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Tini a Tangaroa

# Fishery characterisation for blue cod (*Parapercis colias*) in BCO 7, to 2021/22

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## EXECUTIVE SUMMARY

Langley, A.D.<sup>1</sup> (2023). Fishery characterisation for blue cod (*Parapercis colias*) in BCO 7, to 2021/22.

*New Zealand Fisheries Assessment Report 2023/03. 13 p.*

Most (80–90%) of the catch from the BCO 7 commercial fishery was taken in the outer Marlborough Sounds with the remainder of the catch taken off the west coast of the South Island. The outer Marlborough Sounds fishery is dominated by the potting method with a minor proportion of the catch taken by handlining.

Initially, the Marlborough Sounds potting fishery was identified as the most likely candidate for the development of CPUE indices for BCO 7, utilising catch and effort data from 1989/90 onwards. However, a number of key limitations were identified from the detailed characterisation of the potting fishery, specifically:

- There are a limited number of vessels (2) currently active in the fishery and only one vessel has operated in the fishery over the long term (20+ years). Most other vessels operated in the fishery for relatively short periods (5–10 years) and are no longer active. The ownership of the main vessel has changed several times over the last decade, resulting in a loss of the continuity of the operation of the vessel. Further, the small size of the current fleet is unlikely to provide sufficient coverage of the fishery to derive reliable estimates of average annual catch rates.
- The potting fishery is conducted in discrete locations, typically along rocky coastal areas associated with headland or island features. The catch rates of blue cod were variable between individual fishing locations. Prior to the introduction of the Electronic Reporting System (ERS) in 2019/20, detailed location data were not available as fishing activity was reported by Statistical Area only. Thus, it is not possible to evaluate longer-term trends in the spatial operation of the fishery that will influence trends in overall CPUE.
- Operational constraints of the fishery, especially the proximity to port, influence the main areas fished. Trends in the blue cod catch rates in those areas are unlikely to represent trends in the overall abundance of blue cod.

Based on these observations, it was concluded that it was not feasible to develop CPUE indices for the outer Marlborough Sounds cod potting fishery. The study did provide useful information of the distribution of recent (post ERS) fishing activity and also revealed that blue cod catch rates were typically higher in the peripheral areas of the fishery. This information may contribute to the design of future potting surveys in the area. There may be potential to monitor future trends in spatial catch rates once a longer time series of ERS location data is available.

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<sup>1</sup> Trophia Ltd, Kaikōura, New Zealand.

## 1. INTRODUCTION

The blue cod (BCO, *Parapercis colias*) commercial catch in BCO 7 (Figure 1) is predominantly taken by potting, principally in the outer areas of the Marlborough Sounds. During 1995/96–2021/22, the Total Allowable Commercial Catch (TACC) for BCO 7 was 70 t, although annual catches fluctuated over the period and were below the TACC in recent years (Fisheries New Zealand 2022a).

There is also an important recreational fishery for blue cod in the Marlborough Sounds. The most recent estimate of recreational catch was 67 t from the 2018 national panel recreational catch survey (Fisheries New Zealand 2022a).

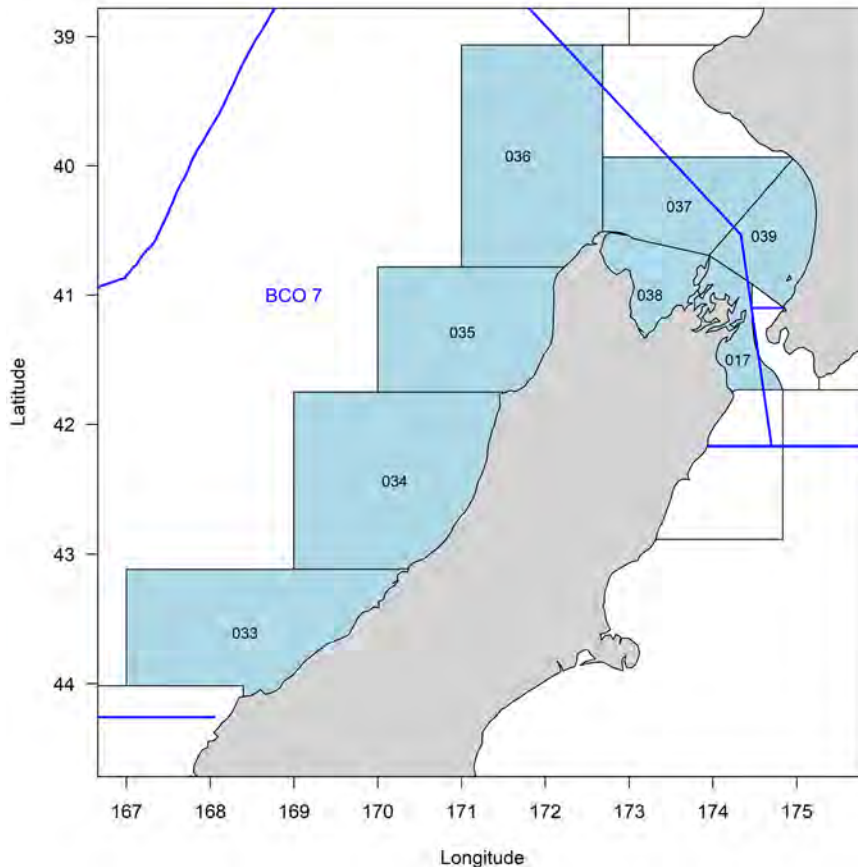
Monitoring of the BCO 7 stock is conducted based on a potting survey of the inner and outer Marlborough Sounds (Beentjes et al. 2022). The potting surveys were instigated in 1995, although there were frequent changes in survey design over subsequent surveys. The most recent random site survey in 2021 was comparable with previous surveys in 2013 and 2017. Age compositions of blue cod from these three potting surveys were used to derive estimates of fishing mortality rates using catch curve analysis (Beentjes et al. 2022). In 2022/23, the TACC for BCO 7 was reduced from 70 t to 58 t on the basis that the Marlborough Sounds component of the fishery is very likely to be overfished (Fisheries New Zealand 2022a).

This report summarises the recent trends in the BCO 7 commercial fishery and investigates the utility of catch-per-unit-effort (CPUE) indices for the monitoring longer-term trends in BCO 7 abundance. The project was funded by Fisheries New Zealand under Project SEA2022-02.

## 2. FISHERY CHARACTERISATION

Commercial catch and effort data from the BCO 7 commercial fishery were sourced from the Fisheries New Zealand database. The data extract included the catch and effort data from any fishing trip that recorded a catch of blue cod from the BCO 7 fishstock and adjacent fishstocks (BCO 2, BCO 3, and BCO 8). The extract was supplemented by data from any additional fishing trips that conducted fishing within the main statistical areas that constitute the fishstock area (Statistical Areas 017, 033–039) and targeted blue cod.

The Fishery Statistical Areas represent a poor approximation of the area comprising BCO 7, particularly Statistical Areas 037 and 039, which are partitioned by the boundary between BCO 7 and BCO 8 (Figure 1). An examination of the blue cod catches from individual potting event records (since 2019/20) revealed that most of the blue cod catch from Statistical Areas 037 and 039 was from the BCO 7 portion of the area. On that basis, Statistical Areas 037 and 039 were included in the definition of BCO 7 fishing effort records.



**Figure 1: Map of the statistical areas that constitute the BCO 7 fishstock (blue shading) for the purpose of defining the BCO 7 catch and effort data sets.**

For the qualifying trips, all effort records were sourced, regardless of whether or not blue cod 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 May of the 2021/22 fishing year; i.e., the data set did not include all catch and effort records from June to September 2022. The June to September period accounted for 30% of the total reported BCO 7 catch from the 2021/22 fishing year.

From 1989/90, most inshore fishing vessels reported catch and effort data via the Catch Effort Landing Return (CELR), which recorded aggregated fishing effort and the estimated catch of the top five species. Fishing effort and catch were 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 green weight obtained at the end of the trip was recorded on the Landings section of the CELR form.

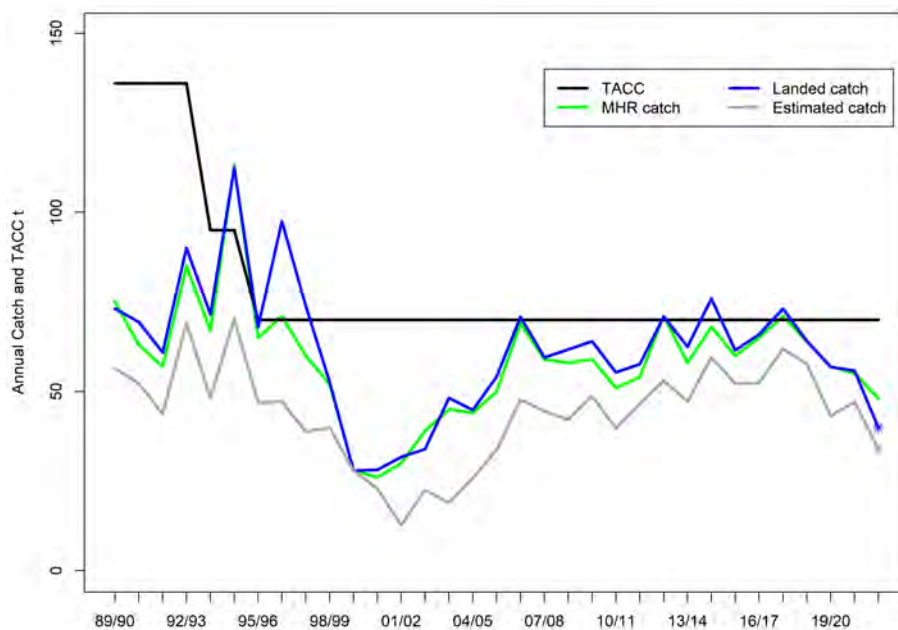
In 2007/08, the Trawl Catch Effort Return (TCER) was introduced specifically for the inshore trawl fisheries and was adopted by most of the inshore trawl vessels that caught BCO 7. The TCER form recorded detailed fishing activity, including trawl start location and depth, and associated catches from individual trawls. Landed catches associated with trips reported on TCER forms were reported at the end of a trip on the Catch Landing Return (CLR). From mid-2019, the inshore fishing fleet transitioned to Electronic Reporting Systems (ERS) (Fisheries New Zealand 2022b).

Vessels conducting cod potting continued to report catch and effort data via the CELR form until the introduction of ERS. For the potting method, the ERS records the location of individual groups of pots (within 2 nm), the number of pot lifts and soak time (Fisheries New Zealand 2022b). The associated species (estimated) catches are also recorded. Landed catch weights are provided by the Licenced Fish Receiver (LFR) following unloading.

In the Marlborough Sounds potting fishery, catches from individual fishing trips are not always landed directly to an LFR. Instead, the catch may be held in a temporary storage facility (e.g., chiller) prior to the final receipt of the catch by the LFR. The change to ERS clarified the reporting requirements for this type of landing and defined an explicit destination code (QL) for the landed catch (Fisheries New Zealand 2022b).

Blue cod estimated catch data were assigned to the associated fishing event records from within the constituent statistical areas of BCO 7. Initially, BCO 7 landed catches were assigned to the individual fishing trips. However, a significant proportion of the fishing trips with an estimated catch of blue cod had no associated landed catch record, representing 20% of the total estimated catch. Most of the estimated catch records were associated with the blue cod potting fishery in the Marlborough Sounds during 2005/06–2019/20. The reporting of catch data from this fishery is examined in more detail in Section 2.1.

Total annual catches of BCO 7 under the Quota Management System (QMS) are compiled from Monthly Harvest Returns (MHR) submitted by fishing permit holders (Fisheries New Zealand 2022a). The total annual landed catches included in the BCO 7 catch and effort data sets approximated the QMS annual catches (Figure 2). The total estimated catches of BCO 7 accounted for approximately 60–80% of the annual landed catches. With the introduction of the ERS reporting, the estimated catches accounted for a larger proportion (approximately 85%) of the landed catch (Figure 2).



**Figure 2:** A comparison of total annual BCO 7 estimated and landed catches (t) by fishing year from the catch and effort returns and the total reported landings (t) to the QMS (MHR). Data from 2021/22 fishing year are incomplete (denoted by an asterisk).

The catch and effort data set was used to characterise the main trends in the catch from BCO 7 during 1989/90–2021/22. Landed catches were assigned to fishing event records following the methodology of Langley (2014). For those trips with no associated landed catch, the fishing event catches were assigned using the estimated catches of blue cod.

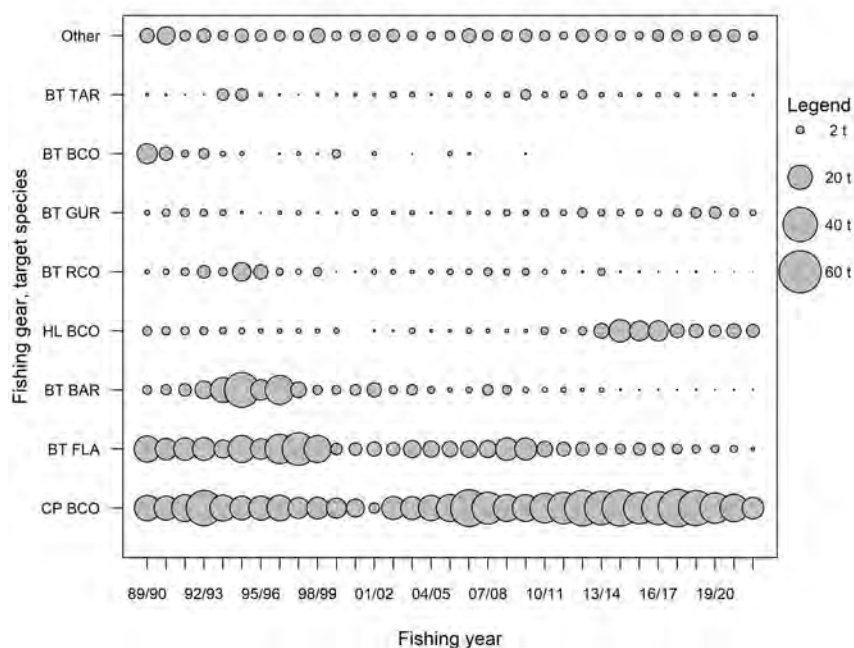
Annual catches from BCO 7 were dominated by the cod potting fishery (Figure 3), predominantly from the Marlborough Sounds (Statistical Area 017) and the western side of D’Urville Island (Statistical Area 038) (Figure 4 and Figure 5).



Since 2013/14, a small handline fishery targeted blue cod (Figure 3). Annual catches from the fishery peaked in 2014/15–2016/17 at about 15 t, while catches in more recent years were about 5 t per annum (Figure 3). Most of the catch was taken in Marlborough Sounds (Statistical Area 017) by two vessels, although only one vessel has operated in the fishery in the most recent years.

During the 1990s, a significant proportion (50–70%) of the annual blue cod catches was taken by bottom trawl (Figure 3), primarily as a bycatch of the flatfish fishery within Statistical Area 038 (Figure 4). Trawl location data available from 2007/08 reveal most of the blue cod trawl catch was taken from western Tasman Bay and Admiralty Bay. Since 2013/14, the BCO 7 trawl catch has been relatively minor, about 7–10 t per annum (Figure 3).

Catches of blue cod are taken throughout the year (Figure 6). Over the last decade, catches from the cod pot fishery were typically lower during October–December and often highest in July–September, although the monthly distribution of catch varied considerably between years.



**Figure 3: Landed catch of blue cod by fishing method/target species and fishing year. Target codes are: BCO (blue cod), FLA (flatfish species), BAR (barracouta), RCO (red cod), TAR (tarakihi) and GUR (red gurnard). Predominant fishing methods are CP (cod potting), BT (bottom trawl), and HL (handlining). Data from 2021/22 are incomplete.**

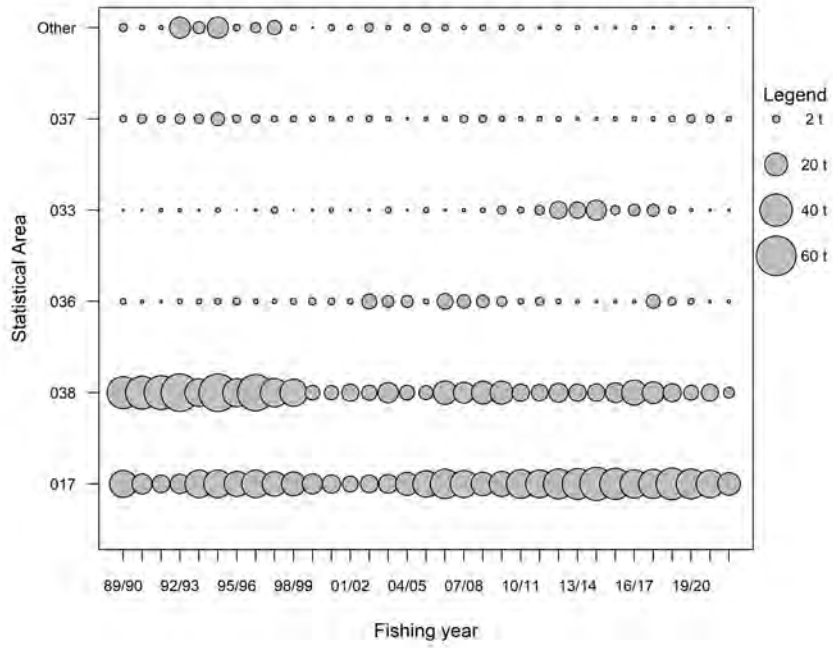


Figure 4: Landed catch of blue cod by statistical area and fishing year. Data from 2021/22 are incomplete.

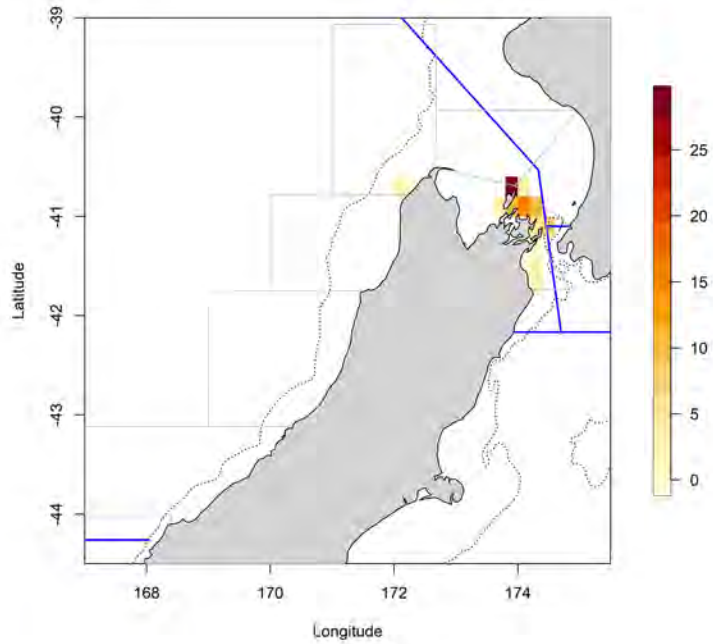
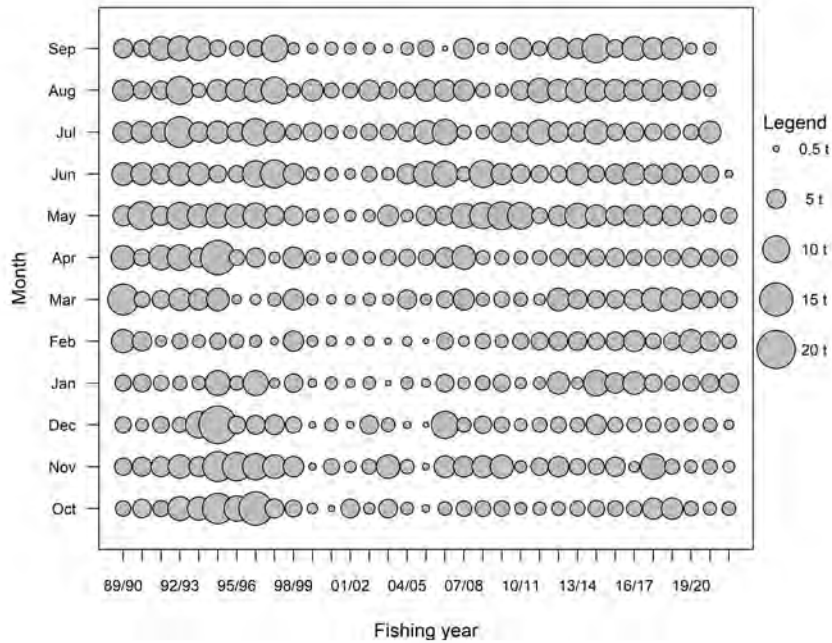


Figure 5: Spatial distribution of BCO 7 potting catches (t) from 2019/20 to 2021/22 fishing years (combined). The main coastal statistical areas are outlined in grey. The dotted line represents the 200 m depth contour.

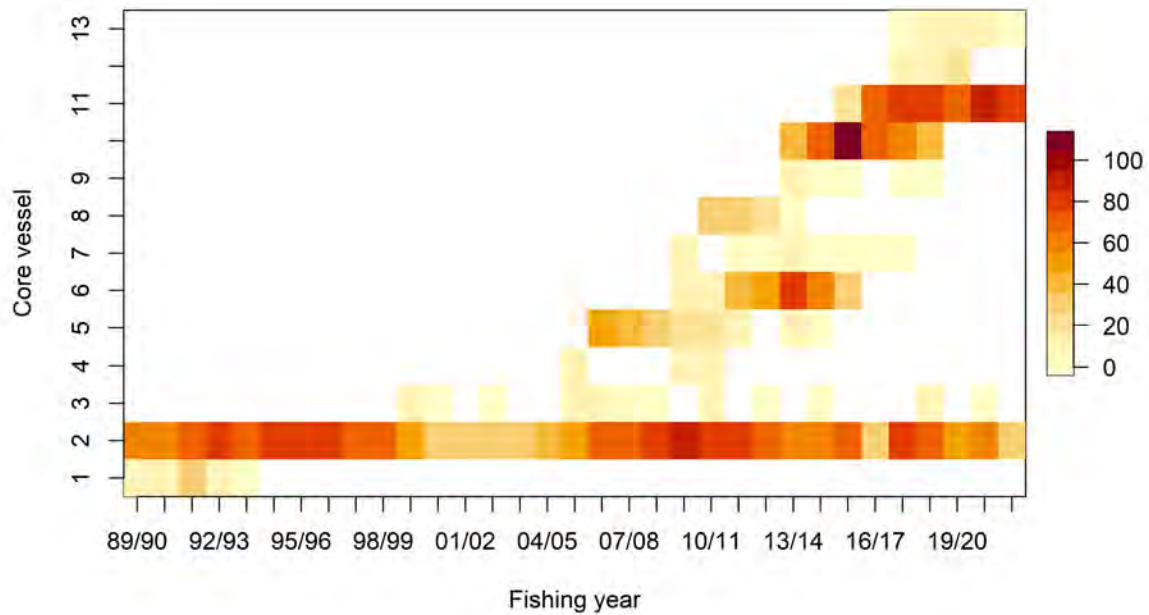


**Figure 6: Landed catch of blue cod by month and fishing year. Data from 2021/22 are incomplete.**

## 2.1 Marlborough Sounds potting fishery

The target potting fishery within the Marlborough Sounds was considered to have the most potential for the development of CPUE indices for blue cod; the fishery has accounted for a large proportion of the total BCO 7 catch and there were several vessels that operated in the fishery for many years.

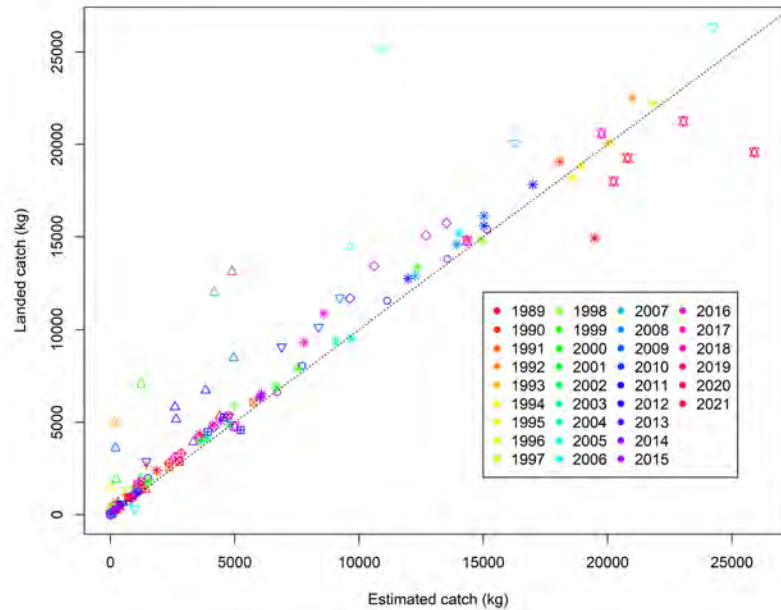
Individual fishing trips were identified from blue cod potting catch and effort records within Statistical Areas 017, 037, 038, and 039. These data were also restricted to individual vessels that completed at least five days of fishing in a minimum of two years. The data set included 2285 fishing trips by 13 vessels with two vessels accounting for 61% of the trips (Figure 7). One of those vessels operated continuously in the fishery from 1989/90 to 2021/22. Catch and effort data from the individual fishing trips were summarised, including blue cod catches from the adjacent fishstocks (BCO 2, BCO 3, and BCO 8). BCO 7 accounted for 92% of the catch from those trips with most of the remainder of the catch taken from BCO 8.



**Figure 7: Number of days fished by the vessels participating in the Marlborough Sounds blue cod potting fishery by fishing year.**

For each trip, the aggregated estimated and landed catches of blue cod were compared. While there was good correspondence between the two catch metrics for a large proportion of trips (58%), the remainder of the trips (42%) had no associated landed catch. Nonetheless, there was a strong correspondence between blue cod estimated and landed catches aggregated by fishing vessel and fishing year (Figure 8). This identified that the landed catch from a significant proportion of trips was reported on landing returns that were “orphaned” from the trip effort and estimated catch records. Most of the orphaned landing records were from the two main vessels from the years prior to the introduction of ERS. It is speculated that those landing records may have represented the final landing of catch to an LFR from an intermediate holding facility, although there were no corresponding intermediary landings reported (destination type Q).

Given the close correspondence between estimated and landed catches from many of the landings and the overall correspondence between annual estimated and landed catches, it was concluded that the estimated catch provided a reliable measure of the catch from individual fishing events. It was not considered necessary to prorate the annual landed catches amongst the corresponding annual trip records for an individual vessel.



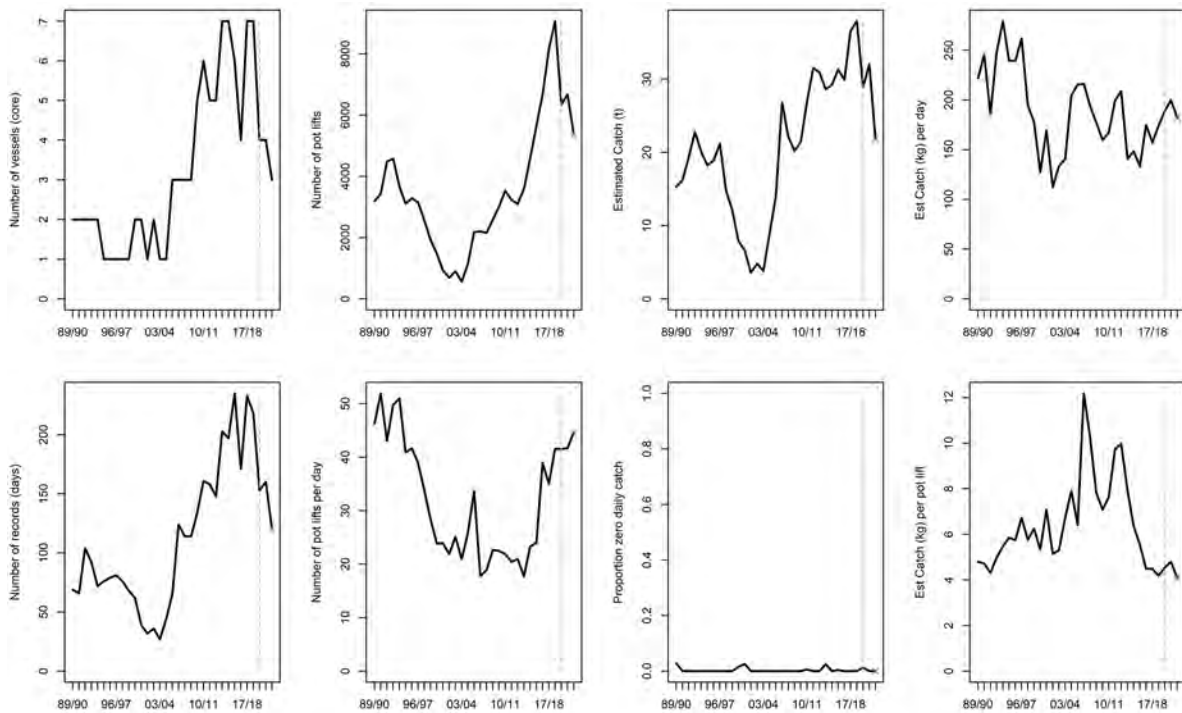
**Figure 8:** A comparison of the aggregated annual estimated and landed catches of blue cod by the vessels operating in the Marlborough Sounds cod potting fishery. The colours represent individual fishing years and the symbols represent individual vessels. The diagonal line represents equivalence. Note fishing years are denoted by the calendar year at the start of the fishing year (e.g., 1989 represents the 1989/90 fishing year).

Recent ERS fishing event data were summarised in a format compatible with the CELR reporting form; i.e., fishing event records were aggregated by fishing day to determine the total number of pot lifts and the associated estimated catch of blue cod. Initial summaries identified that one of the main vessels had been erroneously reporting the fishing effort in the CELR format. Following discussions with the vessel skipper, the erroneous records were corrected and the resultant daily number of pot lifts were comparable with the subsequent ERS data.

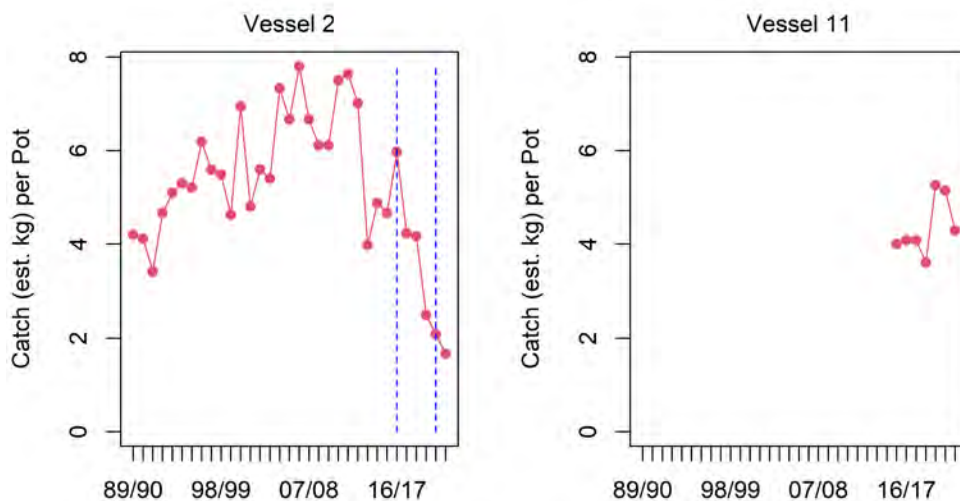
During the 1990s and early 2000s, a small number of vessels operated in the potting fishery and the overall level of fishing effort (fishing days and number of pot lifts) was relatively low (Figure 9). The number of vessels increased during the late 2000s and 2010s with a corresponding increase in fishing effort and blue cod catch. The fleet was rationalised over the last four years and the fleet was increasingly dominated by the two main vessels in the fishery (Figure 7). Those two vessels typically conducted more pot lifts per day than the remainder of the fleet.

The total catch from the fishery was maintained at a relatively high level during 2011/12–2020/21 (Figure 9), while the total number of pot lifts increased considerably during 2012/13–2018/19. Correspondingly, the overall average catch rate of blue cod (kg per pot lift) was considerably lower in 2016/17–2021/22 than the preceding years (Figure 9).

Trends in the nominal CPUE differed considerably between the two main vessels operating in the fishery (Figure 10). Most of the recent decline in the overall CPUE is attributable to a large decline in the catch rate of the long-term vessel, with CPUE for the vessel declining markedly over the last decade. During that period, there were two changes in the ownership of the vessel, although the changes in ownership do not directly coincide with the stepped reductions in CPUE (Figure 10). By comparison, the catch rates of the other main vessel remained relatively stable over the recent period.

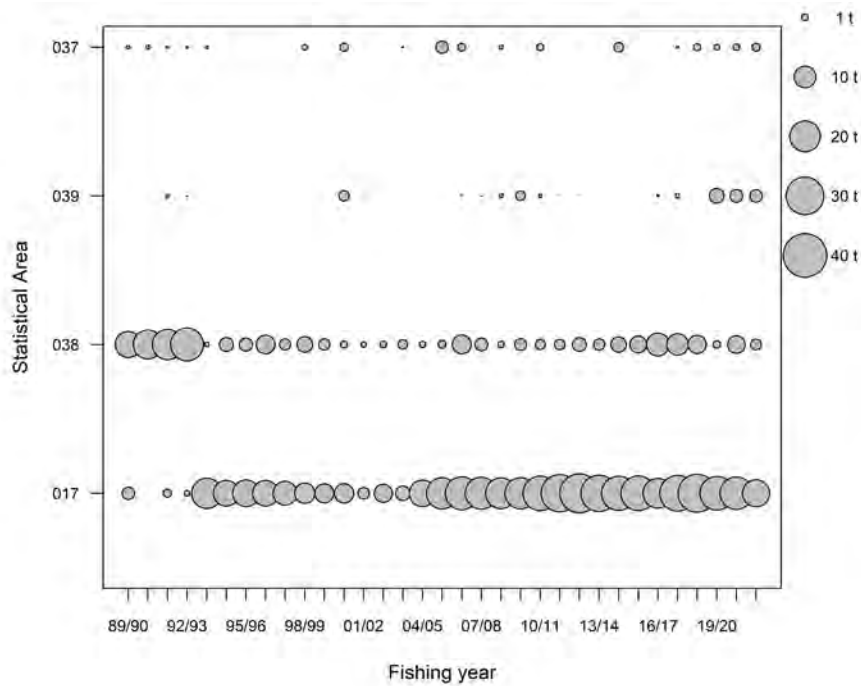


**Figure 9:** A summary of the catch and effort data from the Marlborough Sounds blue cod potting fishery by fishing year. Data from 2021/22 are incomplete (x). The dashed vertical line represents the year of the introduction of the ERS for the potting fleet.



**Figure 10:** Annual nominal blue cod CPUE (kg per pot lift) for the two main vessels operating in the fishery in recent years. The vertical blue lines in the left panel indicate the years when the ownership and operation of the vessel changed.

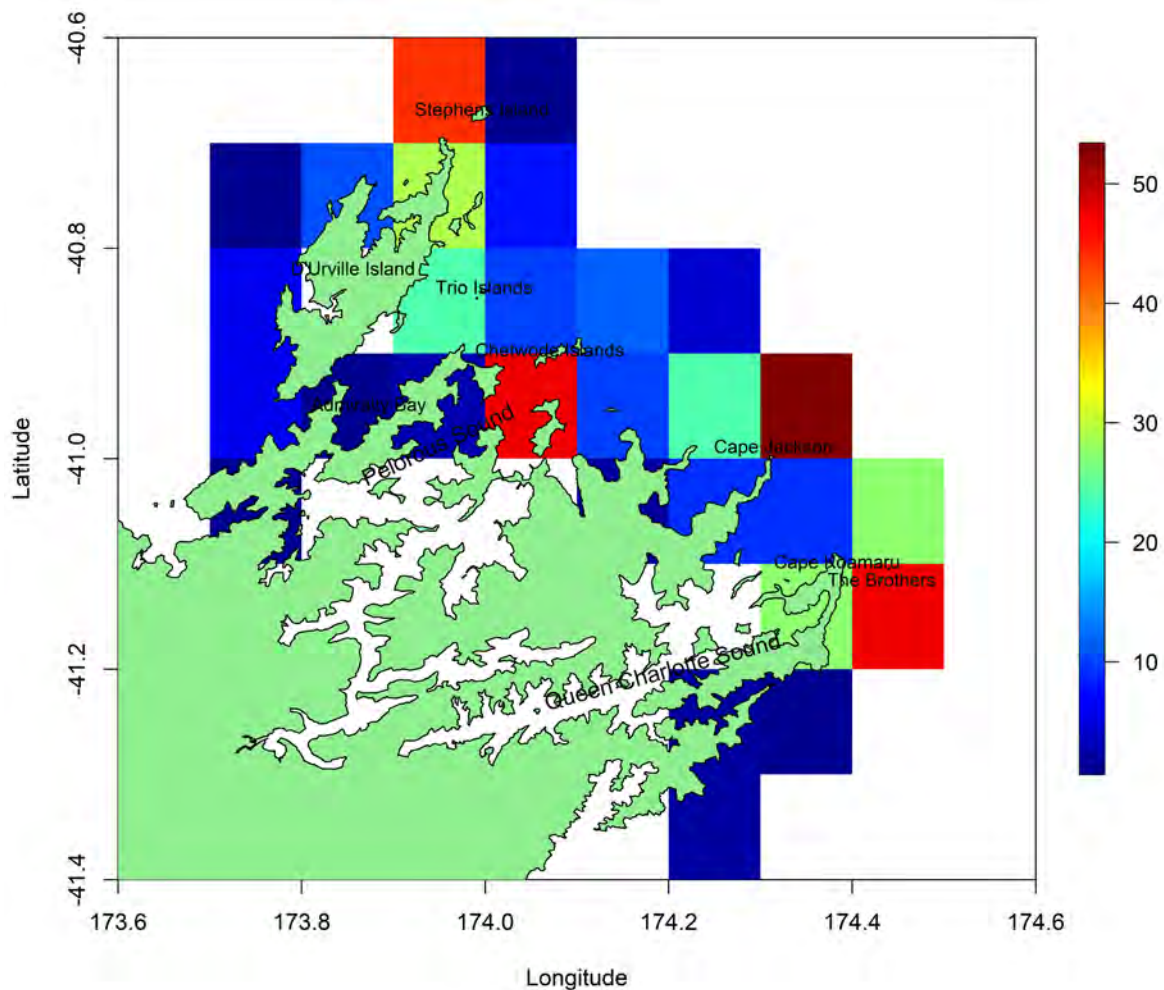
During 1989/90–1992/93, catches were predominantly taken along the western side of D’Urville Island (Statistical Area 038), while in the subsequent years the fishery has mainly operated eastward of D’Urville Island (Statistical Area 017) (Figure 11). The aggregated CELR data do not enable a detailed evaluation of the longer-term trends in the spatial operation of the fishery. Fishing location data were available from the ERS data for 2019/20–2021/22. Those data provided an opportunity to compare the recent fishing locations of the two main vessels and investigate spatial differences in the catch rate of blue cod. A general summary of those data is provided; however, the detailed results are not included due to the confidentiality of data from a small number of operators fishing in discrete locations.



**Figure 11: Blue cod catch from the Marlborough Sounds target potting fishery by statistical area and fishing year.**

In recent years, the fishing in the outer Marlborough Sounds was concentrated at a number of locations typically around headlands and island features, most notably around northern D’Urville Island, Stephens Island, Trio Islands, Chetwode Islands, Cape Jackson, Cape Koamaru, and The Brothers (Figure 12). The distribution of fishing effort by the two vessels overlapped around D’Urville Island and Chetwode Islands and the local scale catch rates of the two vessels were comparable. However, there was considerable variation in blue cod catch rates between individual fishing locations; catch rates tended to be higher at locations that were further seaward of the Marlborough Sounds with especially high catch rates from Stephens Passage (between D’Urville Island and Stephens Island).

Only one of the vessels fished to the east of the Chetwode Islands in the areas beyond Queen Charlotte Sound (i.e., Cape Jackson, Cape Koamaru, and The Brothers). Catch rates in those areas were quite variable with lower catch rates in closer proximity to the entrance of Queen Charlotte Sound. The vessel was based in Picton and typically conducted daily fishing trips, limiting the range of operation to those main fishing areas.



**Figure 12: Spatial distribution of BCO 7 potting fishing activity (number of fishing event records) at 0.1° resolution by main fishing operator from 2019/20 to 2021/22 fishing years (combined). Information released with permission of the operator.**

### 3. DISCUSSION

Initially, the Marlborough Sounds potting fishery was identified as the most likely candidate for the development of CPUE indices of abundance for BCO 7, utilising catch and effort data from 1989/90 onwards. However, a number of key limitations were identified from the detailed characterisation of the potting fishery, specifically:

- There are a limited number of vessels (2) currently active in the fishery and only one vessel has operated in the fishery over the long term (20+ years). Most other vessels operated in the fishery for a relatively short period (5–10 years) and are no longer active. The ownership of the main vessel has changed several times over the last decade resulting in a loss of the continuity of the operation of the vessel. Further, the small size of the current fleet is unlikely to provide sufficient coverage of the fishery to derive reliable estimates of average annual catch rates.
- The potting fishery is conducted in discrete locations, typically along rocky coastal areas associated with headland or island features. The catch rates of blue cod were variable between individual fishing locations. Prior to the introduction of the ERS, detailed location data were not available as fishing activity was reported by statistical area only. Thus, it is not possible to evaluate longer-term trends in the spatial operation of the fishery that will influence trends in overall CPUE.



- Operational constraints of the fishery, especially the proximity to port, influence the main areas fished. Trends in the blue cod catch rates in those areas are unlikely to represent trends in the overall abundance of blue cod.

Based on these observations, it was concluded that it was not feasible to develop CPUE indices for the outer Marlborough Sounds cod potting fishery. The study did provide useful information of the distribution of recent (ERS) fishing activity and also revealed that blue cod catch rates were typically higher in the peripheral areas of the fishery. This information may contribute to the design of future potting surveys in the area. There may be potential to monitor future trends in spatial catch rates once a longer time series of ERS location data is available.

#### **4. ACKNOWLEDGEMENTS**

This stock assessment was funded by Fisheries New Zealand (Project SEA2022-02). Craig Perano, skipper of *Sapphire Bay*, provided useful insights into the operation of the potting fishery. Members of the Inshore Working Group, in particular Marc Griffiths, provided a constructive review of the analysis.

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