR 2 and Cook Strait fisheries, the CPUE indices increased over the last decade, whereas CPUE indices from the east Northland and Bay of Plenty fisheries declined since the early 2000s.

Standardised CPUE indices from the ECSI trawl fishery have been relatively low since the mid-2000s and were at the lowest level in 2022–23 and 2023–24. There was a corresponding decline in the abundance of tarakihi biomass indices from the *Kaharoa* ECSI inshore trawl surveys and recent trawl surveys indicate the juvenile tarakihi (2 y old) abundance has been low.

The previous (2022) stock assessment of eastern tarakihi was updated to 2024–25 with the inclusion of additional CPUE and ECSI trawl survey abundance indices and age compositions from the main trawl fisheries and from the *Kaharoa* ECSI trawl survey programme. The contradictory trends in the recent CPUE indices from eastern TAR 1 (ENLD and BPLE) compared to TAR 2 and eastern TAR 7 led to spatial stratification of the base assessment model with three regions approximating the main constituent QMAs (TAR 1, 2 and 3).

The assessment estimated that the stock had declined to about 20% of the initial biomass (*SB0*) by the mid-1970s with exploitation rates considerably higher than the F_{msy} reference level ($F_{SB40\%}$). Since the mid-1970s, biomass is estimated to have continued to slowly decline while exploitation rates remained high.

The extent of the initial decline in stock abundance is strongly informed by the magnitude of early catches from the stock and the key age composition data from the East Northland fishery available from the mid-2010s. The low proportions of older (greater than 20 years) fish in the age compositions indicate that exploitation rates were high during the earlier period. The more recent decline in biomass (from 1990) is informed by the decline in the CPUE indices from the ENLD and BPLE trawl fisheries. These declines were corroborated by longline CPUE series in both areas.

Spawning biomass is estimated to have been below the default hard limit (10% SB_0) since the mid-2000s, and current spawning biomass (2024–25) is estimated to be at 7.7% of the pre-exploitation equilibrium biomass level (SB_{2025}/SB_0 = 0.077). Fishing mortality rates declined in 2019–2023, following the reductions in the TACCs, although current fishing mortality rates are estimated to remain well above the reference level (i.e., $F_{2025}/F_{SB40\%}$ = 2.62).

Overall, estimates of current stock status are relatively insensitive to the spatial configuration of the model. However, the historical distribution of biomass amongst the three model regions is sensitive to those assumptions, particularly the parameterisation of movement between the central and northern regions. On that basis, the assessment model is not considered to be sufficiently reliable to provide robust management advice at the regional scale (QMAs).

Recruitment is estimated to be below average for 2017–2022 and it is predicted that this would lead biomass to decline slightly over the next five years under current catches. The recent low recruitments corresponded to a period of warmer sea temperatures off south-eastern New Zealand. Further work is required to investigate the relationship between tarakihi recruitment and prevailing oceanographic conditions. It is unknown whether the recent low recruitments are simply a transient process or represent a longer-term shift in the overall productivity of the stock. Ongoing monitoring of recruitment will be important for the assessment of the eastern tarakihi stock over the medium term (5–10 years).

1. INTRODUCTION

Tarakihi (*Nemadactylus macropterus*) supports important inshore fisheries around the New Zealand coast. In the 2024–25 fishing year, the tarakihi (TAR) fisheries around the northern North Island (TAR 1 Total Allowable Commercial Catch (TACC) 978 t), off the central east coast of the North Island (TAR 2 TACC 1104 t), off the east coast of the South Island (TAR 3 TACC 694 t), in Southland (TAR 5 TACC 153 t), off the west coast of the South Island and Cook Strait (TAR 7 TACC 994 t), and lower west coast of the North Island (TAR 8 TACC 225 t) yielded a cumulative commercial catch of 3574 t of tarakihi (Fisheries New Zealand 2025).

The stock structure of tarakihi around mainland New Zealand was reviewed by Langley & Starr (2012) and Langley (2018, 2022). Trends in fishery CPUE indices and age compositions from commercial catches and trawl surveys indicate that tarakihi along the eastern coast of the North and South Island represent a single stock. Sampling of the age compositions of the tarakihi catches from the main fisheries around coastal New Zealand identified persistent differences in the age structure between the fisheries in the eastern and western areas (McKenzie et al. 2017, 2021, 2026). Tagging studies indicate that there is a considerable northward movement of fish from the east coast of the South Island to the Wairarapa coast, East Cape, and the Bay of Plenty (Annala 1988). These results support the current stock hypothesis that eastern tarakihi represents a separate stock unit, while providing evidence of a separate western tarakihi stock unit. Nonetheless, a small number of tagged fish released off Kaikoura were recovered from the west coast North Island (Annala 1988), suggesting some degree of connectivity between the eastern and western areas.

A stock assessment for eastern tarakihi, encompassing TAR 3, TAR 2, and the eastern portions of TAR 1 and TAR 7 was conducted in 2018 and updated in 2019, 2020 and 2021 (Langley 2018, 2019, 2022). For western tarakihi, the first stock assessment of the entire stock was conducted in 2026 (Langley 2026a). The assessment reinforced the presumption of distinct eastern and western stocks of tarakihi; the stock units are discriminated based on differential trends in abundance indices (CPUE and trawl surveys), persistent differences in the age structure (year class strengths) and differences in growth rates (Langley 2026a).

Previous eastern tarakihi stock assessments incorporated the annual catches, age composition data, and CPUE indices from the constituent fisheries. The model data sets were structured into three areas: east coast South Island (including eastern Cook Strait), central east coast North Island and the Bay of Plenty combined (TAR2-BPLE), and East Northland. The east coast South Island area included three commercial fisheries: the Canterbury Bight/Pegasus Bay trawl fishery, Kaikōura set net fishery and the eastern Cook Strait trawl fishery. The other two areas included a commercial trawl fishery and a relatively small non-commercial fishery. For each area, a corresponding time series (or multiple series) of CPUE indices was available (Langley 2021).

The time series of *Kaharoa* inshore ECSI trawl surveys also provided an important series of abundance indices for tarakihi in the southern area (MacGibbon et al. 2024).

The 2018 assessment estimated the eastern tarakihi stock to be at 17% of the unfished, equilibrium biomass level (SB_{2016}/SB_0 = 0.170), which is below the soft limit of 20% SB_0 (Langley 2018). In response, a rebuild strategy was implemented for the stock including reductions in the TACCs for TAR 1 (a 24% reduction), TAR 2 (16%), TAR 3 (26%), and TAR 7 (4%) for the 2018–19 fishing year. A range of voluntary measures were also introduced in 2018–19, including measures to ensure that the reductions in the TAR 1 and TAR 7 TACCs were applied to the east coast portions of those Fishstocks. The TAR 1, 2, 3, and 7 TACCs were further reduced in 2019–20 to 1045 t, 1350 t, 936 t and 1024 t, respectively (Fisheries New Zealand 2025).

Ongoing monitoring of tarakihi includes regular sampling of the age compositions from the main tarakihi fisheries. The most recent sampling was completed in 2023–24 and 2024–25 (McKenzie et al. 2026), providing key data required to update the eastern tarakihi stock assessment.

This report documents the stock assessment of eastern tarakihi for 2026 funded by Fisheries New Zealand under Fisheries Research Services Project TAR2025-01 entitled "Stock assessment of East

Coast tarakihi". The project also updates the characterisation and CPUE analysis of each of the main tarakihi fisheries off the east coasts of the North Island and South Island (to 2024–25).

2. STOCK STRUCTURE

The stock structure of tarakihi was most recently reviewed by Langley (2022). Since then, additional data are available from a comprehensive catch sampling programme in 2023–24 and 2024–25 that simultaneously sampled tarakihi from the main fisheries around the North Island and South Island, supplementing previous sampling conducted in 2018–19 and 2019–20.

There are persistent differences in the average fish length at age between fisheries (Langley 2026a). Overall, male and female from the west coast fisheries (western TAR 7, TAR 8 and western TAR 1) are larger than fish from the east coast fisheries (TAR 3, eastern TAR 7, TAR 2 and eastern TAR 1). Notably, there were considerable differences in growth between the western and eastern areas around the north of the North Island (from the west coast North Island and East Northland fisheries) (Langley 2026a).

The persistent differences in average length-at-age between these areas indicates regional scale differences in growth and a lack of broad scale mixing of fish between areas, particularly between the western and eastern areas.

The growth rates for both male and female tarakihi are broadly similar for the East Northland (ENLD), Bay of Plenty (BPLE), central North Island (TAR 2), and Cook Strait (COOK) fisheries off the east coast, at least for fish up to about 15 years of age. This is consistent with the assumption of an eastern stock of tarakihi, with considerable mixing of fish between the areas. The male fish from the East Coast South Island (ECSI) fishery also exhibit a similar growth rate to the other areas, although female growth is considerably higher (Langley 2026a).

Tarakihi spawn during autumn (March-April). Within the domain of the eastern stock, important spawning areas for tarakihi are off East Northland, eastern Bay of Plenty and East Cape (Robertson 1978), Cape Campbell and along the Conway Ridge (south of Kaikoura) (Annala et al. 1990, Robertson 1978). The main nursery grounds for eastern tarakihi are in Canterbury Bight and Pegasus Bay (Vooren 1975, Beentjes et al. 2023).

The development of an assessment model for the western stock of tarakihi enabled the direct comparison of the annual recruitment estimates for the eastern and western stocks (Langley 2026a). There is also a general correspondence in the recruitments between the two stocks with strong year classes in the eastern stock also evident as strong year classes in the western stock. However, there are strong year classes in the western stock that are estimated to be either at or below average recruitment for the eastern stock. Conversely, there are a number of weak year classes in the western stock that are estimated to be at least average strength for the eastern stock (Langley 2026a).

These observations suggest that in some years there are broad scale environmental processes that are influencing tarakihi recruitment in both areas, whereas there is a decoupling of the recruitment processes in other years. Those differences in annual recruitments between the two assessments strengthen the current stock hypothesis for tarakihi around mainland New Zealand.

3. COMMERCIAL FISHERY CHARACTERISATION

3.1 Fishery structure

Previous characterisations of the tarakihi fisheries around the South Island and North Island have defined the main fisheries by fishing method and Statistical Area (e.g. McKenzie et al. 2017, McKenzie et al. 2021). Where appropriate, the fishery definitions also maintain the approximate demarcation of the individual tarakihi Quota Management Areas (QMAs). The fishery definitions

were adopted by the recent catch sampling programmes and, hence represent the basic level of resolution for the age composition data (McKenzie et al. 2017, McKenzie et al. 2021, McKenzie et al. 2026).

For the eastern stock, six main fisheries have been identified: trawl fisheries in ENLD (north-eastern portion of TAR 1), BPLE (eastern portion of TAR 1), TAR 2, the eastern Cook Strait (eastern portion of TAR 7) and ECSI (TAR 3) and the Kaikoura set net fishery (TAR 3) (Figure 1).

Previously, trends in catch and effort from the eastern tarakihi fisheries were described in Langley 2021. This section updates the previous analyses, incorporating data up to the 2024–25 fishing year.

3.2 Data set

The eastern fisheries were defined based on Statistical Areas (Table 1) to enable the apportionment of catches from the entire period from which catch and effort data were available. Since 2007–08, all trawl catch and effort data have been collected by fishing location enabling a more accurate assignment of catches between fishery areas. The Statistical Area boundaries only provide an approximation of the Quota Management Areas (QMAs) (Figure 1). In particular, Statistical Area 018 straddles the boundary between TAR 3 and TAR 7. An examination of the tarakihi catches within Statistical Area 018 revealed that most of the trawl catch was taken within TAR 7, while the set net catch was taken within TAR 3 (Table 1).

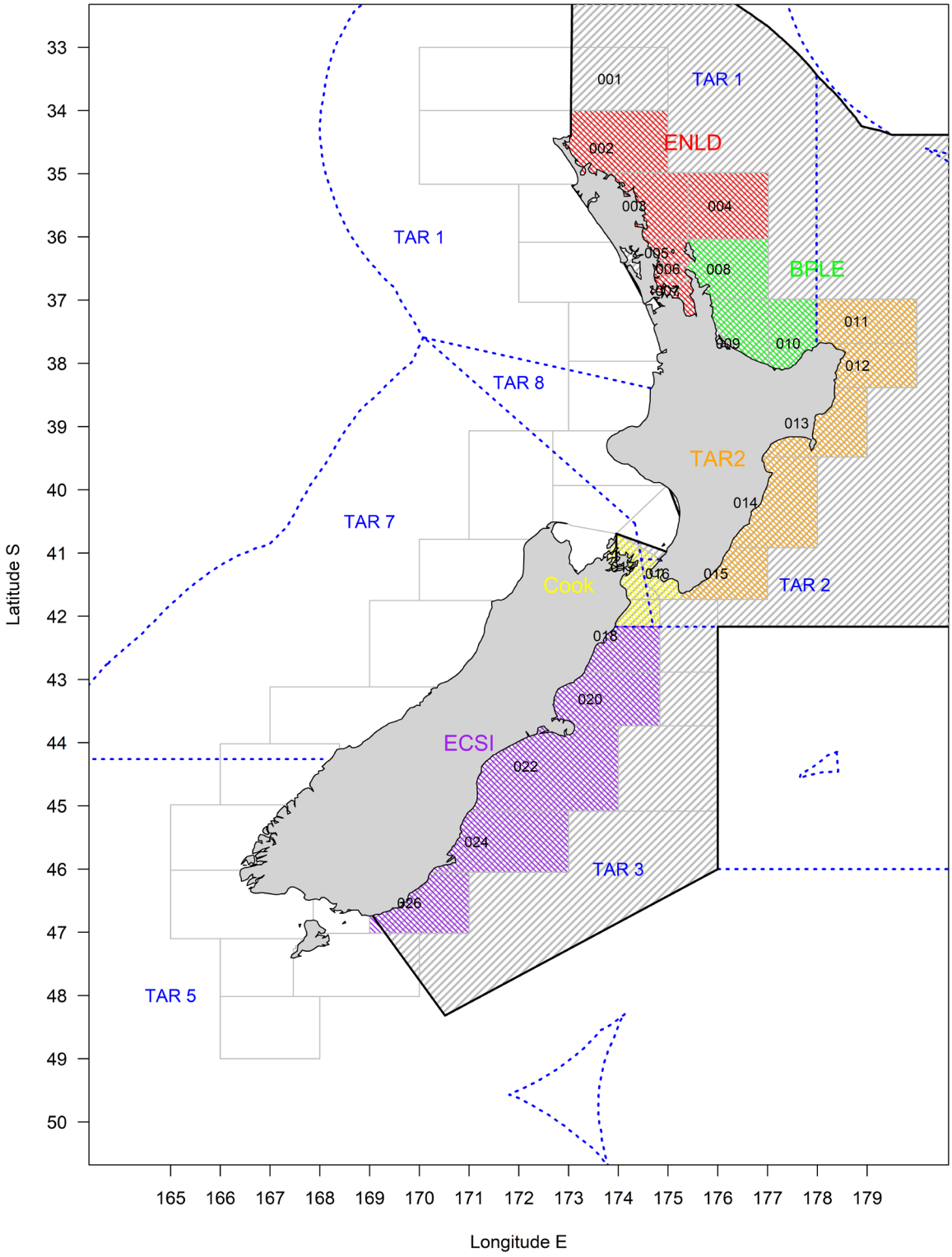


Figure 1: Map of the domain of the eastern tarakihi stock assessment and constituent Statistical Areas.

Table 1: Fishery Statistical Area used to define the commercial tarakihi fisheries.

Fishery	Main QMA	Statistical Areas
East Northland ENLD	TAR 1 (E)	002, 003, 004, 005, 006, 007
Bay of Plenty BPLE	TAR 1 (E)	008, 009, 010
TAR 2	TAR 2	011–015
Eastern Cook Strait COOK	TAR 7 (E)	016, 017, 018 (trawl)
Kaikoura Set Net	TAR 3	018 (set net)
East Coast South Island ECSI	TAR 3	020, 022, 024, 026

Commercial catch and effort data from the tarakihi fishery were sourced from the Fisheries New Zealand EDW database. Initially, a complete set of tarakihi catch and effort data was obtained for the tarakihi QMAs around mainland New Zealand: TAR 1 TAR 2, TAR 3, TAR 5, TAR 7, and TAR 8 QMAs. The wider scope of the data extract was to enable an appraisal of the tarakihi across QMAs and defined fishery boundaries.

The data extract included the catch and effort data from any fishing trip that recorded a catch of tarakihi from the QMAs. The extract was supplemented by data from any additional fishing trips that conducted fishing within the statistical areas that comprise the inshore area around mainland New Zealand (Statistical Areas 001–048) and targeted the range of inshore species (tarakihi, TAR; snapper *Chrysophrys auratus*, SNA; trevally *Pseudocaranx dentex*, TRE; red cod *Pseudophycis bachus*, RCO; barracouta *Thyrsites atun*, BAR; gemfish *Rexea solandri*, SKI; blue warehou *Seriolella brama*, WAR; red gurnard *Chelidonichthys kumu*, GUR; ghost shark, GSH; giant stargazer, STA; and John dory *Zeus faber*, JDO) that are caught in association with tarakihi.

For the qualifying trips, all effort data records were sourced whether or not tarakihi was landed. The estimated catches and landed catch records of all finfish species were also sourced for the qualifying fishing trips. Data were complete to the end of the 2024–25 fishing year.

From 1989–90, most inshore fishing vessels reported catch and effort data via the Catch Effort Landing Return (CELR), which records aggregated fishing effort and the estimated catch of the top five species. Fishing effort and catch was required to be recorded for each target species and statistical area fished during each day, although typically catch and effort data were aggregated by fishing day (Langley 2014). The verified landed greenweight that is obtained at the end of the trip was recorded on the Landings section of the CELR form.

From 1994–95, many of the inshore trawlers operating in TAR 1 reported fishing effort and catch data for individual trawls/tows via the Trawl Catch Effort and Processing Return (TCEPR). In 2007–08, the Trawl Catch and Effort Return (TCER) was introduced specifically for the inshore trawl fisheries and was adopted by most of the inshore trawl vessels within the tarakihi fishery. The TCEPR and TCER forms recorded detailed fishing activity, including trawl start location and depth, and associated (estimated) catches from individual trawls. Landed catches associated with trips reported on TCEPR and TCER forms were reported at the end of a trip on the Catch Landing Return (CLR).

From mid-2019, Electronic Reporting Systems (ERS) were introduced for the main inshore trawl fleet and most other fishing methods, following the initial introduction on vessels operating in deepwater fisheries. The ERS record positional data for fishing events and store and transmit the associated fishing event and catch data for statutory reporting. The ER system is based around the seven reporting components: Trip Start, Fish Catch, Non Fish Protected Species (NFPS) Catch, Processing, Disposal, Landing, and Trip End. Fish Catch reports record the details of the fishing activity and the estimated species catch. Trawl vessels under 28 m are required to report the catch of the top 8 (Quota Management System (QMS) and non QMS) species caught from each trawl, although typically catches have been recorded for a larger number of species.

The initial set of tarakihi landed catch records was screened to retain the records that represented the final destination of the tarakihi catch (destination codes L, LR, EOY, A, C, E, and O). Almost all (99.7%) of the landed catch was attributed to destination code L (i.e., conveyed to an LFR at the time of landing).

The catch and effort data sets were processed following the methodology described by Langley 2014. Two data sets were configured:

1) **Daily** aggregated catch and effort data set from 1989–90 to 2024–25. Tarakihi catch and effort data were aggregated by vessel fishing day and fishing method to approximate the CELR data format. The predominant statistical area and target species recorded during the fishing day were assigned to the Daily aggregate record. For each trip, the landed catch of tarakihi was apportioned amongst the daily fishing records in proportion to the estimated catches of tarakihi (when included within the five main species caught in the day). Tarakihi landed catches from trips without corresponding estimated catches were distributed amongst daily records in proportion to fishing effort (number of trawls).
2) **Trawl** based catch and effort data set from 1994–95 to 2024–25. TCEPR, TCER, and ERS format catch and effort records. For each trip, the landed catch of tarakihi was apportioned amongst the individual trawl records (events) in proportion to the estimated catches of tarakihi (when recorded in the five main species caught in the trawl). Tarakihi landed catches from trips without corresponding estimated catches were distributed equally amongst trawl records.

For the daily data set, almost all (98%) of the landed catch of tarakihi was allocated to fishing days with associated estimated catches. The remainder of the landed catch was allocated equally amongst the associated fishing events, representing a significant proportion of the overall fishing days (29%) assigned small quantities of tarakihi catch (about 2–3 kg).

Total annual catches of tarakihi under the Quota Management System (QMS) are compiled from Monthly Harvest Returns (MHR) submitted by fishing permit holders. Overall, the annual landed catches for TAR 1, 2, 3, 5, 7, and 8 included in the characterisation data set approximated the corresponding Fishstock catches reported by Fisheries New Zealand (Fisheries New Zealand 2025) (Figure 2).

Estimated catches were assigned to QMAs based on Statistical Area definitions. This could not be done exactly, due to differences in the boundaries between QMAs and Statistical Areas. For example, estimated tarakihi catches attributed to TAR 8 exceeded the TAR 8 landed catches in some years (Figure 2) because all the tarakihi catch from Statistical Area 041 was allocated to TAR 8, rather than splitting the catch from Statistical Area 041 between TAR 8 and the western portion of TAR 1.

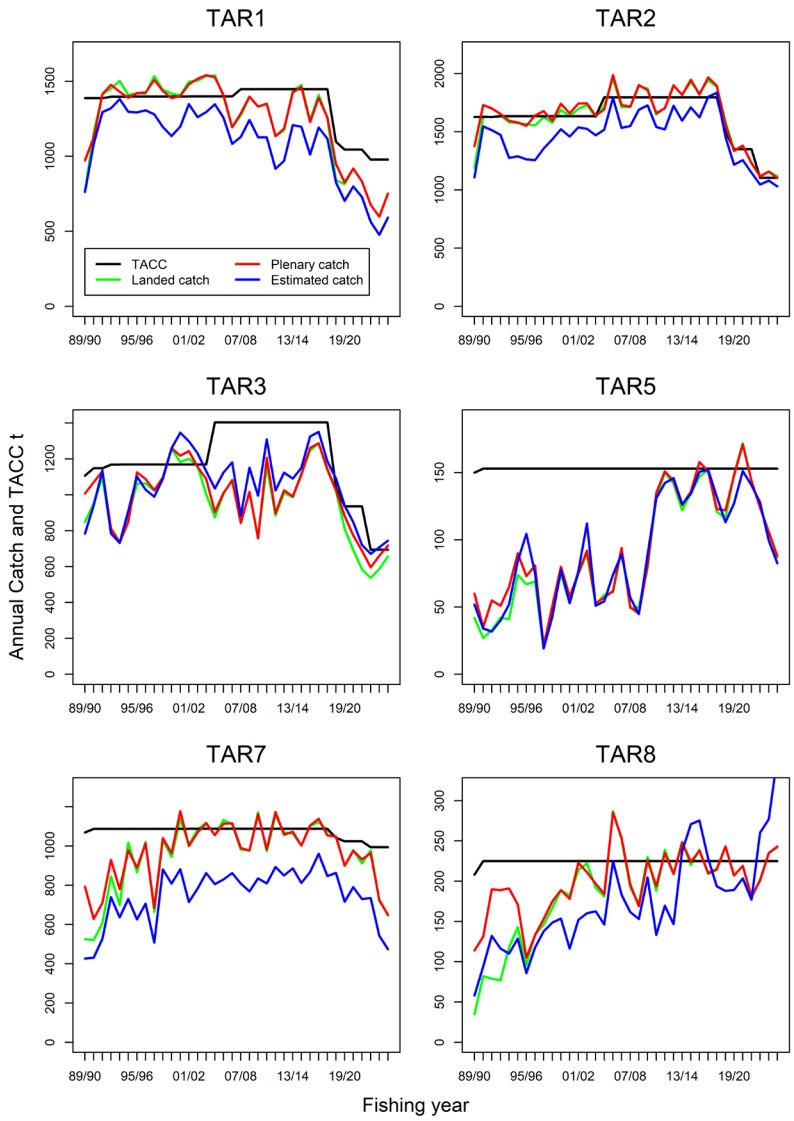


Figure 2: Annual tarakihi reported catches (Plenary catch) and Total Allowable Commercial Catch (TACCs) by Quota Management Area and the landed and estimated catches included in the catch and effort data set.

3.3 Recent trends

Tarakihi catches are taken throughout the coastal areas around the North Island and South Island, predominantly shallower than about 200 m (Figure 3 and Figure 4). For the eastern areas, tarakihi trawl catches were highest in the eastern Bay of Plenty (TAR 1E) and Tairawhiti (TAR 2), off Cape Campbell (TAR 7E) and Pegasus Bay (TAR 3). Local target fisheries also occur off East Northland (TAR 1E) and Wairarapa (TAR 2) (Figure 3 and Figure 4).

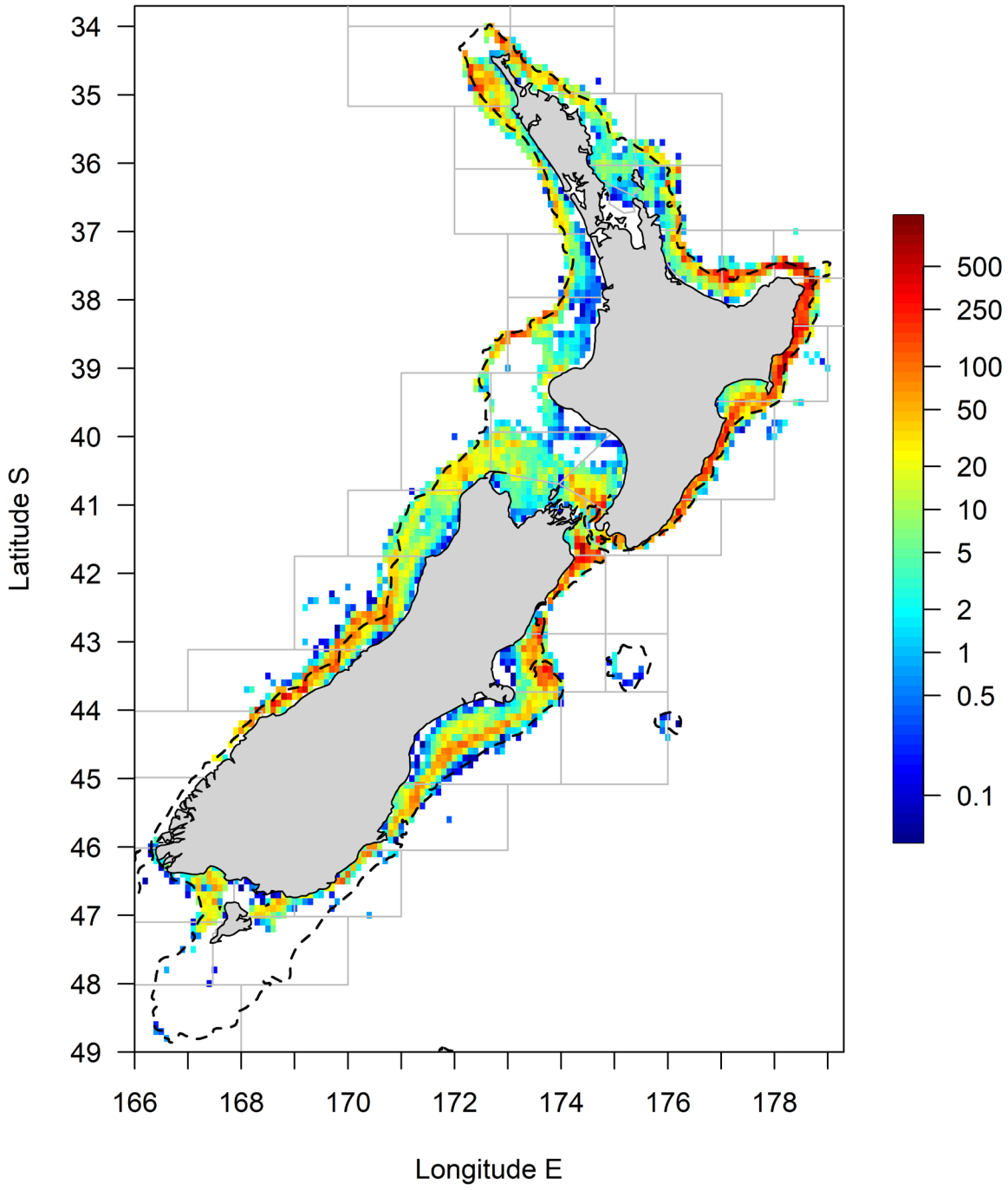


Figure 3: **Distribution of the total tarakihi catch (t) from BT and PRB by 0.1 degree latitude and longitude (log scale) from 2007–08 to 2024–25. The black dashed line represents the 200 m depth contour. Each cell has data from a minimum of three permit holders.**

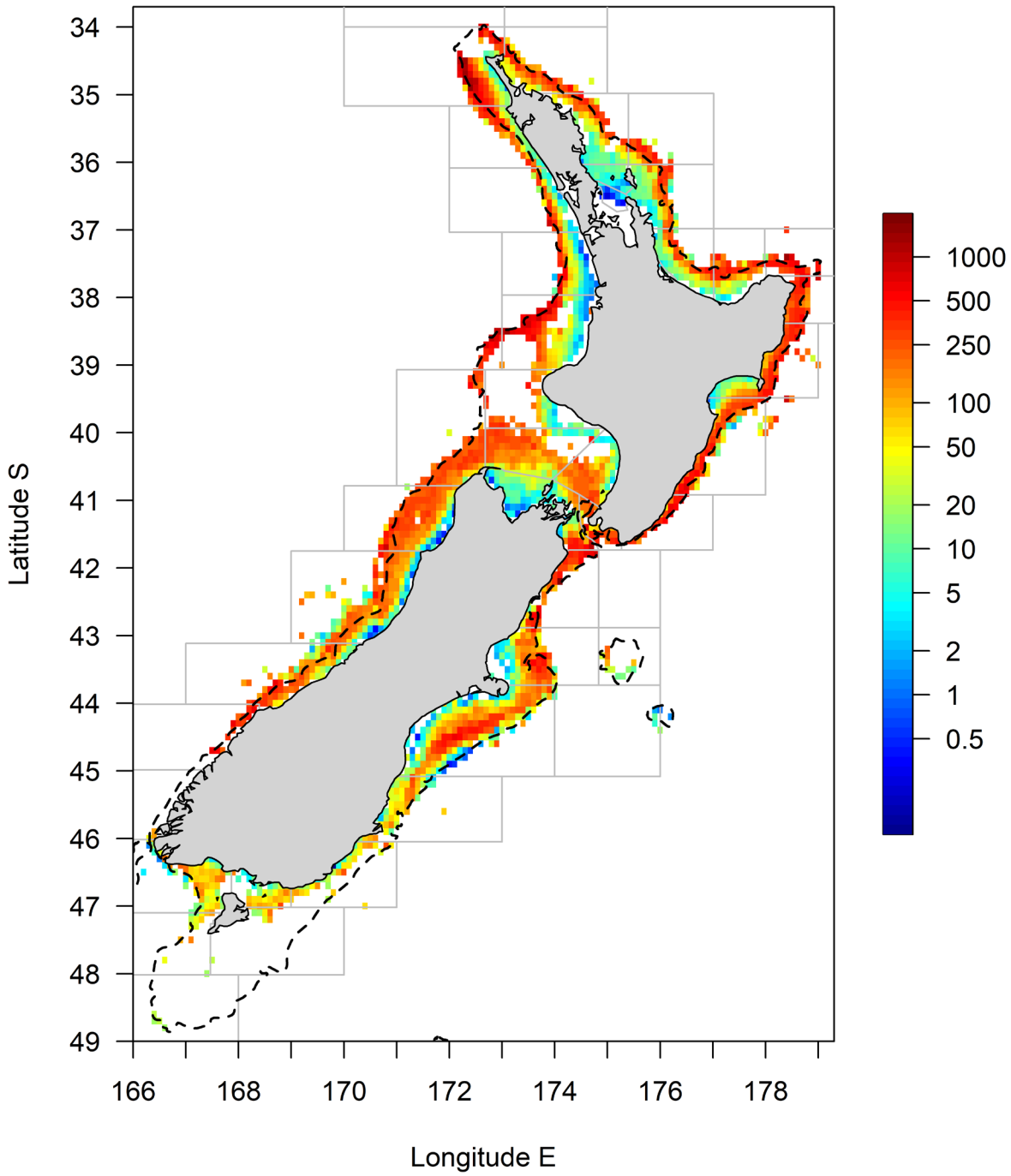


Figure 4: **Average tarakihi catch per trawl (kg) from BT and PRB by 0.1 degree latitude and longitude (log scale) from 2007–08 to 2024–25. The black dashed line represents the 200 m depth contour. Each cell has data from a minimum of three permit holders.**

Annual catches of tarakihi from the eastern area have been dominated by the TAR 2 and ECSI fisheries (Figure 5 and Figure 6). Catches from all fisheries declined from 2017–18 following the series of reductions in the TACCs.

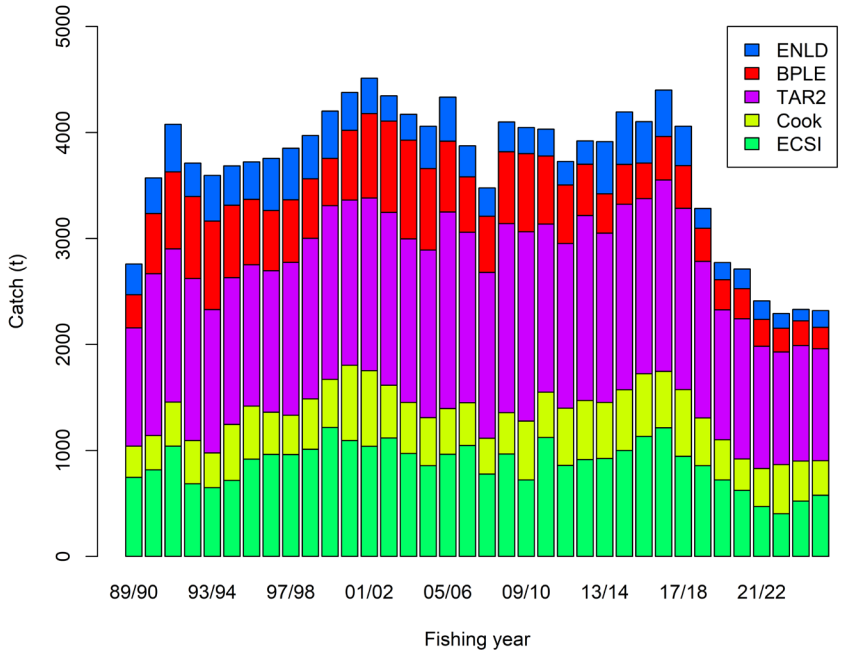


Figure 5: Distribution of annual eastern tarakihi catches by fishery area. Catches from the Kaikoura set net fishery are included in the ECSI area.

Most of the catch from the East Northland fishery was from Statistical Area 002 (Figure 6). Catches from the ENLD fishery were relatively high from 2013–14 to 2017–18 and declined considerably in 2018–19, remaining at the lower level over the subsequent years. Catches from the BPLE fishery declined steadily from 2009–10 to 2024–25 (Figure 6).

Catches from the northern areas of TAR 2 (Statistical Areas 011 and 012) declined from the early 2010s, with catches initially increasing in Statistical Area 013 (Figure 6). Since 2017–18, the reductions in the TAR 2 TACC have resulted in declining catches in all Statistical Areas.

Most of the tarakihi catch taken from the portion of Statistical Area 018 within the ECSI (TAR 3) fishery was taken by the set net fishery operating along the Kaikoura coast. The catch from this fishery declined considerably from 2003–04 and has been low in recent years (Figure 6).

Since 2017–18, an increasing proportion of the ECSI catch was from Pegasus Bay (020) while catches from the Canterbury Bight (022) declined substantially (Figure 6).

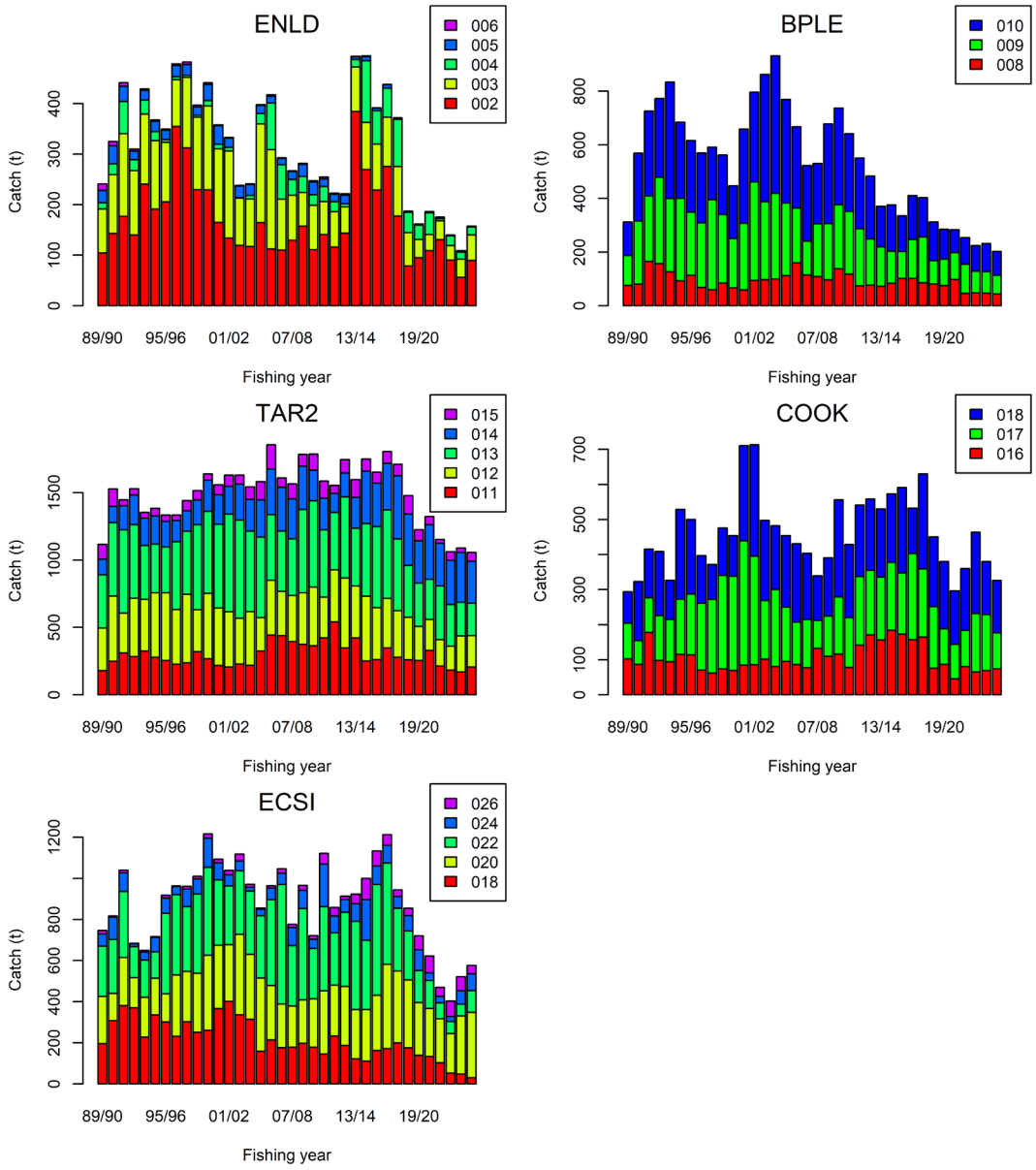


Figure 6: Distribution of annual tarakihi catches by Statistical Area for each fishery area. Catches from the Kaikoura set net fishery are included in the ECSI area.

East Northland ENLD

Most of the ENLD catch was taken by the target trawl (BT and, more recently, PRB) (Figure 7). The daily aggregation of the tarakihi catch and effort data is likely to overstate the proportion of the tarakihi catch attributed to target snapper and trevally trawls. Most of the tarakihi trawl catch was taken within the 70–200 m depth range.

Tarakihi have also been caught by the bottom longline (BLL) fishery, primarily as a bycatch from the snapper longline fishery (Figure 7). Tarakihi were also targeted by longline from 2012–13 to 2017–18.

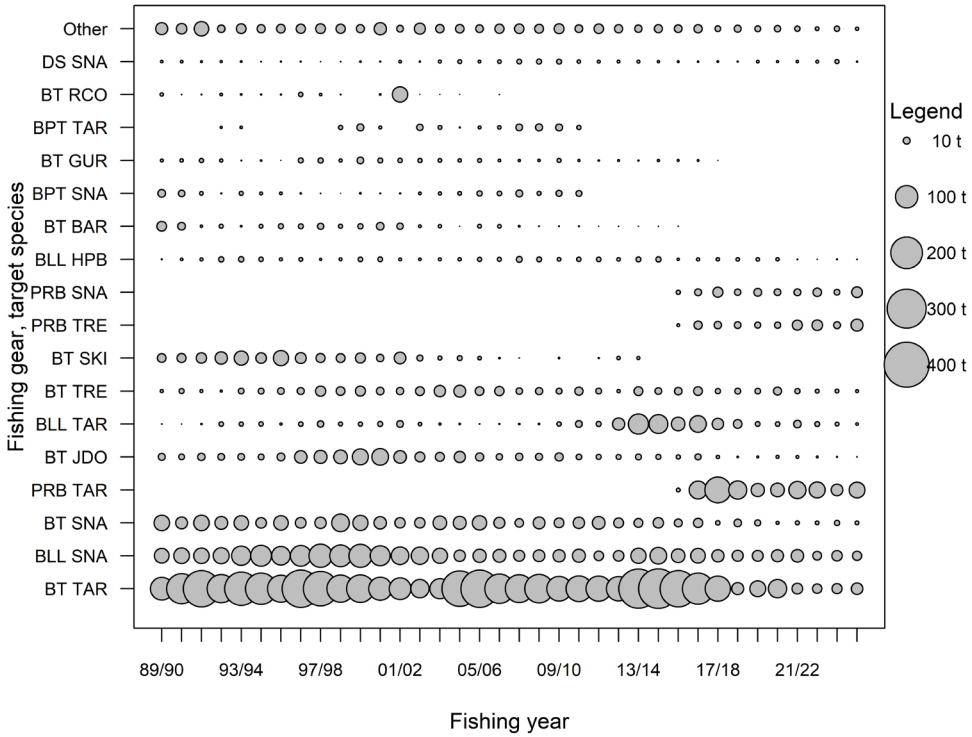


Figure 7: Annual tarakihi catch from the ENLD (TAR 1) fishery by fishing gear (BT, bottom single trawl; BPT, bottom pair trawl; BLL, bottom longline; PRB, Precision Harvesting bottom trawl gear; DS, Danish seine) and declared target species (SNA, snapper; TRE, trevally; GUR, red gurnard; TAR, tarakihi; JDO, John dory; SKI, gemfish; HPB, hapuku; BAR, barracouta; RCO, red cod). The area of the circle is proportional to the catch.

Bay of Plenty BPLE

The tarakihi catch from the Bay of Plenty was predominantly taken by the target trawl fishery with a small bycatch of tarakihi from other trawl fisheries (Figure 8). A target set net fishery for tarakihi operated in the early 1990s.

Since 2004–5, there was a general increase in the proportion of the tarakihi catch taken during March–May (Figure 9). The target trawl fishery predominantly occurred during this period.

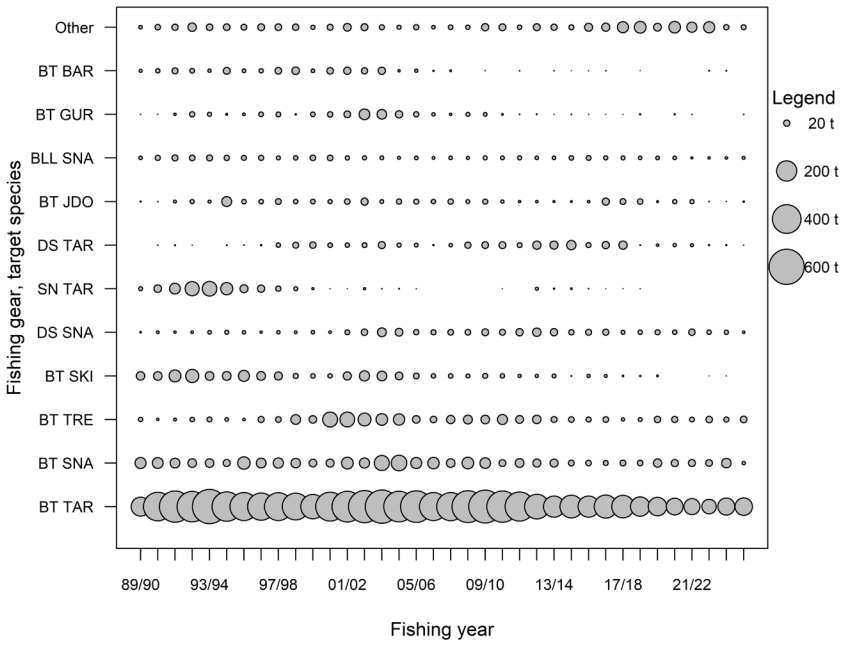


Figure 8: Annual tarakihi catch from the BPLE fishery by fishing gear (BT, bottom single trawl; DS, Danish seine; SN, set net; BLL, bottom longline) and declared target species (SNA, snapper; TRE, trevally; GUR, red gurnard; TAR, tarakihi; SKI, gemfish; BAR, barracouta; JDO, John dory). The area of the circle is proportional to the catch.

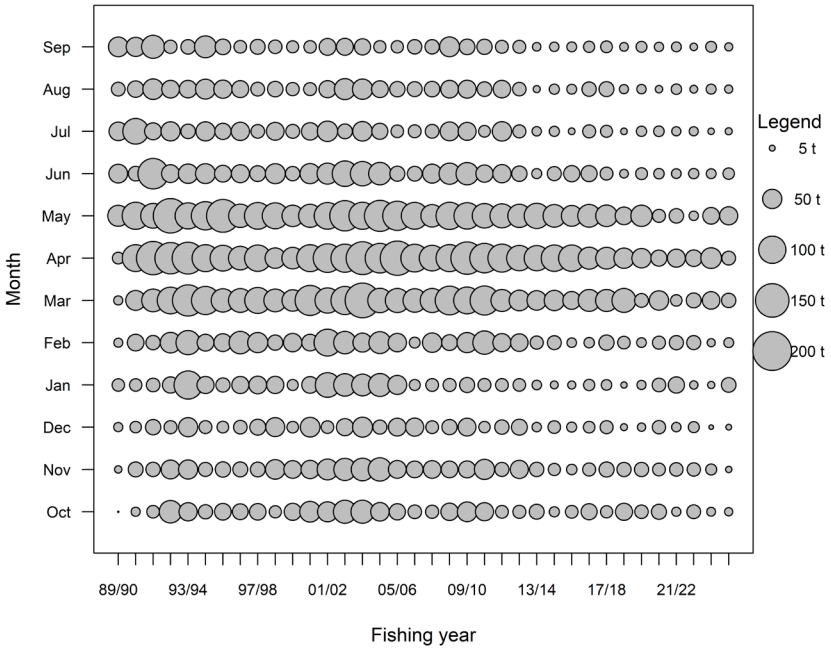


Figure 9: Annual tarakihi catch from the BPLE fishery by month. The area of the circle is proportional to the catch.

TAR 2

Within TAR 2, tarakihi was predominantly caught by the target trawl fishery with a minor bycatch taken from other trawl fisheries, most notably red gurnard (Figure 10). The tarakihi trawl fishery operates throughout the year (Figure 11).

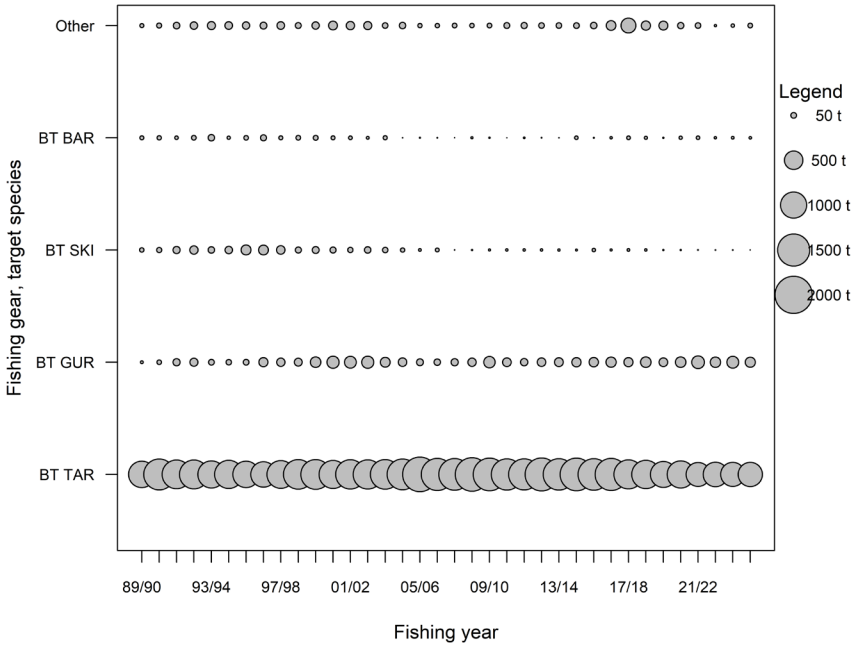


Figure 10: Annual tarakihi catch from the TAR 2 fishery by fishing gear (BT, bottom single trawl) and declared target species (GUR, red gurnard; TAR, tarakihi; BAR, barracouta; JDO, John dory; SKI, gemfish). The area of the circle is proportional to the catch.

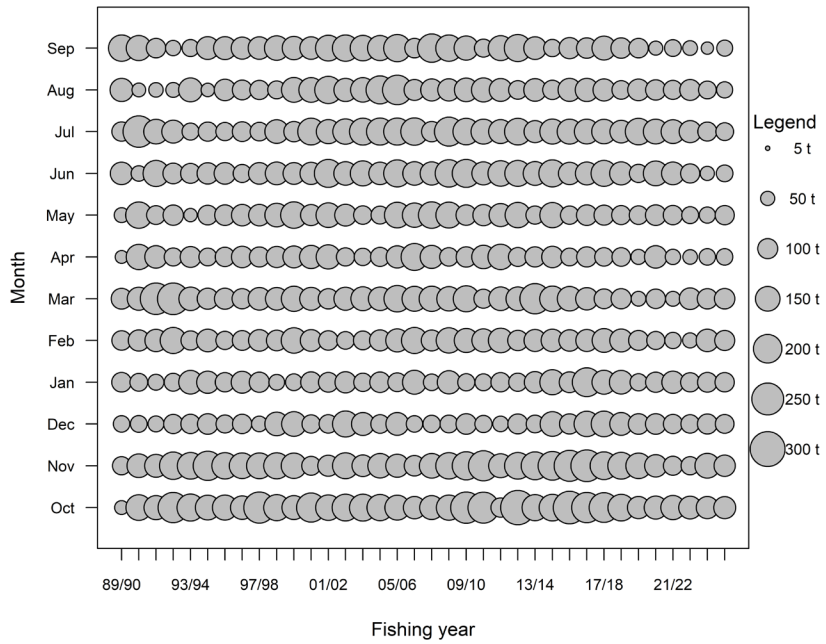


Figure 11: Annual tarakihi catch from the TAR 2 fishery by month. The area of the circle is proportional to the catch.

Eastern Cook Strait COOK

In the eastern Cook Strait, the tarakihi catch was predominantly taken by the target trawl fishery (Figure 12) with an additional bycatch from trawls targeting barracouta and red cod. Most of the tarakihi caught by these fisheries was taken in the 50–150 m depth range. From 2018–19, the reductions in the TAR 7 TACC resulted in a substantial decline in the target tarakihi catch (Figure 12). Most of the tarakihi catch from the COOK fishery was taken during November–May with a peak during January–March (Figure 13). Catches were generally low during July–October.

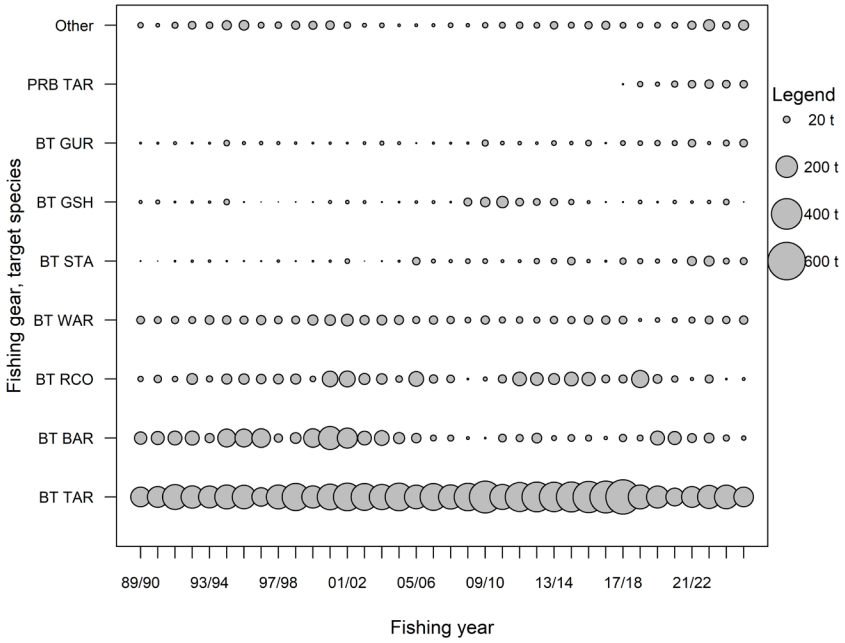


Figure 12: Annual tarakihi catch from the Cook fishery by fishing gear (BT, bottom single trawl; PRB, Precision Harvesting bottom trawl gear) and declared target species (GUR, red gurnard; TAR, tarakihi; BAR, barracouta; WAR, blue warehou; RCO, red cod; STA, stargazer; GSH, dark ghost shark). The area of the circle is proportional to the catch.

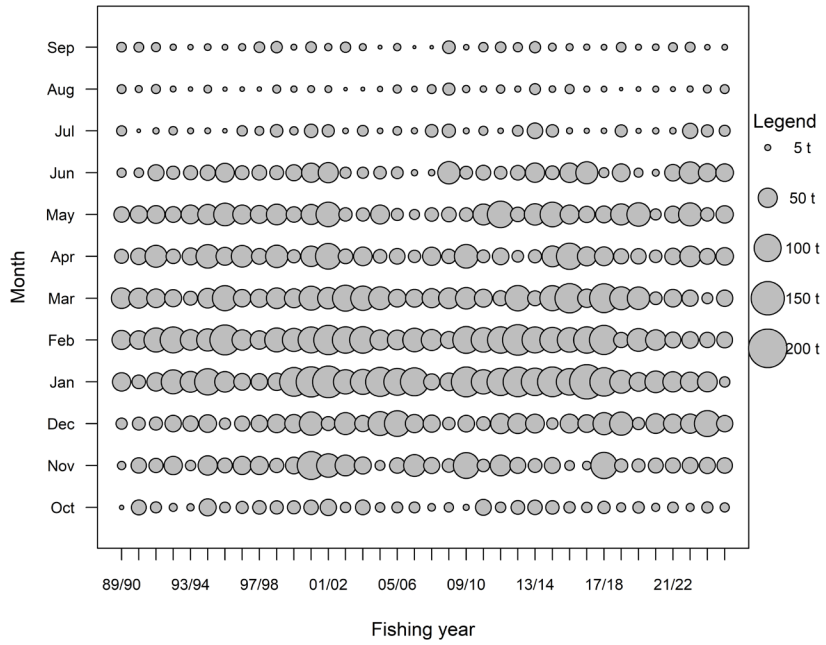


Figure 13: Annual tarakihi catch from the Cook fishery by month. The area of the circle is proportional to the catch.

East Coast South Island ECSI

During the 1990s, the ECSI catch of tarakihi was dominated by the Kaikoura tarakihi set net fishery and the bycatch from the red cod trawl fishery. Catches from both fisheries declined from the early 2000s, especially for the red cod trawl fishery. The set net fishery continued to operate at a lower level until the late-2010s before declining further in more recent years (Figure 14).

From the early 2000s, an increasing proportion of the catch was taken by the target tarakihi trawl fishery with a target Danish seine fishery also operating from 2005–06 to 2017–18 (Figure 14). Tarakihi was also caught by a range of "Other" fisheries (primarily trawls targeting red gurnard, elephantfish, stargazer and sea perch).

Tarakihi catches were higher during January-May (Figure 15).

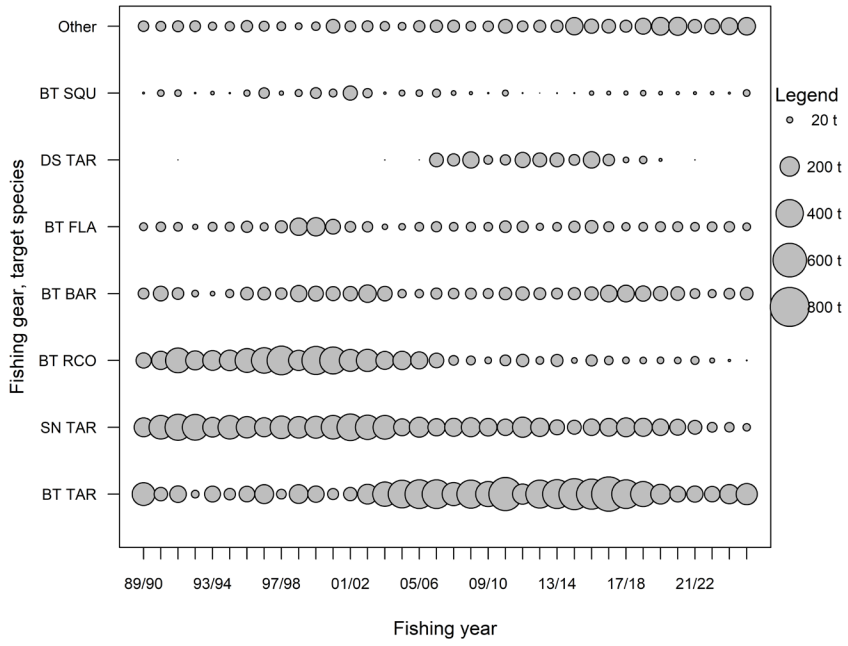


Figure 14: Annual tarakihi catch from the ECSI fishery by fishing gear (BT, bottom single trawl; SN, set net; DS, Danish seine) and declared target species (TAR, tarakihi; BAR, barracouta; FLA, flatfish species; RCO, red cod; SQU, arrow squid). The area of the circle is proportional to the catch.

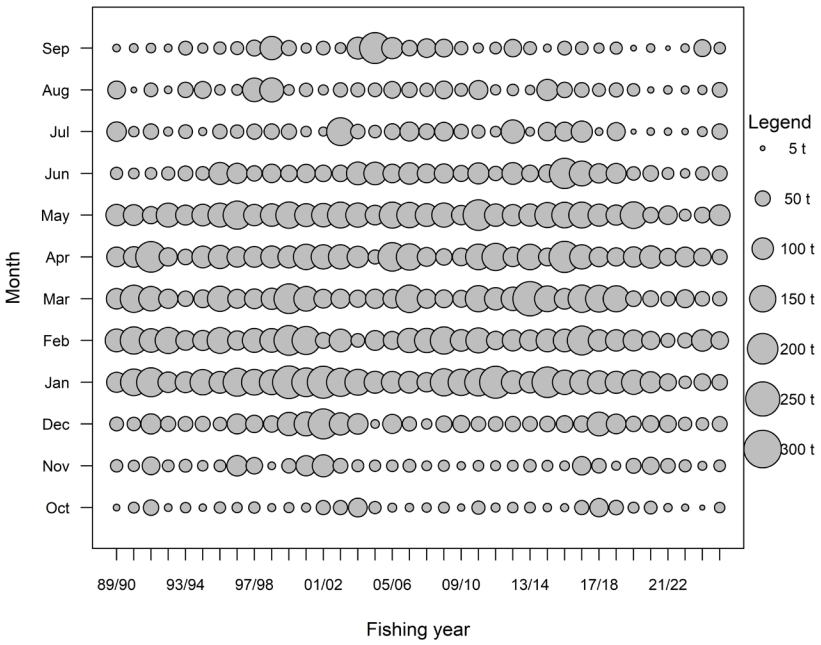


Figure 15: Annual tarakihi catch from the ECSI fishery by month. The area of the circle is proportional to the catch.

Spatial CPUE

Seasonal and spatial trends in tarakihi trawl catch rates were investigated using trawl based catch and effort data from the entire eastern stock and (and immediately adjacent areas). The data set included inshore trawl records with an associated catch of tarakihi from 2007–08 to 2024–25 fishing years. Individual trawl records were assigned to a 0.5º lat/long spatial grid. A Generalised Linear Model was configured to model the relationship between tarakihi catch (natural logarithm) and a range of explanatory variables, most importantly, lat/long grid cell, vessel, month, fishing year were included as categoric variables. Most of the explanatory power of the model was accounted for by the spatial grid cells (89 cells accounting for 34% of the total variation).

The residuals from the model were summarised by month or quarter and spatial lat/long grid cell (Figure 16 and Figure 17). There are some persistent patterns in the aggregated residuals that indicate seasonal patterns in relatively higher catch rates (positive residuals) and relatively lower catch rates (negative residuals), most notably:

i. Positive residuals off Doubtless Bay (Statistical Area 002) for February-May and negative residuals for September-January. A reciprocal pattern in the residuals for Statistical Areas 003 (Tutukaka coast) and 005 (outer Hauraki Gulf); negative residuals for February-May and positive residuals for June-December.
ii. Positive residuals for Bay of Plenty (009 and 010) during March-May and negative residuals for June-January.
iii. Positive residuals for East Cape during March-May and negative residuals for June-January. A reciprocal pattern in the residuals for Mahia (Statistical Areas 013); negative residuals for January-April and positive residuals for June-December.
iv. Positive residuals for Wairarapa (014) during May-July and negative residuals for March-September.
v. Positive residuals for Cape Campbell (Statistical Areas 017 and 018) for December-April and negative residuals for July-October.
vi. Positive residuals for Pegasus Bay and Canterbury Bight (Statistical Areas 020 and 022) for December-April and negative residuals for July-October.

vii. No strong pattern in residuals from the southern area of TAR 3 (Statistical Areas 024 and 026).

The positive residuals off east Northland, Bay of Plenty and East Cape in March-April correspond to the main spawning period for tarakihi and the aggregation of fish during that period. Tarakihi appear to disperse from those areas following the spawning period, with higher catch rates in adjacent areas during winter and spring. There appears to be a strong seasonal pattern in catch rates off the Wairarapa coast, possibly related to a northward movement of tarakihi during January-February (prior to spawning) and a southward movement during June-August (following spawning) (Figure 17).

The seasonal variation in catch rates within the Canterbury Bight (highest in December-April) may relate to the dynamics of younger tarakihi recruiting into the commercial fishery once they attain the Minimum Legal Size (MLS) of 25 cm (Figure 17).

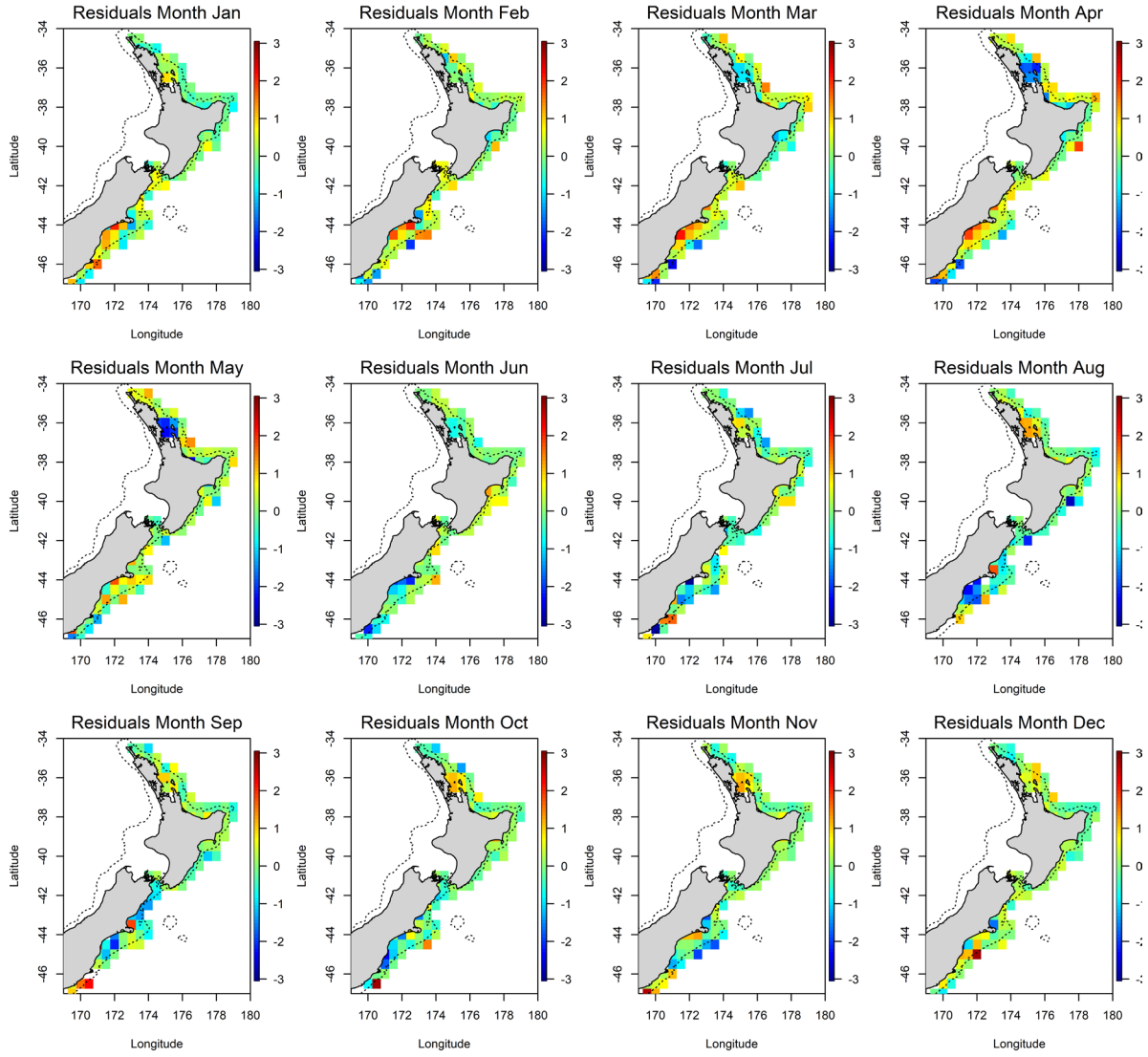


Figure 16: Median spatial CPUE model residuals aggregated by 0.5 lat/long grid cell and month.

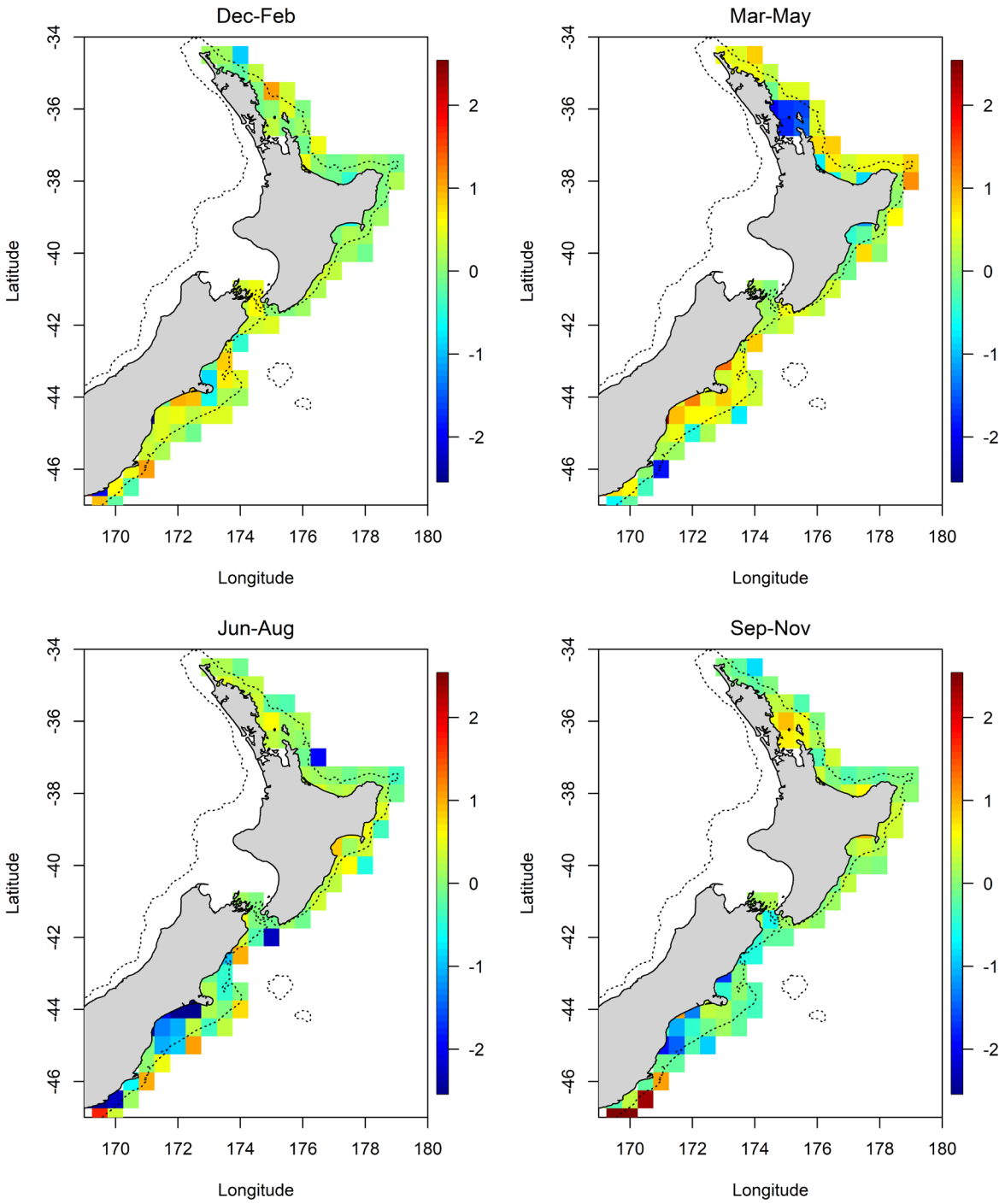


Figure 17: Median spatial CPUE model residuals by aggregated 0.5 lat/long grid cell and season.

4. CPUE ANALYSIS

CPUE analyses were conducted for each of the main eastern tarakihi fisheries. The CPUE analyses updated and refined the previous analyses conducted by Langley (2021) to include data to the 2024–25 fishing year.

4.1 Methodology

The CPUE analyses were based either on the daily (CELR) format or the trawl event-based data sets configured in Section 3.2. The individual data sets were defined by gear method, Statistical Area and the target species (Table 2). Each CPUE data set was further limited to a set of core vessels based on the continuity criteria specified for each analysis.

For the TAR 2, Cook, and ECSI trawl fisheries, CPUE modelling was initially conducted using both daily and event-based data formats with event-based data available from 2007–08 to 2024–25 (Table 2). The trawl event-based analyses for TAR 2, Cook and TAR 3 used the data from the fishing trips selected for the corresponding Day based analyses, maintaining the same set of core vessels for the two analyses.

Tarakihi are also caught in the bottom longline fisheries in east Northland and the Bay of Plenty, predominantly caught in small quantities as a bycatch of the snapper longline fishery. Separate CPUE analyses were conducted for the two longline fisheries to corroborate the CPUE indices from the ENLD and BPLE trawl fisheries (Table 2).

Table 2: Definitions of the data sets included in each of the final CPUE analyses.

Index	Method	Statistical Areas	Target species	Data format	First year	Status
ENLD_Event	BT, PRB	002, 003	TAR	Event	1993–94	Updated
ENLD_BLL	BLL	002–004	TAR, SNA, RSN	Event	2007–08	New
BPLE_Event	BT	008–010	TAR, SNA, GUR, JDO, TRE	Event	1993–94	New
BPLE_BLL	BLL	008–010	TAR, SNA, RSN	Event	2007–08	New
TAR2_Day	BT	011–015	TAR, SNA, GUR, BAR, SKI, WAR	Day	1989–90	Updated
TAR2_Event	BT	011–015	-	Event	2007–08	New
Cook_Day	BT	017, 018	TAR, STA, BAR, WAR, GSH, RCO	Day	1989–90	Updated
Cook_Trawl	BT	017, 018	-	Event	2007–08	New
Kaikoura_SN	SN	018	TAR	Day	1989–90	Updated
TAR3_Day	BT	020, 022, 024, 026	TAR, BAR, WAR, GUR, RCO	Day	1989–90	Updated
TAR3_Event	BT	020, 022, 024, 026	-	Event	2007–08	New

A Generalised Linear Modelling (GLM) approach was used to separately model the occurrence of tarakihi catches (presence/absence) and the magnitude of positive tarakihi catches. The dependent variable of the catch magnitude CPUE models was the natural logarithm of catch. For the positive catch CPUE models, a lognormal error structure was assumed, with the exception of the ENLD trawl fishery which used a Weibull distribution following previous analyses (Langley 2021). The presence/absence of tarakihi catch was modelled based on a binomial distribution.

The potential explanatory variables available for inclusion in the daily CPUE models are defined in Table 3, and the trawl event-based variables are presented in Table 4. Potential explanatory variables for the ENLD and BPLE longline CPUE models are defined in Table 5.

The CPUE analysis for the Kaikoura target tarakihi set net fishery was limited to Daily aggregated data only. A limited number of explanatory variables were available for inclusion in the CPUE model, specifically fishing year (*FishingYear*), vessel (*Vessel)*, month (*Month*) and the total length of net set (*NetLength*).

Table 3: The variables included in the daily CELR format trawl catch and effort data sets.

Variable	Definition	Data type
Vessel	Fishing vessel category	Categoric
FishingYear	Fishing year	Categoric
Month	Month	Categoric
StatArea	Statistical area for day of fishing	Categoric
TargetSpecies	Target species for day of fishing	Categoric
NumTrawl	Natural logarithm of the number of trawls conducted	Continuous
Duration	Natural logarithm of total trawl duration (hours)	Continuous
Speed	Trawl speed (knots)	Continuous
GearWidth	Wingspread of trawl gear (m)	Continuous
GearHeight	Headline height of trawl gear (m)	Continuous
TARcatch	TAR trawl catch (kg)	Continuous
TARbin	Presence (1) or absence (0) of TAR catch in trawl	Categoric

Table 4: The variables included in the trawl event-based CPUE data sets.

Variable	Definition	Data type
Vessel	Fishing vessel category	Categoric
FishingYear	Fishing year	Categoric
Month	Month	Categoric
Latitude	Latitude at the start location of trawl	Continuous
Longitude	Longitude at the start location of trawl	Continuous
Loc2	Start location of trawl categorised by 0.2 degree latitude/longitude cell	Categoric
Latitude1	Start location of trawl categorised by 0.1 degree latitude	Categoric
TargetSpecies	Declared target species for trawl	Categoric
Duration	Natural logarithm of trawl duration (hours)	Continuous
Depth	Fishing depth (m)	Continuous
StartTime	Hour at the start of trawl	Continuous
Speed	Trawl speed (knots)	Continuous
GearWidth	Wingspread of trawl gear (m)	Continuous
GearHeight	Headline height of trawl gear (m)	Continuous
TARcatch	Scaled estimated TAR trawl catch (kg)	Continuous
TARbin	Presence (1) or absence (0) of TAR catch in trawl	Categoric

Table 5: The variables included in the East Northland and Bay of Plenty longline event-based CPUE data sets.

Variable	Definition	Data type
Vessel	Fishing vessel category	Categoric
FishingYear	Fishing year	Categoric
Month	Month	Categoric
Latitude	Latitude at the start location of set	Continuous
Longitude	Longitude at the start location of set	Continuous
TargetSpecies	Declared target species for set	Categoric
Depth	Fishing depth (m)	Continuous
StartTime	Hour at the start of set	Continuous
TARcatch	Scaled estimated TAR trawl catch (kg)	Continuous
TARbin	Presence (1) or absence (0) of TAR catch in trawl	Categoric

A step-wise fitting procedure was implemented to configure each of the CPUE models. The fitting procedure initially considered the range of potential explanatory variables with the continuous variables typically parameterised as a third order polynomial function. The categoric variable *FishingYear* was included in the initial models and subsequent variables were included in the model based on the improvement in the deviance explained. Additional variables were included in the model until the improvement in the R^2 statistic was less than 0.5%.

The influence of each of the main variables in the CPUE models were examined following the approach of Bentley et al. (2012). Annual trends in the residuals of each model were examined with respect to target species and statistical area.

The final (combined) indices were determined from the product of the positive catch CPUE indices and the binomial indices following the approach of Stefansson (1996). The confidence intervals associated with the combined indices were determined using a bootstrapping approach.

4.2 Results

ENLD trawl

The ENLD Trawl CPUE indices were derived from the target trawl event-based data available from 1993–94. The derivation of the ENLD Trawl CPUE data set is described in Appendix 1. Limited data are available from the fishery from 2018–19 to 2024–25. The CPUE model diagnostics are presented in Appendix 1.

From 2018–19, an increasing proportion of the trawls occurred in the northern area of the fishery (off Doubtless Bay) and in deeper water (150–200 m). Further, the more efficient vessels were increasingly dominant in the fishery from 2017–18 onwards (see Appendix 1). Both the positive catch (Weibull) and binomial GLM models included the explanatory variables *Vessel* and *Depth*, while the positive catch model also included the explanatory variable *Latitude*. The inclusion of these explanatory variables compensated for the shift in the distribution of the fishery and reduced the CPUE indices relative to the unstandardised (nominal) series.

The positive catch indices declined over the series with a more pronounced decline from 2013–14 (Figure 18). Zero catch records account for a small proportion of the dataset, typically less than 10% per annum. However, the occurrence model predicts the probability of catching tarakihi declined considerably once changes in fishing location and vessel are taken into account (Figure 18). Nonetheless, the annual indices from the occurrence model are highly uncertain contributing considerably to the uncertainty of the combined indices. The combined indices decline substantially from the mid-1990s to a low level in 2022–23 to 2024–25 (Figure 18).

The magnitude of the recent decline in the ENLD trawl CPUE indices is comparable to the decline in the ENLD longline CPUE indices from 2007–08 to 2024–25 (Figure 19). Over the period, the indices declined by approximately 70%.

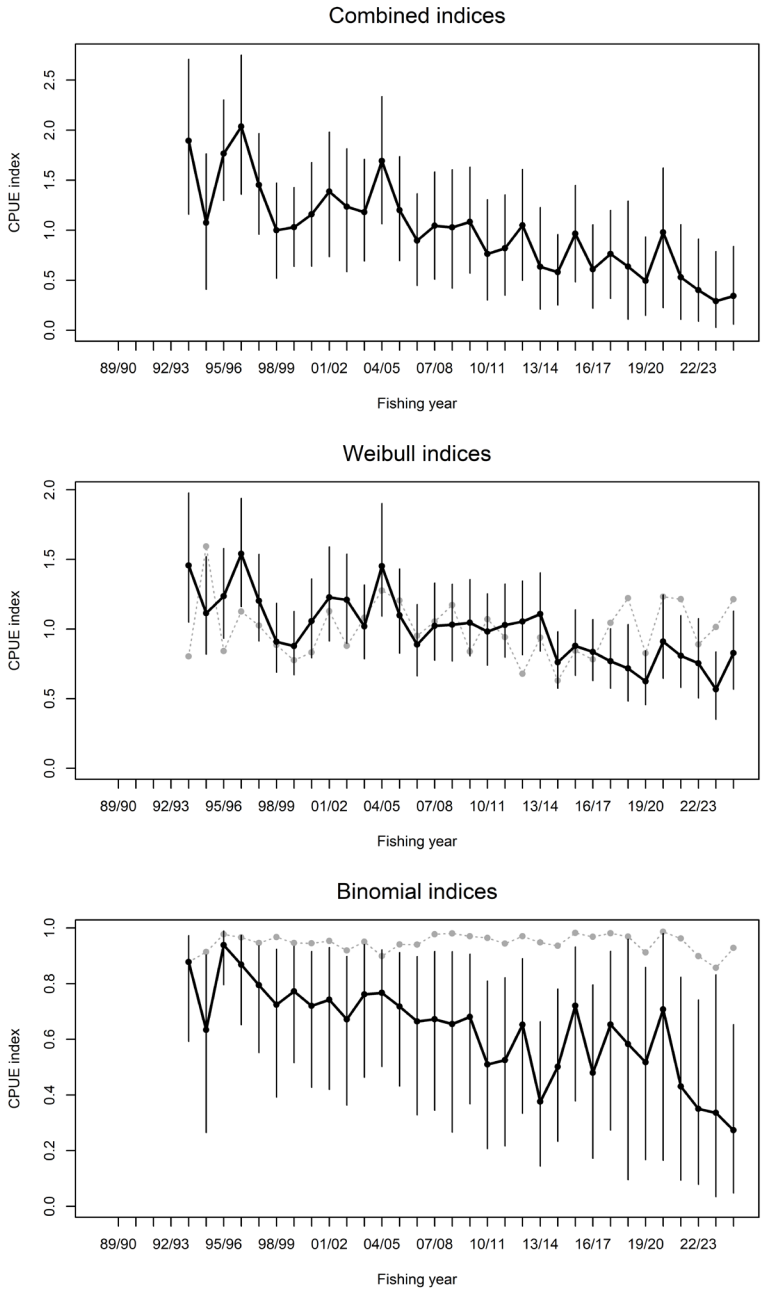


Figure 18: A comparison of: (middle panel) the ENLD Trawl positive index and the geometric mean of the annual catch per trawl; (bottom panel) the binomial index and the annual proportion of positive catch records in the data set; and (top panel) the combined index. The error bars represent the 95% confidence intervals associated with each index. The annual indices are provided in Table A5 (Appendix 1).

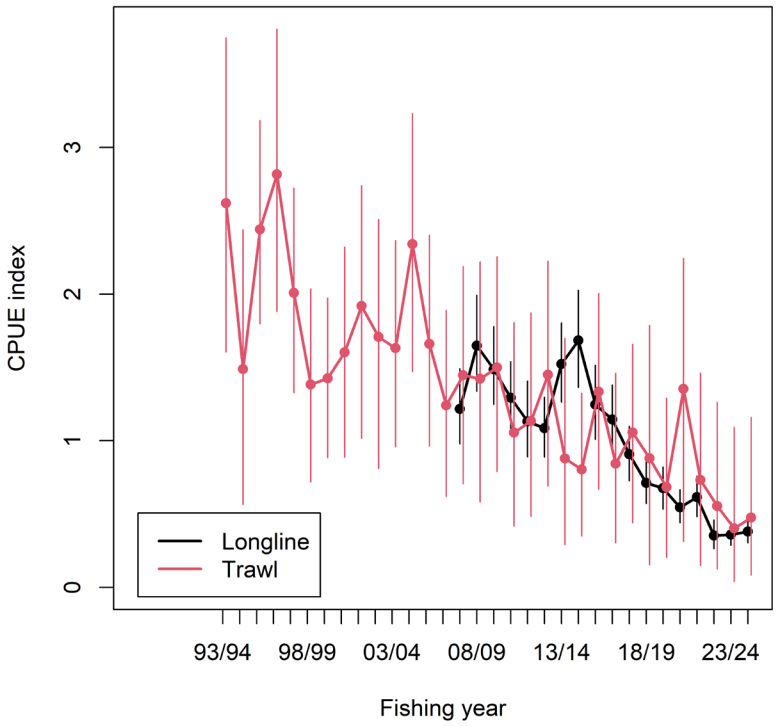


Figure 19: A comparison between the ENLD Trawl CPUE indices and the ENLD Longline CPUE indices. The error bars represent the 95% confidence intervals associated with each index.

BPLE trawl

The BPLE Trawl CPUE indices were derived from the trawl event-based data available from 1993–94. The derivation of the BPLE Trawl CPUE data set is described in Appendix 2. The CPUE model diagnostics are also presented in Appendix 2.

The combined (delta-lognormal) CPUE indices are dominated by the trend in the positive catch (lognormal) component (Figure 20). The lognormal indices increased sharply in the late 1990s to a peak in the early 2000s. Over the subsequent years, the indices steadily declined to a low level in 2023–24 and 2024–25. Key variables included in the lognormal model are *Depth* and *Vessel*. The model accounts for an increased dominance of more efficient vessels in the fishery from the early 2000s.

The trends in the trawl CPUE indices are comparable for the main target trawl fisheries (SNA, TAR, TRE and JDO) and Statistical Areas (008, 009 and 010) that constitute the Bay of Plenty trawl fishery (Appendix 2 Figures A15 and A16). The magnitude of the recent decline in the BPLE trawl CPUE indices is similar to the decline in the BPLE longline CPUE indices from 2007–08 to 2024–25 (Figure 21).

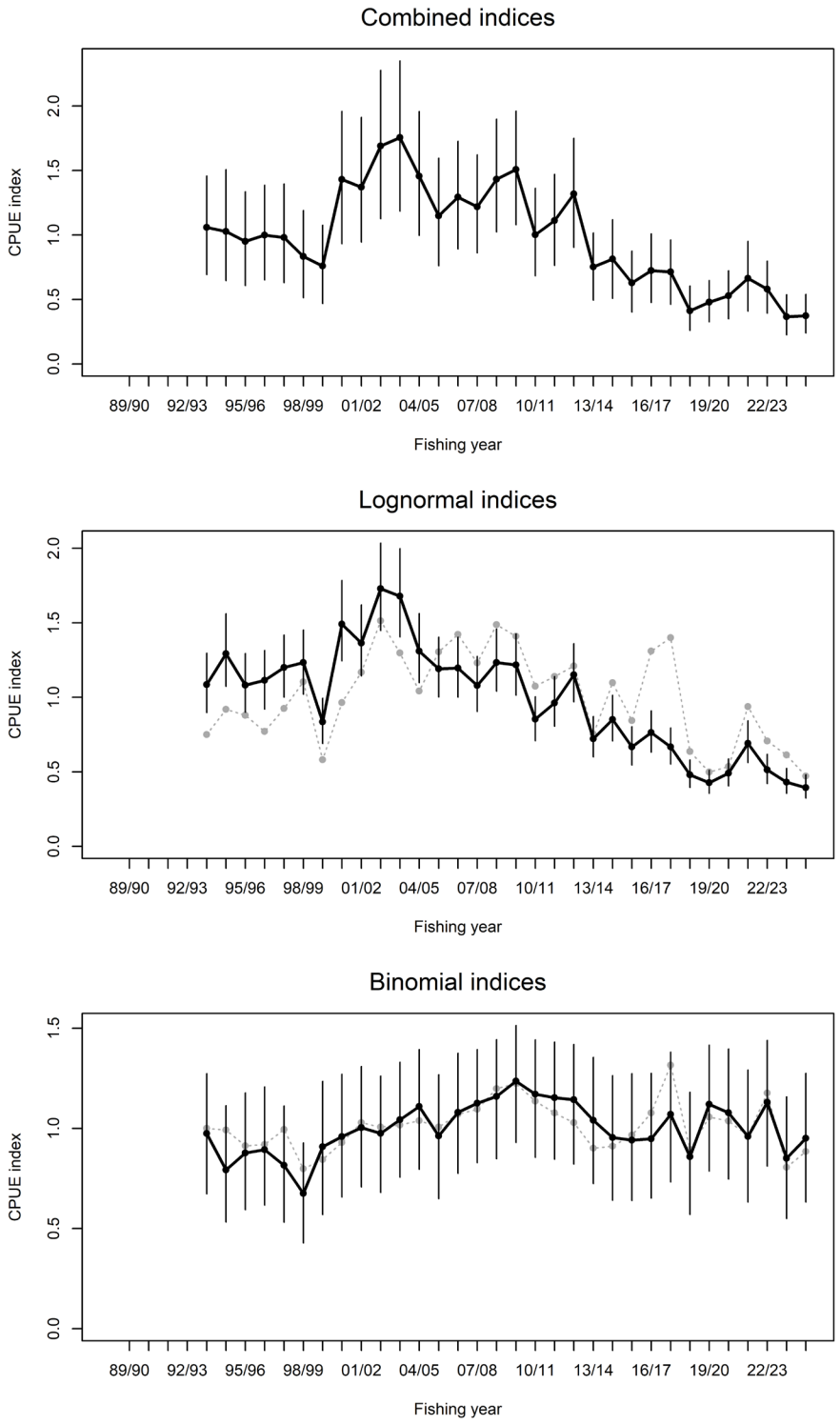


Figure 20: **A comparison of: (middle panel) the BPLE Trawl positive index and the geometric mean of the annual catch per trawl; (bottom panel) the binomial index and the annual proportion of positive catch records in the data set; and (top panel) the combined index. The error bars represent the 95% confidence intervals associated with each index. The annual indices are provided in Table A10 (Appendix 2).**

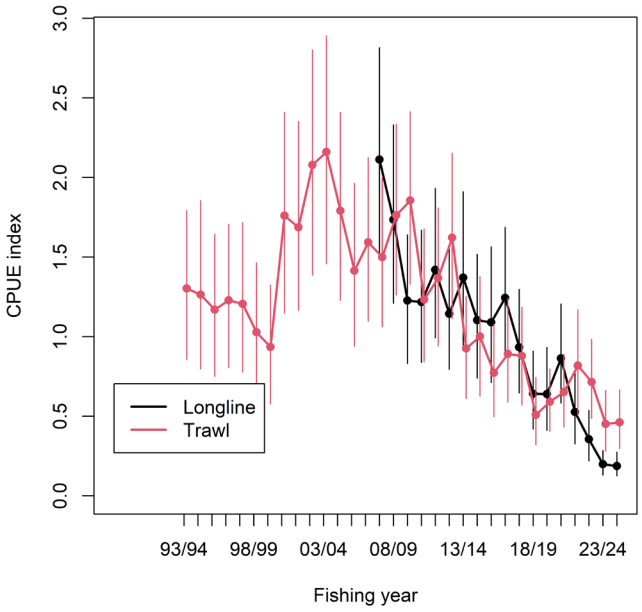


Figure 21: A comparison between the BPLE Trawl CPUE indices and the BPLE Longline CPUE indices. The error bars represent the 95% confidence intervals associated with each index.

TAR 2 trawl

Initially, TAR 2 CPUE indices were derived from Daily catch and effort data available from 1989–90 to 2024–25. The key variables included in the positive catch and occurrence models were *TargetSpecies* and *Vessel*. The resulting CPUE indices increased considerably in 2021–22 (Figure 22), partly due to the influence of an increased proportion of the effort assigned to trawls targeting red gurnard.

For comparative purposes, a separate CPUE analysis was conducted using the event-based dataset from 2007–08 to 2024–25, incorporating trawl location and depth instead of the *TargetSpecies* variable. The resulting CPUE indices moderated the magnitude of the recent increase in the Daily CPUE indices (Figure 22 and Figure 23). For both the daily and event-based indices, the 2024–25 index was considerably lower than the indices for the previous three years.

A summary of the event-based dataset and key model diagnostics is presented in Appendix 3.

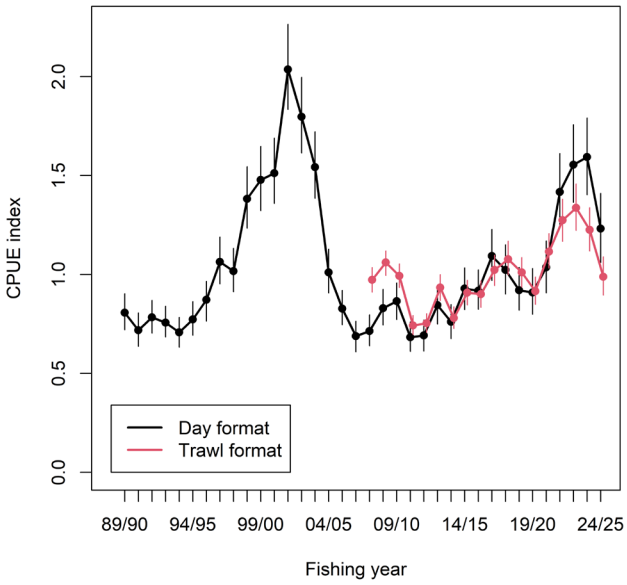


Figure 22: A comparison between the TAR 2 Trawl CPUE indices derived from Daily and Trawl Event format catch and effort data. The error bars represent the 95% confidence intervals associated with each index.

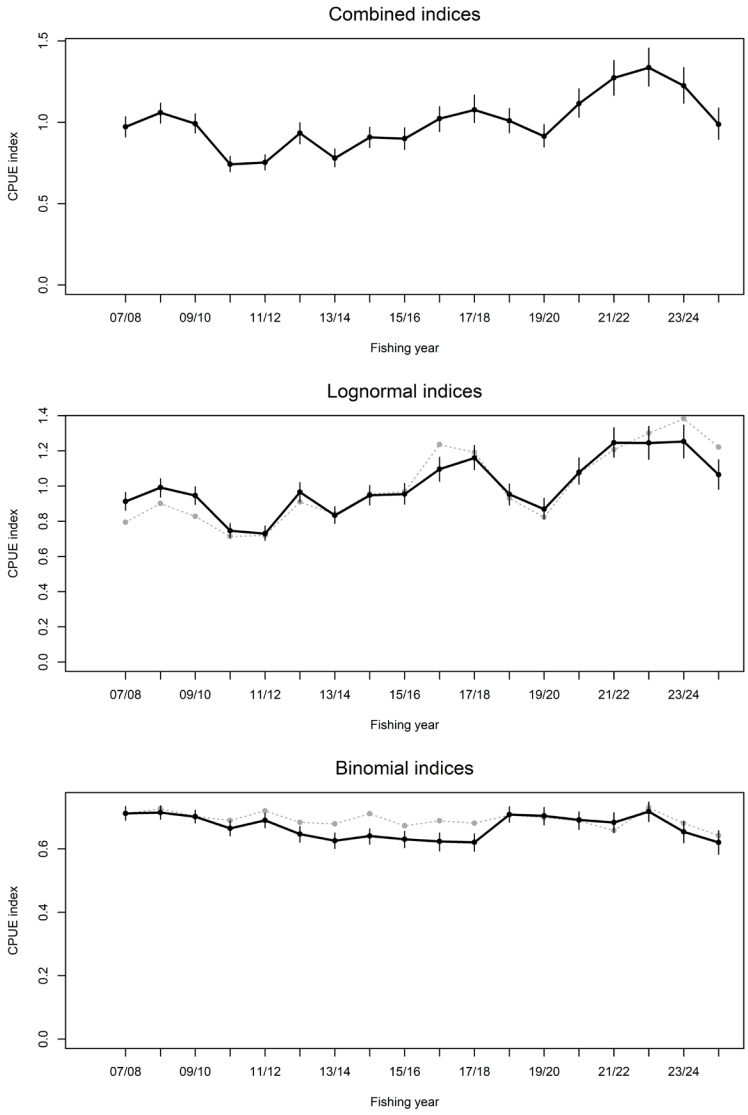


Figure 23: A comparison of: (middle panel) the TAR 2 Trawl positive index and the geometric mean of the annual catch per trawl; (bottom panel) the binomial index and the annual proportion of positive catch records in the data set; and (top panel) the combined index. The error bars represent the 95% confidence intervals associated with each index. The annual indices are provided in Table A15 (Appendix 3).

Cook Strait trawl

Initially, CPUE indices for the Cook Strait trawl fishery were derived from Daily catch and effort data available from 1989–90 to 2024–25 (Figure 24). The key variables included in the positive catch and occurrence models were *TargetSpecies* and *Vessel*.

For comparative purposes, a separate CPUE analysis was conducted using the event-based dataset from 2007–08 to 2024–25, incorporating trawl location and depth instead of the *TargetSpecies* variable Appendix 4). Since 2017–18, there was a southward shift in the operation of the fishery (see Appendix 4, Figure A25). The event-based positive catch and occurrence GLM models accounted for the change in the distribution of fishing effort with the inclusion of the *Latitude* explanatory variable

in both models. The resulting event-based CPUE indices are similar to the Daily CPUE indices for the corresponding period (Figure 24 and Figure 25). Over the last decade, both sets of indices increased considerably (approximately doubling).

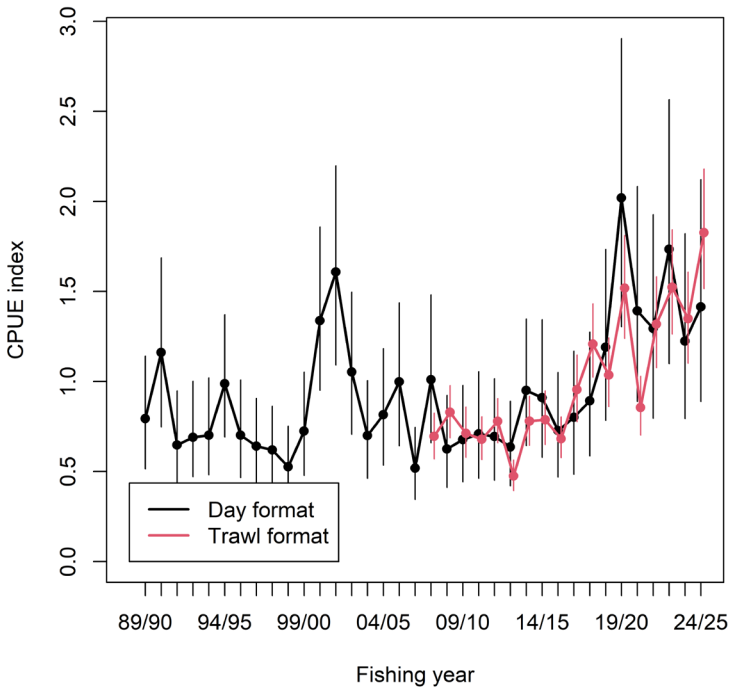


Figure 24: A comparison between the Cook Strait CPUE indices derived from Daily and Event (trawl) format catch and effort data. The error bars represent the 95% confidence intervals associated with each index.

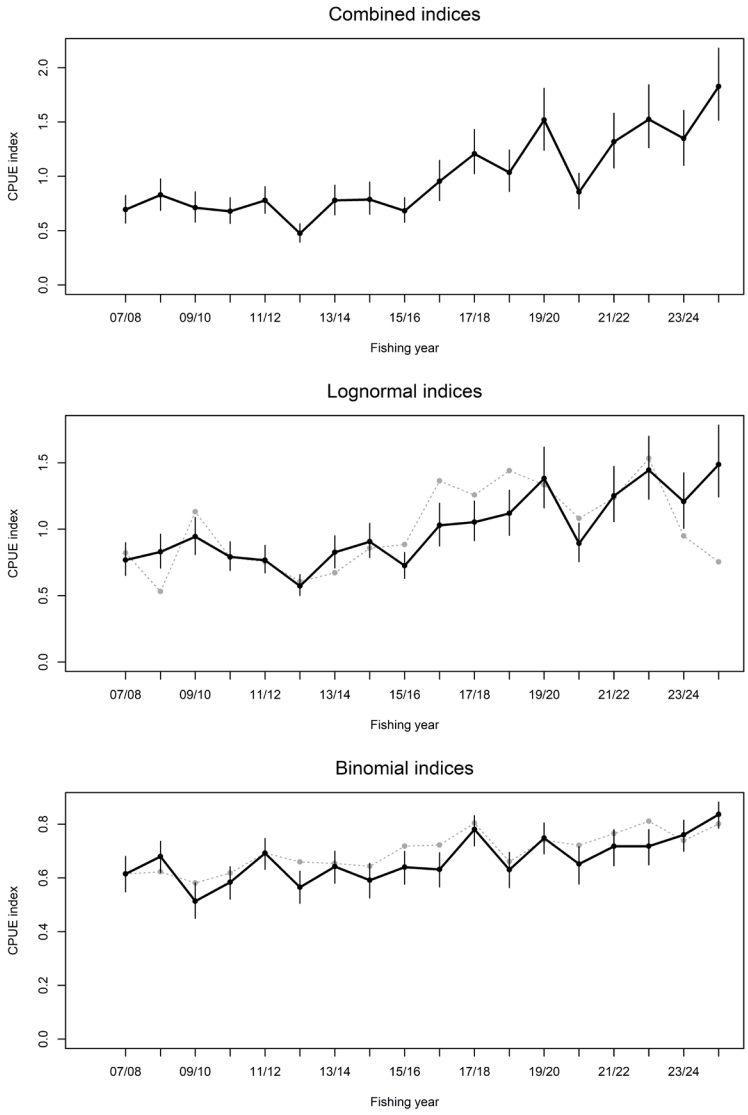


Figure 25: A comparison of: (middle panel) the Cook Strait Trawl positive index and the geometric mean of the annual catch per trawl; (bottom panel) the binomial index and the annual proportion of positive catch records in the data set; and (top panel) the combined index. The error bars represent the 95% confidence intervals associated with each index. The annual indices are provided in Table A20 (Appendix 4).

Kaikoura set net

The tarakihi target set net fishery operates seasonally (December-June) along the edge of submarine canyon features south of Kaikoura. A limited number of vessels have participated in the fishery with the fleet composed of only five vessels over the last decade (Appendix 5). The targeted nature of the fishery means that almost all fishing days reported a catch of tarakihi, hence the CPUE analysis was limited to modelling the positive catches only. The main explanatory variables included in the lognormal CPUE model were the total length of net set (*NetLength*), *Vessel* and *Month* (see Appendix 5). The most influential variable was *Vessel* as the GLM model indices accounted for the attrition of the less efficient vessels from the fleet, particularly since the late 1990s.

The resultant CPUE indices are relatively high through the 1990s, followed by a peak in the indices in 2000–01 (Figure 26). The indices declined during the 2000s and early 2010s, recovered during the late 2010s and then declined in 2022–23.

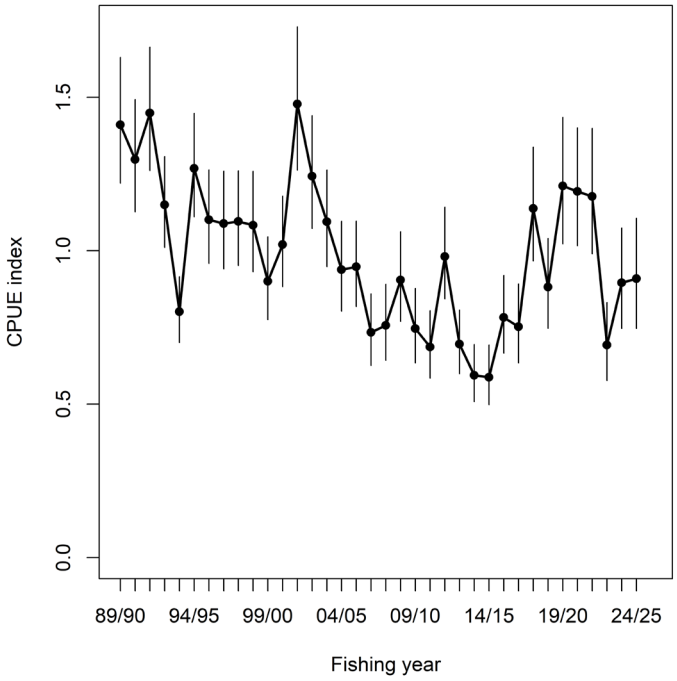


Figure 26: Annual CPUE indices for the Kaikoura Set Net fishery. The error bars represent the 95% confidence intervals associated with each index. The annual indices are provided in Table A24 (Appendix 5).

ECSI trawl

Initially, CPUE indices for the ECSI trawl fishery were derived from Daily catch and effort data available from 1989–90 to 2024–25 (Figure 27). The key variables included in the positive catch and occurrence models were *TargetSpecies* and *Vessel*. The inclusion of the *TargetSpecies* variable was highly influential in the resultant CPUE indices, accounting for the large decline in the red cod target trawl fishery since the late 1990s and, correspondingly, a proportional increase in the tarakihi target trawl fishery.

For comparative purposes, a separate CPUE analysis was conducted using the event-based dataset from 2007–08 to 2024–25, incorporating trawl location and depth instead of the *TargetSpecies* variable. A summary of the event-based dataset and key model diagnostics is presented in Appendix 6. The resulting CPUE indices are similar to the Daily CPUE indices for the corresponding period (Figure 27 and Figure 28. Both sets of indices were at a low level in 2022–23 and 2023–24.

The event-based positive catch and occurrence models account for changes in fishing depth since 2020–21 (see Appendix 6, Figure A33). There are considerable differences in the CPUE trends between the constituent Statistical Areas of the ECSI fishery (see Appendix 6, Figure A36). The recent low CPUE indices are predominantly driven by the data from Canterbury Bight (Statistical Area 022), whereas catch rates increased in Pegasus Bay (020) in recent years.

The trends in the daily ECSI CPUE indices are broadly comparable to the trends in the tarakihi biomass indices from the time-series of ECSI *Kaharoa* trawl surveys (Figure 28), despite the higher proportion of younger (1–3 y) fish comprising the trawl survey index relative to the fishery age structure. The abundance indices are highest during the late 1990s and lowest in the most recent years. The seasonal timing of the trawl surveys differed between these two periods, although the results of the stock assessment modelling indicate that the catchability (and selectivity) of tarakihi is comparable for the summer and winter trawl surveys (see Section 7).

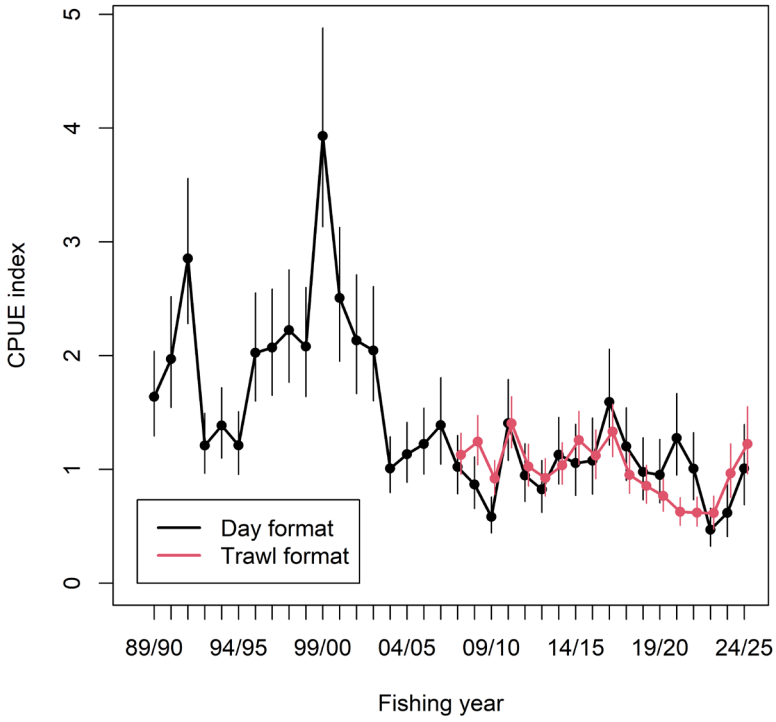


Figure 27: **A comparison between the ECSI CPUE indices derived from Daily and Event (trawl) format catch and effort data. The error bars represent the 95% confidence intervals associated with each index.**

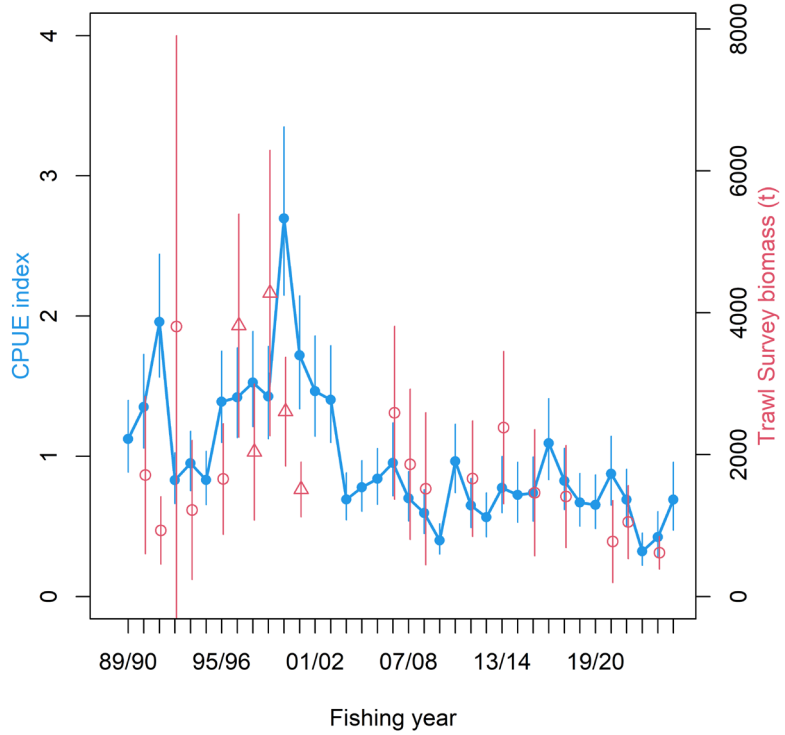


Figure 28: **Comparison between the daily ECSI Trawl CPUE indices and the ECSI *Kaharoa* trawl survey biomass indices (winter surveys, open circles; summer surveys, triangles). The error bars represent the 95% confidence intervals associated with each index.**

Comparison of CPUE indices

Trends in the longer-term series of CPUE indices from each region were compared (Figure 29). For the ECSI fishery, there was a strong peak in the CPUE indices in 1999–2000 (Figure 29). This was followed by a strong peak in the CPUE indices around 2001–02 for the BPLE, TAR2, Cook trawl fisheries. For these fisheries, the catch rates declined over the following 3–4 years (until about 2004–05). The decline in CPUE coincided with an increase in the ENLD CPUE index in 2004–05 (Figure 29) and several years of higher catch from the ENLD fishery.

More recently, Kaikoura Set Net and Cook Strait (COOK) trawl CPUE indices increased in 2018–19, although this was not preceded by an increase in CPUE from the ECSI fishery (Figure 29). There was a subsequent increase in the TAR 2 CPUE indices in 2021–22, although CPUE indices for BPLE and ENLD have remained low (Figure 29).

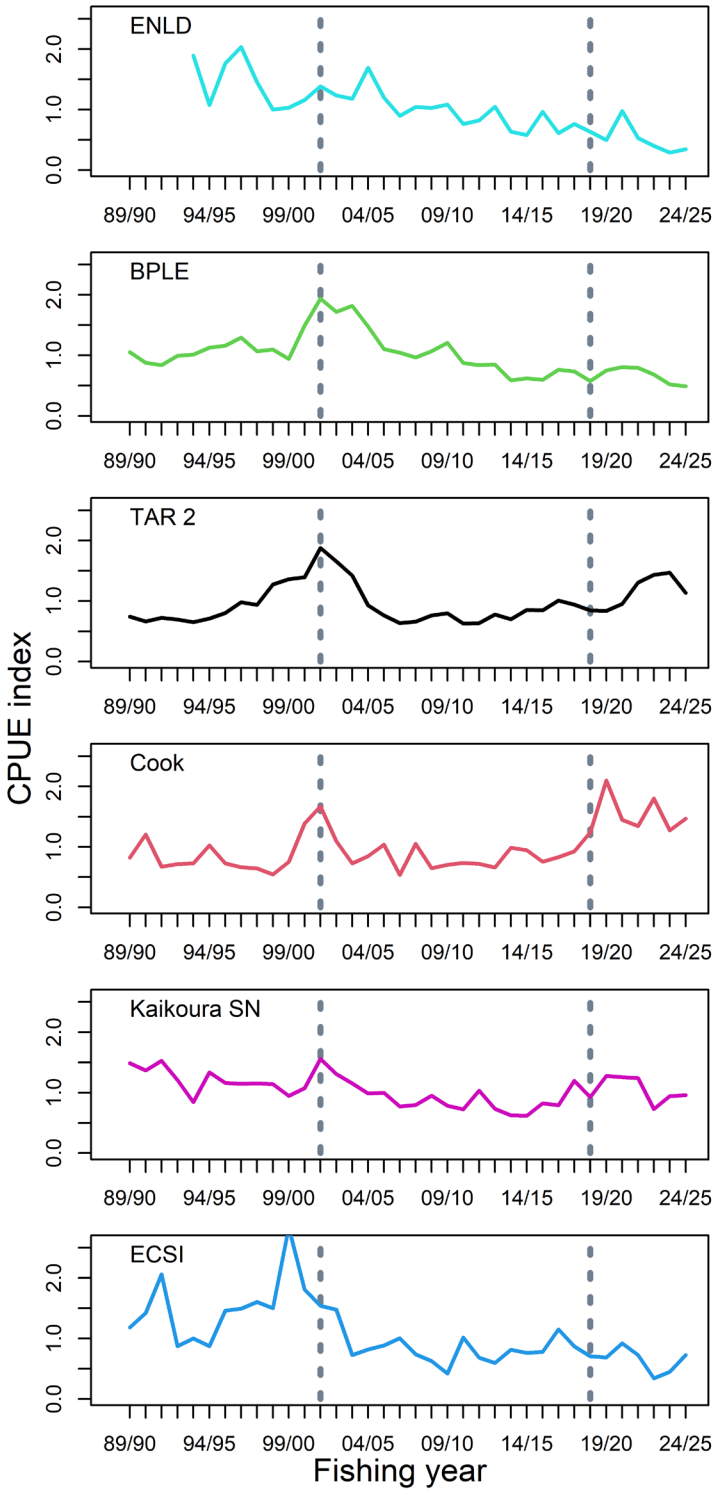


Figure 29: **A comparison of the annual indices from the long term CPUE indices from each fishery. The sets of indices are stacked from south (bottom) to north (top). The grey dashed vertical lines reference specific years referred to in the text.**

5. BIOLOGICAL PARAMETERS

5.1 Age and Growth

Previous estimates of growth for eastern tarakihi were available from tarakihi sampled from off the northeast coast of the South Island (Cape Campbell and Conway Ridge) in 1987 (Annala et al. 1990). Since then, protocols for the ageing of tarakihi otoliths have been formalised (Walsh et al. 2016). Those protocols were applied to age the otolith sets collected from the east coast South Island *Kaharoa* trawl surveys and the sampling of the tarakihi catches from the main commercial fisheries in 2018–19 & 2019–20 (sampling project TAR201801) and 2023–24 & 2024–25 (sampling project TAR202301). The samples from the *Kaharoa* trawl surveys included the youngest age classes (1–3 y), which are not observed in the commercial fisheries.

The aged data set was used to estimate growth parameters for male and female tarakihi for the overall eastern stock area (Figure 30). The composite data set provided sufficient observations from the full range of age classes.

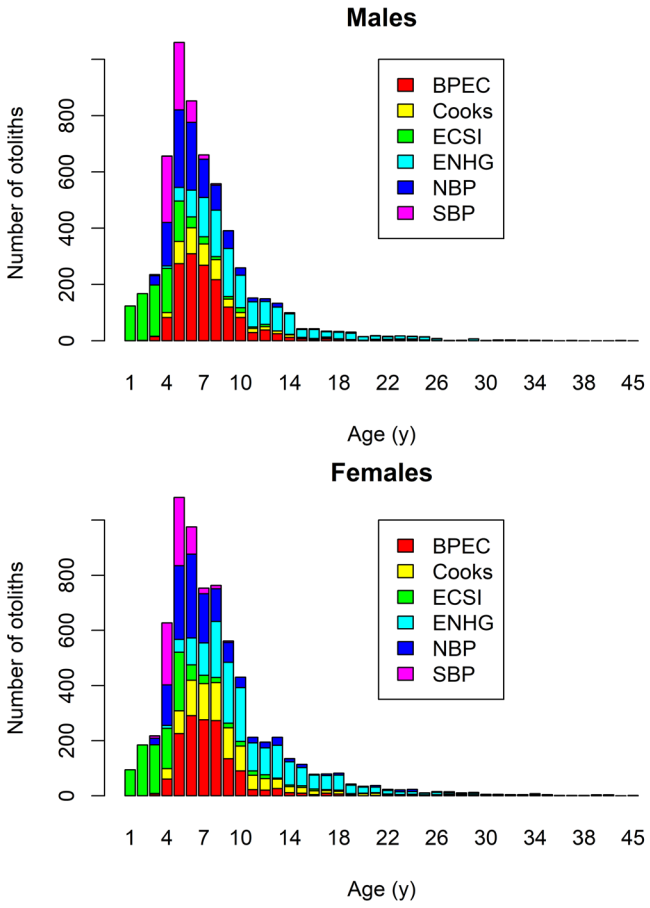


Figure 30: A summary of the aged otolith data set used in the estimation of eastern tarakihi growth parameters from by age class and area. The areas are defined by the recent catch sampling programmes: BPEC, Bay of Plenty and TAR 2; Cooks, eastern Cook Strait; ENHG, east Northland; NBP, Pegasus Bay; SBP, Canterbury Bight. ECSI represents otoliths from *Kaharoa* ECSI trawl surveys.

For each sex, growth parameters were estimated using a nonlinear least squares model (*nls* function in R). Initially, growth parameters were estimated assuming a Von Bertalanffy growth model. The individual age observations were also weighted in the fitting procedure by the inverse of the number

in the age class, effectively increasing the influence of the small number of observations from the older age classes. However, there were persistent patterns in the model residuals for both sexes; growth was under-estimated for ages older than 15 years. There was a substantial improvement in the fit to the data using a Schnute growth model (Figure 31) which allows for a more flexible structure with the inclusion of an additional shape parameter *b* (Table 6).

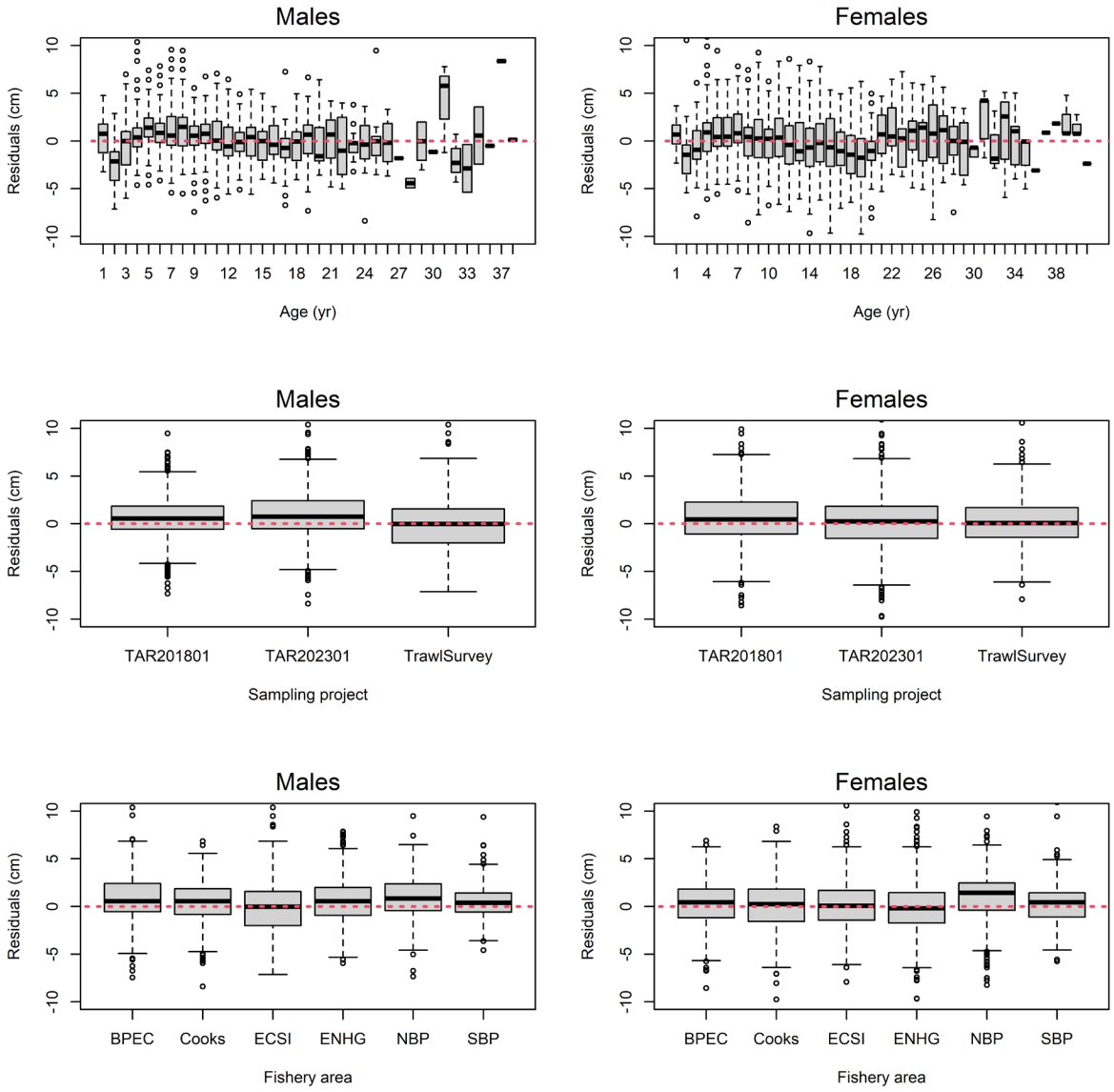


Figure 31: Boxplots of the residuals for the Schnute growth models by age (top panels), project (middle), and area (bottom) and for male (left) and female (right) tarakihi.

Table 6: Estimated Schnute growth parameters for male and female eastern tarakihi and the standard error of the estimate in brackets. *L min* and *L max* were derived for age 1 and 40 y, respectively.

Parameter	Males	Females
L min	12.23 (0.23)	12.32 (0.21)
L max	41.74 (0.08)	45.25 (0.06)
k	0.085 (0.004)	0.104 (0.003)
b	3.39 (0.09)	2.53 (0.06)

The estimated Schnute growth rates are equivalent for male and female fish up to 5 years of age. For both sexes, growth rates reduce with increasing age, with male fish attaining a smaller maximum length than female fish (Figure 32).

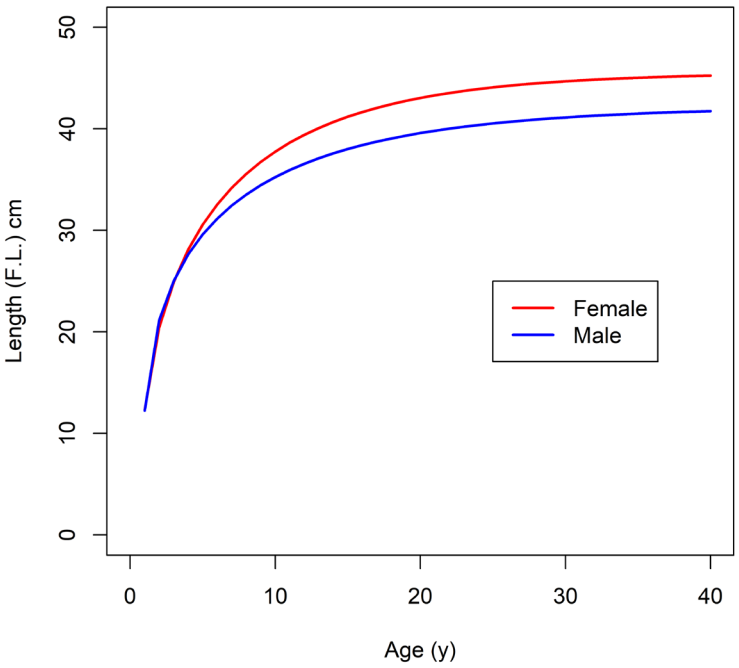


Figure 32: Estimated Schnute growth functions for male and female eastern tarakihi.

The Schnute growth functions were compared to the individual length-at-age observations from each of the sampled fisheries and *Kaharoa* ECSI trawl survey. Overall, the age data from the individual commercial fisheries are consistent with the estimated growth models, with the exception that growth is under-estimated for female fish from the Pegasus Bay (NBP) area (Figure 33). Similarly, the length of the older female fish sampled from the *Kaharoa* ECSI trawl surveys, which included the Pegasus Bay (NBP) area, are also under-estimated by the growth model (Figure 33). Nonetheless, it was considered that the Schnute growth functions provided the best available representation of growth for the overall eastern tarakihi stock.

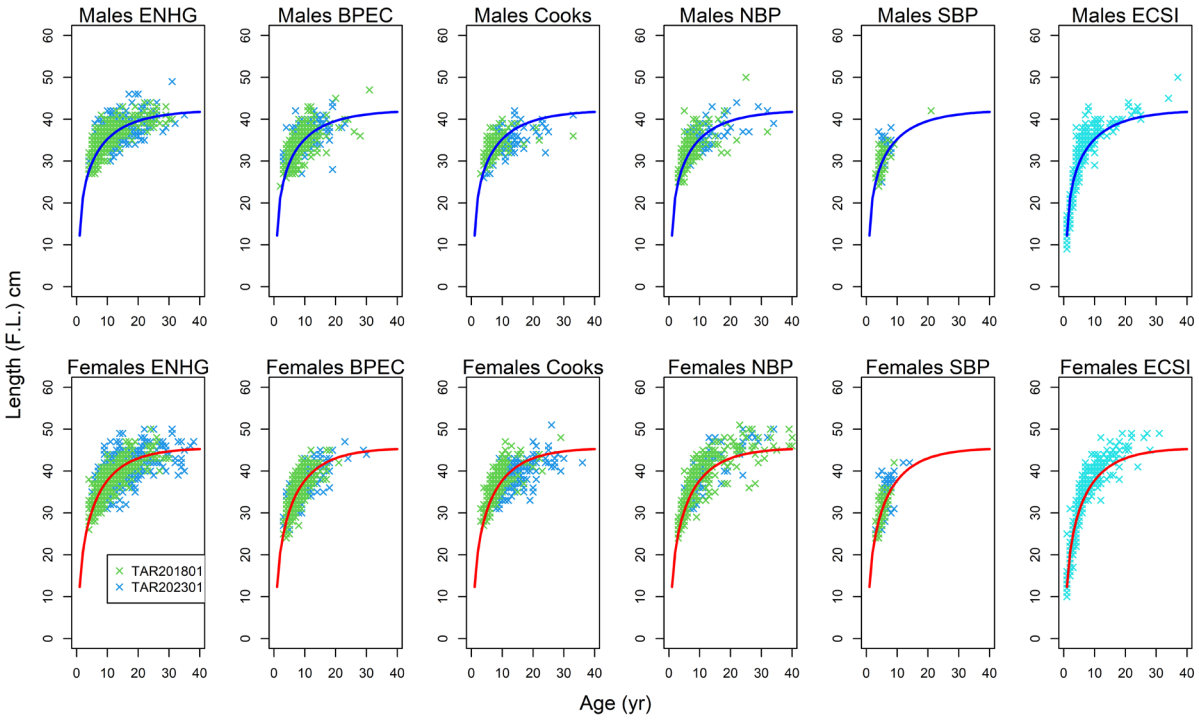


Figure 33: A comparison of the Schnute growth functions for male (top) and female (bottom) tarakihi (lines) with the length at age (points) of tarakihi sampled from the individual fishery areas and from the ECSI trawl survey. The fishery samples were collected under sampling projects TAR201801 and TAR202301.

6. DATA COMPILATION

6.1 Commercial catch history

Francis & Paul (2013) compiled reported landings of tarakihi by the domestic and foreign fleets by Fishery Management Areas (FMAs) from 1931–1982. For the domestic fleet, the FMA catches were derived based on the port of landing of the catch, whereas foreign catches were reported by management areas. Prior to 1983, catches were summarised by calendar year, while more recent catches are reported by fishing year (to 2024–25) and Quota Management Area (QMA) (Fisheries New Zealand 2025). Catches by fishing year were assigned to the calendar year at 1 January (e.g., catches from the 2024–25 fishing year were assigned to 2025).

Reported catches from each FMA/QMA were apportioned amongst the constituent fisheries based on either the Port of Landing (pre-1983) or Statistical Area (Table 7). The catches from TAR 1 and TAR 7 are partitioned between the eastern and western stocks. To ensure consistency with the western tarakihi stock assessment (Langley 2026a) an equivalent approach was applied to the allocation of catches between the relevant fisheries.

Table 7: Summary of the methodology applied to apportion the annual commercial catches between fisheries for the eastern tarakihi stock assessment. Fisheries included in the western stock assessment are italicised.

Period	FMA	QMA	Fishery1	Fishery2	Fishery3	Comment
1932–1982	1		ENLD	BPLE		Partitioned based on Region/Port of Landing
1932–1982	2		TAR 2			
1932–1982	3		TAR 3 BT	Kaikoura SN		Assumed catch split by method.
1932–1982	7		Cook	*WCSI*	*TBGB*	Partitioned based on Region/Port of Landing
1983–2025		TAR1	ENLD	BPLE	*WCNI*	Partitioned based on estimated catch distribution
1983–2025		TAR 2				
1983–2025		TAR 3	TAR 3 BT	Kaikoura SN		Partitioned based on estimated catch by method
1983–2025		TAR7	Cook	*WCSI*	*TBGB*	WC = Stat Area 032–036 TBGB = Stat Area 037, 038 Cook = Stat Area 017

Due to the assignment of catches based on port of landing, there is considerably more uncertainty associated with the fishery specific catches prior to 1983. Catches landed in Auckland were attributed to the ENLD fishery, whereas Tauranga landings were assigned to the BPLE fishery. As a result, most of the FMA 1 catch prior to 1960 was allocated to the ENLD fishery (Figure 34). A larger proportion of the FMA 1 catch was attributed to the BPLE fishery in the subsequent years.

The TAR 2 fishery developed in the late-1940s and catches reached a peak in the 1960s and early 1970s and then declined (Figure 34). Catches from the TAR 3 trawl fishery generally increased from the 1940s to the late 1970s before dropping sharply following the declaration of the Exclusive Economic Zone in 1977 resulting in the exclusion of foreign trawlers from the inshore areas (Figure 34).

An additional level of unreported catch was assumed for each fishery; unreported catches were assumed to represent 20% of the annual reported catch prior to the introduction of the QMS and 10% of the annual reported catch in the subsequent years (Figure 34). These assumptions are consistent with the approaches used in other inshore finfish stock assessments (e.g. SNA 1, SNA 8 and SNA 7).

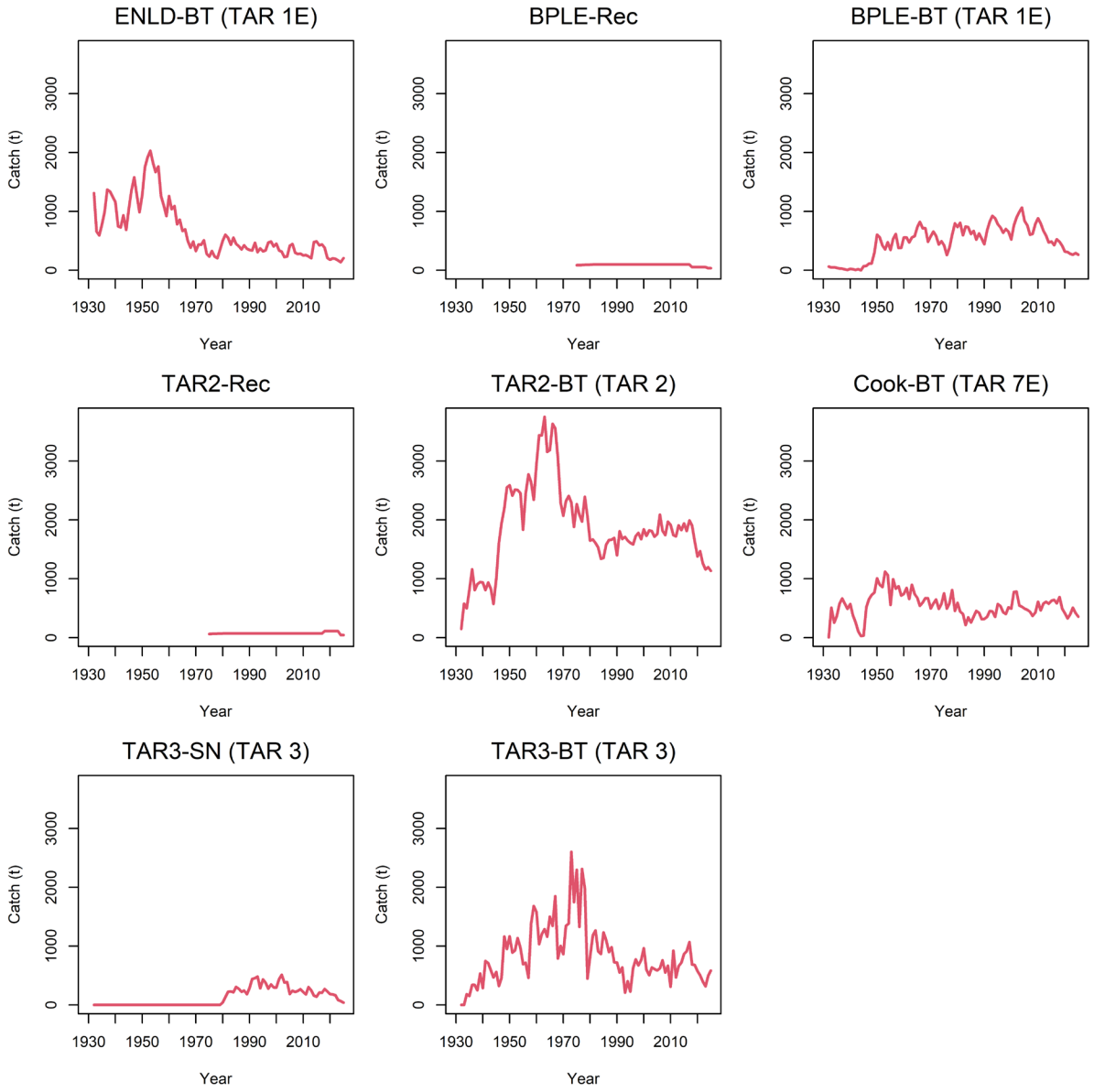


Figure 34: **Annual commercial catches by fishery compiled for the eastern tarakihi assessment model, including the additional level of unreported catch assumed in the assessment (20% pre 1986–87 and 10% for subsequent years).**

3.2 Non commercial catch

Annual recreational catches were configured based on the national panel survey (NPS) estimates (following Langley 2018). The 2012 NPS estimated recreational catches of tarakihi in the eastern area of TAR 1 (FMA 1) (97 t) and TAR 2 (71 t) (Fisheries New Zealand 2025). Annual catches for the Bay of Plenty and TAR 2 recreational fisheries were set at the 2012 NPS estimates for 1981–2017 and updated with the 2018 NPS estimates (50 t and 110 t) applied to 2018–2022 and the 2023 NPS estimates (37 t and 44 t) applied to 2023–2025 (Figure 34). There was no explicit customary catch included in the assessment.

6.2 Trawl survey indices and age compositions

Starting in 1991, a time series of inshore trawl surveys was conducted by R.V. *Kaharoa* off the east coast of the South Island (ECSI) during winter (May-June) in the 30–400 m depth range (Table 8). An additional set of five summer surveys were conducted during 1996–2000 (Table 8). The final survey by *Kaharoa* was conducted in 2024 before it was replaced by the new *Kaharoa II* (MacGibbon et al. 2024).

Table 8: Tarakihi biomass (t) indices (and CV %) for the time series of *Kaharoa* ECSI winter and summer trawl surveys.

Series	Survey	Year	Model Year	Biomass (t)	CV (%)	Reference
Winter	KAH9105	1991	1991	1 712	33	Beentjes & Wass 1994
	KAH9205	1992	1992	932	26	Beentjes 1995a
	KAH9306	1993	1993	3 805	55	Beentjes 1995b
	KAH9406	1994	1994	1 219	41	Beentjes 1998a
	KAH9606	1996	1996	1 656	24	Beentjes 1998b
	KAH0705	2007	2007	2 589	24	Beentjes & Stevenson 2008
	KAH0806	2008	2008	1 863	29	Beentjes & Stevenson 2009
	KAH0905	2009	2009	1 519	36	Beentjes et al. 2010
	KAH1207	2012	2012	1 661	25	Beentjes et al. 2013
	KAH1402	2014	2014	2 380	23	Beentjes et al. 2015
	KAH1605	2016	2016	1 444	31	Beentjes et al. 2016
	KAH1803	2018	2018	1 407	25	MacGibbon et al. 2019
	KAH2104	2021	2021	775	38	Beentjes et al. 2022
	KAH2204	2022	2022	1 049	25	Beentjes et al. 2023
	KAH2402	2024	2024	617	19	MacGibbon et al. 2024
Summer	KAH9618	1996	1997	3 818	21	Stevenson 1997
	KAH9704	1997	1998	2 036	24	Stevenson & Hurst 1998
	KAH9809	1998	1999	4 277	24	Stevenson & Beentjes 1999
	KAH9917	1999	2000	2 606	15	Stevenson & Beentjes 2001
	KAH0014	2000	2001	1 510	13	Stevenson & Beentjes 2002

Aged otolith sets were available from 10 winter trawl surveys from 2007–2024 and from the 2000 summer survey (KAH0014). For each survey, an age-length key (ALK) was derived from the set of aged otoliths. The ALKs were applied to the survey scaled length compositions to determine survey age compositions (both sexes combined).

The survey age compositions are dominated by 1–5 year old fish with a small proportion of fish older than 10 years (typically less than 7%) (Figure 35). Surveys were generally conducted biennially

enabling two observations of an individual year class; for example the 2019 year class was sampled as 3 year old fish in 2022 and 5 year old fish in 2024 (Figure 35).

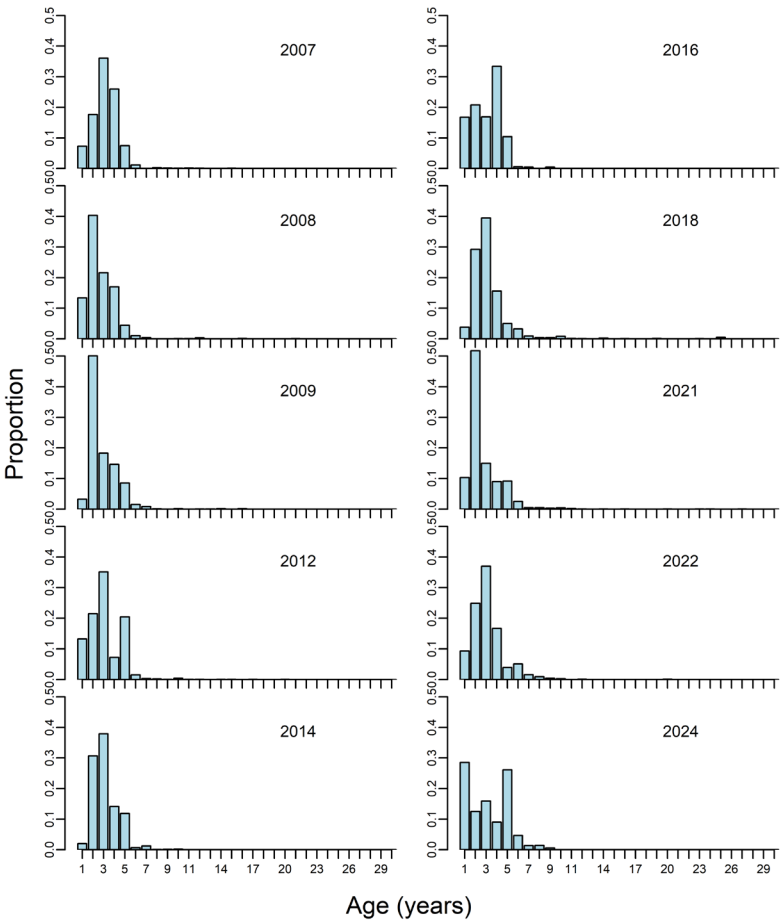


Figure 35: Age compositions from the ECSI trawl surveys for both sexes combined. The 30 y age class is an accumulation of fish 30 y and older ("plus group").

The survey age composition data were used to derive a series of 2 year old (2 Y) indices to more directly inform the model regarding year class strength (Table 9). Estimates of abundance of 1 year old fish have lower precision and the survey availability of 1 year old fish is considerably lower than for two year olds. The most recent 2 Y index (2024) is the lowest of the series, while the last 5 indices are below the average of the series (Figure 36).

The total biomass indices declined over the last decade with the 2024 index the lowest of the entire time-series (Figure 36).

Table 9: Indices of 2 year old tarakihi abundance and associated coefficient of variation (CV).

Survey	Year	Model Year	Year class	Index	CV (%)
KAH0705	2007	2007	2005	213	24
KAH0806	2008	2008	2006	434	29
KAH0905	2009	2009	2007	408	36
KAH1207	2012	2012	2010	163	25
KAH1402	2014	2014	2012	336	23
KAH1605	2016	2016	2014	139	31
KAH1803	2018	2018	2016	182	25
KAH2104	2021	2021	2019	221	38
KAH2204	2022	2022	2020	120	30
KAH2402	2024	2024	2022	33	30

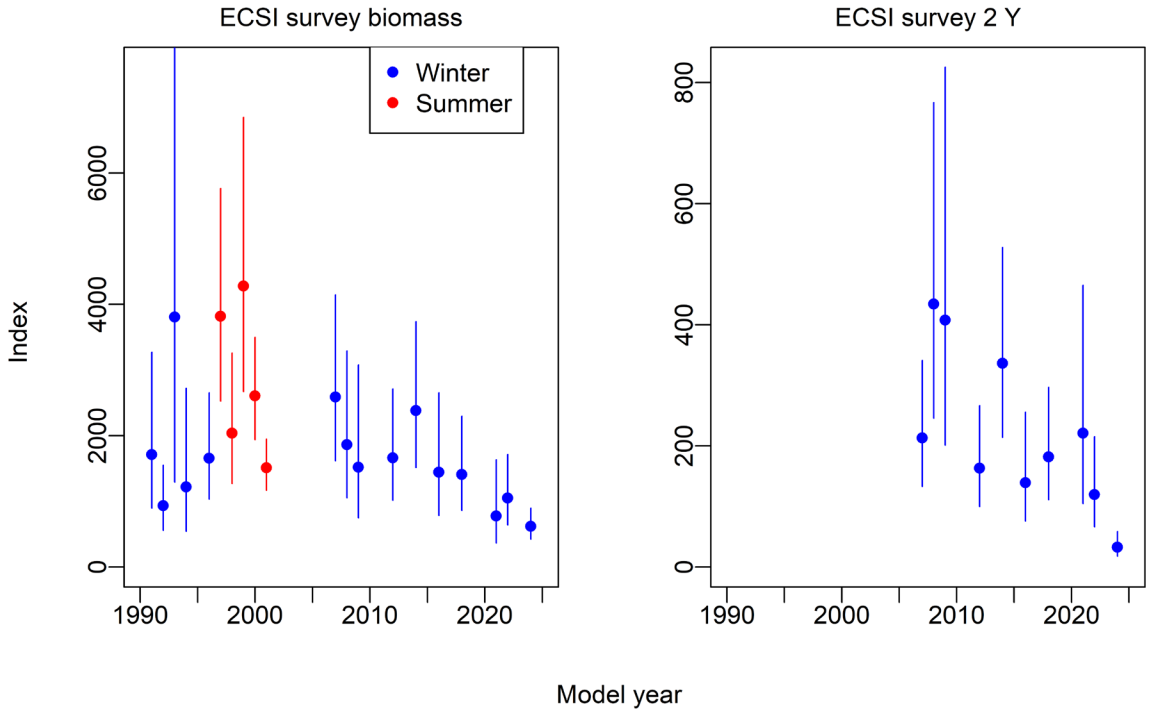


Figure 36: Tarakihi biomass (t) indices (and 95% confidence intervals) for the winter and summer time series of *Kaharoa* ECSI surveys (left panel) and age 2 year abundance indices (right panel) (and associated 95% confidence intervals).

There was a short series of inshore trawl surveys conducted off the east coast of the North Island (FMA 2) by *Kaharoa* in the mid-1990s. The three surveys provided three comparable biomass indices for tarakihi (Table 10). Scaled length compositions are available for each survey. However, no age composition data are available from the surveys. Consequently, the survey data provide very limited information regarding relative abundance or population structure.

Table 10: Tarakihi biomass (t) indices (and CV %) for the time series of *Kaharoa* ECNI trawl surveys.

Survey	Year	Model Year	Biomass (t)	CV (%)	Reference
KAH9402	1994	1994	1 128	20	Stevenson & Kirk 1996
KAH9502	1995	1995	791	23	Stevenson 1996a
KAH9602	1996	1996	943	15	Stevenson 1996b

6.3 Commercial fisheries age compositions

Since 2013–14, a series of comprehensive sampling programmes have derived age compositions from the main eastern fisheries on a regular basis (two successive years in a five year period) with the most recent sampling conducted in 2024–25 (Table 11). A limited number of additional age compositions are available for a number of the fisheries from 2007–08 to 2010–11.

Table 11: A summary of the age compositions available from the eastern tarakihi commercial fisheries.

Fishery	Model year	Source
ENLD	2014, 2015	McKenzie et al. 2017
	2019, 2020	McKenzie et al. 2021
	2024, 2025	McKenzie et al. 2026
BPLE	2008	Armiger el al. 2010
	2011	McKenzie et al. 2015
	2014, 2015	McKenzie et al. 2017
	2019, 2020	McKenzie et al. 2021
TAR 2	2010	Parker & Fu 2011
	2011	Beentjes et al. 2012
	2014, 2015	McKenzie et al. 2017
	2019, 2020	McKenzie et al. 2021
	2024, 2025	McKenzie et al. 2026
Cook	2014	McKenzie et al. 2017
	2019, 2020	McKenzie et al. 2021
	2024, 2025	McKenzie et al. 2026
Kaikoura Set Net	2010	Beentjes 2011
	2011	Beentjes et al. 2012
	2019, 2020	McKenzie et al. 2021
ECSI	2010	Beentjes 2011
	2011	Beentjes et al. 2012
	2014, 2015	McKenzie et al. 2017
	2019, 2020	McKenzie et al. 2021
	2024, 2025	McKenzie et al. 2026

Data were compiled as proportional age compositions with a "plus group" for fish aged 30 years and older (Appendix 4). Previous eastern tarakihi stock assessments were not partitioned by sex and, hence, the age compositions were derived for both sexes combined.

The age composition data sets from the commercial fisheries were compared with the age composition data from the ECSI *Kaharoa* trawl surveys (Figure 37). For this purpose, the annual age compositions were summarised by aggregating the data for fish aged 15 years and older.

The relative strength of individual year classes is broadly comparable amongst the sets of survey and fishery age compositions (Figure 37). For example, the strong 2015 year class observed in the ECSI trawl survey as 3 year old fish in 2018 was also evident in the ECSI trawl fishery age compositions in 2018–19 and 2019–20, but represented a small proportion of the age composition in 2023–24 and 2024–25.

The 2015 year class was also dominant in the Cook and TAR 2 fisheries in 2019–20 and persisted in the fishery, albeit in lower proportions, in 2023–24 and 2024–25 (Figure 37). The recruitment of the 2015 year class into the BPLE and ENLD fisheries lagged the Cook and TAR 2 fisheries. Although poorly represented in 2018–19 and 2019–20 this year class dominated the age composition from the ENLD fishery in 2023–24 and 2024–25 - there were insufficient samples to derive age compositions for the BPLE fishery (Figure 37).

This northward progression of this year class is also evident for the range of year classes repeatedly sampled from 2013–14 to 2024–25. These observations represent one of the most compelling sets of data supporting the eastern tarakihi stock hypothesis.

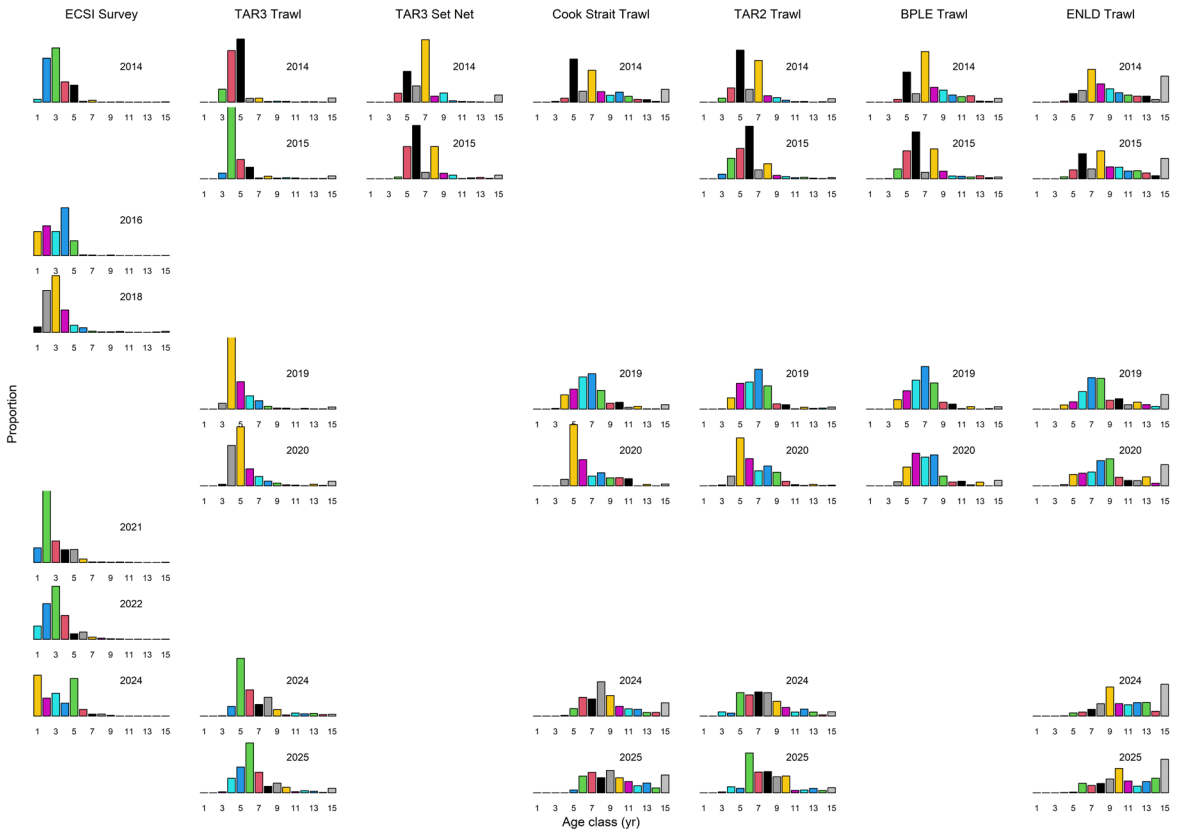


Figure 37: **A comparison of the recent age compositions from the commercial fisheries (TAR3 ECSI trawl, TAR 3 Kaikoura Set Net, Cook Strait trawl, TAR 2 trawl, BPLE trawl and ENLD trawl) and the ECSI trawl surveys. For presentation purposes, both sexes are combined and fish aged 15 years and older are aggregated in a "plus group". Individual year classes were assigned a specific colour while the "plus group" is coloured grey. Age compositions from the years before 2014 are not shown. The years represents the model years (e.g. the 2024–25 fishing year is assigned to the 2025 model year).**

7. STOCK ASSESSMENT

The assessment is based on the assumption of a single eastern stock of tarakihi encompassing the east coast of the South Island (TAR 3), eastern Cook Strait (eastern portion of TAR 7), central east coast of the North Island (TAR 2) and northern east coast of the North Island (eastern portion of TAR 1) (Figure 38).

The assessment was conducted using an integrated age structured population model implemented in Stock Synthesis (version V3.30.23.1), a flexible platform for implementing statistical, age structured population models (Methot & Wetzell 2013, Methot et al. 2020). The assessment model(s) incorporated the available catch, CPUE indices, trawl survey biomass estimates and age frequency distributions, and commercial age composition data.

7.1 Model structure

The model was based on the previous eastern tarakihi stock assessment (Langley 2022), although there were a number of refinements in the configuration of the data sets and model structure (See Section 7.7).

The spatial domain of eastern tarakihi stock was partitioned into three regions approximating the boundaries of the constituent QMAs (Figure 38). The configuration represents the relatively complex spatial structure for the eastern tarakihi population: juvenile tarakihi reside predominantly in the Canterbury Bight/Pegasus Bay area and, coinciding with the onset of sexual maturity, a proportion of the population migrates along the east coast, extending progressively northwards with increased age and terminating in the East Northland area.

The model options assigned the input data to the three model regions: Region 3, east coast South Island (TAR 3); Region 2, eastern Cook Strait (TAR 7E) and central east coast North Island (TAR2); and Region 1, the Bay of Plenty and East Northland (TAR 1E). The east coast South Island region included the Canterbury Bight/Pegasus Bay trawl fishery (ECSI). The central region included the Kaikōura set net fishery (Kaikoura-SN), eastern Cook Strait trawl fishery (Cook) and the TAR 2 trawl fishery, while the northern region included the Bay of Plenty (BPLE) and East Northland (ENLD) trawl fisheries (Figure 38 and Table 12). Small non-commercial fisheries were included in the central and northern regions.

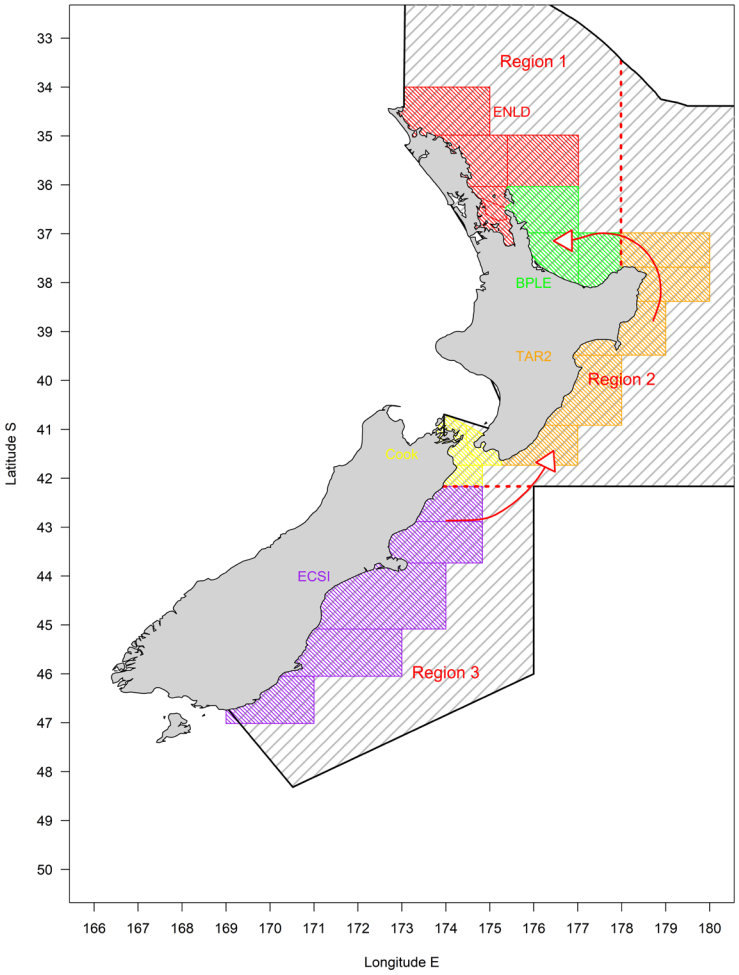


Figure 38: Spatial structure of the eastern tarakihi stock assessment model and constituent fisheries. The arrows represent the northward movements of fish between regions.

The compilation of the catch history for each fishery is described in Section (6.1). The commercial catches included an additional allowance for unreported catch: an additional 20% per annum for the years prior to the introduction of the QMS (in 1986–87) and 10% per annum in the subsequent years.

The 2026 assessment refined the fishery configuration from the 2022 assessment, in particular the BPLE fishery was defined separately from TAR 2 and reassigned to Region 1 based on similarities in

the CPUE indices from the BPLE and ENLD fisheries, while the Kaikoura set net and Cook trawl fisheries were assigned to Region 2 (Table 12).

The ECSI trawl CPUE indices were not included in the assessment model. The indices are considered less reliable than the other indices due to the large influence of change in the operation of the trawl fishery (related to the decline in the red cod fishery) and the recent differences in the indices between constituent statistical areas. The ECSI trawl survey provided the primary series of abundance indices for Region 3.

Table 12: Commercial fisheries included in the eastern stock assessment model and associated CPUE indices.

Commercial fishery	Model region	CPUE indices	Selectivity
ENLD	Region 1	*ENLD_Trawl*	Logistic
BPLE	Region 1	*BPLE_Trawl*	Double normal
TAR2	Region 2	*TAR2_Day* 1990–2007 *TAR2_Event* 2008–2025	Logistic
Cook	Region 2	*Cook_Day* 1990–2007 *Cook_Event* 2008–2025	Double normal
Kaikoura SN	Region 2	*Kaikoura_SN*	Double normal
ECSI	Region 3	-	Logistic

The model was configured to approximate the stock hypothesis; i.e., each region included a discrete population with recruitment in the southern (ECSI) region only and age-specific movement of fish northwards between adjacent regions. Within each region, the oldest age classes in the population were assumed to be fully vulnerable to the key fisheries (ECSI, TAR 2, and ENLD), whereas other fisheries and surveys were parameterised using a double normal function. Fishery catches were taken from the population in each respective region and the abundance indices (CPUE and/or trawl survey) were taken to represent trends in relative abundance in that region.

Previous assessments had initialised the model in 1975 under exploited conditions, removing the influence of the catch from the earlier period. Initial fishing mortality rates were estimated for the established fisheries in each area. However, there are no early age composition data to directly inform the initial fishing mortality rates. The resulting model yielded a stock trajectory and estimates of stock status that were very similar to comparable models with the entire catch history indicating that the overall estimate of stock size (SB_0) was informed based on the average recruitment level from the more recent, data rich period of the model (Langley 2022). This result also held in the current assessment, with the advantage that the model based on the entire catch history reduced the uncertainty associated with the estimation of initial conditions in 1975. On that basis, the entire catch history model (from 1932) was adopted for the current assessment.

The model population was initialized in 1932 in an equilibrium, unexploited state. The population structure was partitioned by sex and included 40 age classes, and the oldest age class represented an aggregated ‘plus’ group (40 years and older). The model data period extended to the 2025 year (2024–25 fishing year).

The key biological parameters are presented in Table 13. For both sexes, natural mortality (M) was specified as a constant value of 0.10 (Fisheries New Zealand 2025). The estimate of M is based on an analysis of the age structure of a lightly exploited tarakihi population sampled off the west coast of the South Island in 1971 and 1972 (Vooren 1977).

The derivation of the growth parameters from the WCSI trawl survey age data is described in Section 5.1. (Table 13). The maturity ogive was equivalent to the 2022 assessment with 50% maturity at age 5 years and full maturity at age 6 years. The ogive is similar to the maturity of western tarakihi (Langley 2026a), although full maturity is at a younger age (6 years compared to 8 years).

Table 13: Biological parameters for the base assessment model.

Parameter	Value
Natural mortality	0.10 y^{-1}
Growth parameters	Males *L1* 12.23 cm, *L40* 41.74 cm, *k* 0.085, *b* 3.39
(Schnute)	Females *L1* 12.32 cm, *L40* 45.25 cm, *k* 0.104, *b* 2.53
Length-wt	*a* 4.0e-05, *b* 2.79
Proportion mature	Age based
	Ages 1–3, 0; Age 4, 0.25; Age 5, 0.5; Ages 6+, 1.0
SRR steepness	*h* 0.8
SigmaR	σR 0.6

The annual time step was divided into two periods (October-March and April-September), partitioning the commercial catch and the main spawning period (season 2). Spawning is assumed to occur instantaneously at the start of the second period. A Beverton-Holt spawning stock recruitment relationship (SRR) was assumed with a fixed value of steepness (*h*) of 0.8. The main recruitment deviates (1980–2023) from the SRR were estimated assuming a standard deviation of the natural logarithm of recruitment (σR) of 0.6. There was no averaging constraint applied to the recruitment deviates (i.e. estimated as simple independent deviates).

CPUE indices derived from trawl event-based data were prioritised in the model. Thus, separate sets of CPUE indices were incorporated for the Cook, TAR 2 fisheries based on either the truncated daily (1990–2007) or event (2008–2025) based data (Table 12 and Table 14). The corresponding sets of indices shared the equivalent selectivity function while estimating separate catchability coefficients. The daily CPUE indices had an associated coefficient of variation (CV) of 20%, while the event based CPUE indices used the native CV and included an additional process error of 10%.

For the southern region (Region 3), three sets of *Kaharoa* trawl survey indices were included in the assessment model: ECSI winter total biomass, ECSI summer total biomass, ECSI 2 year indices (Table 14). Separate double normal selectivity functions were estimated for the ECSI winter and summer surveys. The age 2 year survey indices were incorporated in the model with age-specific selectivity (full selectivity for 2 year old fish only) and an estimated catchability coefficient.

Table 14: Summary of abundance indices included in the Base Case assessment model with the associated coefficient of variation (CV) and additional process error associated with each data set.

Survey/Fishery	Model years	CV
ENLD CPUE indices	1994–2025 (n=32)	0.30
BPLE CPUE indices	1994–2025 (n=32)	0.27–0.34
TAR2 CPUE indices	1990–2007 (n=18)	0.20
	2008–2025 (n=18)	0.14–0.15
Cook CPUE indices	1990–2007 (n=18)	0.20
	2008–2025 (n=18)	0.19–0.21
Kaikoura SN CPUE indices	1990–2025 (n=36)	0.20
ECSI trawl survey Winter	1991–2021, 2022, 2024 (n=15)	0.19–0.55
ECSI trawl survey Summer	1997–2001 (n=5)	0.13–0.24
ECSI trawl survey 2 year	2007–2021, 2022, 2024 (n=10)	0.23–0.38

Age composition data from previous assessments were available for both sexes combined, rather than partitioned by sex. The age specific selectivity functions were informed by the fishery and survey age compositions. Initially, the individual age compositions were all assigned an Effective Sample Size (ESS) of 20. The final ESS assigned to each fishery/survey was derived via reweighting of the data based on Method TA1.8 of Francis (2011) (Table 15).

Table 15: Summary of age composition data included in the Base Case assessment model with the associated Effective Sample Size (ESS) for the individual data sets.

Survey/Fishery	Model years	ESS
ENLD fishery	2014, 2015, 2019, 2020, 2024, 2025	15
BPLE fishery	2008, 2011, 2014, 2015, 2019, 2020	20
TAR2 fishery	2010, 2011, 2014, 2015, 2019, 2020, 2024, 2025	30
Cook fishery	2014, 2019, 2020, 2024, 2025	5
Kaikoura SN fishery	2010, 2011, 2014, 2015	10
ECSI fishery	2010, 2011, 2014, 2015, 2019, 2020, 2024, 2025	30
ECSI Winter survey	2007, 2008, 2009, 2012, 2014, 2016, 2018, 2021, 2022, 2024	20
ECSI Summer survey	2001	20

The movement rates of tarakihi from the southern region to the central region were assumed to be constant over time, whereas recent movement rates between the central region and the northern region were allowed to vary annually (during 2010–2024, 15 deviance parameters) to enable the model to fit to different trends in the recent CPUE indices from the two regions.

There are limited observations available to strongly inform the movement parameters of the spatial model. The base movement parameters are informed by the fishery specific age compositions that are available since 2010 and regional trends in the CPUE indices. Hence, the base movement parameters are correlated with the fishery selectivity parameters and, to improved model stability during the MCMC phase, priors were assigned to the movement parameters and key selectivity parameters. The base movement parameters strongly influence the regional distribution of biomass during the earlier period of the model; the assessment model estimated most of the spawning biomass to be within the northern region prior to 1980. Model trials evaluating lower rates of movement from the central region to the northern region retained a larger proportion of biomass within the central region but did not appreciably change the overall biomass trajectory or estimate of current stock status, although the fits to the recent age composition data deteriorated considerably.

For the base assessment model, the likelihood objective function included the following components:

i. The fit to the abundance indices (CPUE indices and trawl survey biomass indices) assuming a lognormal error structure.
ii. The fit to the ECSI trawl survey 2 y abundance indices (lognormal error structure).
iii. The fit to the trawl survey and fishery age composition data assuming a multinomial error structure.
iv. Recruitment deviations. The formulation of the likelihood constrains recruitment deviations relative to the (assumed) standard deviation (*sigmaR*).
v. Parameter priors. Deviation of estimated parameter(s) from assumed prior distribution(s).

The formulation of the individual likelihood components is documented by Methot & Wetzell (2013). The estimation procedure minimises the negative log-likelihood of the objective function. Model uncertainty was determined using MCMCs implemented using the Metropolis-Hastings algorithm. For each model option, 1000 MCMC samples were drawn at 1000 intervals from a chain of 1.1 million following an initial burn-in of 100 000. The performance of the MCMC sample was evaluated using a range of diagnostics.

7.2 Parameter estimates

The selectivity of the main commercial fishery in each region (ENLD, TAR 2 and ECSI) was assumed to be logistic. The estimated selectivity functions are similar for the ENLD and TAR 2 fisheries, with 50% selectivity at about 5 years (Figure 39). The selectivity of the ECSI fishery is shifted towards younger fish, with knife edge selectivity at age 4 y (approximately the MLS of 25 cm). The trawl surveys within the ECSI area (winter and summer) have a high selectivity for the

2–5 y age classes, while the relative selectivity of older fish is low (Figure 39). The survey selectivity for 1 year old fish is relatively low, indicating a lower availability to the survey.

Within the northern region (Region 1), the selectivity of the BPLE fishery is shifted towards younger (5–9 year old) fish relative to the ENLD fishery, reflecting the lower proportion of older fish in the BPLE age compositions. Similarly, within Region 2 the Kaikoura SN fishery has a lower selectivity for fish older than 8 years compared to the TAR 2 fishery, while the selectivity of the Cook fishery approximates the TAR 2 fishery (Figure 39).

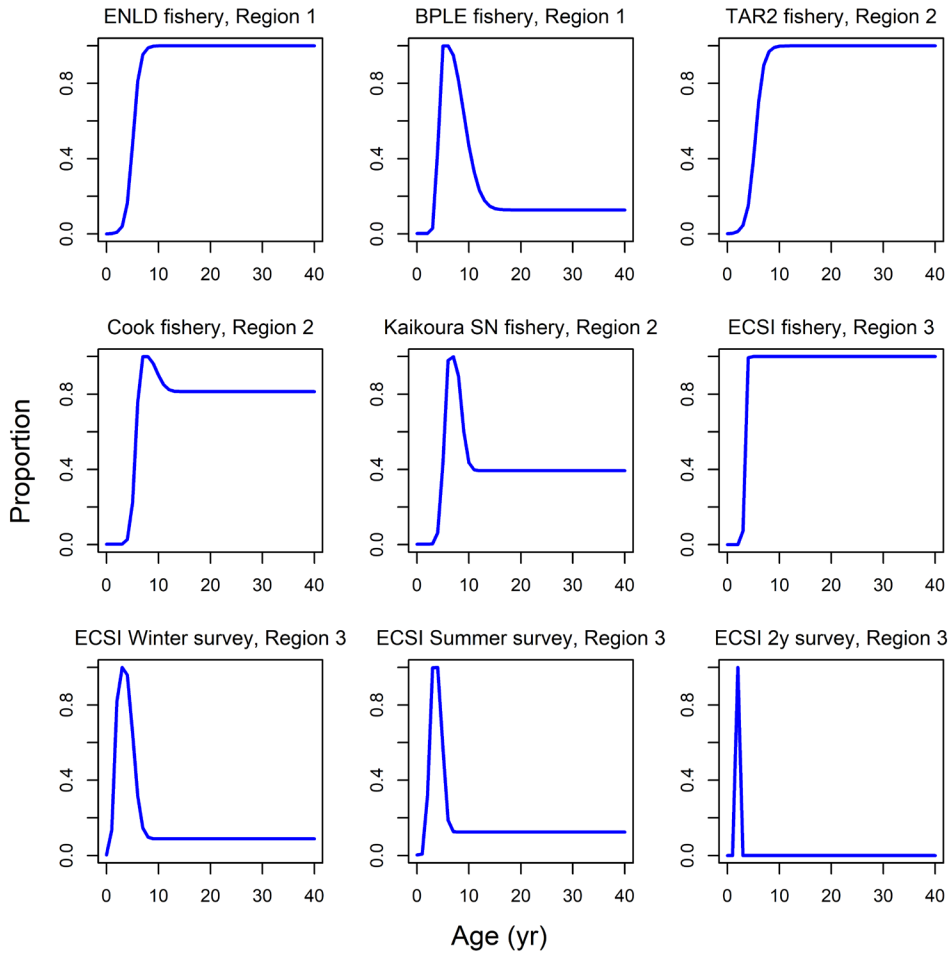


Figure 39: Age specific selectivity functions for commercial fisheries and trawl surveys (both sexes).

Relatively high movement rates of young fish (from 2 y) are estimated from the southern region (Region 3) to the central region (Region 2) (Figure 40). These high movement rates ensure that sufficient fish are available to the fisheries within the central region. The movement rate decreases with increasing age, although northward movements continue for the older ages (12 years and older) (Figure 40).

Movement rates from the central region (Region 2) to the northern region (Region 1) are relatively low for the youngest age classes, but increase to a relatively high level for older fish (Figure 40). This reflects the relatively small proportion of old fish observed in the catches from the TAR 2 fishery (Region 2) and the predominance of older fish in the ENLD fishery (Region 1). However, over the last decade the abundance indices for tarakihi in Region 1 declined considerably, while there was a general increase in the abundance indices for Region 2. To account for the divergent trends in abundance, annual deviates were estimated for the movement parameter that determines the youngest

(2 y) transittion point of the age specific function. The estimated deviates increase the movement rates for the first two years (2010 and 2011) followed by declining movement rates over the subsequent years (2012–2024) (Figure 41).

As noted, the estimated movement rates from Region 2 to Region 1 are strongly informed by the age composition data from the TAR 2 fishery. Alternative movement rates were evaluated during model testing. Constraining movement rates to be lower from Region 2 to Region 1, resulted in a higher biomass retained within Region 2, but resulted in a considerable deterioration in the fits to the TAR 2 age composition data. The scenarios with lower movement rates tended to estimate slightly higher levels of current (2025) biomass.

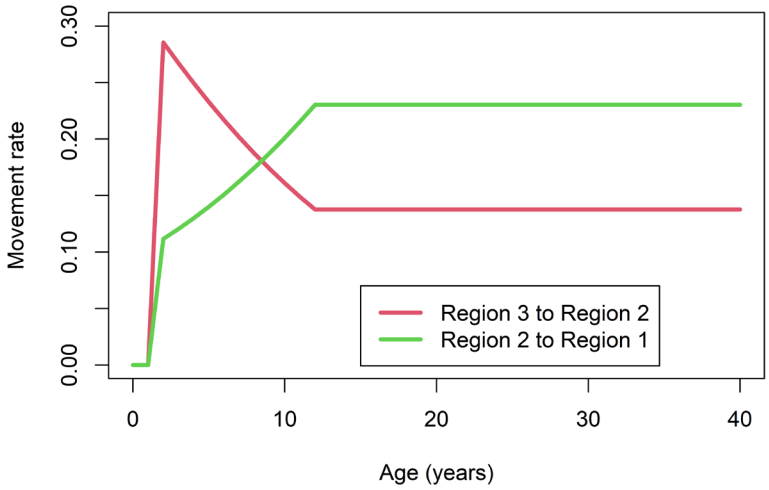


Figure 40: Age specific movement rates (per annum) between regions estimated for the base model.

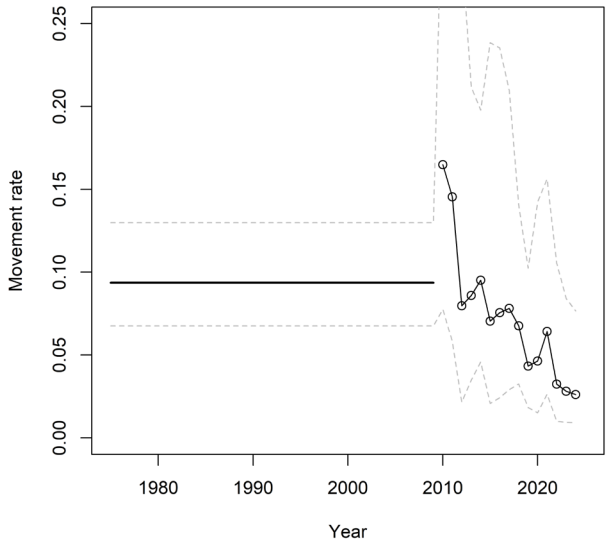


Figure 41: The estimated proportion of two year old fish moving from Region 2 to Region 1. The annual movement rate was assumed to be constant prior to 2010 (1932–2009). Annual movement rates were estimated for 2010–2024. The dashed lines represent the 95% confidence interval.

The recent declining trends in estimates of annual movements to the northern area suggest that the base movement parameters are not consistent with current dynamics; i.e., the levels of catch from the northern region are not sufficient to have caused the magnitude of stock decline over the last 15 years and, hence, the model is estimating a decline in the immigration of fish to the region.

To contrast the movement dynamics of the base assessment model, a separate three region spatially discrete model was configured (*ThreeRegionNoMove*). The model estimated an overall proportion of the total recruitment that was distributed amongst the three regions and then estimated regional variation in the proportion of the recruitment assigned to each region during the main data period (1980–2023). There was no movement between the model regions. The model estimated a substantial proportion of recruitment to the central region and a corresponding large proportion of the historical biomass was within the central region. The trends in relative annual recruitments were similar between the three regions. The model provided a fit to the main data sets that was comparable to the base model but included a higher number of parameters (associated with the annual variation in regional recruitments).

For the base model, a likelihood profile was estimated for the overall population scale parameter (R_0) (Figure 42). The lower bound of the estimate of R_0 is primarily determined by the cumulative catch and a number of key data sets, specifically age composition data from the ECSI, TAR 2, BPLE fisheries and associated CPUE indices as well as the variation in recruitment deviates (informed by the *sigmaR* parameter). The upper bound of the estimate of R_0 is largely informed by the ENLD fishery age compositions data. These data indicate that there is a low probability of a substantially higher overall biomass, given the associated model assumptions (particularly M and the logistic fishery selectivity function) (Figure 42).

The upper bound is also constrained by the relatively uninformed priors associated with the movement and selectivity parameters (Figure 43 and Figure 44). The priors were included to stabilise the model estimation of these two sets of correlated parameters between model regions, although the inclusion of the priors did not entirely smooth the individual components of the likelihood (Figure 42). Excluding these priors from the model did not appreciably influence the estimate of R_0, current stock status or the associated uncertainty.

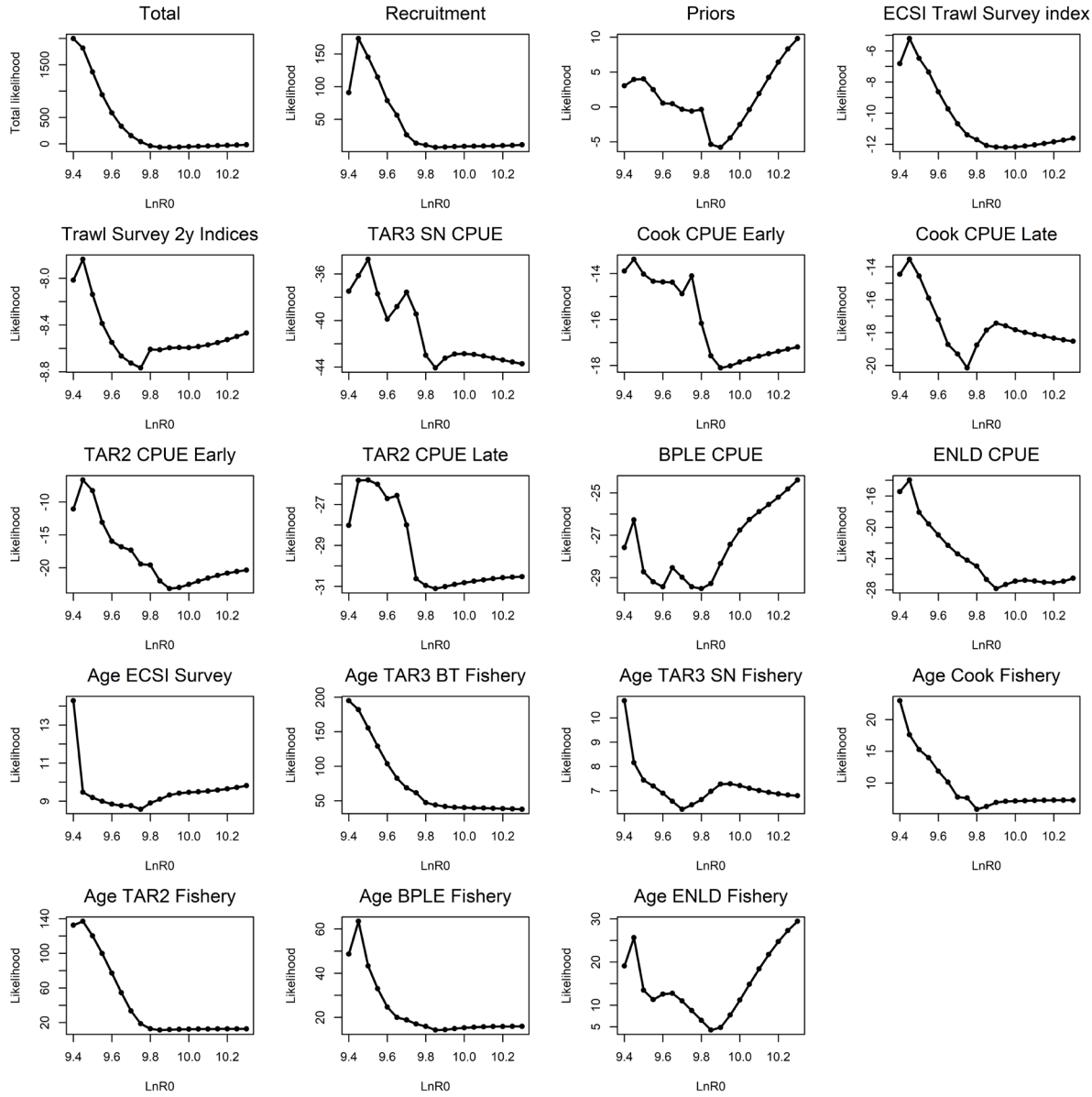


Figure 42: Likelihood profiles for the recruitment parameter *R0* for all likelihood components combined (total) and the individual components of the likelihood.

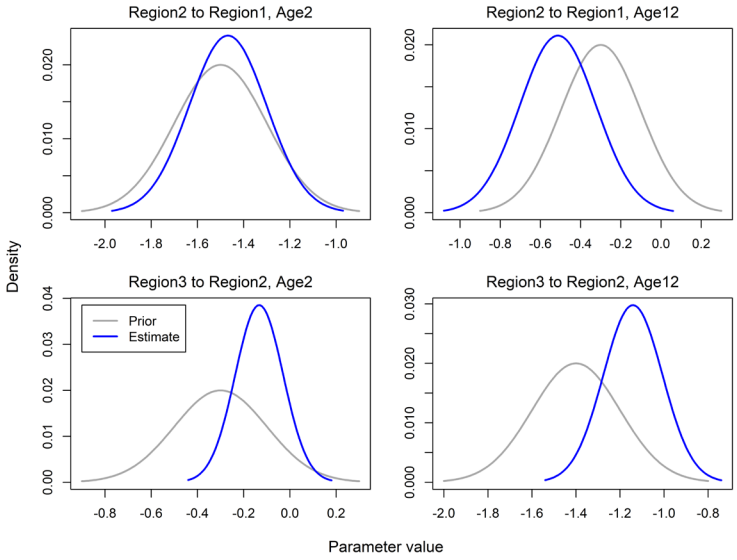


Figure 43: Distributions of priors and estimated parameters for movement parameters.

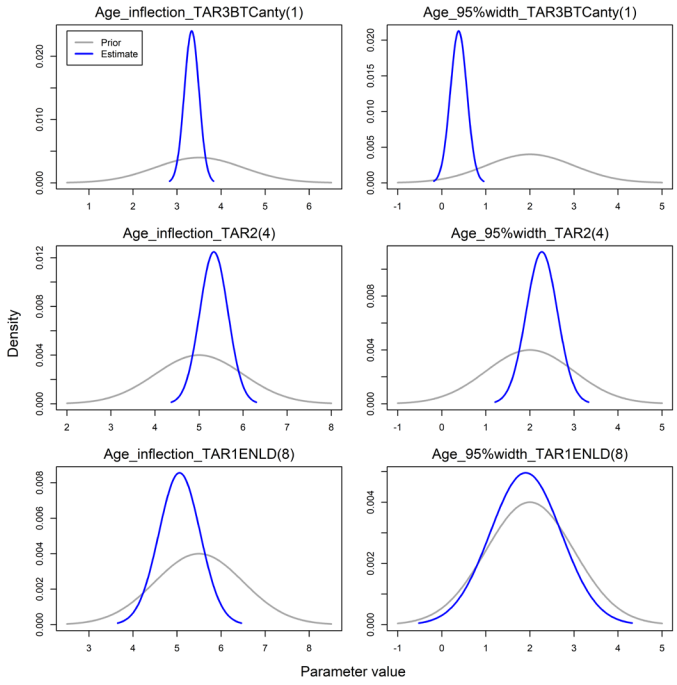


Figure 44: Distributions of priors and estimated parameters for selectivity parameters.

Recruitment deviates estimated from the SRR were estimated for 1980–2023. Recruitments were estimated to be above average during 1994–1996 and below average during 1998–2002 (Figure 45). Annual recruitments were more variable during 2007–2015 with strong recruitments every 2–3 years. Overall, recruitment was estimated to be well below average during 2017–2022 (with the exception of 2019), with a very low recruitment deviate estimated for 2022 (Figure 45).

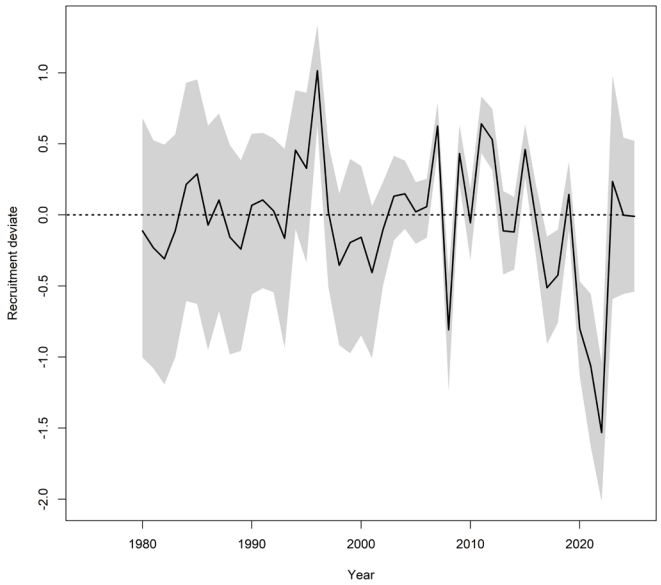


Figure 45: Annual recruitment deviates (median values) and 95% confidence intervals derived from MCMCs. The black line represents the median of the MCMC estimates and the shaded error represents the 95% confidence interval.

7.3 Diagnostics

The model incorporates ten sets of abundance indices, with multiple sets of indices in each region (Figure 46). For the northern region (Region 1), the model fits the strong decline in both the ENLD and BPLE CPUE indices. For the central region (Region 2) the TAR2 and Cook CPUE indices are partitioned into two time blocks (pre- and post 2008), while the Kaikoura set net CPUE indices span the entire period. There is a good correspondence in the three sets of indices during the earlier period. For the more recent period, the model provides a reasonable fit to the Kaikoura set net and TAR 2 CPUE indices, although the model over-estimates the TAR 2 CPUE index from 2025. The model also under-estimates the extent of the increase in the CPUE indices from the Cook fishery in the most recent years (especially 2023–2025) (Figure 46). There is conflict in the TAR 2 and Cook CPUE indices in the most recent year and the model is mediating the trend in the two sets of indices.

The ECSI trawl survey (winter) provides the main abundance indices for the southern region (Region 3). The model fits the considerable decline in the abundance index from 2014 to 2024 (Figure 46) and also fits the index of 2 year old fish derived from the survey (Figure 46). The most recent (2023) year class estimated in the model is informed solely by the survey observations.

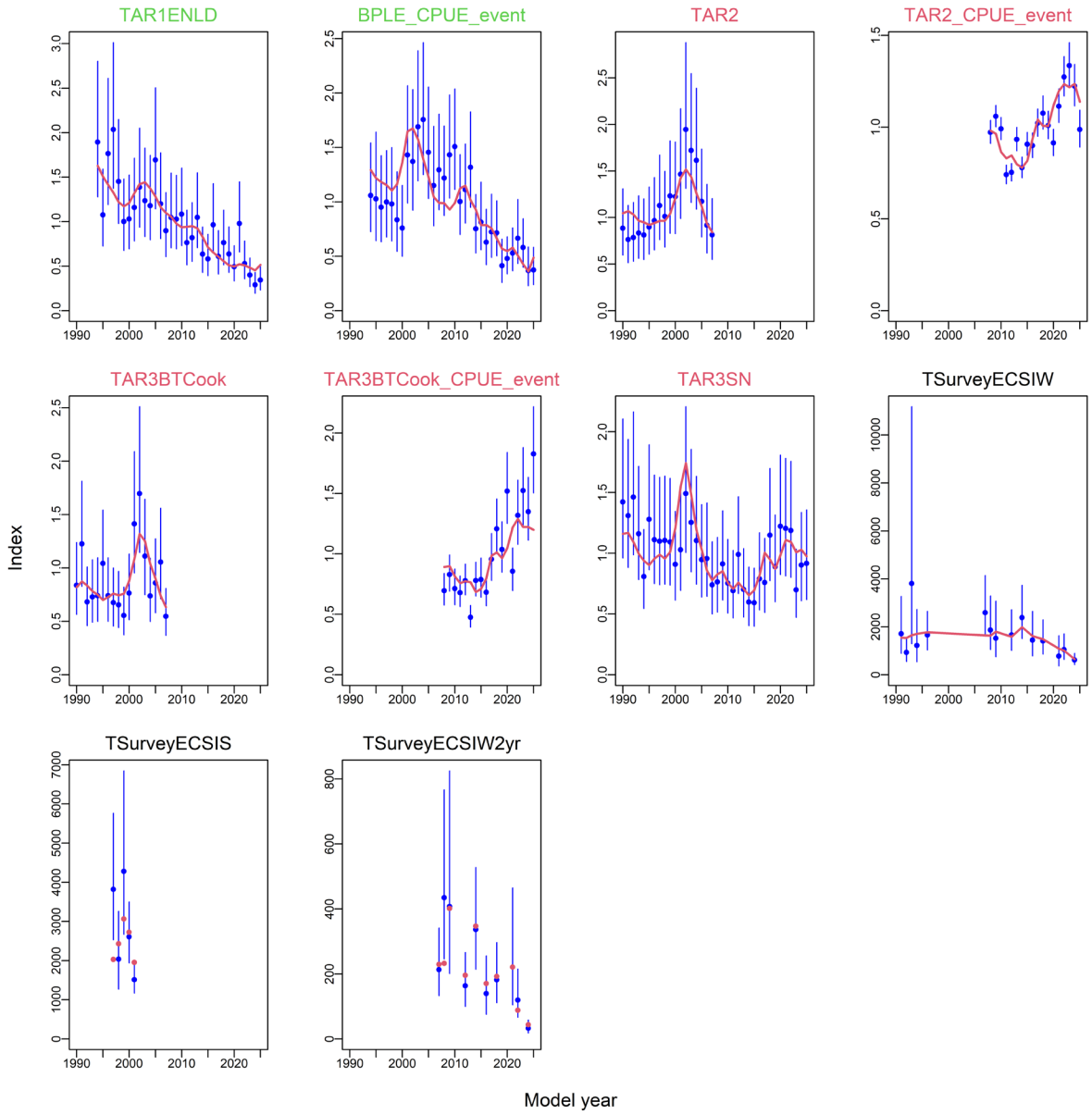


Figure 46: The observed abundance indices (blue points) and predicted values (red lines or points) from the base stock assessment model. The colour of the labels corresponds to the model regions; green, Region 1; red, Region 2; black, Region 3.

Overall, the model provided a good fit to the age composition data from the ECSI trawl survey and for most of the fisheries (Figure 47 to Figure 50). However, there are some notable exceptions. The model under-estimates the strength of the 5 year old age class (2019 year class) in the most recent (2024) ECSI survey age composition (Figure 47 and Figure 48). The 2019 year class was also observed in the 2021 (aged 2 years) and 2022 (aged 3 years) ECSI survey age compositions.

The 2019 year class was also under-estimated in the fits to the 2024 and 2025 age compositions from the ECSI fishery (Figure 49). Those observations were in conflict with the age compositions from the Cook fishery in which the year class was over-estimated in the fits to the 2024 (at age 5 y) and 2025 (at age 6 y) age compositions (Figure 49). Conversely, the 2019 year class was dominant in the 2025 age composition from the TAR 2 fishery (Figure 49).

Overall, the model provided a good fit to the age compositions from both the BPLE and ENLD fisheries (Figure 49).

An examination of the sampling data from the Cook fishery revealed a considerable shift in the depth distribution and monthly distribution of the sampled catch between the two recent programmes (2018–19 & 2019–20 and 2023–24 & 2024–25). For the latter programme, a higher proportion of the sampled catch was taken from tarakihi caught by trawls deeper than 100 m during November–February, while the earlier programme predominantly sampled catches taken during May–June and a higher proportion of catch predominantly shallower than 100 m. The variation in the distribution of the sampled catches may have contributed to the poor fit to the age composition data, given the assumption of constant selectivity for the fishery.

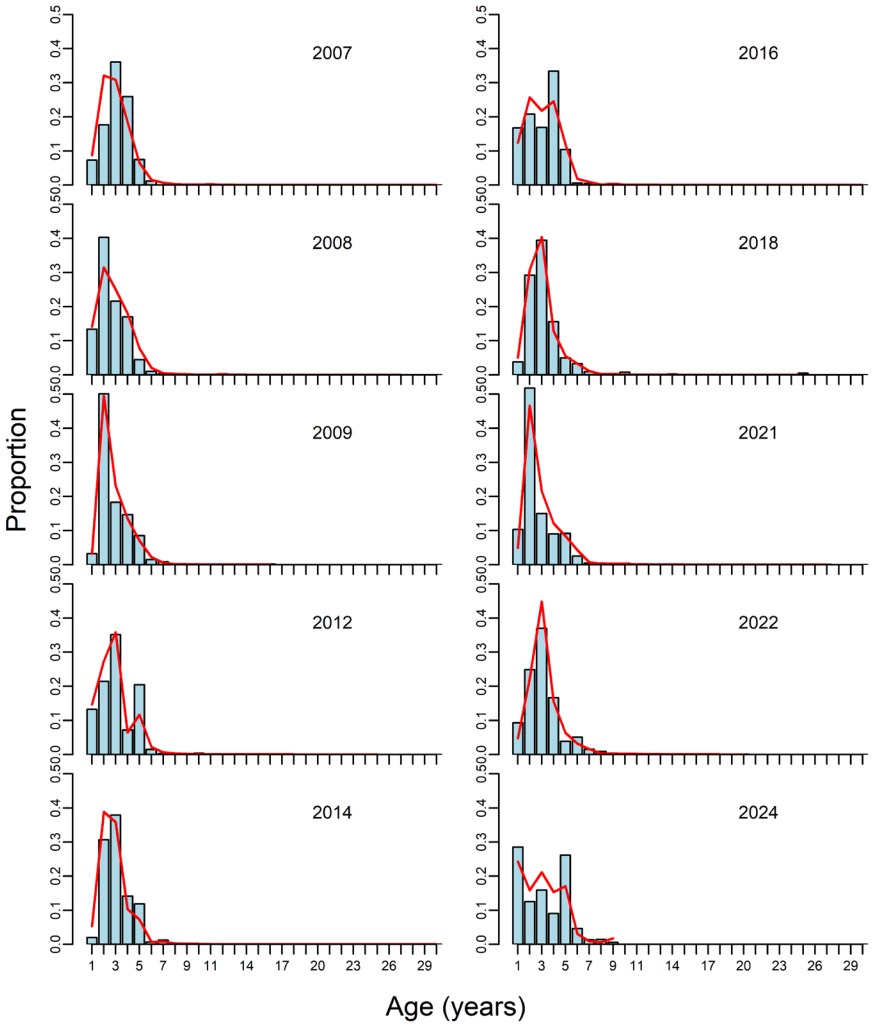


Figure 47: Observed (bars) and predicted (red lines) proportions at age for age compositions from the *Kaharoa* ECSI trawl surveys.

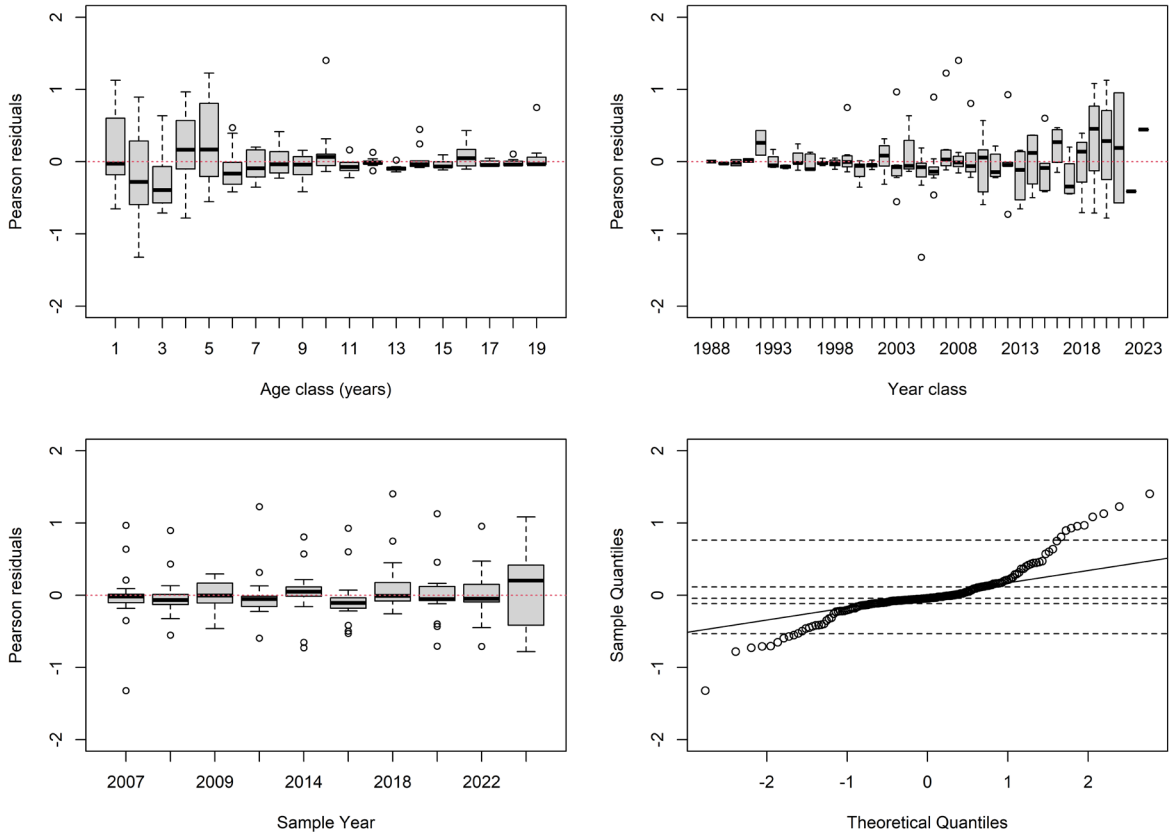


Figure 48: Residuals for the model fits to the proportions at age for age compositions from the *Kaharoa* ECSI trawl surveys by age class, year class and sample year. The quantile plots for the distributions of the residuals are also presented.

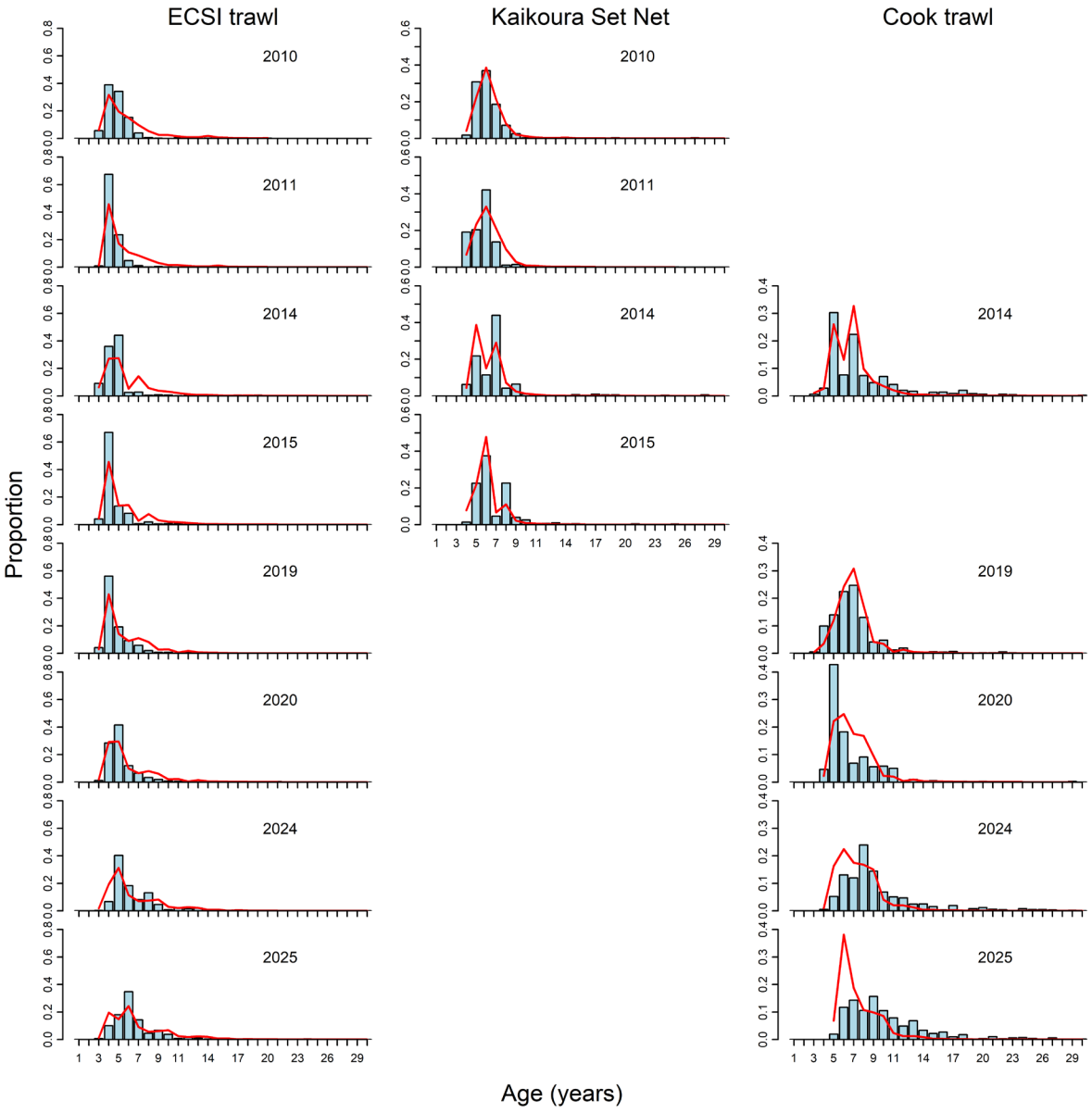


Figure 49: Observed (bars) and predicted (red lines) proportions at age compositions from the ECSI trawl, Kaikoura set net and Cook trawl commercial fisheries.

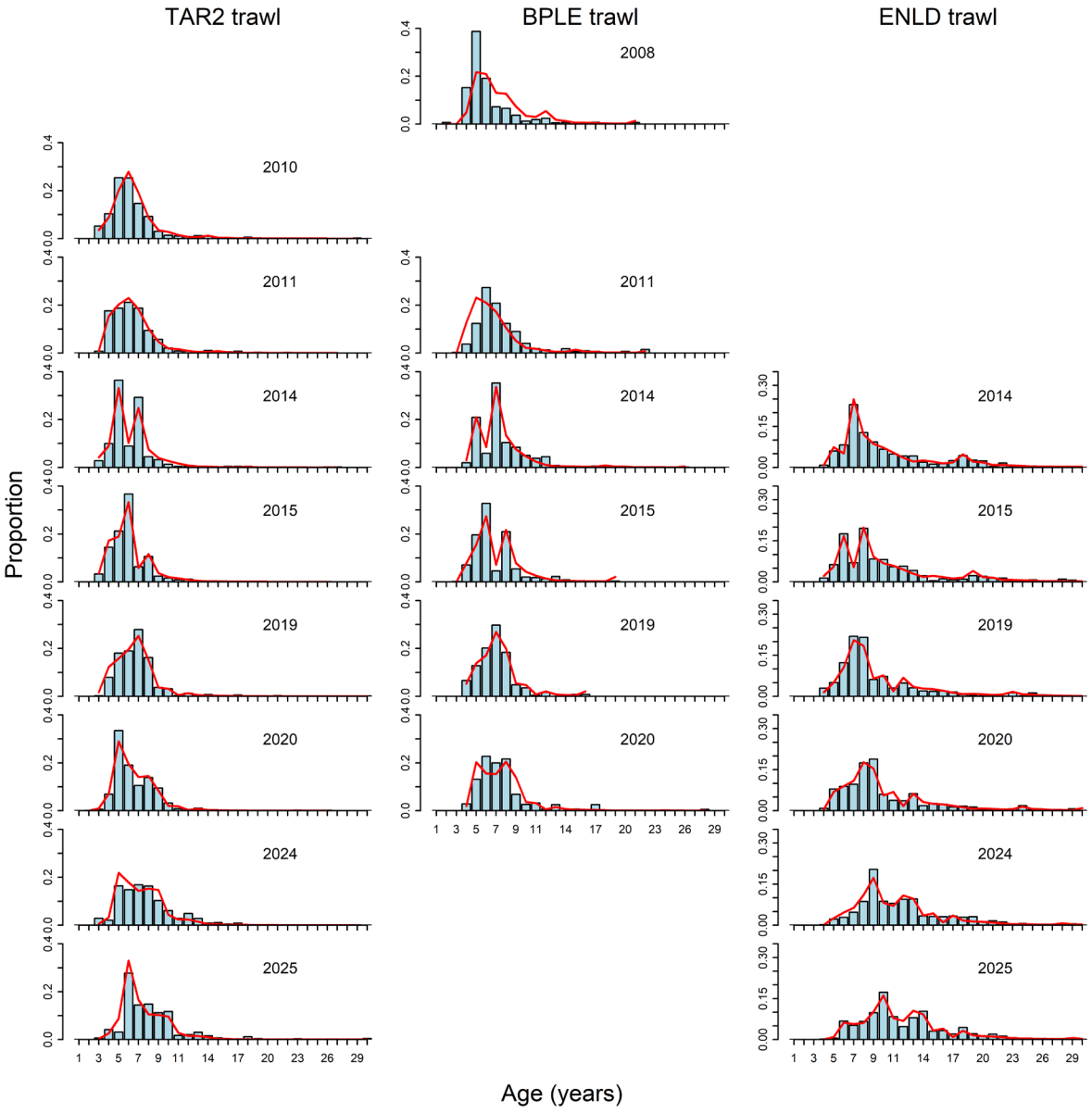


Figure 50: Observed (bars) and predicted (red lines) proportions at age for age compositions from the TAR2, BPLE and ENLD trawl fisheries.

7.4 Model dynamics

The assessment model estimated that biomass declined substantially during the 1950s and 1960s (Figure 51) when catches were at the highest level (5000–7000 t per annum). Spawning biomass is estimated to have declined to about 20% SB_0 by 1975 and continued to decline at a slower rate over the subsequent period (Figure 51). The overall level of depletion is informed by CPUE indices and age compositions from multiple fisheries, particularly Bay of Plenty and East Northland.

Recruitment was estimated to be below average in 2017–2022 (Figure 52). The strength of the 2023 year class is uncertain, while the most recent year classes (2024 and 2025) are determined from the spawner-recruit relationship (dev = 0).

The estimates of annual recruitments have been determined for a period when spawning biomass was relatively stable. Hence, there is insufficient contrast in the spawning biomass to define the relationship between spawning biomass and annual recruitments (Figure 53).

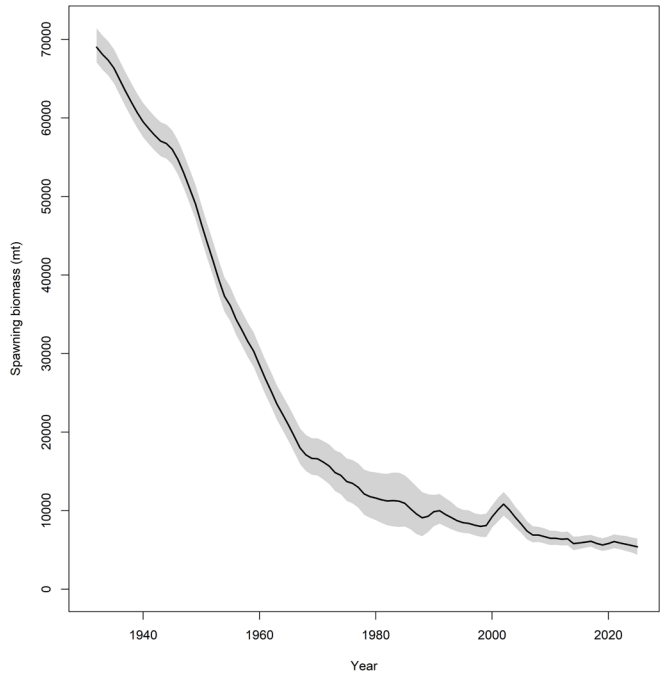


Figure 51: Annual spawning biomass (female, tonnes) from the base eastern tarakihi assessment model. The shaded grey area represents the 95% confidence interval.

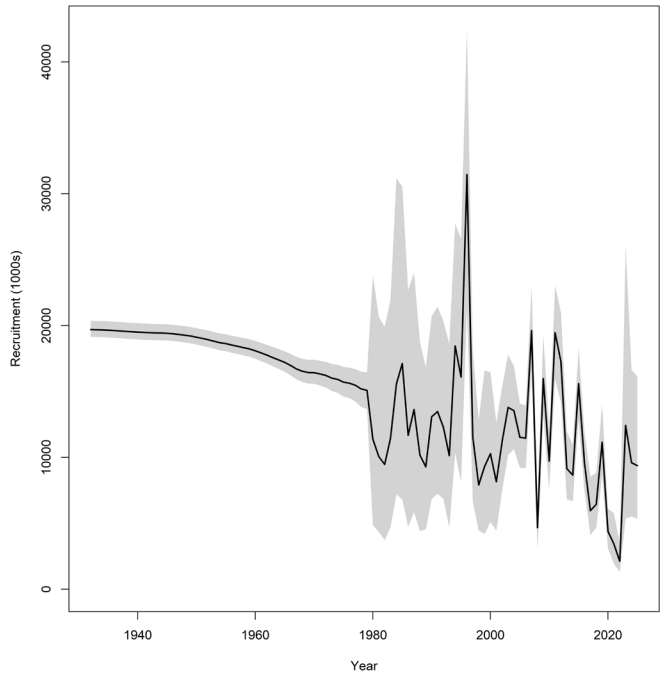


Figure 52: **Annual recruitments (in thousands of fish) from the base eastern tarakihi assessment model. The shaded grey area represents the 95% confidence interval.**

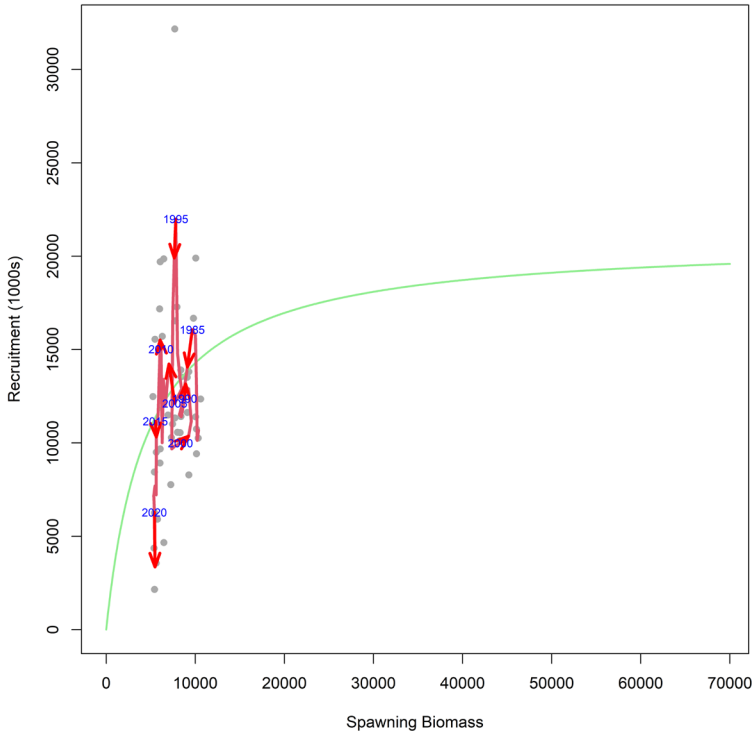


Figure 53: **The Beverton-Holt spawner-recruit relationship with the assumed value of 0.8 for steepness (green line). The grey points are the estimated annual recruitments. The red line represents a 3-year moving average with labels at 5-year intervals.**

The regional distribution of spawning biomass is estimated to have changed substantially over the model period. The estimated movement parameters are constant for the period prior to 2010. The relatively high movement rates (23% per annum for fish 12 y and older) result in the equilibrium biomass accumulating in the northern region (Region 1), whereas Region 2 represents a transitional zone with a lower accumulation of biomass (Figure 54). During the 1950s, catches were relatively high in Region 1 resulting in a considerable decline in regional biomass. Further, catches in Region 2 were relatively high through the 1950s, 1960s and 1970s and biomass in the region declined. In turn, this reduced the replenishment of fish into Region 1 and the marked decline in regional biomass continued (Figure 54). Since 1980, biomass in all three regions is estimated to have been low.

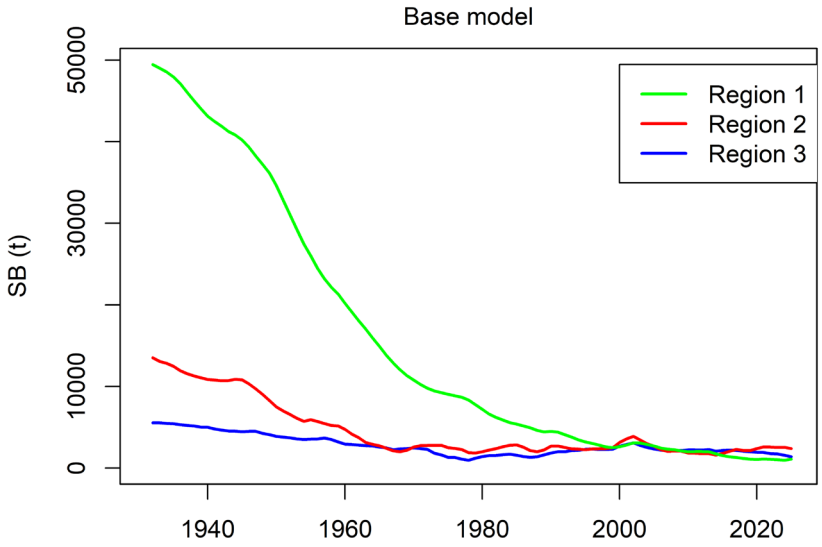


Figure 54: Annual trend in spawning biomass by region for the base model.

7.5 Model sensitivity trials

A range of model sensitivity trials were conducted, including lower and higher values of natural mortality and a higher value of steepness for the SRR (Table 16).

The sensitivity of the model results to the spatial structure of the assessment was evaluated by configuring a model with discrete populations in the three model regions; i.e., no movement between regions and annual recruitments estimated independently for each region (Table 16). The *ThreeRegionNoMove* model is considered to represent an extreme contrast with the spatial dynamics of the base model (with high movements). For all models, total spawning biomass was derived by aggregating the biomass from the three regions.

Table 16: Description of model sensitivity trials.

Sensitivity trial	Description
HighM	$M = 0.125$
LowM	$M = 0.075$
Steep90	SRR steepness 0.9
ThreeRegionNoMove	Spatially segregated, three region model; no movement, independent regional recruitment.

The biomass trajectories are similar for the range of model options and parameter sensitivity trials (Figure 55).

For the *ThreeRegionNoMove* model sensitivity, the distribution of spawning biomass between regions (Figure 56) differs considerably from the base model (Figure 54) as the catches within each region are sustained by regional recruitments. Regardless, the *ThreeRegionNoMove* model estimates a high level of depletion for each of the three regions (Figure 56).

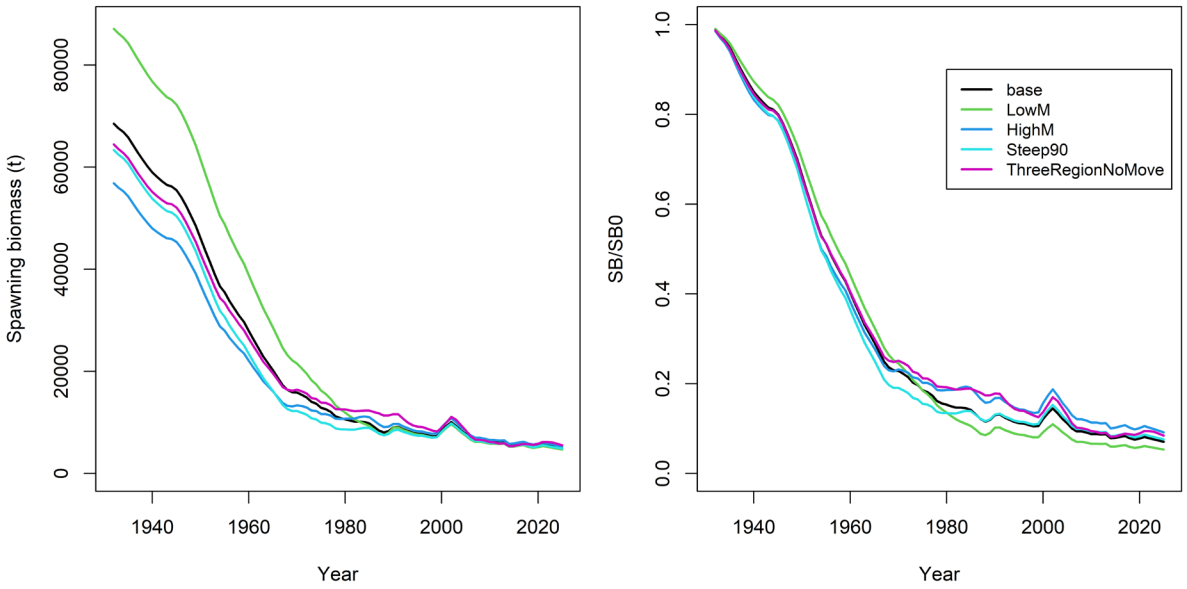


Figure 55: Trends in spawning biomass (left) and spawning biomass relative to reference biomass (*SB0*) (right) (model MPDs) for the Base model and the range of model sensitivity trials.

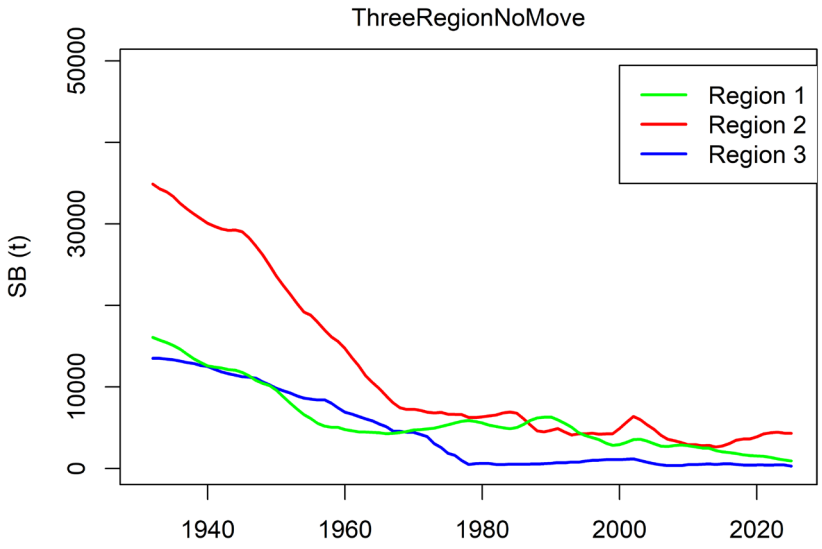


Figure 56: Annual trend in spawning biomass by region for the *ThreeRegionNoMove* model sensitivity trial.

7.6 Stock status

Current stock status was defined as the mid-year spawning biomass (female fish) in 2024–25 relative to equilibrium, unexploited biomass (SB_{2025}/SB_0). Current fishing mortality was estimated relative to a reference fishing mortality that corresponds to the default target biomass of 40% of SB_0 (i.e., $F_{2025}/F_{SB40\%}$).

Spawning biomass is estimated to have been below the default hard limit since the mid-2000s, and current spawning biomass (2025) is estimated to be at 7.7% of the unexploited, equilibrium biomass level (Table 17). The stock status is similar for the range of model options and sensitivity trials (Table 17).

Table 17: Estimates of current (SB_{2025} 2024–25) and equilibrium, unexploited spawning biomass (SB_0) (median and the 95% confidence interval from the MCMCs) and probabilities of current biomass being above specified levels for the base case model and associated sensitivity trials.

Model option	SB_0 (t)	SB_{2025} (t)	SB_{2025}/SB_0	Pr ($SB_{2025} > X\%SB0$)		
				40%	20%	10%
Base	69 831 (67 885–72 224)	5 403 (4 398–6 466)	0.077 (0.063–0.092)	0.000	0.000	0.005
Mhigh	60 759 (57 016–63 450)	6 215 (5 009–7 694)	0.102 (0.084–0.127)	0.000	0.000	0.603
Mlow	88 531 (84 871–91 533)	6 268 (5 172–7 486)	0.071 (0.058–0.084)	0.000	0.000	0.000
Steep90	64 754 (62 816–67 257)	5 420 (4 472–6 642)	0.083 (0.069–0.101)	0.000	0.000	0.034
ThreeRegionNoMove	67 080 (64 313–70 604)	6 218 (5 017–7 720)	0.093 (0.074–0.115)	0.000	0.000	0.233

From the late 1950s, annual fishing mortality rates are estimated to have exceeded the level of fishing mortality that corresponds to default target biomass level (i.e., $F_{SB40\%}$) (Figure 57). Fishing mortality rates generally increased to a maximum in 2017. Fishing mortality rates reduced in 2019–2023, following the reductions in TACC, although current fishing mortality rates are estimated to remain well above the reference level (i.e., $F_{2025}/F_{SB40\%} = 2.62$) (Table 18). The estimates of current fishing mortality rates are similar for the range of model options and sensitivity trials.

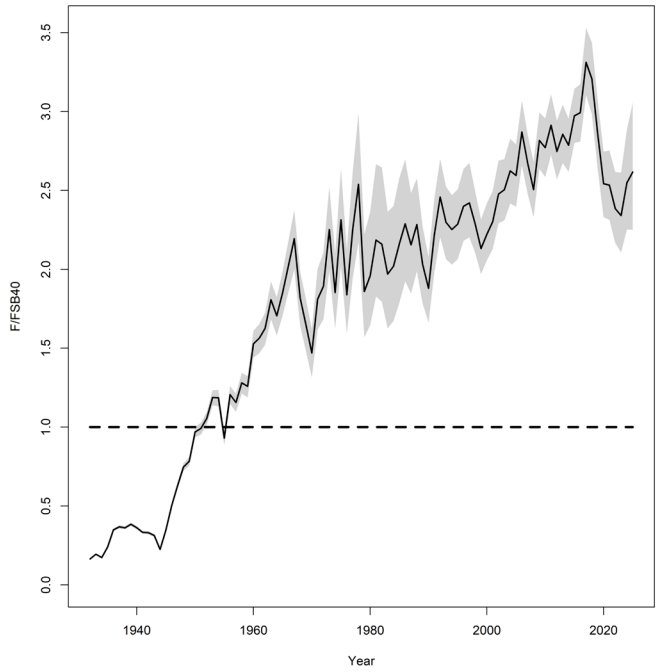


Figure 57: Annual trend in fishing mortality relative to the $F_{SB40\%}$ interim target biomass level for the base east coast tarakihi model. The line represents the median and the shaded area represents the 95% credible interval.

Table 18: Estimates of current (F_{2025} 2024–25) and reference levels of fishing mortality ($F_{SB40\%}$) (median and the 95% confidence interval from the MCMCs) and the probability of fishing mortality being below the level of fishing mortality associated with the interim target biomass level for the base case model and associated sensitivity trials.

Model option	F_{SB40}	$F_{2025}/F_{SB40\%}$		Pr($F_{2025}<F_{SB40\%}$	$F_{SB40\%}$ *Yield*	
		Median	95% CI		Median	95% CI
Base	0.065	2.62	2.25–3.06	0.000	881	698–1 080
Mhigh	0.074	2.00	1.65–2.36	0.000	1,212	958–1 473
Mlow	0.053	3.03	2.57–3.49	0.000	811	674–972
Steep90	0.070	2.41	2.03–2.82	0.000	941	749–1 164
ThreeRegionNoMove	0.064	2.21	1.79–2.66	0.000	959	772–1 184

Projections

Stock projections were conducted for the 5-year period following the terminal year of the model (i.e., 2025–26 to 2029–30). During the projection period, recruitment was derived from the SRR with deviates sampled from the normal distribution (standard deviation *sigmaR* = 0.6). Recent (10 year) model estimates of recruitment were equivalent to the SRR recruitment average level (i.e., average recruitment deviates ~ 0).

Stock projections were conducted for three options: a) TACCs for the 2025–26 fishing year, including eastern splits for TAR 1 and TAR 7 and 10% allowance for unreported catch and recreational catch (total catch of 2642 t), b) status quo (2024–25) commercial and recreational catches, including the 10% allowance for unreported catch (total catch of 2666 t), and c) constant fishing mortality at *FSB40%*. Spawning biomass is predicted to decline slightly under a) and b), due in part to recent low

recruitments (2020–2022) (Table 19). Spawning biomass increases following a large reduction in fishing mortality to *FSB40%* with the corresponding sharp reduction in overall catch.

Table 19: Estimated stock status (and 95% confidence intervals) and the probabilities of the spawning biomass being above default biomass limits and interim target level in 2030 (5 years) from catch and TACC based projections for the base case.

Projection option			Pr ($SB_{2030} > X\%SB_0$)		
	Median	95% CI	10%	20%	40%
TACC	0.069	0.036–0.114	0.070	0.000	0.000
Catch	0.067	0.035–0.112	0.062	0.000	0.000
FSB40%	0.123	0.096–0.160	0.948	0.002	0.000

7.7 Comparison with the 2022 assessment

The 2026 base assessment model differs in a number of ways from the 2022 stock assessment (Langley 2022). For comparative purposes, the changes made in the 2026 stock assessment were "rolled back" in a step-wise manner to revert to the configuration of the 2022 assessment model, to identify what changes made significant differences.

The 2022 assessment estimated the stock status for 2021 (SB_{2021}/SB_0) at 19% SB_0 (MCMC estimate, while the MPD estimate was 18.2%). The current assessment estimated the stock status for 2021 (SB_{2021}/SB_0) at 8.7% SB_0 (MCMC estimate, while the MPD estimate was 8.1%).

Prior to the current assessment, an error was detected in the 2022 stock assessment with the spawning biomass incorrectly calculated based on numbers of mature fish rather than the biomass of mature fish (note that the biomass of each fish is approximately 1 kg). This affected the ratio between current biomass and reference biomass (SB_0). Therefore, the first step in reconstructing the comparative 2022 assessment was to reintroduce the error in the definition of the biomass based reference point. All comparisons are made on the basis of the MPD estimates rather than MCMC estimates of stock status.

Reintroducing the error resulted in a slightly more optimistic estimate of stock status in 2025 (from 7.7% to 9.9%) and 2021 (from 8.1% to 12.1%) (Table 20). Subsequent step-wise changes in the model configuration resulted in relatively minor changes in stock status in 2025 and 2022. Step 6 truncates the model in 2021 and, hence, estimates of stock status for 2025 are not available from the subsequent iterations. One of the more influential changes was the change in the configuration of the CPUE indices (step 8), reverting to the entire daily series of Cook and TAR 2 CPUE indices rather than including the event-based indices from 2008 onwards (Table 20).

The final step (step 9) was to reapply the correct definition of spawning biomass, reducing the 2021 spawning biomass (relative to SB_0) from 17.7% to 12.2%. The changes in the assessment configuration are represented by the difference between the spawning biomass in 2021 from the final step (12.2%) and the current base model (8.1%) (Table 20). These results indicate that approximately 42% of the difference in 2021 stock status for old and new assessments is due to incorrect spawner biomass specification and that 58% of the difference is due to new model structure.

Table 20: Step-wise changes in the configuration of the current base assessment model to approximate the configuration of the 2022 eastern tarakihi stock assessment model. Estimates of stock status in 2025 and 2021, relative to SB_0, are MPD estimates.

Label	Description	SB_{2025}/SB_0	SB_{2021}/SB_0
	Current Base model (2026)	0.077	0.081
Step 1	Spawning biomass incorrectly defined as numbers of fish.	0.099	0.121
Step 2	SRR steepness of 0.9 (from 0.8).	0.107	0.129
Step 3	Revert to old growth parameters, both sexes the same.	0.103	0.126
Step 4	Initialise model in 1975 under exploited conditions; estimate initial Fs.	0.121	0.146
Step 5	Exclude 2023–24 and 2024–25 fishery age composition data.	0.117	0.137
Step 6	Terminate model in 2021, rec devs end 2020, exclude 2022–2025 catches, exclude 2022–25 CPUE and survey indices.	-	0.144
Step 7	Revert to previous spatial configuration of fisheries; BPLE to Region 2, Cook to Region 3 and old selectivity parameterisations. Exclude BPLE CPUE trawl series. Old movement parameterization with uninformative priors and annual deviates.	-	0.157
Step 8	Revert to old format CPUE - daily series throughout rather than split daily and event. Approximates 2022 assessment model.	-	0.177
Step 9	Correct spawning biomass definition again (back to biomass).	-	0.122

7.8 Environmental covariates

The lower recent recruitments for eastern tarakihi may have been driven by changes in prevailing environmental conditions. Similarly, the decline in abundance in the northern region may be attributable, in part, to a decline in the immigration of fish into the region in response to recent conditions (as modelled by declining movement deviates from Region 2 to Region 1).

To investigate these hypotheses, a time series of three oceanographic variables was derived for four sub areas that represent important spawning areas or juvenile tarakihi habitat: East Northland, East Cape, Wairarapa and Pegasus/Canterbury Bight (Figure 58).

The indices for each area were derived from the NOAA NCEP ocean model datasets for sea surface temperature, North/South current strength (V component) and East/West current strength (U component) aggregated at monthly intervals and 1º latitude/longitude spatial resolution (Behringer & Xue 2004, Reynolds et al. 2002). The oceanographic variables were available from January 1982 to December 2022. For each area, an index was calculated as the average monthly value from the constituent grid cells (Figure 59).

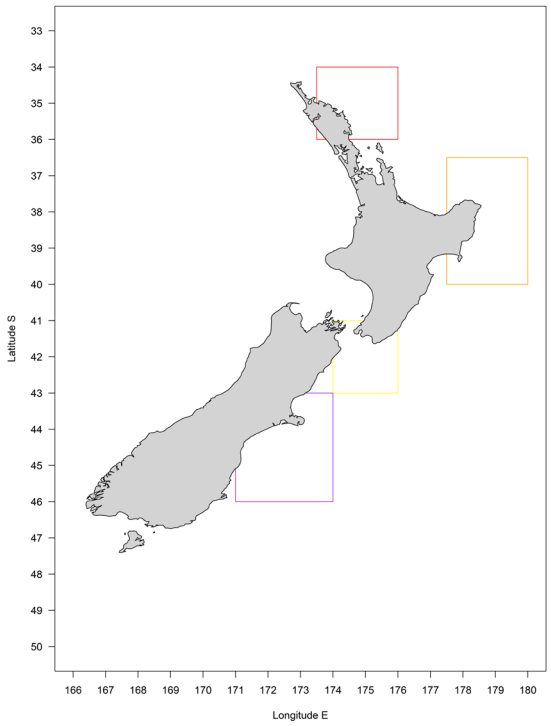


Figure 58: Areas defined for derivation of oceanographic variables.

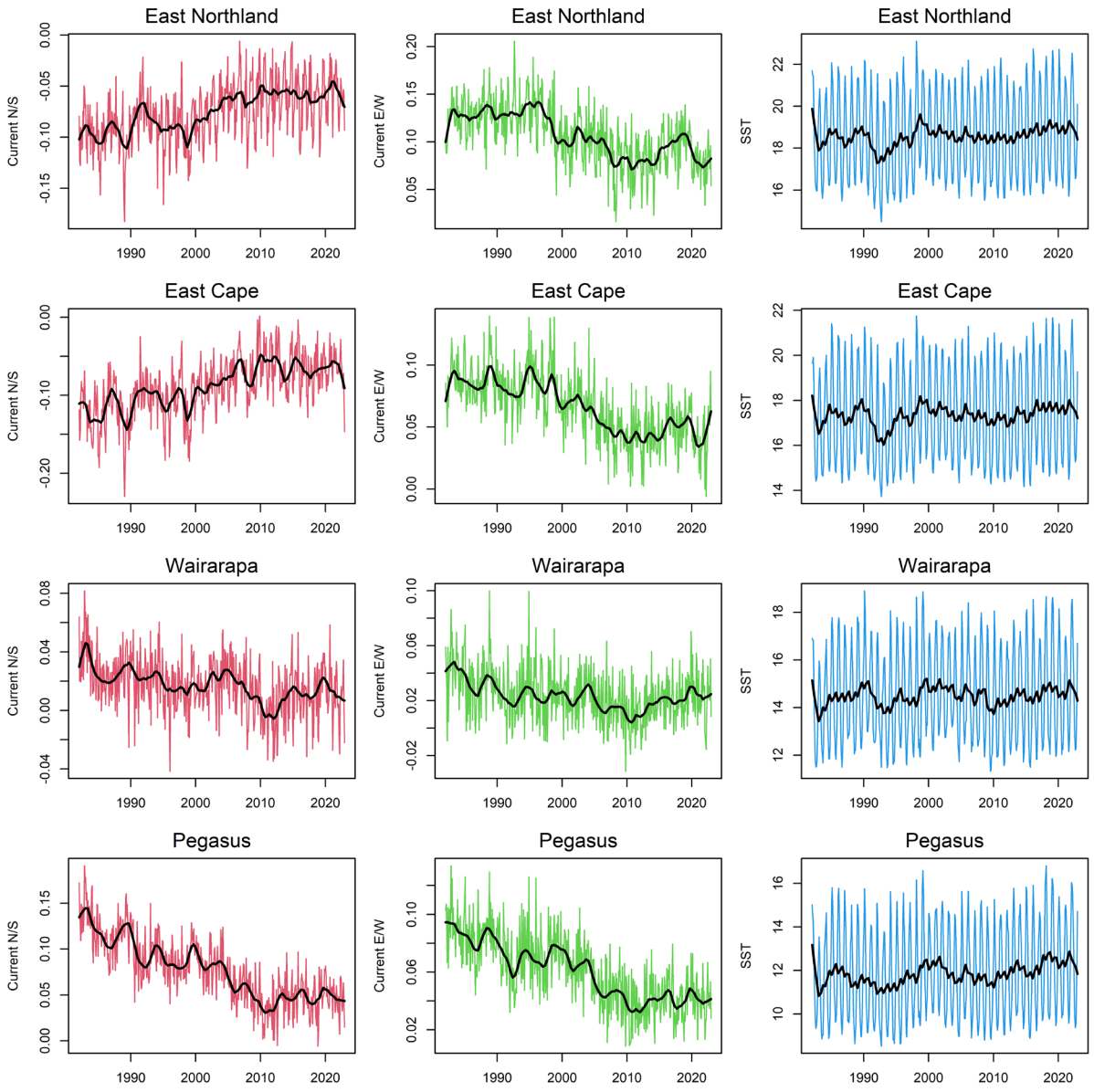


Figure 59: Monthly oceanographic variables for the four areas (East Northland, East Cape, Wairarapa, Pegasus). The black line represents a 12-month running average.

To investigate the potential relationship between recruitment and the prevailing environmental conditions, the estimates of annual recruitment (1982–2022, n = 41) from the base model were correlated with each of the monthly set of oceanographic variables. Overall, the highest correlation was between the SST in the Pegasus area in September (i.e., approximately 6 months after the main spawning period) (correlation coefficient of -0.60) (Figure 60). The variable accounted for 36% of the variation in annual recruitments using a simple linear relationship. In general, the relationship predicts the inter-annual variation in the "observed" recruitments (Figure 60). The lower recent recruitments corresponded to higher SST in the Pegasus area during September of 2015–2022. However, the relationship under-estimated the variation at the extreme range of recruitments; the high recruitment in 1996 and the low recruitments in 2008 and 2022 (Figure 60).

The higher recent SST is also correlated with lower rates of northward current flow in the Pegasus area (Figure 60).

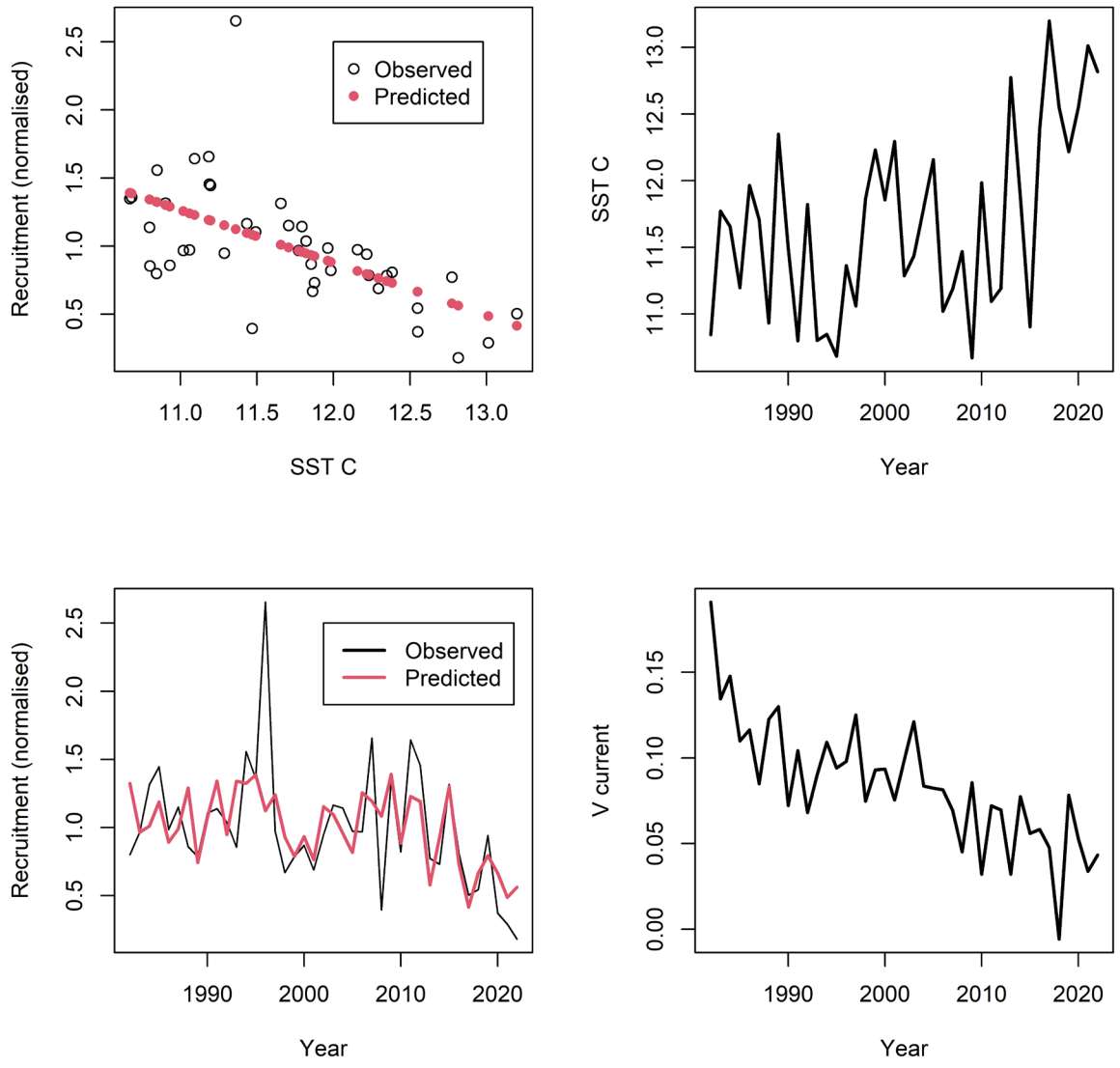


Figure 60: **A comparison of the annual recruitment deviates from the base assessment model and the SST index for November (of the year of spawning) from the Pegasus area. The predictions from a simple linear relationship between the two variables are also presented.**

Similarly, the annual movement deviates (2010–2022, n = 13) from the base assessment model were correlated with the monthly oceanographic variables from each of the four areas. The higher correlations were for the SST variables from East Northland and East Cape during August-October with the highest correlation for East Northland in September (correlation coefficient -0.75) (Figure 61). The estimated decline in movement from Region 2 to Region 1 during 2010–2022 is correlated with the increased SST in the East Northland and East Cape areas over the period (Figure 61). A simple linear relationship with the explanatory variable accounted for 56% of the variation in the movement deviates.

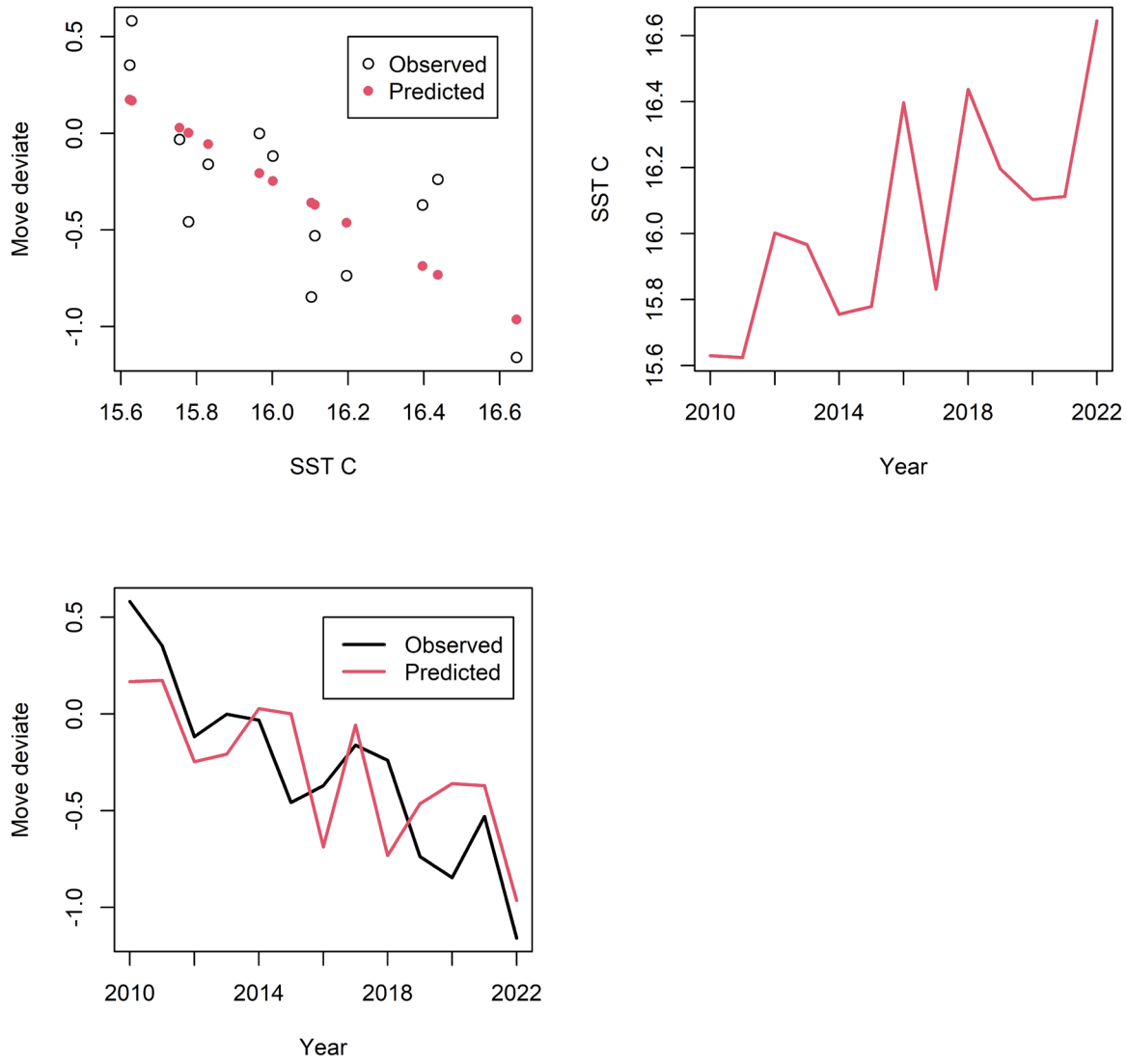


Figure 61: **A comparison of the annual movement deviates from the base assessment model and the SST index for September (end of the model year) from the ENLD area. The predictions from a simple linear relationship between the two variables are also presented.**

8. DISCUSSION

The accumulation of age composition data from trawl surveys and commercial fisheries has further contributed to our understanding of the stock structure of tarakihi around mainland New Zealand. There is a clear delineation between western and eastern stocks based on differences in growth rates and variation in recruitment and trends in abundance indices supported by direct observations from tag release/recovery data.

This study represents an update and refinement of the stock assessment for the eastern stock of tarakihi. The assessment was accepted by the Fishery Assessment Plenary in May 2026.

The eastern tarakihi fishery developed from the 1930s and catches reached a peak in the 1960s and 1970s, with the largest proportion of the catch taken from off the central North Island (TAR 2). The nominal catch rate of tarakihi from the East Cape trawl fishery declined considerably during the 1960s (Vooren 1974), while there was a general decline in catch rates of tarakihi in Canterbury Bight during the 1960s and early 1970s (Sullivan 1981). During the 1970s, the overall catch from the eastern tarakihi stock declined.

These trends are consistent with the current stock assessment which estimates that the stock had declined to about 20% of the initial biomass (*SB0*) by the mid-1970s with fishing mortality rates considerably higher than the reference level ($F_{SB40\%}$ = 0.065). Since the mid-1970s, biomass is estimated to have continued to slowly decline while fishing mortality rates remained high.

The overall scale of the initial decline in stock abundance is strongly informed by the magnitude of early catches from the stock and the key age composition data from the East Northland fishery (in conjunction with the natural mortality value and selectivity assumptions). The low proportions of older (greater than 20 years) fish in the age compositions indicate exploitation rates were high during the preceding years. The more recent decline in biomass (from 1990) is informed by the decline in the CPUE indices from the ENLD and BPLE trawl fisheries. These trends are corroborated by the decline in CPUE indices from the corresponding longline fisheries.

Like the northern (TAR 1E) area, the central (TAR 2 and TAR 7E) area of the assessment is reliant on CPUE indices to monitor stock abundance. Improvements in the current assessment included utilising trawl event resolution data where available, enabling distributional changes in fishing effort to be incorporated in the standardisation of CPUE indices. However, this partitioned the CPUE time-series for some key fisheries, reducing the continuity of the CPUE series, particularly for the TAR 2 and eastern Cook Strait fisheries.

More generally, there is concern that the reliability of the various sets of CPUE indices may have declined due to recent changes in the operation of the individual fisheries. These changes are in response to the reductions in the tarakihi TACCs from 2017–18 and an increase in the avoidance of snapper, particularly within TAR 2. To improve the monitoring of tarakihi and other inshore species, two pilot multi vessel trawl surveys have been conducted in the northern area of TAR 2 (Langley 2026b). The next survey is scheduled for March 2027. Further refinements in the survey design will be implemented to improve the monitoring of tarakihi.

For the southern area (TAR 3), the inshore trawl surveys conducted by R.V. *Kaharoa*, particularly the winter ECSI surveys, have provided crucial inputs for the current stock assessment. The replacement of the vessel with *Kaharoa II* will require a recalibration of the series of abundance indices between the two vessels, either externally (Devine et al. 2026) or within the assessment modelling framework. The first ECSI survey by *Kaharoa II* was conducted in May-June 2026.

The contradictory trends in CPUE indices from the fisheries in the northern and central areas led to the spatial stratification of the base assessment model, including the estimation of movement of tarakihi between model regions. While the overall estimates of stock status are relatively insensitive to the spatial configuration of the model, the historical distribution of biomass amongst the three model

regions is sensitive to those assumptions, particularly the parameterisation of movement between the central and northern regions. On that basis, the assessment model is not considered to be sufficiently reliable to provide robust management advice at the regional scale of the model.

The next iteration of the assessment should investigate the relative scale of biomass between regions. This could be informed by the application of spatio-temporal modelling approaches (e.g. using *tinyVAST*, Thorson et al. 2025) over the domain of the assessment model. The analysis would integrate across the model regions to enable the derivation of regional trends in relative stock abundance.

The next iteration of the assessment should also review historical data not included in the current assessment. Tarakihi age composition data are available from trawl surveys conducted off East Cape in March 1971 (Vooren & Tong 1973), Cape Campbell and Kaikoura in March 1978 (Tong 1979) and Cape Campbell 1987 (Annala et al. 1990). These data may inform the model regarding exploitation rates in the earlier period and, potentially, enable the estimation of natural mortality within the assessment framework.

The relationship between TAR 5 (Southland) and the eastern tarakihi stock is unclear. While the 2026 assessment does not include the catch from TAR 5, the limited age composition data available from the TAR 5 fishery indicate a degree of linkage with TAR 3 (McKenzie et al. 2021). The previous assessment (Langley 2022) demonstrated that the stock assessment conclusions were not sensitive to the inclusion of the relatively small catch from TAR 5. Nonetheless, it may be appropriate to include TAR 5 within the management of the eastern tarakihi stock.

The recent (2017–2022) low recruitments have corresponded to a period of warmer sea temperatures off south-eastern New Zealand. Further work is required to investigate the relationship between tarakihi recruitment and prevailing oceanographic conditions. It is unknown whether the recent low recruitments are simply a transient process or represent a longer-term shift in the overall productivity of the stock. On going monitoring of recruitment will be important for the assessment of the tarakihi stock over the medium term (5–10 years).

9. ACKNOWLEDGMENTS

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10. REFERENCES

Annala J.H. (1988). Tarakihi. *New Zealand Fisheries Assessment Research Document 1988/28*. 31 p.

Annala, J.H.; Wood, B.A.; Hadfield, J.D.; Banks, D.A. (1990). Age, growth, mortality and yield-per-recruit estimates of tarakihi from the east coast of the South Island during 1987. MAF Fisheries Greta Point Internal Report No. 138. 23 p. (Unpublished report held in ESNZ Greta Point library, Wellington.)

Armiger, H.; McKenzie, J.; Walsh, C.; Buckthought, D.; Sutton, C.; Stevenson, M. (2010). Length and age structure of commercial tarakihi landings in TAR 1 in 2007/08. NINS Working Group Report NINSWG-2010-12b. Unpublished document held by the Ministry for Primary Industries, Wellington, N.Z.

Beentjes, M.P. (1995a). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, May–June 1992 (KAH9205). *New Zealand Fisheries Data Report 55*. 58 p.

Beentjes, M.P. (1995b). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, May–June 1993 (KAH9306). *New Zealand Fisheries Data Report 56*. 78 p.
Beentjes, M.P. (1998a). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, May–June 1994 (KAH9406). *NIWA Technical Report 20*. 65 p.
Beentjes, M.P. (1998b). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, May–June 1996 (KAH9606). *NIWA Technical Report 21*. 66 p.
Beentjes, M.P. (2011). TAR 3 catch sampling in 2009–10 and a characterisation of the commercial fishery (1989–90 to 2009–10). *New Zealand Fisheries Assessment Report* 2011/52.
Beentjes, M.P.; Lyon, W.S.; Stevenson, M.L. (2010). Inshore trawl survey of Canterbury Bight and Pegasus Bay, May–June 2009 (KAH0905). *New Zealand Fisheries Assessment Report 2010/29*. 102 p.
Beentjes, M.P.; MacGibbon, D.; Lyon, W.S. (2013). Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2012 (KAH1207). *New Zealand Fisheries Assessment Report 2013/36*. 135 p.
Beentjes, M.P.; MacGibbon, D; Lyon, W.S. (2015) Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2014 (KAH1402). *New Zealand Fisheries Assessment Report 2015/14*. 136 p.
Beentjes, M.P.; MacGibbon, D.J.; Parkinson, D. (2016) Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2016 (KAH1605). *New Zealand Fisheries Assessment Report 2016/61*. 135 p.
Beentjes, M.P.; MacGibbon, D.J.; Escobar-Flores, P. (2023). Inshore trawl survey of Canterbury Bight and Pegasus Bay, May–June 2022 (KAH2204). *New Zealand Fisheries Assessment Report 2023/35.* 147 p.
Beentjes, M.P.; MacGibbon, D.J.; Ladroit, Y. (2022). Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2021 (KAH2104). *New Zealand Fisheries Assessment Report 2022/23*. 147 p.
Beentjes, M.P.; Parker, S.; Fu, D. (2012). Characterisation of TAR 2 & TAR 3 fisheries and age composition of landings 2010/11. *New Zealand Fisheries Assessment Report* 2012/25.
Beentjes, M.P.; Stevenson, M.L. (2008). Inshore trawl survey of Canterbury Bight and Pegasus Bay, May-June 2007 (KAH0705). *New Zealand Fisheries Assessment Report 2008/38*. 95 p.
Beentjes, M.P.; Stevenson, M.L. (2009). Inshore trawl survey of Canterbury Bight and Pegasus Bay, May–June 2008 (KAH0806). *New Zealand Fisheries Assessment Report 2009/57*. 105 p.
Beentjes, M.P.; Wass, R. (1994). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, May-June 1991 (KAH9105). *New Zealand Fisheries Data Report 48*. 49 p.
Behringer, D.W.; Xue, Y. (2004). Evaluation of the global ocean data assimilation system at NCEP: The Pacific Ocean. Eighth Symposium on Integrated Observing and Assimilation Systems for Atmosphere, Oceans, and Land Surface, AMS 84th Annual Meeting, Washington State Convention and Trade Center, Seattle, Washington, 11-15.
Bentley, N.; Kendrick, T.H.; Starr, P.J.; Breen, P.A. (2012). Influence plots and metrics: tools for better understanding fisheries catch per unit effort standardisations. *ICES Journal of Marine Science 69*: 84–88.
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.
Fisheries New Zealand (2025). Fisheries Assessment Plenary, May 2025: stock assessments and stock status. Compiled by the Fisheries Science Team, Fisheries New Zealand, Wellington, New Zealand. 1955 p.
Francis, M.P.; Paul, L.J. (2013). New Zealand inshore finfish and shellfish commercial landings, 1931–82. *New Zealand Fisheries Assessment Report 2013/55*. 140 p.
Francis, R.I.C.C. (2011). Data weighting in statistical fisheries stock assessment models. *Canadian Journal of Fisheries and Aquatic Sciences* 68: 1124–1138.
Langley. A.D. (2014). Updated CPUE analyses for selected South Island inshore finfish stocks. *New Zealand Fisheries Assessment Report 2014/40*.

Langley, A.D. (2018). Stock assessment of tarakihi off the east coast of mainland New Zealand. *New Zealand Fisheries Assessment Report 2018/05*. 85 p.

Langley, A.D. (2019). An update of the assessment of the eastern stock of tarakihi for 2019. *New Zealand Fisheries Assessment Report 2019/41.* 29 p.

Langley, A.D. (2021). Fishery characterisation and Catch-Per-Unit-Effort indices for tarakihi in TAR 1, TAR 2, TAR 3, TAR 5, TAR 7, and TAR 8. *New Zealand Fisheries Assessment Report 2021/71.* 126 p.

Langley, A.D. (2022). A stock assessment of eastern tarakihi for 2021. *New Zealand Fisheries Assessment Report 2022/07*. 68 p.

Langley, A.D. (2026a). A stock assessment of western tarakihi for 2026. *New Zealand Fisheries Assessment Report 2026/23.* 94 p.

Langley, A.D. (2026b). A multi vessel inshore trawl survey of FMA 2 (February-March 2026). *New Zealand Fisheries Assessment Report 2026/19*. 53 p.

Langley, A.D.; Starr, P. (2012). Stock relationships of tarakihi off the east coast of mainland New Zealand and the feasibility of developing a statistical assessment of the corresponding tarakihi stock(s). *New Zealand Fisheries Assessment Report 2012/30.* 69 p.

MacGibbon, D.J.; Beentjes, M.P.; Escobar-Flores, P. (2024). Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2024 (KAH2402). *New Zealand Fisheries Assessment Report 2024/87*. 150 p.

MacGibbon, D.J.; Beentjes, M.P.; Lyon, W.L.; Ladroit, Y. (2019). Inshore trawl survey of Canterbury Bight and Pegasus Bay, April–June 2018 (KAH1803). *New Zealand Fisheries Assessment Report 2019/03*. 136 p.

McKenzie, J.R.; Beentjes, M.; Armiger, H.; Bradley, A.; Spong, K.; Walsh, C.; Buckthought, D.; Stevenson, M.; Taylor, R.; Evans, O.; Bian, R.; Parsons, D.; Sutton, C.; Hart, A.; Ó Maolagáin, C.; Patke, S.; Wilson, O.; Langley, A.; Kater, D.; Sykes, J.; O'Driscoll, M.; Qureshi, Y.; Miller, A.; Bodie, C.; Rush, N.; Smith, M.; Hartill, B.; Toman, D.; Maggs, J.; Bagley, N. (2021). Fishery characterisation and age composition of tarakihi in TAR 1, 2, 3, 5 ,7 & 8 for 2018/19 and 2019/20. *New Zealand Fisheries Assessment Report 2021/79*. 118 p.

McKenzie, J.R.; Beentjes, M.P.; Parker, S.; Parsons, D.M.; Armiger, H.; Wilson, O.; Middleton, D.; Langley, A.; Buckthought, D.; Walsh, C.; Bian, R.; Maolagáin, C.Ó.; Stevenson, M.; Sutton, C.; Spong, K.; Rush, N.; Smith, M. (2017). Fishery characterisation and age composition of tarakihi in TAR 1, 2 and 3 for 2013/14 and 2014/15. *New Zealand Fisheries Assessment Report 2017/36.* 80 p.

McKenzie, J.R.; Johnson, K.S.; Beentjes, M.; Armiger, H.; Walsh, C.; Buckthought, D.; Evans, O.; Bian, R.; Parsons, D.; Bodie, C.; Madden, B.; Hamill, J.; Stead, J.; Smith, M.; Barry, F.; Lambert, A.; Lambert, P.; Olmedo-Rojas, P.; Toman, D.; Sutton, C.; Wood, B.; Miller, A.; Haywood, L. (2026). Fishery characterisation and age composition of tarakihi in TAR 1, 2, 3, 7, and 8, for 2023–24 and 2024–25. *New Zealand Fisheries Assessment Report 2026/XX*. XX p.

McKenzie, J.R.; Walsh, C.; Bian, R. (2015). Characterisation of TAR 1 fisheries and age composition of landings in 2010/11 from Industry at-sea catch sampling. *New Zealand Fisheries Assessment Report 2015/74.* 47 p.

Methot, R.D.; Wetzel, C.R. (2013). Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. *Fisheries Research 142:* 86–99.

Methot, R. D.; Wetzel, C.R.; Taylor, I.G.; Doering, K. (2020). Stock Synthesis User Manual Version 3.30.15. U.S. Department of Commerce, NOAA Processed Report NMFS-NWFSC-PR-2020-05. https://doi.org/10.25923/5wpn-qt71

Parker, S.; Fu, D. (2011). Age composition of commercial tarakihi (*Nemadactylus macropterus*) in quota management area TAR 2 in fishing year 2009–10. *New Zealand Fisheries Assessment Report 2011/59. 35* p.

Reynolds, R.W.; Rayner, N.A.; Smith, T.M.; Stokes, D.C.; Wang, W. (2002). An Improved In Situ and Satellite SST Analysis for Climate. *Journal of Climate 15*, 1609–1625.

Robertson, D.A. (1978). Spawning of tarakihi (Pisces: Cheilodaetylidae) in New Zealand waters. *New Zealand Journal of Marine and Freshwater Research*, 12:3, 277–286.

Stefansson, G. (1996). Analysis of groundfish survey abundance data: combining the GLM and delta approaches. *ICES Journal of Marine Science 53*: 577–588.
Stevenson, M.L. (1996a). Bottom trawl survey of inshore waters of the east coast North Island, March–April 1995 (KAH9502). *New Zealand Fisheries Data Report 78*. 57 p.
Stevenson, M.L. (1996b). Bottom trawl survey of inshore waters of the east coast North Island, March–April 1996 (KAH9602). *New Zealand Fisheries Data Report 79*. 58 p.
Stevenson, M.L. (1997). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, December 1996–January 1997 (KAH9618). *NIWA Technical Report 7*. 66 p.
Stevenson, M.L.; Beentjes, M.P. (1999). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, December 1998–January 1999 (KAH9809). *NIWA Technical Report 63*. 66 p.
Stevenson, M.L.; Beentjes, M.P. (2001). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, December 1999–January 2000 (KAH9809 & CMP9901). *NIWA Technical Report 99*. 94 p.
Stevenson, M.L.; Beentjes, M.P. (2002). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, December 2000–January 2001 (KAH0014 & CMP0001). *NIWA Technical Report 112*. 97 p.
Stevenson, M.L.; Hurst, R.J. (1998). Inshore trawl survey of the Canterbury Bight and Pegasus Bay, December 1997–January 1998 (KAH9704). *NIWA Technical Report 32*. 74 p.
Stevenson, M.L.; Kirk, P.D. (1996). Bottom trawl survey of inshore waters of the east coast North Island, March–April 1994 (KAH9402). *New Zealand Fisheries Data Report 69*. 54 p.
Sullivan, K.J. (1981). Trends in the Canterbury Bight trawl fishery from 1963 to 1976. *Fisheries Research Division Occasional Publication, No. 19.*
Thorson J.T.; Anderson S.C.; Goddard P.; Rooper C.N. (2025). *tinyVAST*: R package with an expressive interface to specify lagged and simultaneous effects in multivariate spatio-temporal models. *Global Ecology and Biogeography*, 34(4).
Tong, L.J. (1979). The tarakihi fishery: Is there a problem? *In:* Elder, R.D. and Taylor, J.L. (Comps.), Prospects and problems for New Zealand's demersal fisheries: Proceedings of the Demersal Fisheries Conference, October 1978, pp. 87–90. *Fisheries Research Division Occasional Publication, No. 19.*
Walsh, C.; Horn, P.; McKenzie, J.; Ó Maolagáin, C.; Buckthought, D.; Stevenson, M.; Sutton, C. (2016). Age determination protocol for tarakihi (*Nemadactylus macropterus*). *New Zealand Fisheries Assessment Report 2016/13.* 37 p.
Vooren, C.M. (1974). An analysis of the statistics on the fishery for tarakihi, *Cheilodactylus macropterus* (Bloch and Schneider), in New Zealand waters from 1936 to 1969, with notes on the trawl fishery in general. *Fisheries Research Bulletin, No. 7.* 45 p.
Vooren, C.M. (1975). Nursery grounds of tarakihi (Teleostei: Cheilodactylidae) around New Zealand. *New Zealand Journal of Marine and Freshwater Research 9*: 121–158.
Vooren, C.M. (1977). Growth and mortality of tarakihi (Pisces: Cheilodactylidae) in lightly exploited populations. *New Zealand Journal of Marine and Freshwater Research 11*: 1–22.
Vooren, C.M.; Tong, L.T. (1973). A survey of the tarakihi *Cheilodactylus macropterus* (Bloch and Schneider) in the East Cape area, New Zealand, 26–30 March 1971. *Fisheries Research Bulletin No. 9.* 28 p.

APPENDIX 1: ENLD CPUE ANALYSIS

The ENLD Trawl CPUE indices were derived from the trawl event-based data available from 1993–94 onwards. The data selection criteria are presented in Table A1.

Table A1: Data selection for the ENLD Trawl CPUE data set.

Attribute	Selection criteria	Number of records retained	TAR catch (t) retained
Fishing Years	1993–94 to 2024–25		
Statistical Area	002, 003	44 226	4 707.0
Fishing method	BT, PRB	44 226	4 707.0
Depth range	10–500 m	44 196	4 705.9
Target species	TAR	11 463	3 586.4
Tarakihi catch	< 6000 kg	11 462	3 577.0
Fishing duration	1–6 h	9 895	2 862.1
Vessel continuity	1 t TAR, >5 years	7 090	2 351.9
Trawl speed	2.0–5.0	7 084	2 351.2
Final data set		7 084	2 351.2

Table A2: Summary of the ENLD Trawl CPUE data set (core vessels only).

Fishing year	Number records	Number vessels	Number trips	Catch (t)	Number trawls	Duration (hrs)	Percent zero catch
1993–94	49	4	8	14.3	49	151	12.2
1994–95	70	6	15	34.2	70	270	8.6
1995–96	213	14	62	71.6	213	735	2.3
1996–97	237	13	75	120.4	237	797	3.4
1997–98	299	15	86	114.7	299	1 063	5.4
1998–99	214	12	60	65.7	214	741	3.3
1999–2000	411	13	83	97.5	411	1 510	5.4
2000–01	290	16	89	83.8	290	1 068	5.5
2001–02	215	15	72	91.9	215	816	4.7
2002–03	209	12	69	56.6	209	820	8.1
2003–04	160	10	54	60.3	160	654	5.0
2004–05	248	10	70	120.2	248	1 000	10.1
2005–06	253	12	86	93.2	253	1 059	5.9
2006–07	167	9	57	46.0	167	690	6.0
2007–08	343	10	79	115.5	343	1 432	2.3
2008–09	298	8	67	114.9	298	1 214	2.0
2009–10	296	8	69	85.6	296	1 158	3.0
2010–11	274	9	66	94.5	274	1 107	3.6
2011–12	340	8	71	101.0	340	1 302	5.6
2012–13	304	9	64	90.5	304	1 055	3.0
2013–14	553	10	101	180.6	553	2 121	5.2
2014–15	329	11	97	83.5	329	1 330	6.4
2015–16	330	9	88	98.0	330	1 364	1.8
2016–17	343	11	101	90.5	343	1 348	3.2
2017–18	212	10	79	67.4	212	879	1.9
2018–19	32	7	20	13.2	32	135	3.1
2019–20	80	8	44	25.0	80	341	8.8
2020–21	69	7	39	32.6	69	319	1.4
2021–22	79	8	44	33.1	79	354	3.8
2022–23	69	7	34	17.7	69	324	10.1
2023–24	21	5	12	5.1	21	97	14.3
2024–25	83	5	48	32.8	83	383	7.2

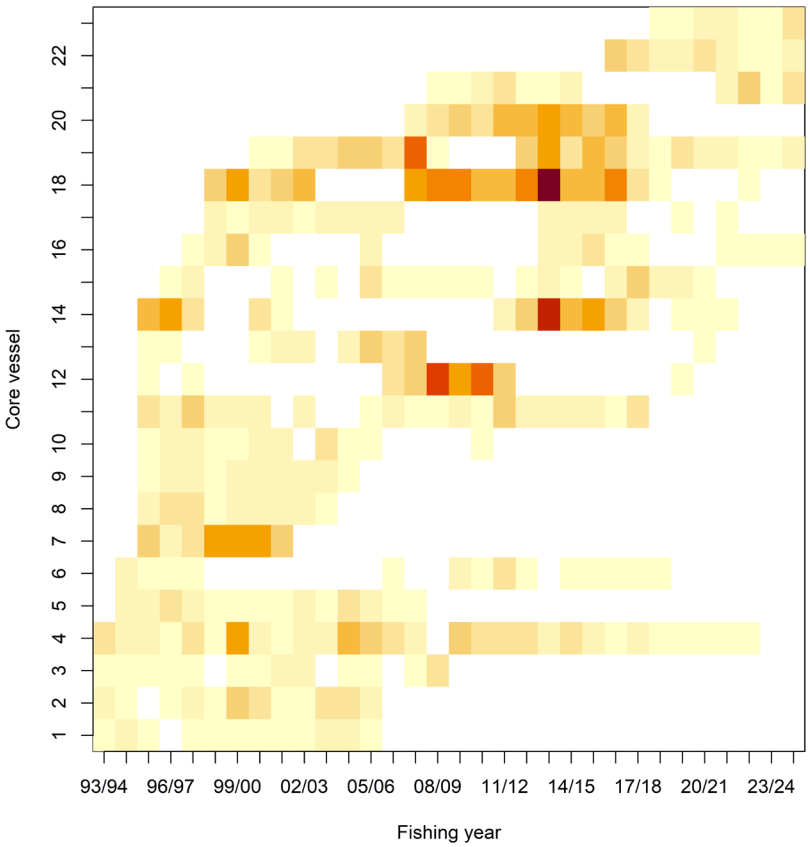


Figure A1: Annual number of trawl event records for each vessel included in the ENLD Trawl core fleet. The colour of the cell represents the number of records from low (pale yellow) to high (dark red).

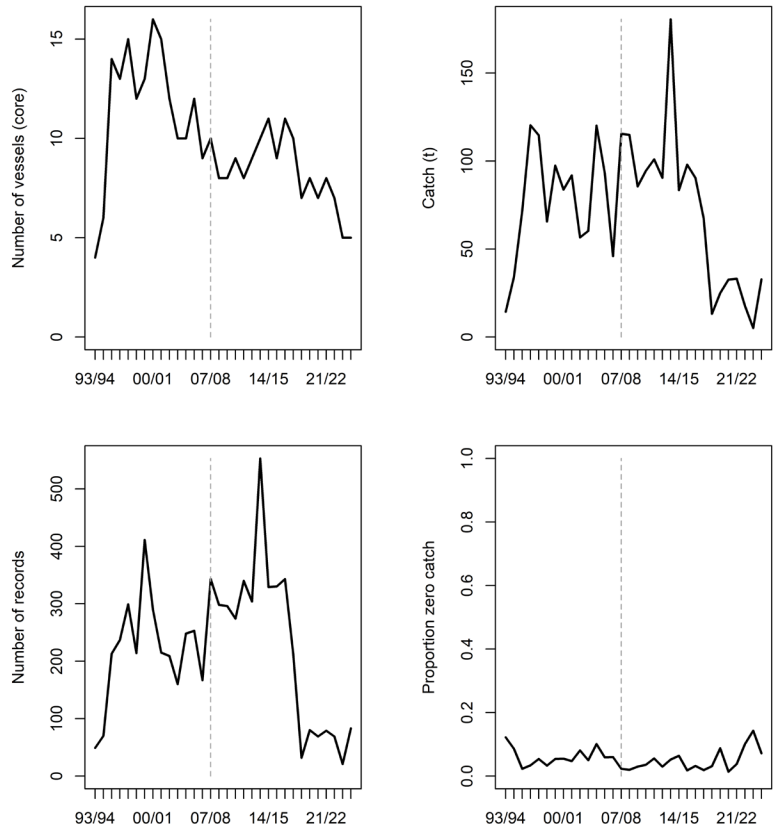


Figure A2: A summary of the data included in the ENLD Trawl CPUE data set.

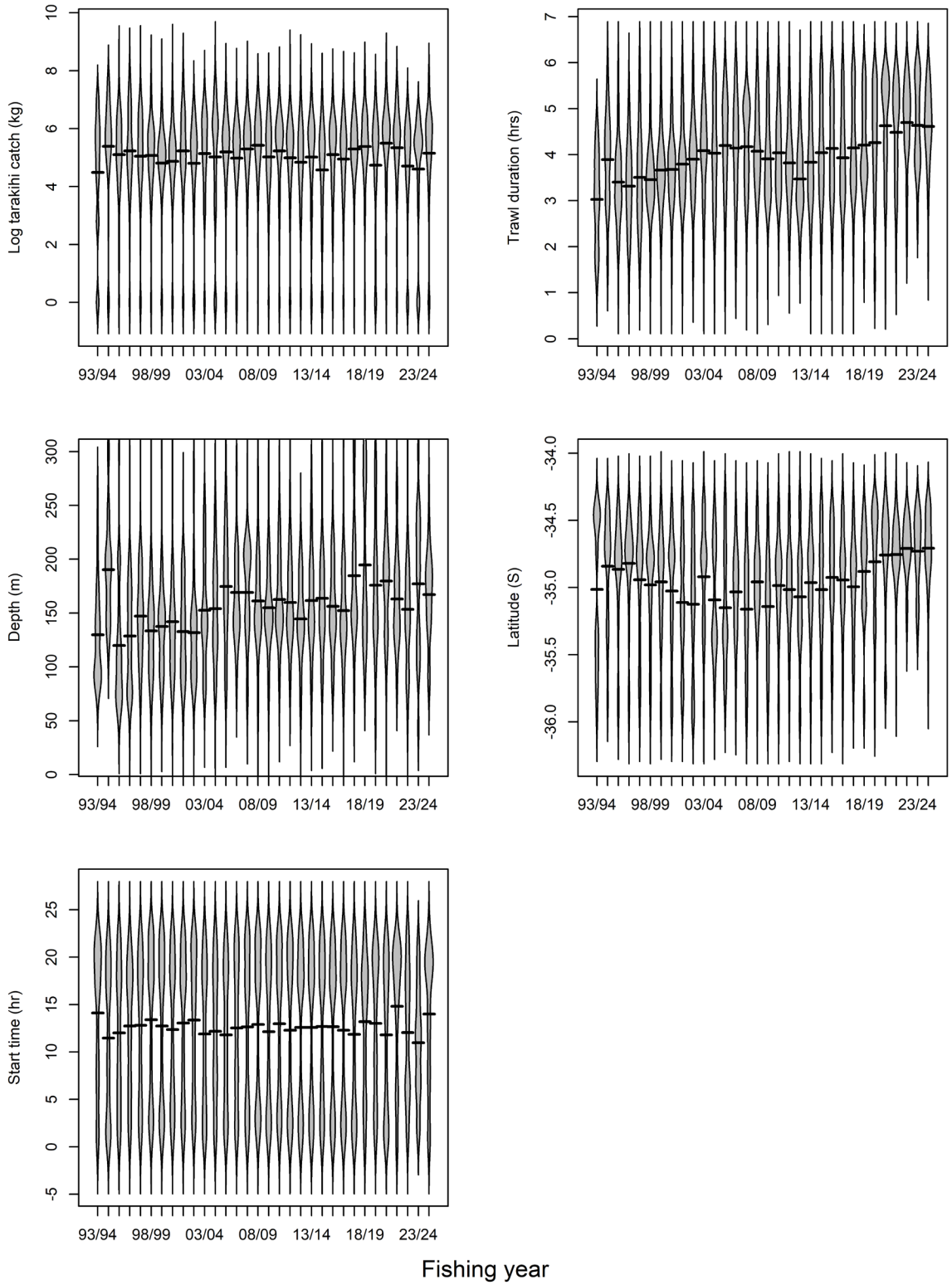


Figure A3: A summary of the fishing event data included in the ENLD Trawl CPUE data set.

Table A3: Summary of stepwise selection of variables in the ENLD Trawl positive catch CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			9 414.7		
FishingYear	31	265.5	9 149.2	0.028	
Latitude	17	1 579.8	7 569.5	0.196	16.8%
Vessel	22	1 034.5	6 535.0	0.306	11.0%
Depth	3	498.8	6 036.1	0.359	5.3%
Duration	3	264.2	5 771.9	0.387	2.8%
Month	11	281.5	5 490.4	0.417	3.0%
StartTime	3	170.0	5 320.4	0.435	1.8%

Table A4: Summary of stepwise selection of variables in the ENLD Trawl occurrence CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			2 635.5		
FishingYear	31	80.6	2 554.9	0.031	
StartTime	3	311.9	2 243.1	0.149	11.8%
Vessel	22	166.9	2 076.2	0.212	6.3%
Depth	3	135.2	1 941.0	0.264	5.1%
Duration	3	33.5	1 907.5	0.276	1.3%
Month	11	32.2	1 875.2	0.288	1.2%

Table A5: ENLD Trawl CPUE indices and associated lower bound (LCI) and upper bound (UCI) of the 95% confidence intervals.

Fishing year	Combined			Binomial			Weibull		
	Index	LCI	UCI	Index	LCI	UCI	Index	LCI	UCI
1993–94	0.855	0.524	1.223	0.878	0.593	0.973	1.000	0.721	1.358
1994–95	0.485	0.185	0.796	0.633	0.265	0.903	0.765	0.563	1.044
1995–96	0.796	0.586	1.039	0.939	0.796	0.989	0.849	0.641	1.084
1996–97	0.919	0.614	1.242	0.868	0.652	0.974	1.058	0.798	1.331
1997–98	0.655	0.434	0.888	0.794	0.552	0.936	0.826	0.628	1.055
1998–99	0.452	0.235	0.664	0.724	0.393	0.924	0.624	0.474	0.815
1999–2000	0.465	0.289	0.644	0.772	0.516	0.934	0.603	0.462	0.774
2000–01	0.523	0.290	0.757	0.720	0.428	0.916	0.725	0.545	0.935
2001–02	0.626	0.332	0.894	0.742	0.420	0.930	0.843	0.628	1.093
2002–03	0.557	0.265	0.819	0.671	0.364	0.898	0.831	0.617	1.056
2003–04	0.532	0.313	0.771	0.761	0.464	0.940	0.700	0.541	0.904
2004–05	0.764	0.480	1.054	0.767	0.503	0.921	0.997	0.751	1.307
2005–06	0.541	0.314	0.784	0.718	0.432	0.912	0.754	0.569	0.983
2006–07	0.405	0.202	0.616	0.664	0.328	0.898	0.610	0.456	0.808
2007–08	0.472	0.231	0.714	0.672	0.345	0.915	0.703	0.534	0.914
2008–09	0.464	0.190	0.724	0.655	0.267	0.915	0.708	0.529	0.908
2009–10	0.489	0.258	0.736	0.681	0.368	0.906	0.718	0.555	0.931
2010–11	0.344	0.137	0.589	0.510	0.207	0.809	0.675	0.509	0.861
2011–12	0.370	0.158	0.611	0.525	0.217	0.821	0.707	0.548	0.909
2012–13	0.473	0.226	0.726	0.653	0.335	0.890	0.724	0.560	0.924
2013–14	0.287	0.095	0.554	0.376	0.144	0.663	0.761	0.578	0.964
2014–15	0.262	0.114	0.432	0.501	0.234	0.781	0.523	0.396	0.673
2015–16	0.435	0.219	0.654	0.721	0.379	0.932	0.604	0.458	0.782
2016–17	0.275	0.100	0.476	0.480	0.172	0.796	0.574	0.433	0.734
2017–18	0.345	0.144	0.541	0.653	0.274	0.916	0.528	0.396	0.689
2018–19	0.287	0.050	0.583	0.583	0.096	0.959	0.492	0.332	0.709
2019–20	0.223	0.067	0.421	0.518	0.168	0.859	0.429	0.314	0.579
2020–21	0.442	0.102	0.732	0.707	0.165	0.980	0.625	0.444	0.856
2021–22	0.239	0.049	0.477	0.431	0.094	0.823	0.555	0.400	0.753
2022–23	0.181	0.041	0.411	0.350	0.079	0.742	0.518	0.347	0.738
2023–24	0.131	0.013	0.356	0.335	0.035	0.831	0.390	0.243	0.574
2024–25	0.155	0.027	0.378	0.273	0.048	0.653	0.568	0.390	0.776

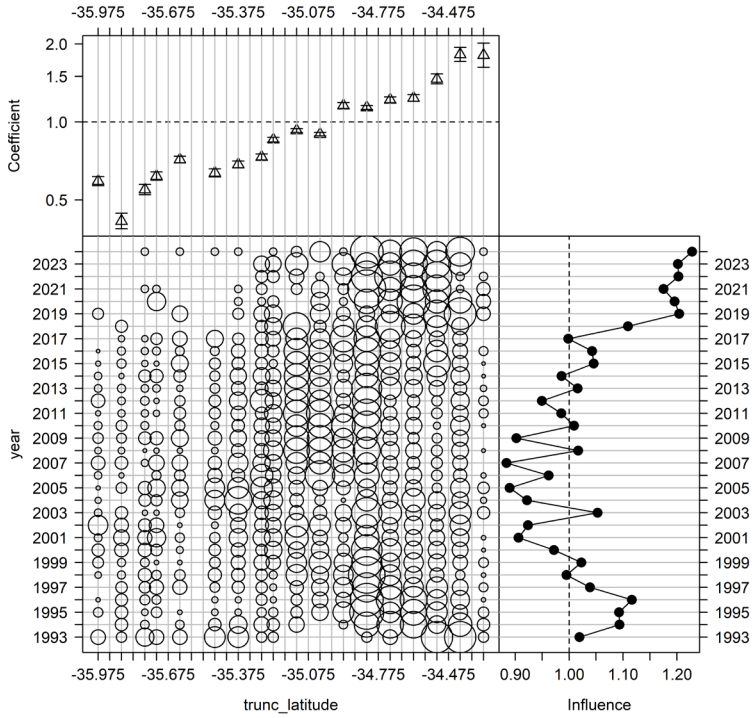


Figure A4: Influence plot of the Latitude variable in the ENLD Trawl positive catch CPUE model.

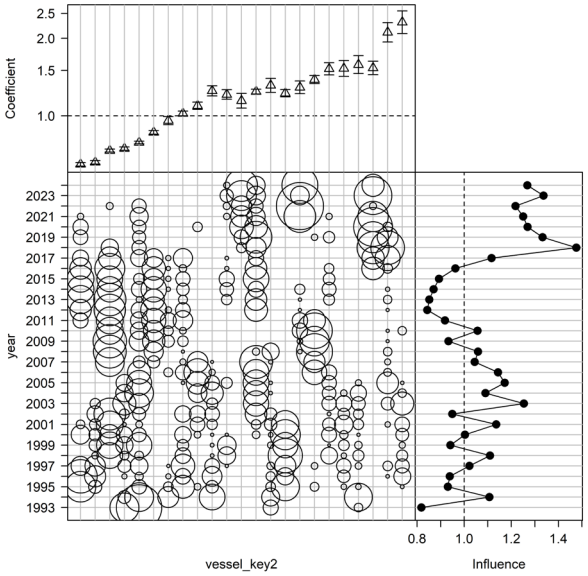


Figure A5: Influence plot of the Vessel variable in the ENLD Trawl positive catch CPUE model.

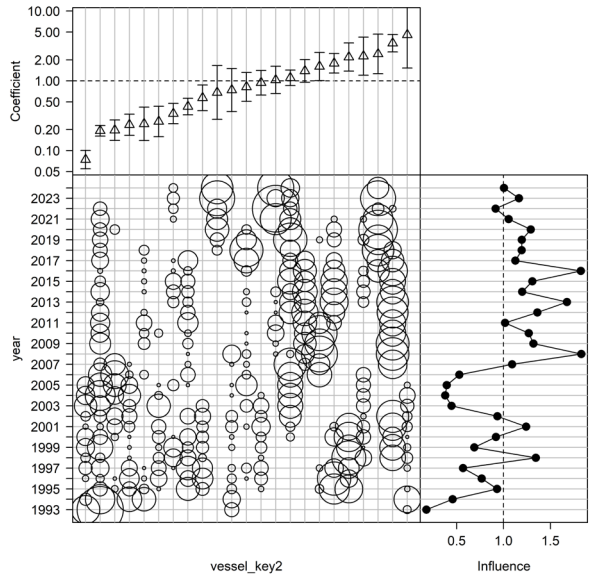


Figure A6: Influence plot of the Vessel variable in the ENLD Trawl occurrence CPUE model.

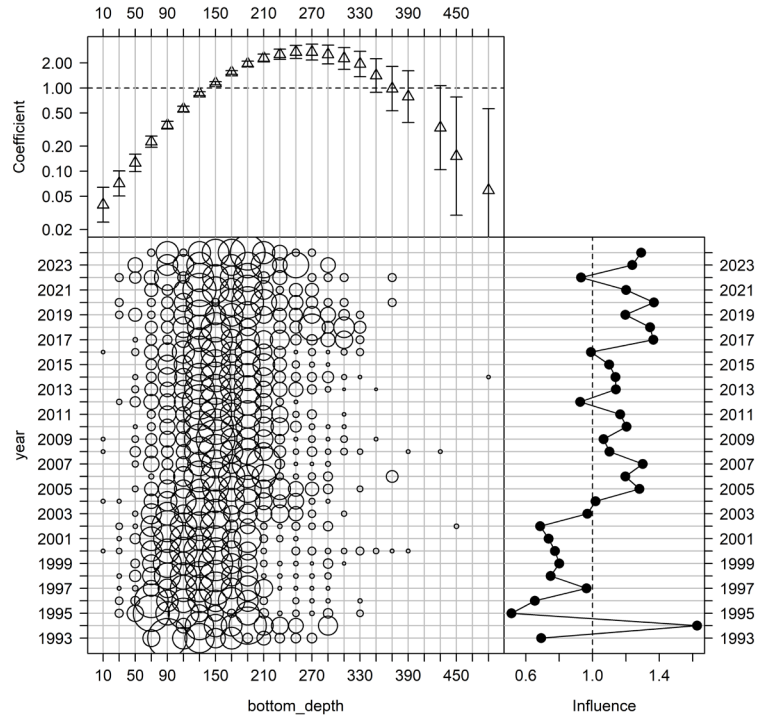


Figure A7: Influence plot of the Depth variable in the ENLD Trawl occurrence CPUE model.

APPENDIX 2: BPLE CPUE ANALYSIS

The BPLE CPUE indices were derived from the trawl event-based dataset. Initially, a core set of vessels was selected from the daily dataset, with minimum criteria of 1000 kg of tarakihi catch per annum for at least 6 years during 1989–90 to 2024–25. The final event-based CPUE data set was then selected to include all the trips conducted by the core set of vessels.

Table A6: Data selection for the BPLE Trawl event-based CPUE data set.

Attribute	Selection criteria	Number of records retained	TAR catch (t) retained
Selected trips (day)	Core vessels	125 437	19 777.5
Fishing Years	1993–94 to 2024–25	124 937	19 749.9
Statistical Area	008–010	90 173	11 000.3
Fishing method	BT	89 979	10 978.8
Depth range	10–500 m	89 945	10 974.3
Target species	-	89 945	10 974.3
Tarakihi catch	< 6000 kg	89 944	10 965.2
Fishing duration	1–6 h	85 452	10 014.7
Vessel continuity	-		
Final data set		85 452	10 014.7

Table A7: Summary of the BPLE Trawl CPUE data set (core vessels only).

Fishing year	Number records	Number vessels	Number trips	Catch (t)	Number trawls	Duration (hrs)	Percent zero catch
1993–94	686	13	68	73.0	686	2 219	50.6
1994–95	1 110	14	143	119.0	1 110	3 495	51.0
1995–96	2 471	29	346	280.5	2 471	7 518	54.9
1996–97	2 338	26	331	221.3	2 338	6 504	54.6
1997–98	2 573	27	341	282.0	2 573	8 236	50.9
1998–99	3 258	21	346	253.6	3 258	9 410	60.6
1999–2000	2 792	17	282	172.8	2 792	7 466	58.3
2000–01	3 765	24	411	416.4	3 765	10 500	54.1
2001–02	3 536	18	433	505.3	3 536	10 661	49.2
2002–03	3 946	23	461	547.0	3 946	12 059	50.3
2003–04	4 292	22	475	597.0	4 292	12 942	49.8
2004–05	4 294	20	420	501.4	4 294	12 963	48.7
2005–06	3 434	19	376	403.3	3 434	10 524	50.3
2006–07	2 581	15	264	364.6	2 581	7 765	47.1
2007–08	3 347	18	374	432.9	3 347	10 362	45.9
2008–09	3 601	19	378	572.2	3 601	11 150	40.8
2009–10	3 623	17	418	590.1	3 623	11 132	39.5
2010–11	3 438	18	377	516.5	3 438	9 924	43.9
2011–12	3 476	15	368	442.5	3 476	9 672	46.8
2012–13	2 834	16	347	349.7	2 834	8 166	49.2
2013–14	3 090	16	336	266.5	3 090	8 529	55.5
2014–15	2 532	16	285	273.1	2 532	7 409	55.0
2015–16	2 149	17	248	225.1	2 149	6 833	52.3
2016–17	2 415	14	236	292.4	2 415	7 452	46.8
2017–18	1 782	11	167	264.4	1 782	5 556	35.0
2018–19	1 925	12	226	169.7	1 925	5 789	55.8
2019–20	1 951	11	231	185.1	1 951	5 991	47.8
2020–21	1 757	10	212	145.0	1 757	5 537	48.8
2021–22	1 288	10	174	126.6	1 288	4 164	52.4
2022–23	1 404	8	169	130.8	1 404	4 672	41.9
2023–24	2 074	7	200	146.6	2 074	6 555	60.2
2024–25	1 342	6	148	76.8	1 342	4 438	56.3

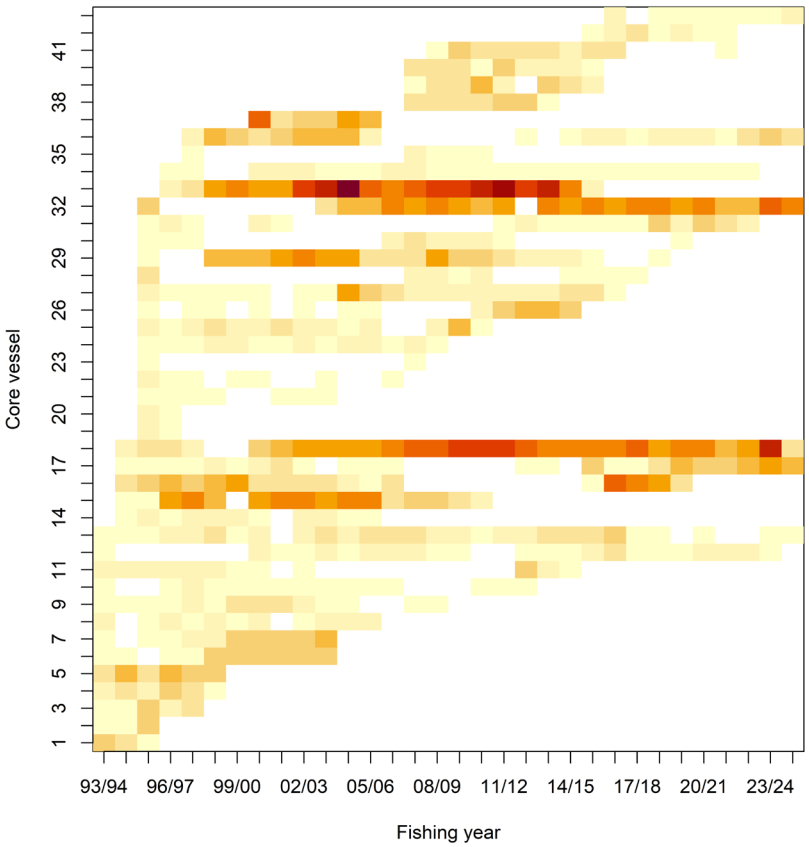


Figure A8: Annual number of trawl event records for each vessel included in the BPLE Trawl core fleet. The colour of the cell represents the number of records from low (pale yellow) to high (dark red).

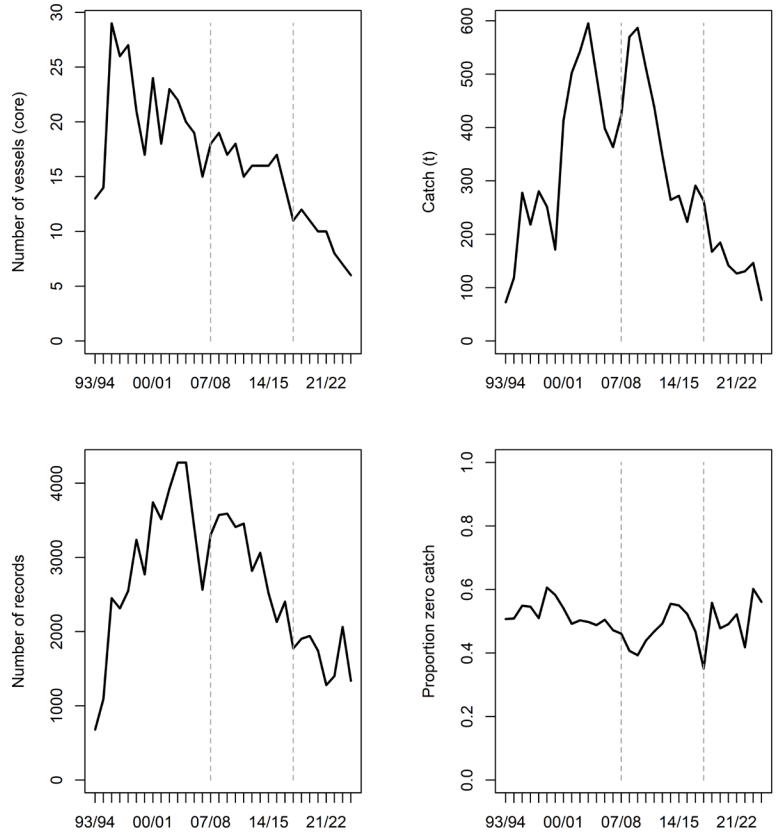


Figure A9: A summary of the data included in the BPLE Trawl CPUE data set.

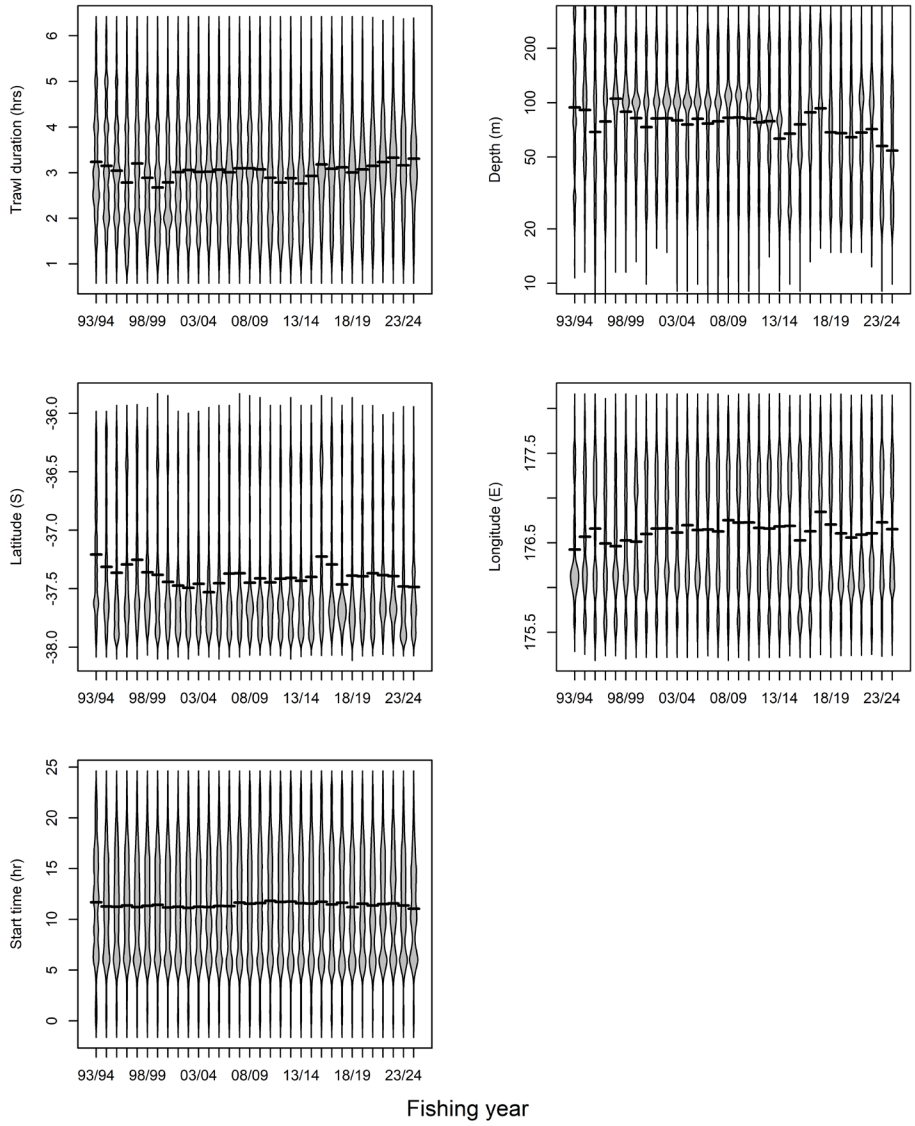


Figure A10: A summary of the fishing event data included in the BPLE Trawl CPUE data set.

Table A8: Summary of stepwise selection of variables in the BPLE Trawl positive catch CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			151 376		
FishingYear	31	4 044	147 332	0.027	
Depth	3	43 560	103 771	0.314	28.8%
Vessel	42	13 881	89 890	0.406	9.2%
Longitude	5	5 398	84 493	0.442	3.6%
Duration	3	3 822	80 671	0.467	2.5%
StartTime	3	2 272	78 399	0.482	1.5%
Latitude	5	1 321	77 079	0.491	0.9%
Month	11	754	76 325	0.496	0.5%

Table A9: Summary of stepwise selection of variables in the BPLE Trawl occurrence CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			117 979		
FishingYear	31	1 098.2	116 881	0.009	
Depth	3	18 894.2	97 986	0.169	16.0%
Vessel	42	5 154.0	92 832	0.213	4.4%
StartTime	3	3 398.6	89 434	0.242	2.9%
Duration	3	1 291.6	88 142	0.253	1.1%
Month	11	1 333.7	86 809	0.264	1.1%

Table A10: BPLE Trawl CPUE indices and associated lower bound (LCI) and upper bound (UCI) of the 95% confidence intervals.

Fishing year	Combined			Binomial			Lognormal		
	Index	LCI	UCI	Index	LCI	UCI	Index	LCI	UCI
1993–94	0.494	0.324	0.680	0.494	0.341	0.646	1.000	0.827	1.195
1994–95	0.479	0.302	0.703	0.402	0.270	0.565	1.191	0.990	1.438
1995–96	0.443	0.284	0.623	0.445	0.301	0.597	0.997	0.830	1.192
1996–97	0.466	0.305	0.647	0.453	0.313	0.612	1.027	0.849	1.212
1997–98	0.457	0.295	0.651	0.414	0.270	0.564	1.106	0.923	1.307
1998–99	0.389	0.240	0.555	0.342	0.217	0.470	1.136	0.941	1.337
1999–2000	0.354	0.219	0.502	0.460	0.289	0.627	0.770	0.637	0.916
2000–01	0.667	0.435	0.914	0.486	0.334	0.644	1.374	1.148	1.645
2001–02	0.640	0.442	0.892	0.509	0.359	0.664	1.257	1.055	1.493
2002–03	0.788	0.526	1.062	0.495	0.345	0.640	1.593	1.335	1.875
2003–04	0.819	0.553	1.096	0.529	0.384	0.675	1.547	1.295	1.842
2004–05	0.679	0.466	0.913	0.563	0.404	0.707	1.207	1.013	1.441
2005–06	0.536	0.356	0.745	0.488	0.330	0.643	1.098	0.924	1.294
2006–07	0.604	0.416	0.806	0.548	0.394	0.698	1.102	0.923	1.293
2007–08	0.568	0.403	0.757	0.571	0.420	0.707	0.995	0.835	1.176
2008–09	0.668	0.478	0.885	0.588	0.431	0.732	1.137	0.960	1.344
2009–10	0.703	0.504	0.915	0.627	0.472	0.768	1.122	0.936	1.314
2010–11	0.467	0.319	0.635	0.594	0.434	0.731	0.787	0.654	0.926
2011–12	0.519	0.357	0.686	0.585	0.430	0.726	0.887	0.743	1.051
2012–13	0.615	0.422	0.816	0.580	0.417	0.720	1.060	0.895	1.254
2013–14	0.351	0.232	0.474	0.528	0.368	0.687	0.665	0.553	0.803
2014–15	0.379	0.238	0.522	0.484	0.325	0.641	0.784	0.653	0.935
2015–16	0.293	0.188	0.409	0.477	0.325	0.646	0.615	0.504	0.740
2016–17	0.338	0.223	0.471	0.481	0.331	0.647	0.703	0.583	0.838
2017–18	0.333	0.216	0.449	0.542	0.372	0.701	0.615	0.509	0.732
2018–19	0.193	0.122	0.282	0.435	0.289	0.599	0.442	0.365	0.534
2019–20	0.224	0.153	0.302	0.568	0.399	0.718	0.394	0.328	0.471
2020–21	0.247	0.164	0.337	0.547	0.379	0.708	0.452	0.374	0.541
2021–22	0.310	0.191	0.443	0.487	0.321	0.655	0.637	0.518	0.777
2022–23	0.271	0.185	0.373	0.573	0.412	0.730	0.473	0.389	0.569
2023–24	0.171	0.106	0.251	0.431	0.279	0.587	0.397	0.329	0.483
2024–25	0.175	0.113	0.252	0.482	0.321	0.647	0.362	0.299	0.444

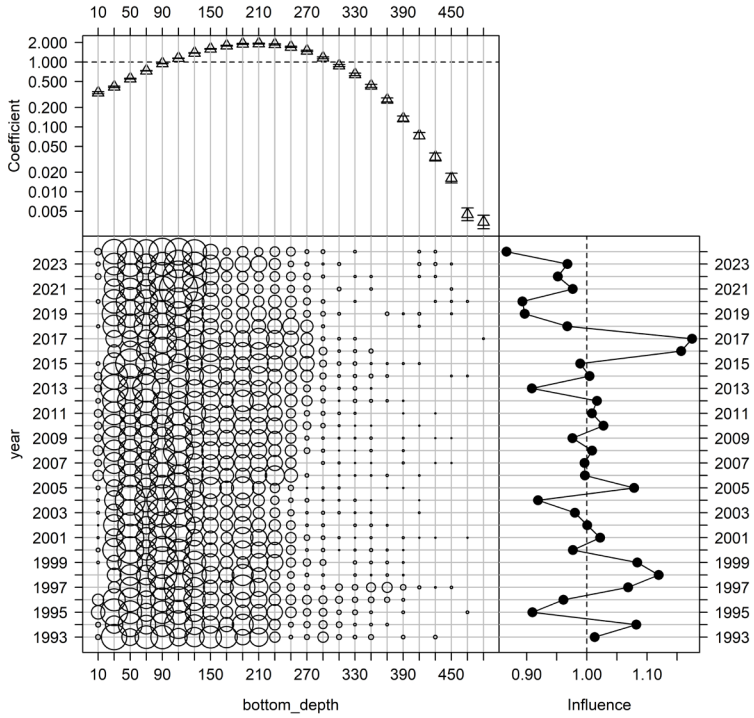


Figure A11: Influence plot of the Depth variable in the BPLE Trawl positive catch CPUE model.

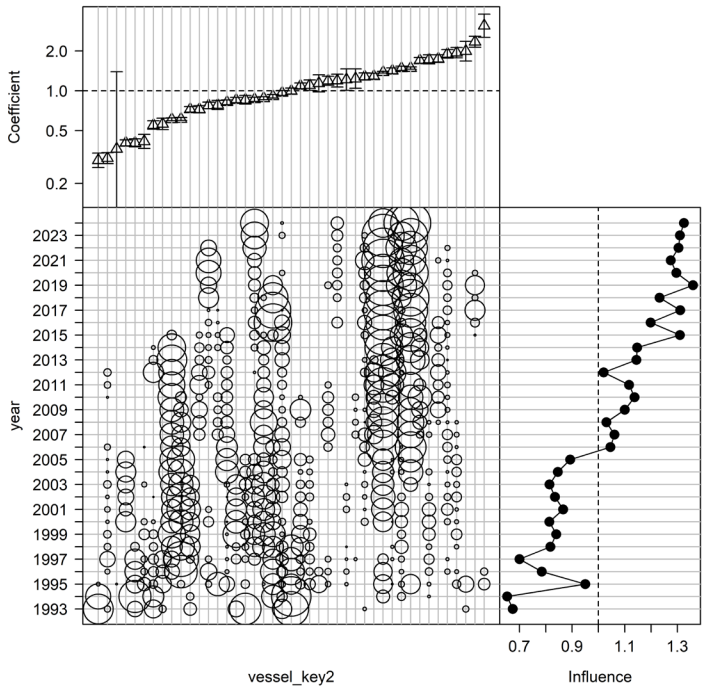


Figure A12: Influence plot of the Vessel variable in the BPLE Trawl positive catch CPUE model.

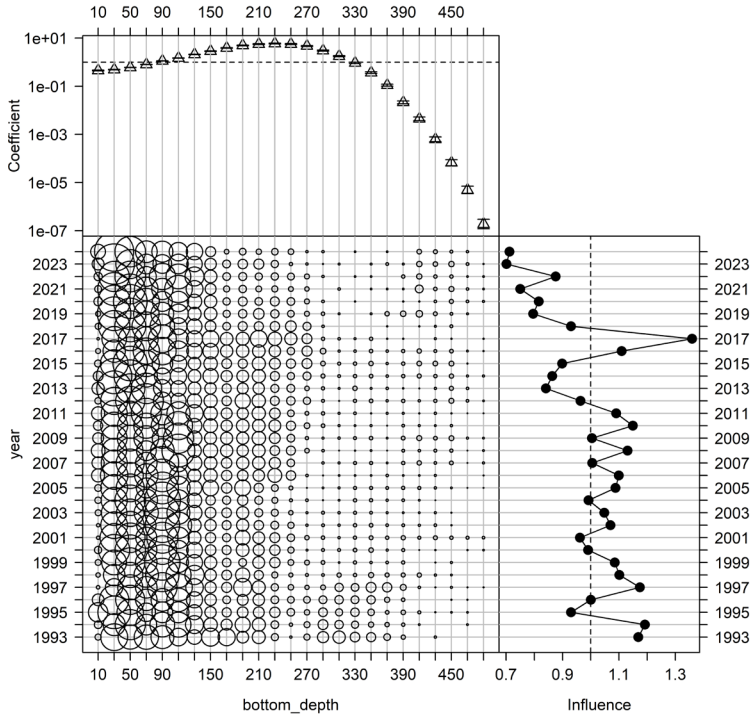


Figure A13: Influence plot of the Depth variable in the BPLE Trawl occurrence CPUE model.

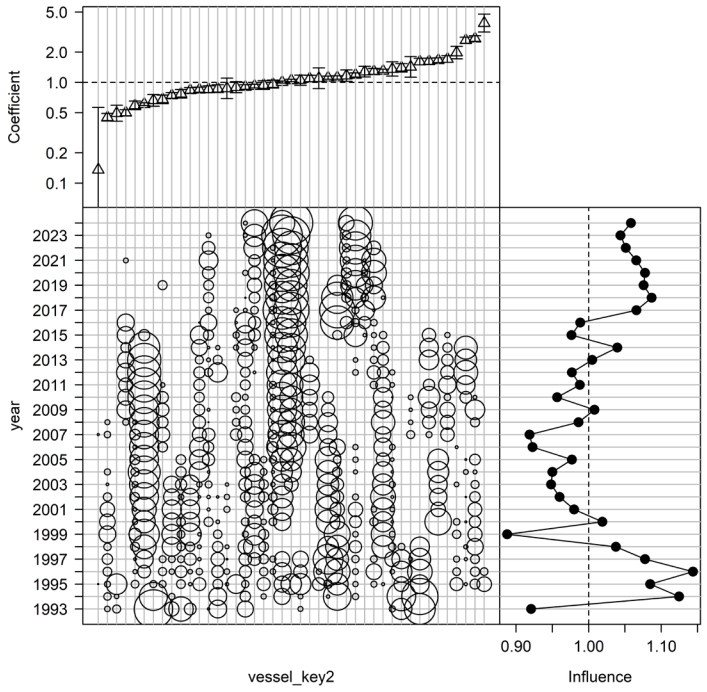


Figure A14: Influence plot of the Vessel variable in the BPLE Trawl occurrence CPUE model.

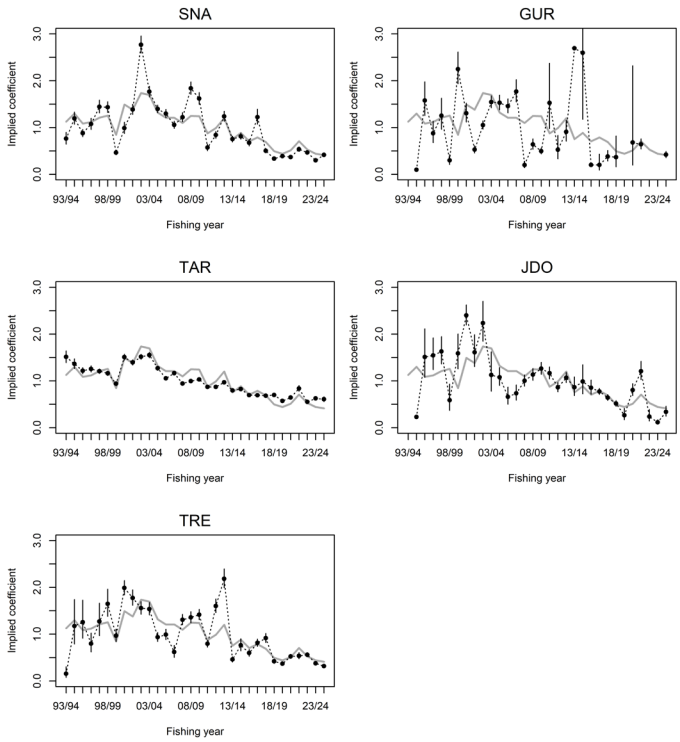


Figure A15: Implied coefficients from the positive catch CPUE model for the individual species targeted by the BPLE trawl fishery.

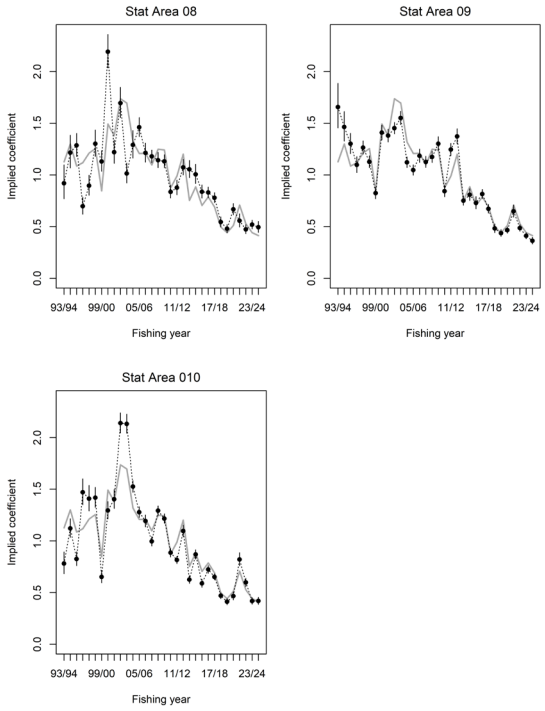


Figure A16: Implied coefficients from the positive catch CPUE model for the individual Statistical Areas that constitute the BPLE trawl fishery.

APPENDIX 3: TAR 2 CPUE ANALYSIS

The trawl event-based TAR 2 CPUE indices were derived for the equivalent set of vessels included in the Daily CPUE indices. Initially, a core set of vessels was selected for the daily CPUE analysis, with minimum criteria of 1000 kg of tarakihi catch per annum for at least 6 years during 1989–90 to 2024–25. The final event-based CPUE data set was then selected to include all the trips conducted by the core set of vessels.

Table A11: Data selection for the TAR 2 Trawl Event CPUE data set.

Attribute	Selection criteria	Number of records retained	TAR catch (t) retained
Selected trips (day)	Core vessels	150 271	34 206.5
Fishing Years	2007–08 to 2024–25	122 824	27 308.0
Statistical Area	011–015	110 352	25 010.7
Fishing method	BT	110 321	24 995.4
Depth range	10–500 m	110 122	24 994.2
Target species	-	110 122	24 994.2
Tarakihi catch	< 6000 kg	110 113	24 920.4
Fishing duration	1–6 h	108 003	24 071.3
Vessel continuity	-	108 003	24 071.3
Latitude	36–42 S	107 986	24 066.3
Longitude	175–180 E	107 986	24 066.3
Trawl speed	1.0–5.0	107 952	24 058.9
Final data set		107 952	24 058.9

Table A12: Summary of the TAR 2 Trawl CPUE data set (core vessels only).

Fishing year	Number records	Number vessels	Number trips	Catch (t)	Number trawls	Duration (hrs)	Percent zero catch
2007–08	7 661	31	892	1 432.5	7 661	27 328	28.8
2008–09	8 599	32	980	1 707.5	8 599	30 814	27.3
2009–10	9 261	33	1068	1 675.5	9 261	32 976	29.7
2010–11	8 849	32	931	1 509.1	8 849	31 069	31.0
2011–12	7 505	29	857	1 473.0	7 505	26 610	28.0
2012–13	7 051	26	785	1 517.8	7 051	25 167	31.6
2013–14	7 706	27	802	1 423.3	7 706	27 413	32.1
2014–15	7 090	27	767	1 647.7	7 090	25 823	28.9
2015–16	6 290	25	766	1 563.6	6 290	23 393	32.7
2016–17	5 962	24	659	1 604.0	5 962	22 309	31.1
2017–18	5 105	23	623	1 309.6	5 105	19 502	31.9
2018–19	5 311	22	657	1 247.2	5 311	20 162	29.3
2019–20	4 401	23	549	1 012.2	4 401	17 082	30.1
2020–21	4 084	23	607	1 131.1	4 084	15 204	31.1
2021–22	3 967	19	687	1 082.4	3 967	14 518	34.2
2022–23	3 028	17	523	963.3	3 028	11 280	27.0
2023–24	3 185	17	571	950.2	3 185	11 775	31.9
2024–25	2 809	16	528	786.5	2 809	10 516	35.8

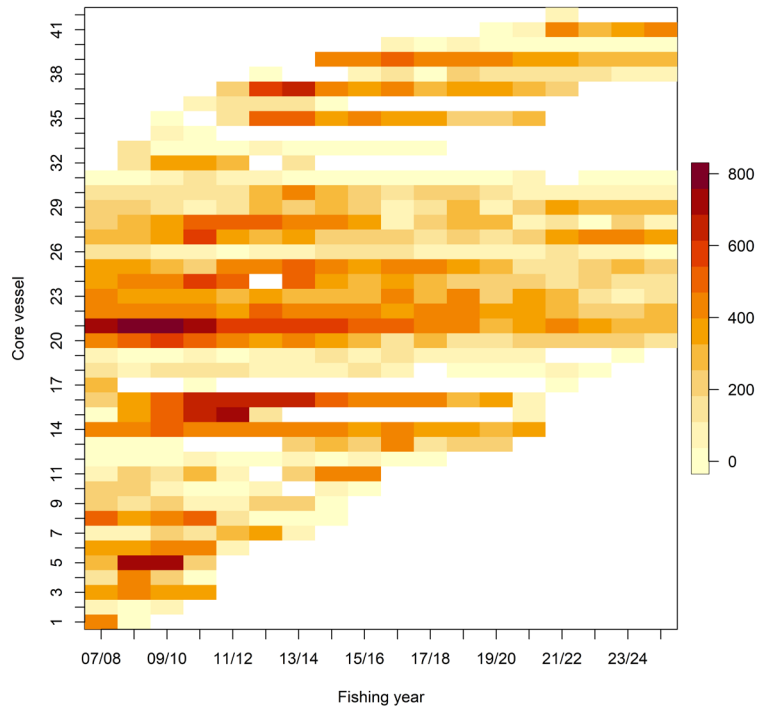


Figure A17: Annual number of trawl event records for each vessel included in the TAR 2 Trawl core fleet. The colour of the cell represents the number of records from low (pale yellow) to high (dark red).

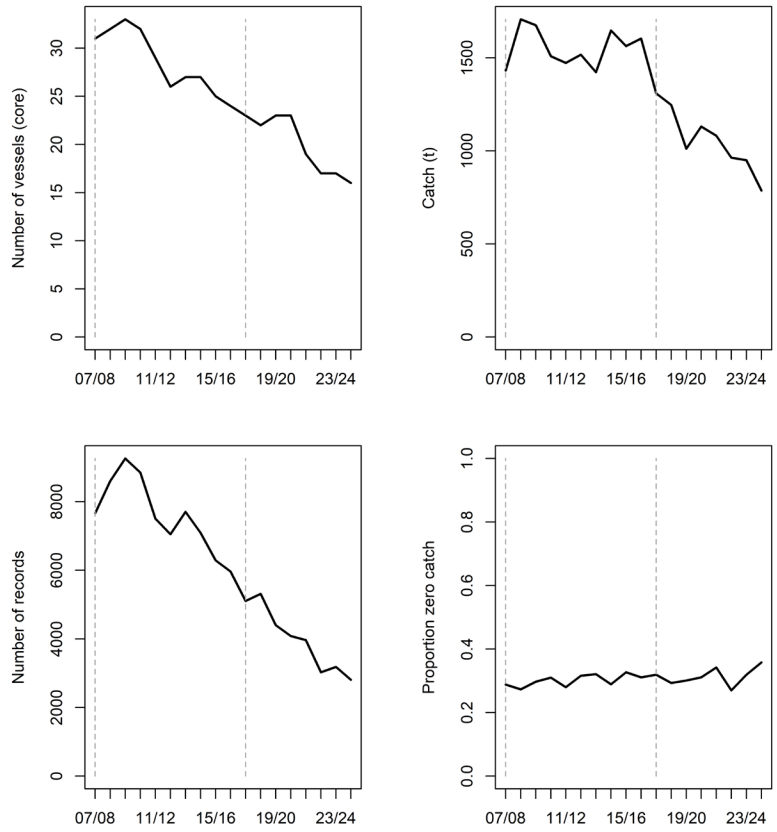


Figure A18: A summary of the data included in the TAR 2 Trawl CPUE data set.

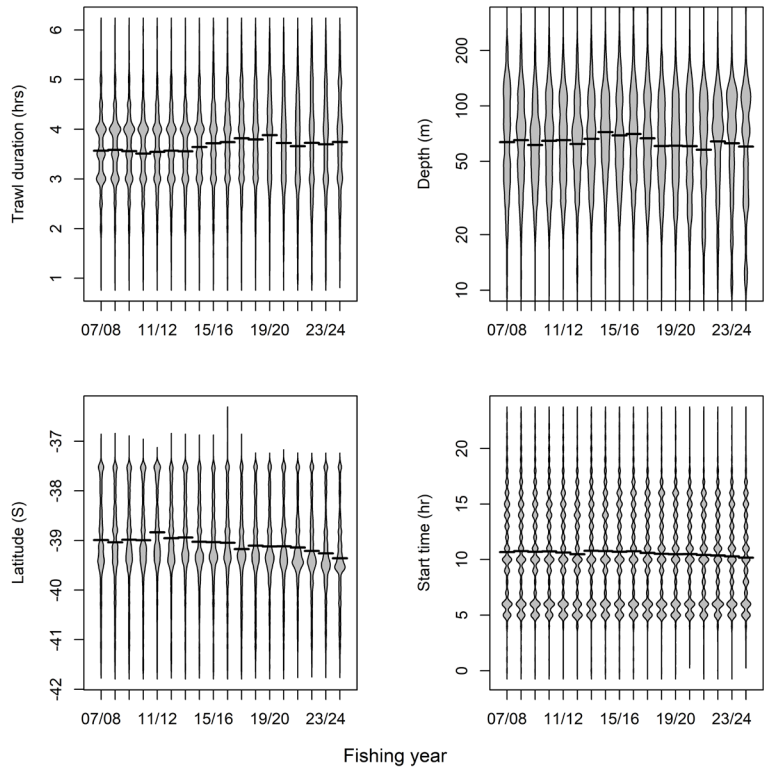


Figure A19: A summary of the fishing event data included in the TAR 2 Trawl CPUE data set.

Table A13: Summary of stepwise selection of variables in the TAR 2 Trawl positive catch CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			251 065		
FishingYear	17	2 629	248 437	0.010	
Vessel	41	56 668	191 768	0.236	22.6%
Depth	3	25 027	166 741	0.336	10.0%
Longitude	5	6 597	160 145	0.362	2.6%
Latitude	5	8 032	152 113	0.394	3.2%
Month	11	3 220	148 893	0.407	1.3%
Duration	3	1 501	147 392	0.413	0.6%
StartTime	3	320	147 071	0.414	0.1%

Table A14: Summary of stepwise selection of variables in the TAR 2 Trawl occurrence CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			132 511		
FishingYear	17	207	132 304	0.002	
Depth	3	36 846	95 458	0.280	27.8%
Longitude	5	7 883	87 574	0.339	5.9%
Month	11	3 273	84 302	0.364	2.5%
Latitude	5	1 332	82 970	0.374	1.0%
Vessel	41	1 322	81 648	0.384	1.0%
StartTime	3	800	80 848	0.390	0.6%

Table A15: TAR 2 Trawl CPUE indices and associated lower bound (LCI) and upper bound (UCI) of the 95% confidence intervals.

Fishing year	Combined			Binomial			Lognormal		
	Index	LCI	UCI	Index	LCI	UCI	Index	LCI	UCI
2007–08	0.713	0.667	0.758	0.712	0.691	0.734	1.000	0.946	1.057
2008–09	0.777	0.729	0.820	0.715	0.694	0.736	1.087	1.027	1.142
2009–10	0.727	0.685	0.772	0.702	0.682	0.722	1.037	0.981	1.092
2010–11	0.544	0.511	0.581	0.665	0.641	0.689	0.818	0.776	0.863
2011–12	0.552	0.519	0.587	0.690	0.667	0.713	0.800	0.758	0.847
2012–13	0.684	0.637	0.732	0.647	0.621	0.671	1.058	0.998	1.117
2013–14	0.572	0.533	0.613	0.626	0.601	0.651	0.913	0.863	0.968
2014–15	0.666	0.620	0.711	0.641	0.615	0.664	1.039	0.979	1.099
2015–16	0.660	0.611	0.709	0.630	0.604	0.656	1.046	0.983	1.113
2016–17	0.750	0.692	0.804	0.624	0.594	0.650	1.202	1.126	1.275
2017–18	0.789	0.732	0.856	0.621	0.593	0.648	1.272	1.199	1.349
2018–19	0.740	0.686	0.796	0.708	0.685	0.733	1.045	0.979	1.109
2019–20	0.670	0.622	0.723	0.704	0.676	0.731	0.952	0.891	1.020
2020–21	0.818	0.756	0.885	0.691	0.662	0.717	1.182	1.108	1.272
2021–22	0.934	0.856	1.012	0.683	0.652	0.714	1.367	1.276	1.460
2022–23	0.979	0.896	1.068	0.718	0.686	0.748	1.364	1.262	1.469
2023–24	0.898	0.820	0.980	0.654	0.620	0.686	1.373	1.271	1.476
2024–25	0.724	0.657	0.798	0.620	0.583	0.658	1.167	1.076	1.261

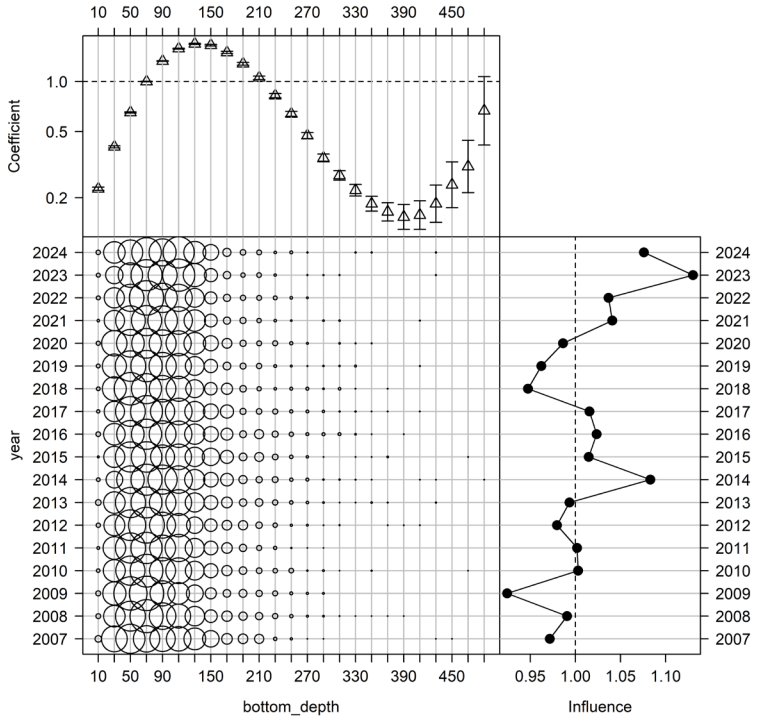


Figure A20: Influence plot of the Depth variable in the TAR 2 Trawl positive catch CPUE model.

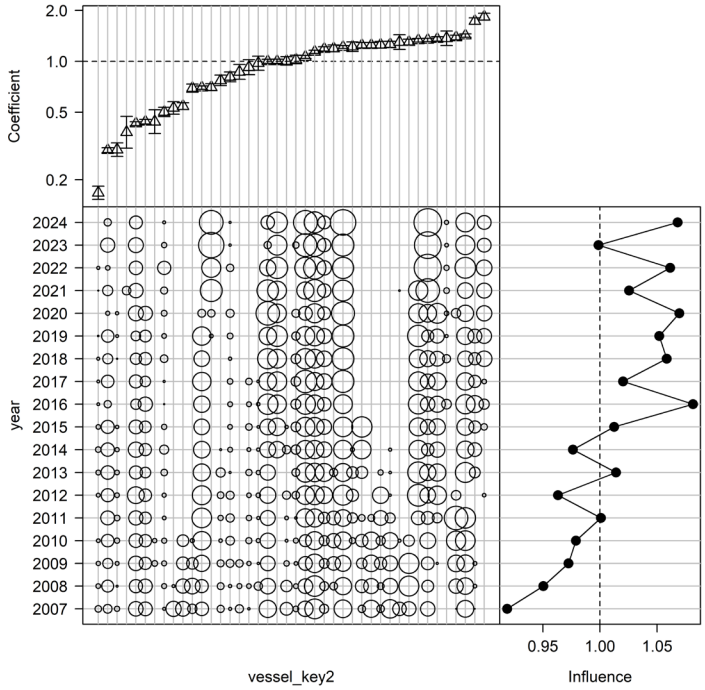


Figure A21: Influence plot of the Vessel variable in the TAR 2 Trawl positive catch CPUE model.

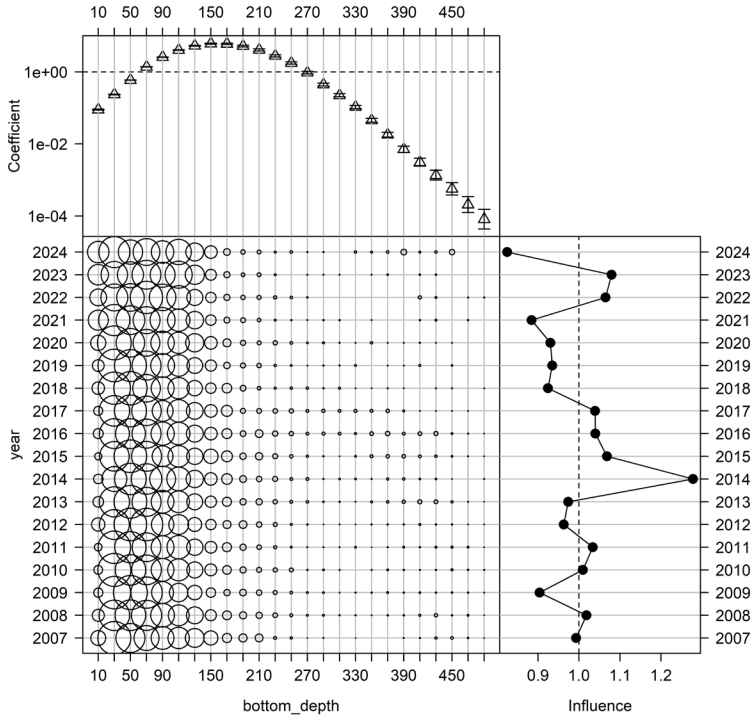


Figure A22: Influence plot of the Depth variable in the TAR 2 Trawl occurrence CPUE model.

APPENDIX 4: COOK CPUE ANALYSIS

The trawl event-based Cook Strait CPUE indices were derived for the equivalent set of vessels included in the Daily CPUE indices. Initially, a core set of vessels was selected for the daily CPUE analysis, with minimum criteria of 1000 kg of tarakihi catch per annum for at least 6 years during 1989–90 to 2024–25. The final event-based CPUE data set was then selected to include all the trips conducted by the core set of vessels.

Table A16: Data selection for the Cook Trawl Event CPUE data set.

Attribute	Selection criteria	Number of records retained	TAR catch (t) retained
Selected trips (day)	Core vessels	32 774	6 874.6
Fishing Years	2007–08 to 2024–25	30 058	5 931.7
Statistical Area	017, 018	20 168	4 721.8
Fishing method	BT	20 168	4 721.8
Depth range	10–500 m	20 112	4 721.6
Target species	-	20 112	4 721.6
Tarakihi catch	< 6000 kg	20 111	4 715.3
Fishing duration	1–6 h	19 625	4 624.5
Vessel continuity	-	19 625	4 624.5
Latitude	35–45 S	19 610	4 623.7
Longitude	173–175 E	19 481	4 614.5
Trawl speed	1.0–5.0	19 471	4 613.6
Final data set		19 471	4 613.6

Table A17: Summary of the Cook Trawl CPUE data set (core vessels only).

Fishing year	Number records	Number vessels	Number trips	Catch (t)	Number trawls	Duration (hrs)	Percent zero catch
2007–08	826	15	138	172.1	826	2 154	38.5
2008–09	1 069	15	154	211.1	1 069	2 819	37.8
2009–10	1 375	15	172	332.6	1 375	3 848	41.9
2010–11	1 753	16	168	293.9	1 753	4 748	38.2
2011–12	1 610	16	174	295.2	1 610	4 507	30.7
2012–13	1 981	17	206	292.5	1 981	5 410	34.1
2013–14	1 267	15	154	195.1	1 267	3 393	34.6
2014–15	1 200	13	152	229.6	1 200	2 968	35.7
2015–16	1 448	11	172	327.9	1 448	3 730	28.2
2016–17	941	11	127	293.0	941	2 345	27.8
2017–18	1 026	12	129	382.0	1 026	2 729	19.6
2018–19	1 039	13	171	278.6	1 039	2 644	33.9
2019–20	667	10	130	212.3	667	1 767	25.9
2020–21	760	9	155	218.8	760	2 039	27.9
2021–22	613	10	128	206.6	613	1 649	23.5
2022–23	609	10	106	263.3	609	1 666	18.9
2023–24	750	8	141	232.2	750	2 145	26.1
2024–25	537	8	141	177.0	537	1 467	19.9

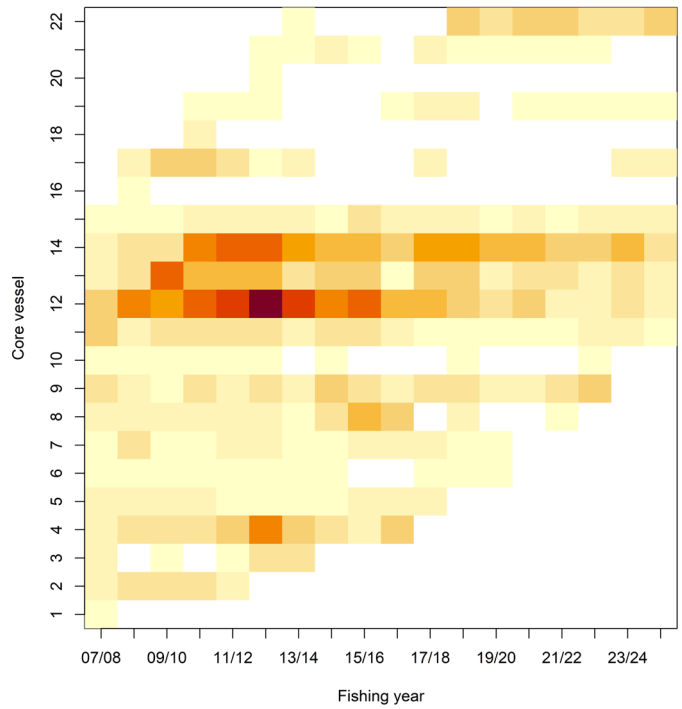


Figure A23: Annual number of trawl event records for each vessel included in the Cook Trawl core fleet. The colour of the cell represents the number of records from low (pale yellow) to high (dark red).

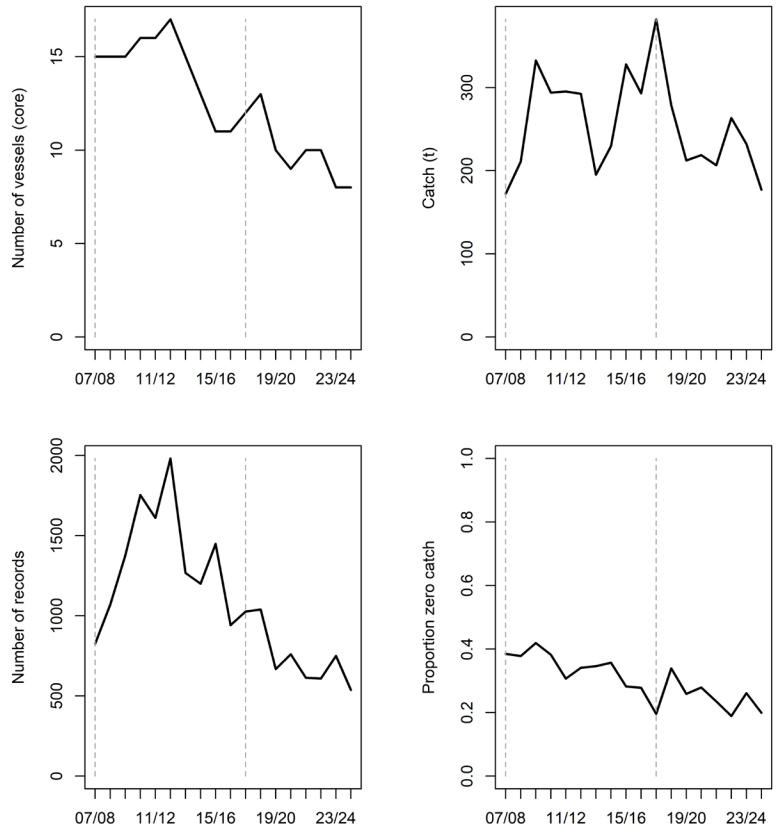


Figure A24: A summary of the data included in the Cook Trawl CPUE data set.

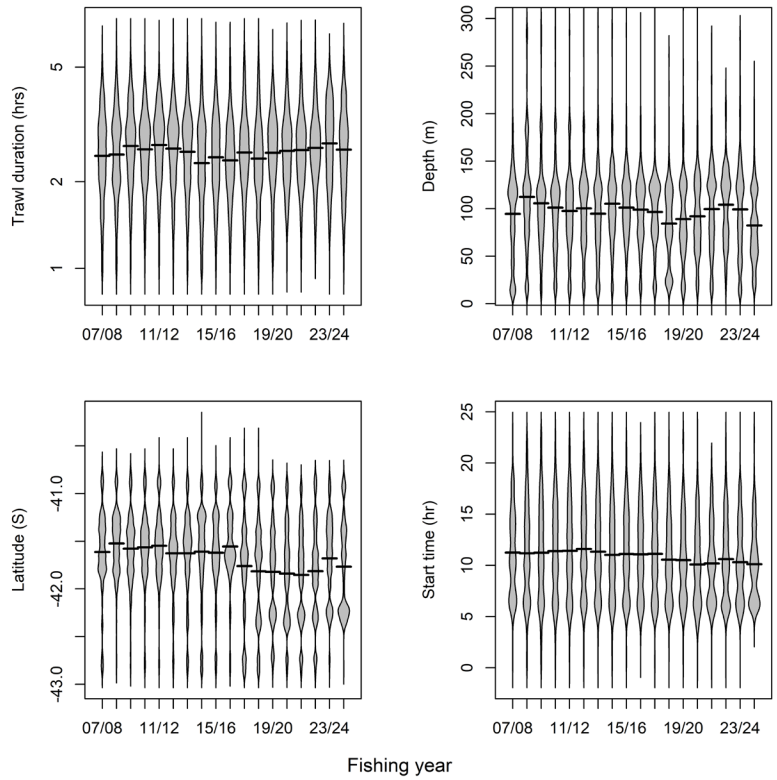


Figure A25: A summary of the fishing event data included in the Cook Trawl CPUE data set.

Table A18: Summary of stepwise selection of variables in the Cook Trawl positive catch CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			39 342		
FishingYear	17	1 218.1	38 124	0.031	
Latitude	5	9 410.1	28 714	0.270	23.9%
Depth	3	2 450.9	26 263	0.332	6.2%
Month	11	1 918.5	24 344	0.381	4.9%
Vessel	21	1 147.6	23 197	0.410	2.9%
Longitude	5	853.6	22 343	0.432	2.2%
StartTime	3	307.1	22 036	0.440	0.8%
Duration	3	199.7	21 836	0.445	0.5%

Table A19: Summary of stepwise selection of variables in the Cook Trawl occurrence CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			24 328		
FishingYear	17	378.5	23 950	0.016	
Latitude	5	5 374.6	18 575	0.236	22.1%
Longitude	5	1 774.7	16 801	0.309	7.3%
Month	11	462.5	16 338	0.328	1.9%
Vessel	21	219.1	16 119	0.337	0.9%

Table A20: Cook Trawl CPUE indices and associated lower bound (LCI) and upper bound (UCI) of the 95% confidence intervals.

Fishing year	Combined			Binomial			Lognormal		
	Index	LCI	UCI	Index	LCI	UCI	Index	LCI	UCI
2007–08	0.616	0.506	0.732	0.615	0.548	0.680	1.000	0.849	1.171
2008–09	0.735	0.610	0.867	0.680	0.621	0.736	1.081	0.922	1.254
2009–10	0.631	0.514	0.761	0.513	0.450	0.582	1.231	1.054	1.419
2010–11	0.602	0.502	0.713	0.584	0.521	0.642	1.032	0.899	1.181
2011–12	0.691	0.585	0.803	0.692	0.632	0.747	0.999	0.875	1.145
2012–13	0.421	0.350	0.501	0.565	0.505	0.625	0.745	0.652	0.859
2013–14	0.691	0.573	0.815	0.642	0.580	0.699	1.077	0.923	1.238
2014–15	0.698	0.577	0.841	0.591	0.525	0.654	1.181	1.026	1.361
2015–16	0.605	0.512	0.713	0.640	0.576	0.699	0.945	0.820	1.075
2016–17	0.847	0.690	1.018	0.631	0.566	0.694	1.342	1.138	1.558
2017–18	1.071	0.909	1.270	0.780	0.719	0.832	1.373	1.191	1.580
2018–19	0.919	0.763	1.102	0.630	0.564	0.695	1.458	1.243	1.686
2019–20	1.347	1.100	1.606	0.748	0.690	0.805	1.801	1.514	2.110
2020–21	0.759	0.623	0.913	0.652	0.577	0.716	1.164	0.985	1.363
2021–22	1.169	0.956	1.403	0.717	0.645	0.780	1.630	1.379	1.918
2022–23	1.352	1.121	1.635	0.718	0.648	0.780	1.882	1.597	2.214
2023–24	1.196	0.977	1.426	0.760	0.699	0.815	1.573	1.312	1.855
2024–25	1.620	1.345	1.934	0.836	0.785	0.882	1.937	1.619	2.325

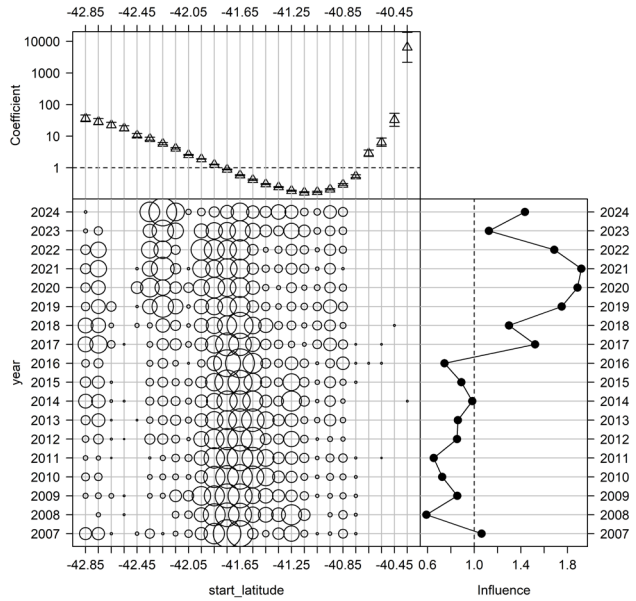


Figure A26: Influence plot of the Latitude variable in the Cook Trawl positive catch CPUE model.

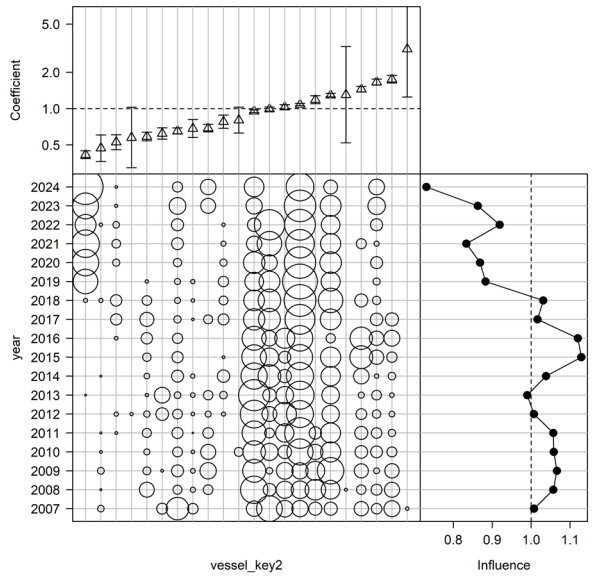


Figure A27: Influence plot of the Vessel variable in the Cook Trawl positive catch CPUE model.

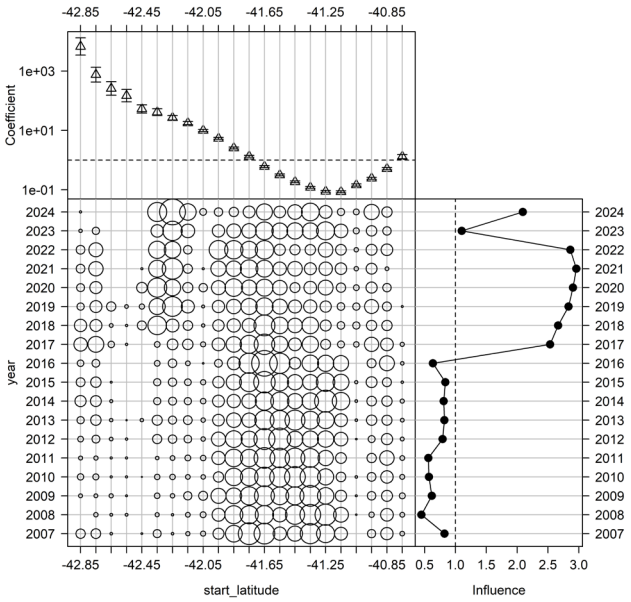


Figure A28: Influence plot of the Latitude variable in the Cook Trawl occurrence CPUE model.

APPENDIX 5: KAIKOURA SET NET CPUE ANALYSIS

CPUE indices for the Kaikoura target tarakihi set net fishery were derived from the daily aggregated catch and effort data set. The data set was limited to vessels that had participated in the fishery for a minimum of six years (with a catch of 1000 kg per annum) from 1989–90 to 2024–25.

Table A21: Data selection for the Kaikoura Set Net Daily CPUE data set.

Attribute	Selection criteria	Number of records retained	TAR catch (t) retained
Fishing Years	1989–90 to 2024–25		
Statistical Area	018		
Fishing method	SN		
Target species	TAR	18 019	7 121.8
Tarakihi catch	< 2500 kg	17 970	6 975.5
Fishing duration	5–40 h	16 050	6 295.8
Net length	200–3000 m	15 456	6 153.7
Vessel continuity	6+ y, 1000 kg	13 876	5 846.5
Final data set		13 876	5 846.5

Table A22: Summary of the Kaikoura set net CPUE data set (core vessels only).

Fishing year	Number records	Number vessels	Number trips	Catch (t)	Percent zero catch
1989–90	297	6	296	114.5	3.0
1990–91	431	5	425	214.8	0.0
1991–92	478	6	475	262.8	0.4
1992–93	749	6	740	312.7	1.6
1993–94	564	6	555	177.1	1.6
1994–95	613	6	542	263.1	0.8
1995–96	490	6	477	184.5	0.6
1996–97	383	6	380	153.0	0.0
1997–98	544	5	539	203.0	2.6
1998–99	435	4	434	145.7	1.1
1999–2000	430	5	422	180.6	0.2
2000–01	520	6	520	250.6	0.4
2001–02	341	5	340	265.4	0.3
2002–03	475	6	472	278.1	0.6
2003–04	568	6	564	267.5	0.7
2004–05	387	5	386	149.2	0.0
2005–06	504	6	504	196.3	0.0
2006–07	331	6	329	118.6	0.0
2007–08	306	5	304	131.9	0.0
2008–09	326	5	326	161.5	0.9
2009–10	315	5	314	146.7	0.6
2010–11	346	5	345	130.1	0.3
2011–12	403	6	400	233.5	0.5
2012–13	432	5	423	187.5	0.2
2013–14	378	5	354	142.5	0.0
2014–15	292	4	284	132.2	0.7
2015–16	317	5	312	162.2	0.9
2016–17	262	5	252	152.0	0.4
2017–18	299	5	297	191.1	0.3
2018–19	274	4	273	161.0	0.0
2019–20	254	4	247	195.6	0.0
2020–21	320	4	305	200.1	0.0
2021–22	249	4	239	195.7	0.0
2022–23	210	4	198	96.3	6.2
2023–24	204	3	187	118.6	0.5
2024–25	149	3	145	84.8	0.7

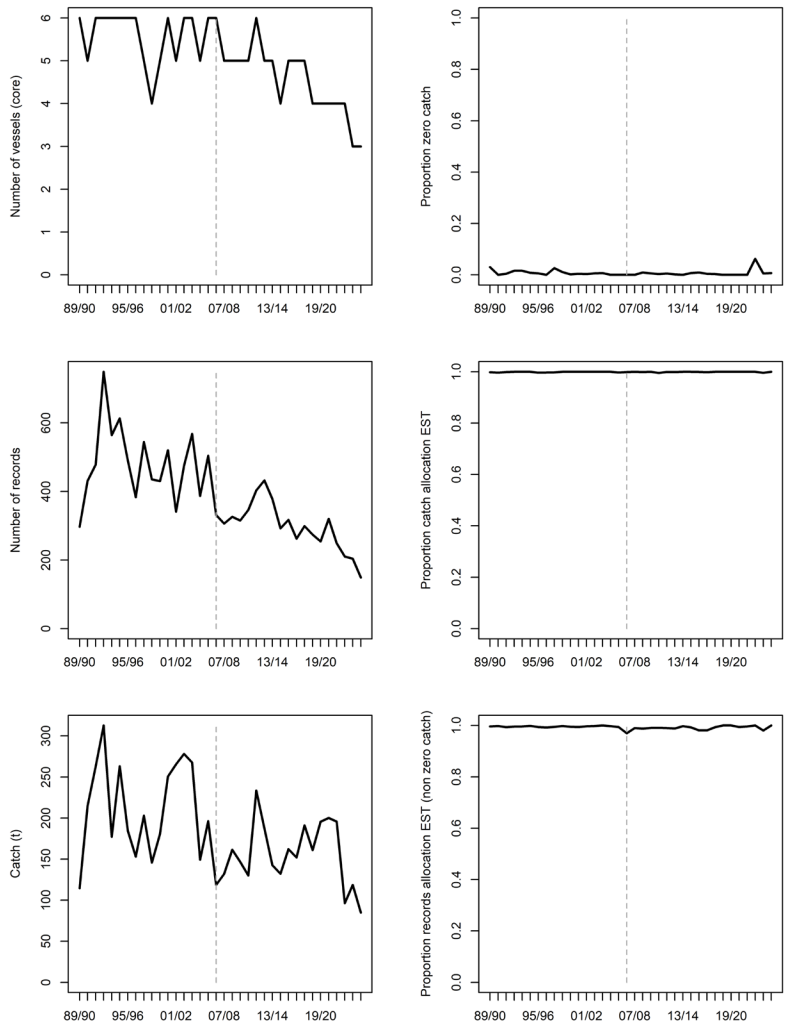


Figure A29: A summary of the data included in the Kaikoura Set Net CPUE data set.

Table A23: Summary of stepwise selection of variables in the Kaikoura set net positive catch CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			19 109		
FishingYear	35	779	18 330	0.041	
NetLength	3	3 776	14 555	0.238	19.8%
Vessel	11	1 668	12 886	0.326	8.7%
Month	10	1 042	11 845	0.380	5.4%

Table A24: Kaikoura set net CPUE indices and associated lower bound (LCI) and upper bound (UCI) of the 95% confidence intervals.

Fishing year	Lognormal		
	Index	LCI	UCI
1989–90	1.000	0.865	1.156
1990–91	0.920	0.799	1.058
1991–92	1.027	0.894	1.180
1992–93	0.815	0.717	0.926
1993–94	0.568	0.497	0.649
1994–95	0.899	0.788	1.026
1995–96	0.780	0.680	0.896
1996–97	0.772	0.667	0.893
1997–98	0.777	0.675	0.894
1998–99	0.768	0.661	0.892
1999–2000	0.638	0.550	0.741
2000–01	0.723	0.626	0.835
2001–02	1.048	0.895	1.227
2002–03	0.881	0.760	1.021
2003–04	0.776	0.672	0.896
2004–05	0.665	0.569	0.777
2005–06	0.672	0.580	0.777
2006–07	0.520	0.444	0.609
2007–08	0.537	0.456	0.632
2008–09	0.641	0.546	0.753
2009–10	0.529	0.450	0.622
2010–11	0.486	0.415	0.570
2011–12	0.696	0.598	0.809
2012–13	0.493	0.425	0.572
2013–14	0.421	0.360	0.492
2014–15	0.416	0.353	0.491
2015–16	0.555	0.472	0.652
2016–17	0.533	0.450	0.632
2017–18	0.806	0.686	0.948
2018–19	0.625	0.530	0.737
2019–20	0.859	0.725	1.017
2020–21	0.846	0.721	0.993
2021–22	0.834	0.702	0.992
2022–23	0.491	0.409	0.589
2023–24	0.635	0.529	0.761
2024–25	0.644	0.529	0.784

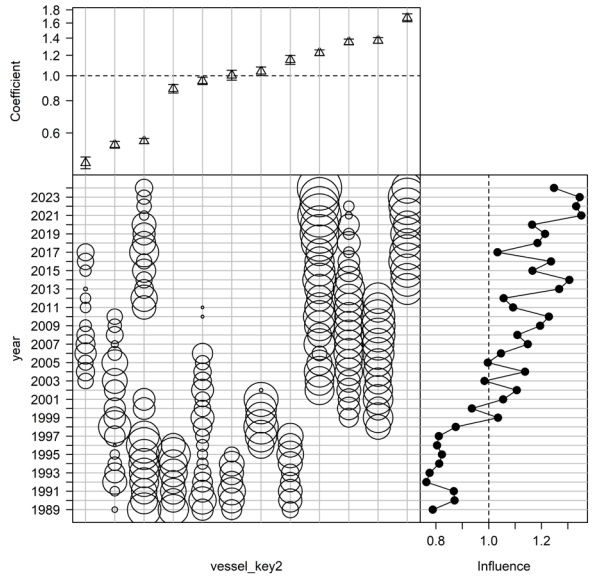


Figure A30: Influence plot of the Vessel variable in the Kaikoura Set Net positive catch CPUE model.

APPENDIX 6: ECSI CPUE ANALYSIS

The trawl event-based ECSI CPUE indices were derived for the equivalent set of vessels included in the Daily CPUE indices. Initially, a core set of vessels was selected for the daily CPUE analysis, with minimum criteria of 1000 kg of tarakihi catch per annum for at least 6 years during 1989–90 to 2024–25. The final event-based CPUE data set was then selected to include all the trips conducted by the core set of vessels.

Table A25: Data selection for the ECSI Trawl Event CPUE data set.

Attribute	Selection criteria	Number of records retained	TAR catch (t) retained
Selected trips (day)	Core vessels	81 587	8 193.9
Fishing Years	2007–08 to 2024–25	66 731	7 427.6
Statistical Area	020, 022, 024, 026	64 480	6 817.1
Fishing method	BT	64 480	6 817.1
Depth range	10–500 m	64 413	6 816.0
Target species	All	64 413	6 816.0
Tarakihi catch	< 6000 kg	64 391	6 636.4
Fishing duration	1–6 h	58 724	5 574.0
Vessel continuity	-	58 724	5 574.0
Latitude	35–48 S	58 724	5 574.0
Trawl speed	1.0–5.0	58 574	5 524.1
Final data set		58 574	5 524.1

Table A26: Summary of the ECSI Trawl CPUE data set (core vessels only).

Fishing year	Number records	Number vessels	Number trips	Catch (t)	Number trawls	Duration (hrs)	Percent zero catch
2007–08	3 592	17	592	251.4	3 592	13 063	57.3
2008–09	4 152	21	719	362.6	4 152	15 389	61.4
2009–10	4 347	20	719	305.5	4 347	15 796	61.0
2010–11	4 296	21	745	550.4	4 296	15 866	55.2
2011–12	3 767	21	695	279.0	3 767	12 266	59.0
2012–13	4 205	20	728	315.4	4 205	13 198	62.4
2013–14	4 259	18	711	391.9	4 259	15 375	55.2
2014–15	3 122	20	566	384.5	3 122	12 010	54.3
2015–16	2 836	20	507	322.1	2 836	9 933	62.4
2016–17	3 841	20	660	534.6	3 841	13 910	48.6
2017–18	3 843	21	613	415.0	3 843	14 244	54.8
2018–19	3 325	23	556	337.7	3 325	12 669	60.3
2019–20	2 600	20	430	261.9	2 600	9 833	52.5
2020–21	2 375	16	383	205.6	2 375	8 868	56.7
2021–22	2 345	19	382	200.5	2 345	8 868	56.9
2022–23	1 979	17	291	129.2	1 979	7 639	67.4
2023–24	1 570	14	254	123.7	1 570	5 939	65.5
2024–25	1 932	13	387	143.0	1 932	7 568	67.1

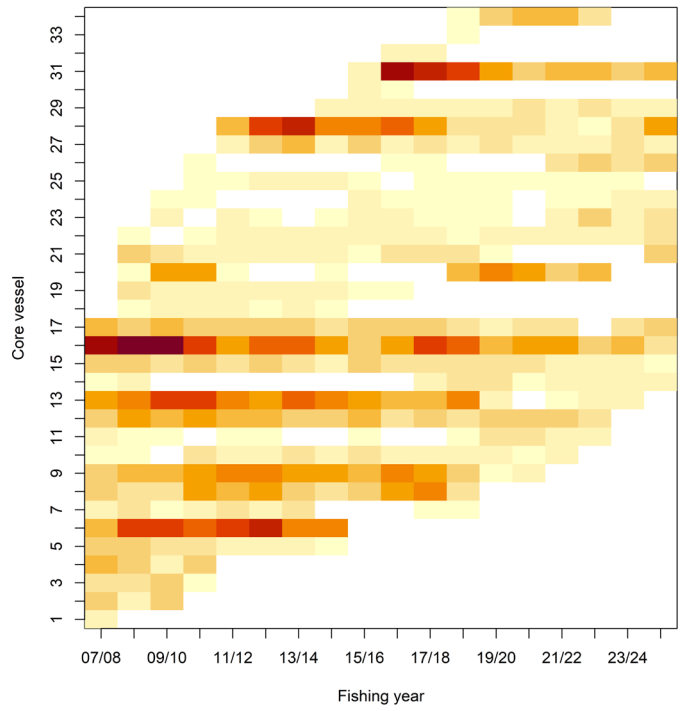


Figure A31: Annual number of trawl event records for each vessel included in the ECSI Trawl core fleet.

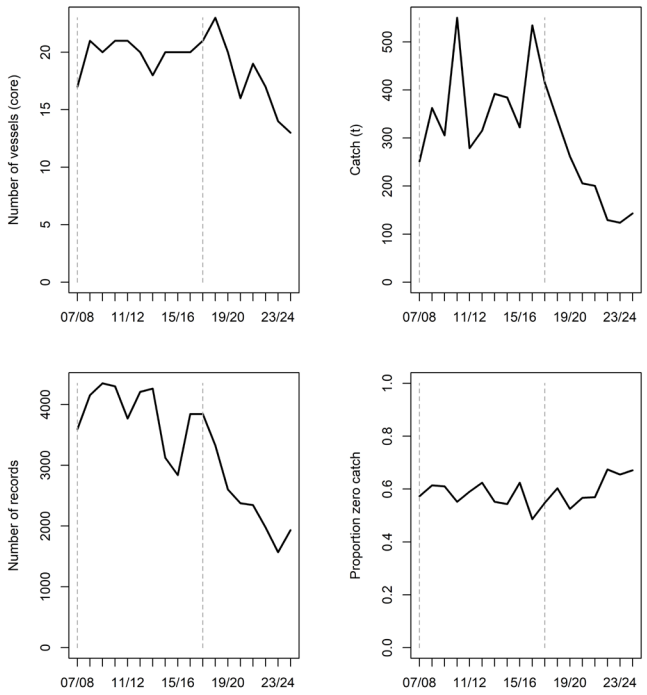


Figure A32: A summary of the data included in the ECSI Trawl CPUE data set.

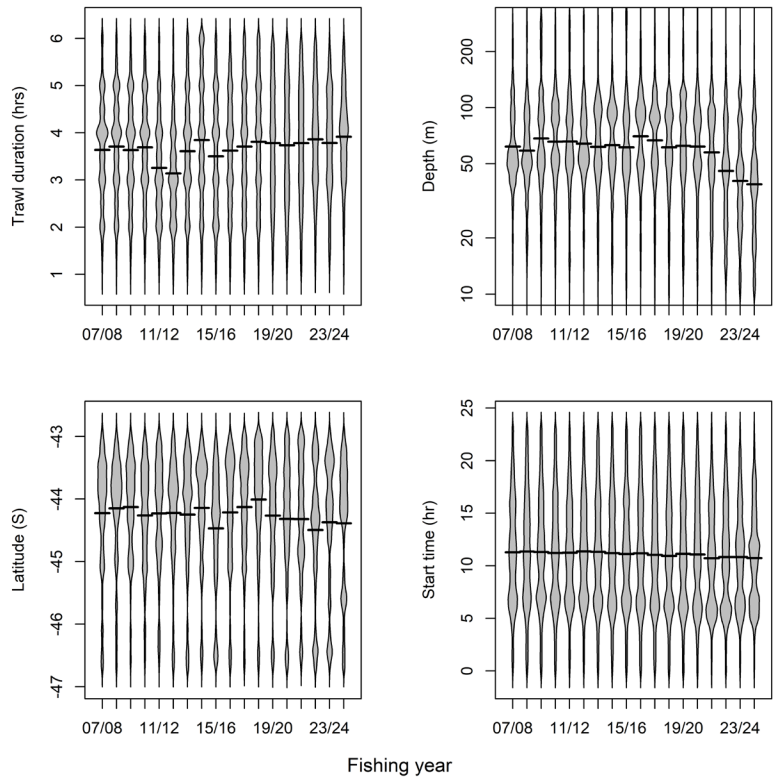


Figure A33: A summary of the fishing event data included in the ECSI Trawl CPUE data set.

Table A27: Summary of stepwise selection of variables in the ECSI Trawl positive catch CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			140 430		
FishingYear	17	2 201	138 229	0.016	
Depth	3	23 567	114 662	0.183	16.8%
Vessel	33	15 342	99 320	0.293	10.9%
Latitude	5	3 574	95 746	0.318	2.5%
Duration	3	2 159	93 588	0.334	1.5%
Month	11	1 790	91 798	0.346	1.3%
Longitude	5	1 740	90 058	0.359	1.2%
StartTime	3	1 094	88 964	0.366	0.8%

Table A28: Summary of stepwise selection of variables in the ECSI Trawl occurrence CPUE model. Model terms are listed in the order of acceptance to the model.

Term	Degrees of freedom	Deviance	Residual deviance	R^2	Improvement
NULL			79 361		
FishingYear	17	511.2	78 850	0.006	
Depth	3	12 346.6	66 503	0.162	15.6%
Vessel	33	3 115.4	63 388	0.201	3.9%
Latitude	5	1 319.9	62 068	0.218	1.7%
Duration	3	1 106.5	60 962	0.232	1.4%
Longitude	5	888.9	60 073	0.243	1.1%
Month	11	711.7	59 361	0.252	0.9%
StartTime	3	378.9	58 982	0.257	0.5%

Table A29: ECSI Trawl CPUE indices and associated lower bound (LCI) and upper bound (UCI) of the 95% confidence intervals.

Fishing year	Combined			Binomial			Lognormal		
	Index	LCI	UCI	Index	LCI	UCI	Index	LCI	UCI
2007–08	0.428	0.364	0.501	0.427	0.388	0.464	1.000	0.874	1.154
2008–09	0.472	0.395	0.560	0.386	0.350	0.420	1.224	1.064	1.406
2009–10	0.349	0.296	0.409	0.385	0.349	0.423	0.907	0.792	1.032
2010–11	0.533	0.452	0.623	0.382	0.348	0.422	1.396	1.224	1.584
2011–12	0.389	0.324	0.464	0.389	0.351	0.428	1.000	0.863	1.145
2012–13	0.351	0.291	0.416	0.363	0.327	0.399	0.966	0.838	1.114
2013–14	0.393	0.330	0.469	0.396	0.359	0.434	0.992	0.853	1.139
2014–15	0.477	0.396	0.574	0.394	0.352	0.434	1.213	1.050	1.404
2015–16	0.426	0.349	0.512	0.355	0.312	0.398	1.200	1.031	1.398
2016–17	0.506	0.423	0.597	0.409	0.371	0.451	1.235	1.072	1.420
2017–18	0.361	0.300	0.434	0.341	0.301	0.379	1.061	0.917	1.215
2018–19	0.325	0.267	0.393	0.313	0.276	0.351	1.040	0.901	1.208
2019–20	0.291	0.241	0.347	0.411	0.364	0.456	0.708	0.602	0.827
2020–21	0.238	0.194	0.285	0.369	0.325	0.415	0.645	0.546	0.754
2021–22	0.235	0.190	0.287	0.359	0.317	0.404	0.656	0.556	0.771
2022–23	0.234	0.181	0.291	0.322	0.277	0.369	0.727	0.603	0.866
2023–24	0.366	0.286	0.465	0.406	0.350	0.461	0.903	0.734	1.105
2024–25	0.465	0.365	0.589	0.422	0.367	0.478	1.100	0.904	1.319

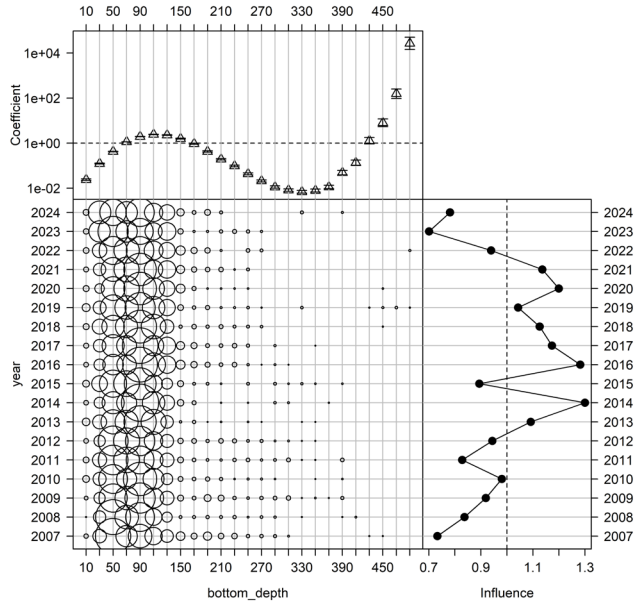


Figure A34: Influence plot of the Depth variable in the ECSI Trawl positive catch CPUE model.

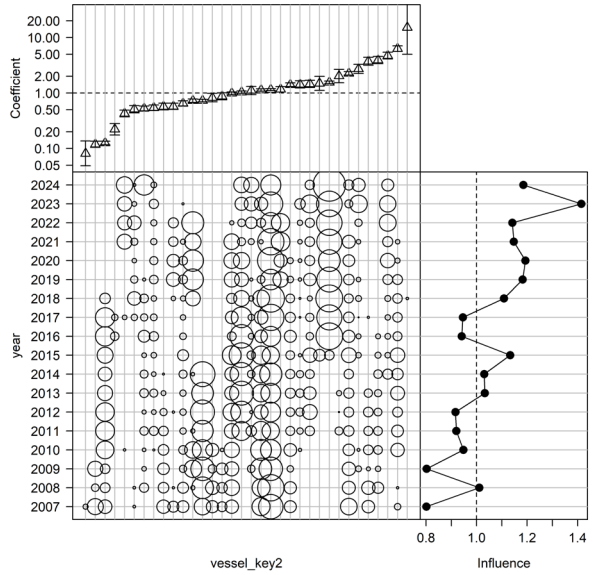


Figure A35: Influence plot of the Vessel variable in the ECSI Trawl positive catch CPUE model.

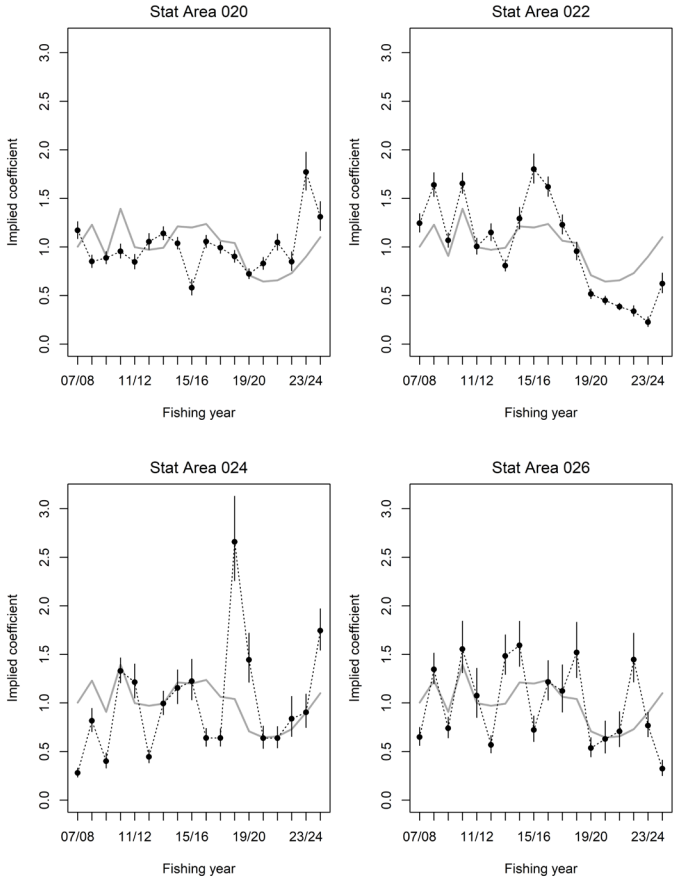


Figure A36: Implied coefficients from the positive catch CPUE model for the individual Statistical Areas that constitute the ECSI trawl fishery.

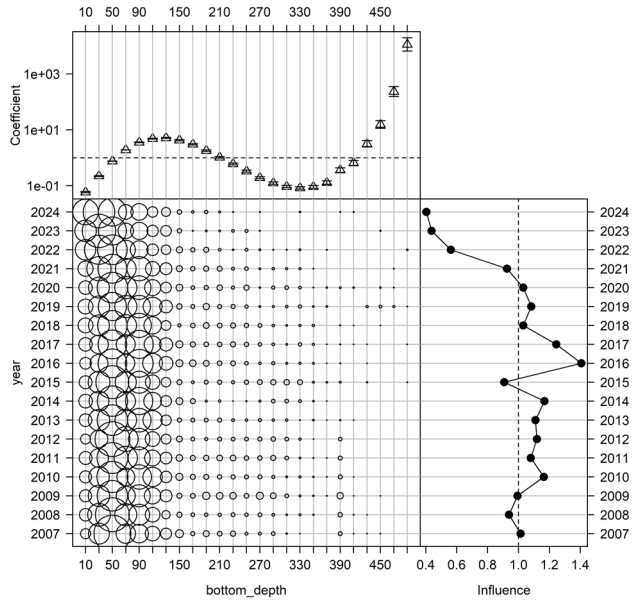


Figure A37: Influence plot of the Depth variable in the ECSI Trawl occurrence CPUE model.

APPENDIX 7: STOCK ASSESSMENT INPUTS

Table A30: Fishery catches (t) included in the assessment model, including allowances for unreported commercial catches.

Year	ECSI trawl	Kaikoura SN	Cook trawl	TAR 2 trawl	TAR 2 Rec	BPLE trawl	BPLE Rec	ENLD trawl
1932	0	0	5	148	0	64	0	1 310
1933	0	0	508	577	0	47	0	658
1934	182	0	256	498	0	50	0	591
1935	152	0	367	806	0	42	0	786
1936	341	0	570	1 163	0	29	0	996
1937	340	0	665	808	0	26	0	1 372
1938	250	0	575	910	0	16	0	1 340
1939	534	0	490	946	0	7	0	1 246
1940	287	0	571	936	0	24	0	1 164
1941	749	0	379	809	0	19	0	746
1942	713	0	263	935	0	6	0	728
1943	589	0	104	829	0	17	0	933
1944	469	0	28	572	0	1	0	687
1945	559	0	35	1 004	0	68	0	1 040
1946	323	0	518	1 608	0	74	0	1 352
1947	460	0	654	1 942	0	113	0	1 579
1948	1 164	0	726	2 197	0	117	0	1 277
1949	952	0	767	2 555	0	301	0	986
1950	1 168	0	1 007	2 588	0	604	0	1 284
1951	892	0	899	2 413	0	561	0	1 747
1952	926	0	860	2 516	0	421	0	1 916
1953	1 138	0	1 120	2 508	0	354	0	2 032
1954	971	0	1 065	2 454	0	477	0	1 829
1955	694	0	554	1 835	0	345	0	1 670
1956	719	0	991	2 447	0	532	0	1 763
1957	461	0	833	2 774	0	615	0	1 265
1958	1 380	0	874	2 640	0	377	0	1 110
1959	1 680	0	717	2 342	0	380	0	922
1960	1 578	0	742	2 957	0	555	0	1 261
1961	1 034	0	843	3 440	0	558	0	1 037
1962	1 202	0	658	3 437	0	472	0	1 090
1963	1 288	0	897	3 751	0	558	0	782
1964	1 162	0	739	3 158	0	581	0	858
1965	1 500	0	676	3 187	0	731	0	665
1966	1 346	0	540	3 632	0	822	0	695
1967	1 847	0	597	3 557	0	715	0	498
1968	788	0	673	3 058	0	715	0	384
1969	1 004	0	670	2 288	0	484	0	488
1970	864	0	495	2 072	0	578	0	327
1971	1 344	0	579	2 318	0	657	0	441
1972	1 384	0	646	2 407	0	587	0	435
1973	2 603	0	490	2 294	0	438	0	509
1974	1 746	0	572	1 882	0	494	0	281
1975	2 296	0	750	2 267	62	426	85	231
1976	1 327	0	493	2 092	64	260	87	327
1977	2 312	0	585	1 974	65	385	89	231
1978	1 978	0	809	2 393	67	601	91	205
1979	448	0	453	2 062	68	797	93	347
1980	816	43	590	1 650	70	735	95	503
1981	1 186	132	443	1 668	71	805	97	603
1982	1 266	223	399	1 607	71	594	97	553
1983	915	229	213	1 532	71	743	97	433

Year	ECSI trawl	Kaikoura SN	Cook trawl	TAR 2 trawl	TAR 2 Rec	BPLE trawl	BPLE Rec	ENLD trawl
1984	866	217	344	1 342	71	731	97	554
1985	1 232	308	258	1 355	71	615	97	448
1986	1 101	275	355	1 582	71	670	97	407
1987	901	225	453	1 658	71	522	97	355
1988	983	246	421	1 663	71	625	97	425
1989	728	182	316	1 694	71	538	97	365
1990	720	290	318	1 401	71	444	97	344
1991	551	441	353	1 808	71	678	97	338
1992	638	456	450	1 676	71	828	97	466
1993	211	483	444	1 713	71	926	97	306
1994	402	284	354	1 651	71	884	97	372
1995	227	434	570	1 612	71	782	97	322
1996	630	377	537	1 584	71	730	97	339
1997	773	279	429	1 726	71	636	97	469
1998	672	348	402	1 780	71	702	97	488
1999	761	299	514	1 674	71	657	97	404
2000	963	296	494	1 839	71	524	97	452
2001	601	442	776	1 731	71	762	97	335
2002	507	513	782	1 822	71	897	97	315
2003	639	381	545	1 809	71	992	97	224
2004	612	387	525	1 716	71	1 064	97	235
2005	587	184	494	1 761	71	837	97	418
2006	623	243	472	2 091	71	761	97	447
2007	760	223	439	1 818	71	603	97	298
2008	551	238	369	1 743	71	617	97	277
2009	668	269	428	1 972	71	787	97	283
2010	310	218	610	1 917	71	883	97	254
2011	922	179	464	1 742	71	796	97	258
2012	469	305	579	1 720	71	669	97	234
2013	657	249	608	1 907	71	589	97	206
2014	722	158	576	1 829	71	473	97	480
2015	866	142	627	1 942	71	489	97	492
2016	915	212	642	1 814	71	424	97	423
2017	1 068	207	582	1 993	71	527	97	442
2018	688	273	690	1 906	108	486	53	384
2019	680	229	494	1 637	108	416	53	207
2020	575	186	414	1 379	108	320	53	180
2021	503	181	325	1 468	108	309	53	203
2022	400	165	395	1 265	108	279	53	193
2023	317	84	509	1 158	108	266	53	166
2024	494	66	417	1 197	44	290	37	137
2025	585	41	357	1 134	44	265	37	205

Table A31: Proportional age compositions (both sexes combined) for ECSI winter trawl surveys.

Age	Model year									
	2007	2008	2009	2012	2014	2016	2018	2021	2022	2024
1	0.0729	0.1336	0.0322	0.1324	0.0202	0.1676	0.0378	0.1033	0.0928	0.2850
2	0.1765	0.4030	0.5006	0.2145	0.3066	0.2074	0.2924	0.5176	0.2487	0.1252
3	0.3603	0.2161	0.1827	0.3511	0.3785	0.1687	0.3949	0.1501	0.3696	0.1590
4	0.2590	0.1696	0.1464	0.0717	0.1415	0.3336	0.1559	0.0898	0.1666	0.0900
5	0.0745	0.0444	0.0852	0.2044	0.1186	0.1039	0.0496	0.0920	0.0388	0.2614
6	0.0118	0.0103	0.0147	0.0148	0.0067	0.0057	0.0325	0.0249	0.0507	0.0465
7	0.0002	0.0034	0.0082	0.0028	0.0123	0.0044	0.0088	0.0048	0.0153	0.0133
8	0.0025	0.0001	0.0012	0.0018	0.0006	0.0000	0.0037	0.0049	0.0088	0.0140
9	0.0014	0.0003	0.0000	0.0002	0.0013	0.0041	0.0038	0.0029	0.0041	0.0054
10	0.0008	0.0005	0.0015	0.0038	0.0019	0.0002	0.0077	0.0041	0.0025	0.0000
11	0.0012	0.0008	0.0000	0.0004	0.0004	0.0000	0.0015	0.0021	0.0000	0.0000
12	0.0008	0.0031	0.0004	0.0005	0.0006	0.0000	0.0009	0.0007	0.0009	0.0000
13	0.0001	0.0000	0.0003	0.0000	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000
14	0.0000	0.0003	0.0016	0.0002	0.0003	0.0000	0.0024	0.0005	0.0000	0.0000
15	0.0006	0.0000	0.0000	0.0002	0.0004	0.0001	0.0000	0.0000	0.0000	0.0000
16	0.0002	0.0015	0.0015	0.0000	0.0002	0.0000	0.0008	0.0006	0.0000	0.0000
17	0.0000	0.0003	0.0000	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
18	0.0001	0.0002	0.0000	0.0000	0.0006	0.0000	0.0000	0.0000	0.0000	0.0000
19	0.0001	0.0000	0.0000	0.0000	0.0003	0.0000	0.0013	0.0000	0.0000	0.0000
20	0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000	0.0003	0.0013	0.0000
21	0.0000	0.0004	0.0000	0.0000	0.0001	0.0000	0.0000	0.0002	0.0000	0.0000
22	0.0001	0.0001	0.0000	0.0000	0.0003	0.0002	0.0000	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0003	0.0000	0.0000
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0006	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0051	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
27	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0000
28	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30+	0.0001	0.0000	0.0000	0.0000	0.0001	0.0002	0.0000	0.0000	0.0000	0.0000

Table A32: Proportional age compositions (both sexes combined) for ENLD commercial fishery.

Age	Model year					
	2014	2015	2019	2020	2024	2025
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0080	0.0140	0.0295	0.0088	0.0019	0.0016
5	0.0600	0.0630	0.0503	0.0790	0.0221	0.0049
6	0.0820	0.1760	0.1227	0.0887	0.0282	0.0663
7	0.2290	0.0700	0.2189	0.0969	0.0473	0.0513
8	0.1270	0.1960	0.2148	0.1751	0.0863	0.0652
9	0.0930	0.0840	0.0610	0.1887	0.2032	0.0967
10	0.0660	0.0820	0.0724	0.0599	0.0870	0.1704
11	0.0490	0.0550	0.0304	0.0380	0.0790	0.0827
12	0.0420	0.0570	0.0486	0.0363	0.0943	0.0466
13	0.0420	0.0420	0.0310	0.0624	0.0952	0.0785
14	0.0190	0.0220	0.0193	0.0185	0.0332	0.1018
15	0.0120	0.0040	0.0178	0.0266	0.0316	0.0300
16	0.0140	0.0110	0.0192	0.0234	0.0309	0.0327
17	0.0250	0.0070	0.0155	0.0141	0.0327	0.0201
18	0.0430	0.0100	0.0062	0.0166	0.0291	0.0435
19	0.0260	0.0230	0.0023	0.0131	0.0310	0.0212
20	0.0240	0.0200	0.0013	0.0046	0.0130	0.0137
21	0.0030	0.0140	0.0030	0.0067	0.0152	0.0193
22	0.0160	0.0140	0.0008	0.0021	0.0118	0.0126
23	0.0010	0.0050	0.0125	0.0066	0.0005	0.0066
24	0.0040	0.0060	0.0012	0.0181	0.0056	0.0024
25	0.0050	0.0070	0.0124	0.0043	0.0037	0.0040
26	0.0020	0.0030	0.0053	0.0029	0.0035	0.0043
27	0.0040	0.0020	0.0005	0.0008	0.0024	0.0019
28	0.0020	0.0100	0.0013	0.0000	0.0022	0.0021
29	0.0000	0.0060	0.0000	0.0065	0.0054	0.0034
30+	0.0010	0.0010	0.0018	0.0011	0.0038	0.0162

Table A33: Proportional age compositions (both sexes combined) for BPLE commercial fishery.

Age	Model year					
	2008	2011	2014	2015	2019	2020
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0138	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0020	0.0000	0.0020	0.0000	0.0000
4	0.3053	0.0370	0.0200	0.0700	0.0657	0.0282
5	0.7748	0.1240	0.2090	0.1960	0.1280	0.1314
6	0.3823	0.2740	0.0590	0.3270	0.2019	0.2274
7	0.1450	0.2080	0.3530	0.0460	0.2970	0.1998
8	0.1314	0.1240	0.1040	0.2090	0.1828	0.2159
9	0.0742	0.0900	0.0840	0.0540	0.0477	0.0682
10	0.0258	0.0400	0.0500	0.0200	0.0352	0.0262
11	0.0386	0.0190	0.0380	0.0180	0.0040	0.0322
12	0.0482	0.0130	0.0450	0.0130	0.0170	0.0073
13	0.0118	0.0040	0.0080	0.0220	0.0000	0.0256
14	0.0136	0.0180	0.0060	0.0080	0.0040	0.0000
15	0.0000	0.0060	0.0050	0.0010	0.0083	0.0073
16	0.0000	0.0090	0.0030	0.0040	0.0083	0.0000
17	0.0142	0.0070	0.0060	0.0020	0.0000	0.0254
18	0.0000	0.0020	0.0020	0.0030	0.0000	0.0000
19	0.0068	0.0000	0.0050	0.0030	0.0000	0.0000
20	0.0000	0.0070	0.0000	0.0000	0.0000	0.0000
21	0.0141	0.0030	0.0010	0.0000	0.0000	0.0000
22	0.0000	0.0150	0.0020	0.0000	0.0000	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0010	0.0000	0.0000	0.0000
27	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0051
29	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
30+	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Table A34: Proportional age compositions (both sexes combined) for TAR 2 commercial fishery.

Age	Model year							
	2010	2011	2014	2015	2019	2020	2024	2025
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0000	0.0000
3	0.0525	0.0078	0.0281	0.0330	0.0018	0.0063	0.0291	0.0066
4	0.1038	0.1762	0.0994	0.1440	0.0789	0.0687	0.0208	0.0418
5	0.2540	0.1875	0.3645	0.2120	0.1801	0.3340	0.1637	0.0317
6	0.2528	0.2113	0.0894	0.3670	0.1890	0.1901	0.1477	0.2775
7	0.1466	0.1868	0.2922	0.0630	0.2785	0.1053	0.1684	0.1444
8	0.0920	0.0937	0.0452	0.1060	0.1620	0.1383	0.1631	0.1481
9	0.0300	0.0573	0.0321	0.0240	0.0368	0.0952	0.1027	0.1122
10	0.0135	0.0210	0.0131	0.0160	0.0308	0.0317	0.0609	0.1175
11	0.0109	0.0086	0.0040	0.0080	0.0025	0.0087	0.0280	0.0174
12	0.0088	0.0078	0.0050	0.0110	0.0128	0.0032	0.0488	0.0201
13	0.0121	0.0053	0.0000	0.0050	0.0050	0.0103	0.0281	0.0310
14	0.0091	0.0102	0.0030	0.0020	0.0071	0.0022	0.0089	0.0158
15	0.0036	0.0058	0.0020	0.0000	0.0000	0.0000	0.0100	0.0071
16	0.0000	0.0049	0.0040	0.0010	0.0000	0.0000	0.0044	0.0022
17	0.0004	0.0078	0.0040	0.0020	0.0050	0.0000	0.0080	0.0023
18	0.0057	0.0019	0.0040	0.0010	0.0017	0.0008	0.0022	0.0125
19	0.0025	0.0029	0.0020	0.0000	0.0000	0.0000	0.0019	0.0037
20	0.0000	0.0001	0.0020	0.0000	0.0010	0.0000	0.0000	0.0000
21	0.0000	0.0002	0.0020	0.0020	0.0032	0.0000	0.0000	0.0000
22	0.0000	0.0024	0.0000	0.0000	0.0000	0.0000	0.0017	0.0000
23	0.0000	0.0000	0.0000	0.0000	0.0014	0.0023	0.0000	0.0030
24	0.0000	0.0004	0.0000	0.0000	0.0015	0.0000	0.0008	0.0000
25	0.0000	0.0000	0.0000	0.0020	0.0000	0.0000	0.0000	0.0000
26	0.0000	0.0000	0.0020	0.0010	0.0000	0.0020	0.0000	0.0000
27	0.0000	0.0002	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
29	0.0016	0.0000	0.0000	0.0000	0.0000	0.0000	0.0008	0.0000
30+	0.0000	0.0000	0.0000	0.0000	0.0010	0.0000	0.0000	0.0051

Table A35: Proportional age compositions (both sexes combined) for Cook commercial fishery.

Age	Model year				
	2014	2019	2020	2024	2025
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0060	0.0053	0.0000	0.0000	0.0000
4	0.0280	0.0990	0.0459	0.0054	0.0000
5	0.3010	0.1392	0.4267	0.0522	0.0196
6	0.0760	0.2244	0.1826	0.1306	0.1169
7	0.2220	0.2467	0.0684	0.1196	0.1427
8	0.0730	0.1304	0.0915	0.2389	0.1056
9	0.0480	0.0416	0.0557	0.1437	0.1559
10	0.0700	0.0477	0.0574	0.0682	0.1047
11	0.0410	0.0121	0.0499	0.0509	0.0788
12	0.0200	0.0192	0.0000	0.0472	0.0493
13	0.0170	0.0020	0.0094	0.0246	0.0686
14	0.0060	0.0020	0.0000	0.0254	0.0336
15	0.0130	0.0058	0.0047	0.0153	0.0220
16	0.0140	0.0050	0.0000	0.0035	0.0270
17	0.0090	0.0063	0.0000	0.0192	0.0102
18	0.0200	0.0000	0.0026	0.0018	0.0174
19	0.0080	0.0000	0.0000	0.0078	0.0009
20	0.0060	0.0019	0.0026	0.0118	0.0033
21	0.0020	0.0020	0.0000	0.0061	0.0103
22	0.0060	0.0053	0.0000	0.0041	0.0031
23	0.0040	0.0019	0.0000	0.0000	0.0063
24	0.0020	0.0000	0.0000	0.0076	0.0074
25	0.0000	0.0000	0.0000	0.0045	0.0040
26	0.0000	0.0000	0.0000	0.0043	0.0000
27	0.0000	0.0000	0.0000	0.0035	0.0061
28	0.0000	0.0000	0.0000	0.0000	0.0013
29	0.0000	0.0000	0.0026	0.0018	0.0010
30+	0.0050	0.0024	0.0000	0.0018	0.0039

Table A36: Proportional age compositions (both sexes combined) for Kaikoura set net commercial fishery.

Age	Model year			
	2010	2011	2014	2015
1	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000
3	0.0000	0.0000	0.0000	0.0000
4	0.0183	0.1915	0.0619	0.0130
5	0.3082	0.2034	0.2148	0.2257
6	0.3683	0.4208	0.1129	0.3741
7	0.1857	0.1374	0.4346	0.0461
8	0.0710	0.0111	0.0420	0.2267
9	0.0260	0.0146	0.0639	0.0391
10	0.0031	0.0072	0.0100	0.0261
11	0.0038	0.0000	0.0050	0.0020
12	0.0000	0.0017	0.0030	0.0070
13	0.0017	0.0000	0.0020	0.0100
14	0.0040	0.0035	0.0000	0.0040
15	0.0000	0.0009	0.0060	0.0050
16	0.0000	0.0009	0.0030	0.0000
17	0.0000	0.0017	0.0090	0.0020
18	0.0000	0.0017	0.0050	0.0020
19	0.0040	0.0000	0.0050	0.0000
20	0.0000	0.0000	0.0000	0.0020
21	0.0000	0.0000	0.0000	0.0040
22	0.0000	0.0000	0.0020	0.0020
23	0.0000	0.0018	0.0000	0.0000
24	0.0000	0.0000	0.0030	0.0020
25	0.0000	0.0017	0.0000	0.0030
26	0.0000	0.0000	0.0000	0.0000
27	0.0040	0.0000	0.0000	0.0000
28	0.0000	0.0000	0.0050	0.0000
29	0.0000	0.0000	0.0000	0.0020
30+	0.0017	0.0000	0.0120	0.0020

Table A37: Proportional age compositions (both sexes combined) for ECSI trawl commercial fishery.

Age	Model year							
	2010	2011	2014	2015	2019	2020	2024	2025
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.0561	0.0098	0.0907	0.0406	0.0413	0.0111	0.0027	0.0074
4	0.3890	0.6734	0.3597	0.6692	0.5592	0.2824	0.0673	0.1013
5	0.3421	0.2352	0.4405	0.1351	0.1910	0.4115	0.4027	0.1802
6	0.1523	0.0473	0.0257	0.0816	0.0927	0.1184	0.1826	0.3472
7	0.0402	0.0101	0.0278	0.0062	0.0586	0.0651	0.0814	0.1436
8	0.0067	0.0014	0.0045	0.0188	0.0201	0.0328	0.1313	0.0455
9	0.0014	0.0040	0.0074	0.0054	0.0070	0.0188	0.0460	0.0680
10	0.0000	0.0021	0.0058	0.0080	0.0065	0.0070	0.0077	0.0383
11	0.0044	0.0009	0.0014	0.0062	0.0006	0.0050	0.0213	0.0081
12	0.0013	0.0009	0.0030	0.0018	0.0049	0.0011	0.0158	0.0146
13	0.0027	0.0021	0.0034	0.0029	0.0019	0.0110	0.0188	0.0113
14	0.0015	0.0040	0.0013	0.0032	0.0018	0.0035	0.0106	0.0027
15	0.0007	0.0037	0.0031	0.0013	0.0006	0.0029	0.0009	0.0055
16	0.0000	0.0000	0.0017	0.0016	0.0003	0.0035	0.0000	0.0016
17	0.0000	0.0023	0.0059	0.0025	0.0008	0.0007	0.0058	0.0000
18	0.0000	0.0000	0.0017	0.0026	0.0013	0.0015	0.0000	0.0064
19	0.0000	0.0000	0.0055	0.0019	0.0011	0.0015	0.0013	0.0000
20	0.0016	0.0019	0.0023	0.0027	0.0005	0.0003	0.0000	0.0007
21	0.0000	0.0000	0.0006	0.0005	0.0010	0.0033	0.0000	0.0014
22	0.0000	0.0000	0.0028	0.0016	0.0005	0.0022	0.0000	0.0012
23	0.0000	0.0000	0.0000	0.0015	0.0013	0.0020	0.0000	0.0031
24	0.0000	0.0000	0.0022	0.0018	0.0009	0.0022	0.0011	0.0047
25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0017	0.0000	0.0000
26	0.0000	0.0000	0.0006	0.0009	0.0006	0.0008	0.0000	0.0028
27	0.0000	0.0000	0.0009	0.0000	0.0014	0.0000	0.0000	0.0007
28	0.0000	0.0000	0.0000	0.0013	0.0000	0.0020	0.0011	0.0000
29	0.0000	0.0000	0.0000	0.0000	0.0009	0.0003	0.0000	0.0018
30+	0.0000	0.0010	0.0014	0.0009	0.0033	0.0076	0.0017	0.0020