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Monitoring the Kaikōura and Motunau boat-based amateur marine fisheries for blue cod, sea perch, and rock lobster, 2021–22

New Zealand Fisheries Assessment Report 2023/33

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EXECUTIVE SUMMARY

Maggs, J.Q.[1]; Davey, N.K.[1]; Hartill, B.W.[1] (2023). Monitoring the Kaikōura and Motunau boat-based amateur marine fisheries for blue cod, sea perch, and rock lobster, 2021–22.

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This survey investigated the recreational fishery along the North Canterbury-Kaikōura coastline during the 2021–22 fishing year. It is the fourth in a series of similar onsite surveys focused on boat ramps in the Kaikōura and Motunau areas. Three key species were investigated: blue cod *Parapercis colias*; sea perch *Helicolenus percoides*; and rock lobster *Jasus edwardsii*.

As with previous studies, an onsite creel survey was used to collect data on the private-vessel recreational fishery. The term 'private-vessel' was used to distinguish the subset of the recreational fishery that is separate from the charter fishery. Bus route methodology was used to survey the five active ramps in the Kaikōura area, while a standalone access-point creel survey was used at the Motunau ramp. In contrast to previous surveys, which used the time interval count approach, combining catch rate and total effort to estimate harvest, we used the direct expansion approach to estimate total harvest directly from interviews. Fishers were intercepted at boat ramps on their return from the day's fishing and interviewed whenever possible. Catch and effort information was recorded during interviews, including information on released catch allowing for the estimation of harvest rates, total harvest, and length frequency analysis. Fish lengths and lobster tail widths were converted to weights using length-weight regression parameters.

A data extract was obtained from the Amateur Fishing Charter Vessel-Amateur Catch Returns (AFCV-ACR) system, managed by Fisheries New Zealand. These data provided additional information on the recreational harvest of the three species, which was not covered by the onsite creel surveys. The AFCV-ACR system does not record fish length or weight. Consequently, total catch in number of fish was converted to an overall harvest weight using the overall mean weight estimates derived from the concurrent onsite creel survey.

Camera monitoring was also undertaken at the Kaikōura South Bay Club ramp. However, the camera was vandalised several times and this rendered the camera inoperable for about a third of the fishing year, preventing any meaningful analyses of the camera images.

Overall, it was estimated that 23 184 blue cod (13.1 t) were harvested in the North Canterbury-Kaikōura private-vessel recreational fishery during the 2021–22 fishing year with an additional 13 107 fish (7.3 t) taken by the charter vessel fishery. For sea perch, an estimated 54 342 fish (21.9 t) were harvested from the private-vessel recreational fishery with an additional 41 475 fish (16.1 t) taken in the charter vessel fishery. An estimated 46 771 rock lobster (26.5 t) were harvested with an additional 3647 lobster (2.0 t) taken in the charter vessel fishery during the 2021–22 fishing year.

Although the harvest rate of blue cod was higher at Motunau, the total harvest and mean size of individuals were higher at Kaikōura. The total harvest, harvest rate, and mean size of sea perch were higher at Kaikōura than at Motunau, where an estimated 208 fish were harvested over the entire fishing year. Rock lobster caught by diving methods had a greater total harvest at Kaikōura, but a higher harvest rate and overall mean size at Motunau. However, female lobster were larger at Kaikōura. For pot-caught rock lobster, the total harvest at Kaikōura was greater than at Motunau, but Motunau had a greater harvest rate and mean size of rock lobster.

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Comparison of catch rate estimates between surveys was complicated by inconsistencies in the recording of fishing effort. Previous surveys recorded fishing effort as the total outing duration, whereas we recorded only the time specifically spent fishing, consistent with the format of the '*rec_data*' database structure.

1. INTRODUCTION

The North Canterbury-Kaikōura coastline, on the east coast of New Zealand's South Island, has several important commercial, recreational (amateur) and customary fisheries. These fisheries are supported predominantly by large populations of blue cod *Parapercis colias* (BCO 3), sea perch *Helicolenus percoides* (SPE 3), and rock lobster *Jasus edwardsii* (CRA 5). There are now known to be two species of sea perch: a shallower species *H. percoides* and a deeper species, the bigeye sea perch *H. barathri.* Given the shallower depth range of *H. percoides*, we expect the recreational catch is dominated by this species.

Commercial landings data showed 183 t of blue cod landed from BCO 3, with 412 t of sea perch landed from SPE 3, and 350 t of rock lobster landed from CRA 5 in the 2020–21 fishing year (Fisheries New Zealand 2022). While commercial BCO 3 landings have consistently exceeded the total allowable commercial catch (TACC), SPE 3 landings have remained well below the TACC since 2004–05. Rock lobster landings from CRA 5 have consistently achieved the TACC. In contrast, the recreational harvest along this coastline is less well understood, with infrequent estimates produced by national diary surveys and onsite boat ramp surveys.

Along the North Canterbury-Kaikōura coastline, two key recreational fisheries for these three species exist at Kaikōura and at Motunau (Kendrick & Hanley 2021). While these areas are relatively close together (being approximately 90 km apart), fundamental differences exist in the two fisheries. Kaikōura has substantial and varied habitat for all three species with a wide range of depths and rocky platforms, whereas the coastline around Motunau is a shallow wide shelf with less rocky seafloor, also supporting fisheries for all three species. The regulations for blue cod also vary between Kaikōura and Motunau, with daily bag limit of six at Kaikōura and only two at Motunau. Furthermore, launching a vessel at Motunau is tidally restricted.

In these fisheries, blue cod and sea perch are caught almost entirely by line fishing, while rock lobster is caught by potting and diving. In the Kaikōura area there are six boat ramps, while at Motunau there is a single ramp. However, the relative usage of the Kaikōura ramps has changed since the earthquake in 2016, which altered the rocky platform and hence accessibility of certain ramps. Most boat-based fishing effort on this coast now takes place from the four ramps located on the Kaikōura Peninsula, but some effort continues to take place at the Motunau ramp.

Over the last two decades, local fishers have become increasingly concerned about the sustainability of the fisheries at Kaikōura and at Motunau, with anecdotal reports of declines in blue cod and sea perch (Hart & Walker 2004). More recently, there have been similar concerns about declines in rock lobster (Kendrick & Hanley 2021).

There was also the perception that recreational fishers may be redirecting their effort towards Kaikōura and Motunau from other regions, such as the Marlborough Sounds and South Canterbury, which have experienced declines in catches and undergone more restrictive catch regulations. However, Kendrick & Hanley (2021) surveyed fishers in the 2012–13 fishing year and found no evidence of fishers from the Marlborough Sounds adding to fishing pressure in Kaikōura and Motunau.

Blue cod and sea perch may be prone to localised depletion, but there are no reliable data to determine how the recreational catch is distributed within the North Canterbury-Kaikōura area. Widespread concerns about the sustainability of blue cod populations led to the introduction of the National Blue Cod Strategy in 2018 (Fisheries New Zealand 2018). This was intended to facilitate responsive management of blue cod stocks. One of the key requirements for implementing this strategy is a sound understanding of levels of recreational harvest from each fish stock.

Previous research relevant to recreational fishing in the North Canterbury-Kaikōura area began in the 1990s with questionnaire surveys (Teirney et al. 1992, Bell et al. 1993), an offsite national telephone-diary survey in 1996 (Bradford et al. 1998), and an onsite roving-access survey (Carbines 2000).

Thereafter, periodic offsite national panel surveys were conducted with the most recent survey completed in 2017–18 (Wynne-Jones et al. 2019). Additionally, three onsite surveys using repeatable designs were conducted in 2003 (Hart & Walker 2004), in 2009 (Kendrick et.al. 2011), and in 2012–13 (Kendrick & Hanley 2021).

The 2017–18 national panel survey showed that blue cod was the third most common recreational finfish species caught in New Zealand with a total catch of 292 t (nearly 600 000 fish) and the most common finfish species caught by recreational fishers in the South Island (Wynne-Jones et al. 2019). The BCO 3 area extends from the Clarence River, north of Kaikōura, to Slope Point in Southland and within this area the 2017–18 recreational take of blue cod was estimated at 98 t. Furthermore, blue cod recreational catch in BCO 3 was the highest from any blue cod quota management area (34% of the total national recreational blue cod catch) with average daily catches of over 13 blue cod taken by 18% of respondents. The most common fishing method by far was by rod and line.

An onsite survey conducted in 2003 provided the first baseline statistics for the North Canterbury – Kaikōura fishery and established a repeatable monitoring design (Hart & Walker 2004). However, this study collected data only during late summer and early autumn (January–April) and did not collect data on rock lobster catches. The onsite survey of 2009 was also only conducted during January–April (Kendrick et al. 2011). The survey followed the sample design of the 2003 survey and similarly did not record rock lobster catches (Kendrick et al. 2011). The 2009 survey documented a substantial increase in fishing effort at both Kaikōura and Motunau. There was also a shift towards greater weekday fishing effort at Kaikōura, with effort expanding to an additional boat ramp. Due to the additional effort, parking space became limited at the two South Bay ramps. Consequently, more trailers were moved offsite, requiring that a correction factor be applied to the 2009 data. The onsite survey conducted in 2012–13 expanded the survey period to the entire fishing year and included rock lobster catches (Kendrick & Hanley 2021). A trailer correction factor was similarly necessary for the time count interval analytical method used when analysing the 2012–13 bus route data.

The overall objective of this research for Fisheries New Zealand project MAF2020-05 was to monitor the amateur marine fishery for key species in the North Canterbury-Kaikōura area from 01 October 2021 to 30 September 2022.

There were five specific objectives:

1. To monitor harvest rates of key species in the North Canterbury-Kaikōura area boat-based amateur marine fisheries in the 2021–22 fishing year.
2. To monitor size composition of the harvest of key species in the North Canterbury-Kaikōura area boat-based amateur marine fisheries in the 2021–22 fishing year.
3. To estimate the harvest of key species in the North Canterbury-Kaikōura area boat-based amateur marine fisheries in the 2021–22 fishing year.
4. To monitor daily levels of recreational boating effort returning to a high traffic boat ramp on the Kaikōura coast.
5. To compare results of this survey with past and present abundance and composition surveys.

In this report, the term ‘private-vessel’ was used throughout to distinguish the subset of the recreational fishery that is separate from the charter fishery.

2. METHODS

This study closely follows the field survey methodology described in previous onsite surveys of the private-vessel recreational fishery at Kaikōura and Motunau in 2003, 2009, and 2012–13 and is thus the fourth comparable survey in the series. However, one notable difference exists with the bus route methodology used at the Kaikōura ramps (see Section 2.2.1). Whereas all three previous onsite surveys used time interval counts to estimate fishing effort, the current study used direct expansion for the

harvest estimation (Pollock et al. 1994). At Motunau, all four studies used the traditional access-point design.

2.1 Study area

The study was undertaken as a bus route survey of the five boat ramps around Kaikōura, with a non-roving access point survey at the remote Motunau ramp (Figure 1). Four of the five bus route ramps exist on the Kaikōura Peninsula, including the Pier Slipway, Armers Beach, South Bay Private Club ramp, and the South Bay Public ramp. The fifth ramp surveyed as part of the bus route is the Oaro Boat Harbour to the southwest of the peninsula. The remote Motunau ramp is approximately 90 km to the southwest of Kaikōura and launching vessels at Motunau is restricted to the high tide.

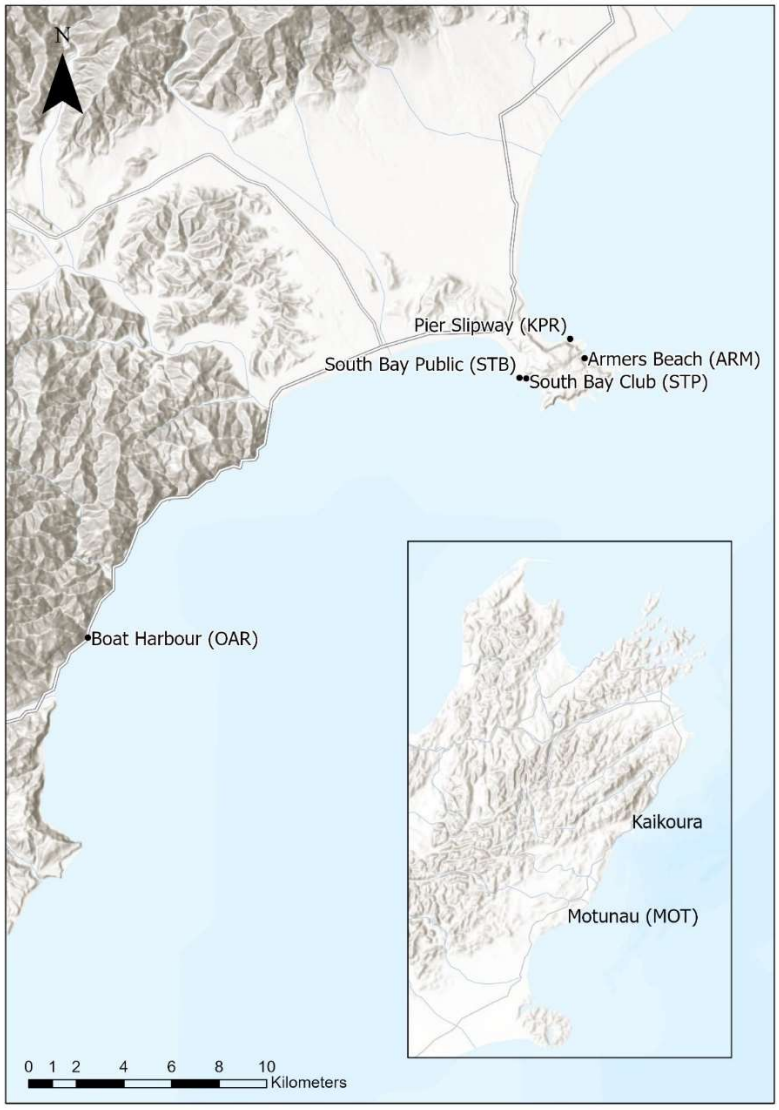

Figure 1: The study area showing the location of boat ramps surveyed in Kaikōura and at Motunau (inset) from 03 October 2021–24 September 2022.

2.2 Data collection

The private-vessel recreational fishery in Kaikōura and Motunau was surveyed over an entire fishing year (October 2021–September 2022). The access points for a boat to launch along this coast are well defined and can be accessed regularly. However, there are fundamental differences in the way that fishers operate at Kaikōura compared with the relatively remote and tidally restricted Motunau ramp.

Thus, a bus route survey was undertaken at the five Kaikōura ramps and provided comprehensive coverage of the private-vessel recreational fishing effort in that area. A sixth ramp at Barney's Rock was surveyed in previous onsite surveys. However, this ramp was excluded from the current survey because the 2016 earthquake had cut off accessibility to this ramp.

All data was collected in a format suitable for the '*rec_data*' database (Appendix 1, 2), which is administered by Fisheries New Zealand's Research Data Manager (Fisher & Dick 2020). Fishing effort duration was recorded as the time spent specifically on fishing by individual fishers. Any time spent on other activities, such as travelling from the boat ramp to the fishing location or moving between fishing locations was not included in the fishing effort duration. This differs from the previous three onsite surveys, which recorded the fishing duration as the entire time from departing the boat ramp to when the vessel returned to the ramp.

2.2.1 Kaikōura bus route survey

The bus route method (Robson & Jones 1989, Jones et al. 1990, Pollock et al. 1994) that was used for the 2003, 2009, and 2012–13 surveys has been used extensively in Australia and the U.S., to survey recreational fishers returning to a series of access points (bus stops on a bus route) in a probabilistic and scalable fashion. With the bus route design, a creel clerk sequentially surveys a loop of access points according to a randomly determined schedule. The starting position of the loop and direction taken by the clerk on each day is randomly predetermined. The time spent at each access point is proportional to the relative intensity of activity typically expected at that site. Returning fishers are interviewed at each site and the reported catch and effort associated with their trip is recorded.

The proportional time allocation in the current study differed to that of previous studies due to the effects of the 2016 earthquake (Table 1, Appendix 3). Information provided by the Regional Compliance Manager (Howard Reid), a boat ramp interviewer employed at Kaikōura in a previous survey and the President of the Kaikōura boating club (Marty Sullivan) suggested that while most ramps were operational, their relative usage had changed.

Table 1: Proportion of the survey day spent at each boat ramp during the bus route survey of the private-vessel recreational fishery in Kaikōura. Data shown for the current (2021–22) and previous bus route surveys.

	Survey year			
Ramp	2003	2009	2012–13	2021–22
Pier Slipway	0.02	–	–	0.04
Armers Beach	0.08	0.06	0.06	0.08
South Bay (club ramp)	0.35	0.27	0.27	0.50
South Bay (public ramp)	0.45	0.40	0.40	0.34
Barney's Rock	0.08	0.01	0.01	–
Boat Harbour (Oaro)	0.02	0.25	0.25	0.04

The temporal stratification of the bus route survey and the number of days for each stratum closely followed that used in the 2012–13 survey (Table 2). This level of sampling effort is over 50% higher than normally undertaken elsewhere, for surveys such as the MAF2019-01 camera creel monitoring programme. However, results from the previous Kaikōura survey suggested that this level of sampling would be required to obtain sufficiently precise harvest estimates in this area, given the exposed and weather prone nature of this fishery (Kendrick & Hanley 2021).

The duration of the bus route survey on each day varied with day length to ensure full coverage of the fishing effort of fishers returning during daylight hours (Table 3). The survey day started soon after dawn and ended at around dusk. The early start was necessary to intercept rock lobster pot fishers who tend to inspect their pots at first light. The late end to the survey day ensured that all returning fishers

were intercepted. It is very unusual for boats to return during the hours of darkness given the rocky shoreline and lack of public lighting at any of the ramps.

Table 2: Temporal sampling design for the bus route survey of the private-vessel recreational fishery in Kaikōura.

Season	Day type	Days in stratum	Days sampled	Sampling intensity
Early summer (October–December)	Weekday	59	17	0.29
	Weekend	33	13	0.39
Late summer (January–April)	Weekday	76	21	0.28
	Weekend	44	17	0.39
Winter (May–September)	Weekday	107	14	0.13
	Weekend	46	10	0.22
	Total	365	92	0.25

Table 3: Duration of survey day and interviewer shift times for the bus route survey of the private-vessel recreational fishery in Kaikōura.

	Start	Finish	Total time		Morning shift		Afternoon shift		Shift	
Month	time	time	Hours	Mins	Start	End	Start	End	length	Overlap
October	06:30	19:30	13:00	780	06:30	13:30	12:30	19:30	7	01:00
November	06:00	20:30	14:30	870	06:00	13:30	13:00	20:30	7.5	00:30
December	06:00	21:00	15:00	900	06:00	13:30	13:30	21:00	7.5	00:00
January	06:00	21:00	15:00	900	06:00	14:00	13:00	21:00	8	01:00
February	06:00	20:30	14:30	870	06:00	13:30	13:00	20:30	7.5	00:30
March	07:00	19:30	12:30	750	07:00	13:30	13:00	19:30	6.5	00:30
April	07:30	18:00	10:30	630	07:30	13:00	12:30	18:00	5.5	00:30
May	07:30	17:30	10:00	600	07:30	13:00	12:00	17:30	5.5	01:00
June	08:00	17:00	09:00	540	08:00	13:00	12:00	17:00	5	01:00
July	08:00	17:00	09:00	540	08:00	13:00	12:00	17:00	5	01:00
August	07:00	17:30	10:30	630	07:00	12:30	12:00	17:30	5.5	00:30
September	06:30	18:00	11:30	690	06:30	12:30	12:00	18:00	6	00:30

2.2.2 Motunau creel survey

A stratified random total census approach was conducted at Motunau as used in previous onsite surveys. This approach was the most appropriate because there is only one access point to survey at Motunau, and it is only accessible for a few hours before and after the high tide. By being present for just a few hours, the interview clerk can intercept all possible fishing effort and catch for the day.

The interviewer at Motunau was required to be present at the ramp from three hours before high tide until three hours after high tide. On days where fishing was possible over two high tide phases (e.g., at dawn and then again at dusk), the interviewer needed to be present for both sessions.

The temporal stratification of the Motunau survey was adapted from that used in 2012–13 by having increased sampling intensity on weekdays (Table 4). The number of weekdays surveyed was increased from two to six days for each of the three seasonal weekday strata, as this is considered the minimum required to estimate the harvest taken in any temporal stratum, regardless of how much effort takes place during these days of the week.

Table 4: Temporal sampling design for the access-point survey of the private-vessel recreational fishery in Motunau.

			Motunau	
Season	Day type	Days in	Days	Sampling
Early summer (October–December)	Weekday	59	6	0.10
	Weekend	33	13	0.39
Late summer (January–April)	Weekday	76	6	0.08
	Weekend	44	17	0.39
Winter (May–September)	Weekday	107	6	0.06
	Weekend	46	9	0.20
	Total	365	57	0.16

2.2.3 Amateur charter vessel fishery

Although most of the catch and effort occurring in the North Canterbury area is conducted from private fishing vessels, some anglers (both New Zealanders and tourists) also fish from charter boats. Catch and effort in the amateur charter vessel fishery was not included in the onsite surveys at Kaikōura and Motunau. A compulsory Amateur Fishing Charter Vessel-Amateur Catch Returns (AFCV-ACR) system has been in place since 2010. Data collected through this system is stored on a database maintained by Fisheries New Zealand. An extract of this database was requested for analysis in this study so that a more complete account of the total recreational harvest could be provided. The extract request was for all outings taking place from 2021-10-01 to 2022-09-30 and fishing in Statistical Area 018 or 020.

2.2.4 Daily monitoring of boat traffic (camera)

A remote camera system was installed to monitor boat traffic at the Kaikōura South Bay Club ramp (STP). The design and methods used to install the camera system followed those used already to monitor traffic at other boat ramps in the North Island and the top of the South Island under project MAF2019-01 (Hartill et al. 2020). Similarly, the camera at Kaikōura was setup to record an image of the boat ramp every minute of the day throughout the fishing year. The resulting images were analysed and counts were made of the number of fishing vessels retrieved across the ramp to provide additional data on daily levels of recreational fishing effort.

2.3 Data analysis

All boats were counted during a survey session, but, for some boats, the fishers could not be interviewed because the interview clerk was already busy with another boat. During the data analysis stage, catch and effort for missed boats were imputed from another vessel that had been successfully intercepted during the same survey session. The imputation procedure used a computational algorithm to choose the 'nearest-neighbour-in-time' vessel to impute data from, first looking back and then forward in time.

Data collected at the Kaikōura ramps using the bus route methodology was analysed separately to the data collected at the Motunau ramp using the single access point creel survey. Catch and effort data for rock lobster caught by diving methods, including snorkel and scuba, were treated separately to the data from the pot fishery. However, total rock lobster harvest and associated estimates of precision were also presented here for both methods combined.

2.3.1 Harvest rates in the private-vessel recreational boat fishery

Harvest rates were calculated as the ratio of the means (mean retained catch / mean effort) for a given stratum and included imputed data. Harvest rates were based only on retained catch taken during targeted effort. For blue cod and sea perch, targeted effort comprised those events that reported using line fishing as a method and were targeting either blue cod or sea perch. For dive-caught rock lobster, targeted effort comprised those events that reported using snorkel or scuba and where rock lobster was the target species. For rock lobster caught by potting, targeted effort comprised those events that

reported using the potting method and where rock lobster was the target species. The metric of effort for blue cod and sea perch was mean angler hours per trip. However, for rock lobster, the metric of effort used mean number of fishers per trip for both diving and potting as the number of rock lobster retained is often less reliant on effort duration (Holdsworth 2016).

The daily harvest rate ($\widehat{H}m$) was estimated as:

$$\widehat{H}m = \frac{\bar{C}_m}{\bar{L}_m} \quad (1)$$

where $\bar{C}_m$ is the mean retained catch in number of individuals, and $\bar{L}_m$ is the mean effort in number of angler hours for survey day m.

2.3.2 Size composition in the private-vessel recreational boat fishery

Blue cod, sea perch, and rock lobster were measured where possible. For blue cod and sea perch, a total length in centimetres (cm) was recorded. For rock lobster, a tail width was recorded as a straight line in millimetres (mm) between the tips of the two large (primary) spines on the second segment of the tail. All length measurements were used in analyses, including those from non-targeted effort and imputed data.

Individual length measurements were converted to weight using the length-weight equation:

$$W = aL^b \quad (2)$$

where W is the weight of the animal, L is the length or width of the animal, and a and b are regression parameters specific to the species and, for rock lobster, the sex of the animal (Table 5).

Table 5: Length-weight relationships used in this study to convert from measured length (finfish) and tail width (rock lobster) to weight. For rock lobster, separate parameters are given for males (m) and females (f) as derived for the CRA 5 fishery.

Common name	Scientific name	*a*	*b*	Conversion	Source of parameter
Blue cod	*Parapercis colias*	0.000005	3.197	mm/kg	Beentjes (unpub. data)
Sea perch	*Helicolenus* spp.	0.0078	3.219	cm/g	Schofield & Livingston (1996)
Rock lobster (m)	*Jasus edwardsii*	0.00000416	2.935	mm/kg	Ministry of Fisheries (2010)
Rock lobster (f)	*Jasus edwardsii*	0.000013	2.545	mm/kg	Ministry of Fisheries (2010)

2.3.3 Total harvest in the private-vessel recreational boat fishery

In the bus route survey of the Kaikōura ramps, the total number of fish landed at the surveyed access points during each day was estimated using the direct expansion approach (Pollock et al. 1994). With the direct expansion method, harvest estimates were calculated by scaling up the catch landed at each bus stop, during the period it was surveyed, by the inverse of the fraction of the day that the interviewer was present at that bus stop. The harvest landed across all sites throughout each day was then calculated by summing up the harvest estimates calculated for each of the bus stops occurring within each bus route.

In the bus route survey, the total daily harvest ($\hat{C}m$) for survey day m was estimated as:

$$\hat{C}m = T \sum_{i=1} \frac{1}{w_i} \sum_{j=1} \frac{C_{ji}}{\pi_j} \quad (3)$$

where

T = total time to complete a full circuit of the bus route, including traveling and waiting;
w_i = waiting time in hours at the *i*th site;
C_{ji} = total retained catch in number of individuals by the *j*th boat at the *i*th site;
π_j = adjustment for the selection probability where partial days are surveyed. Set to 1 in this study because the entire day was surveyed.

Using non-parametric bootstrapping, a coefficient of variation (CV) was calculated for the harvest estimates at the stratum, season, and year resolution. The daily harvest estimates ($\hat{C}m$) were resampled with replacement to obtain 1000 bootstrap samples. The mean of each bootstrap sample (estimate of the average daily harvest within each day type/season stratum) was multiplied by the total available fishing days to obtain 1000 harvest estimates. An estimate of the population variance (σ^2) was estimated as:

$$\sigma^2 = \frac{\sum(x_i - \mu)^2}{N} \quad (4)$$

where x_i is the *i*th of N (1000) harvest estimates and μ is the mean of N harvest estimates.

The population standard deviation (σ) was estimated as:

$$\sigma = \sqrt{\sigma^2} \quad (5)$$

and the CV was estimated as:

$$CV = \sigma/\mu \quad (6)$$

At Motunau, the total catch and effort on each survey day was calculated by simply summing up the catch observed either side of high tide. Motunau harvest and effort estimates were calculated by scaling up average daily counts (of boats, hours fished, or fish landed of each species) by the inverse of the sampling intensity within each seasonal day type stratum. Variances were calculated in a similar fashion, by nonparametrically bootstrapping daily counts within each temporal stratum and scaling the average of these by the inverse of the sampling intensity for that stratum.

In the single access point creel survey, the daily harvest ($\hat{C}m$) for survey day m was estimated as:

$$\hat{C}m = \sum C_j \quad (7)$$

Where $C_j$is the total retained catch in number of individuals by the *j*th boat.

The harvest estimate for each stratum was then estimated by multiplying the mean total daily harvest ($\hat{C}m$) by the total available days in the respective stratum.

2.3.4 Total harvest in the amateur charter vessel fishery

The data extract from the AFCV-ACR included all charter vessel fishing activity taking place in Statistical Areas 018 and 020 for the period 2021-10-01 to 2022-09-30. During analysis, these data were further limited to only those outings originating from Kaikōura or Motunau when estimating the total harvest for the respective fisheries. Less than 2% of charter vessel returns were from outside the Kaikōura-Motunau region. The AFCV-ACR system currently only records data on catch in numbers and does not include any data on fish or lobster size. Therefore, total catch in number of fish was converted to an

overall harvest weight using the overall mean weight estimates derived from the concurrent onsite creel survey.

2.3.5 Daily levels of private-vessel recreational boat launches

The images collected by the camera at the Kaikōura South Bay Club ramp were limited to 236 days (65%) of the fishing year. The analysis of these data was therefore limited to a basic summary of the mean number of boats launching at this ramp per day in each of the strata.

2.3.6 A comparison of results with other surveys

The 2022 survey of the private-vessel recreational fishery at Kaikōura and Motunau is the fourth in a series. Earlier surveys were conducted in 2003, 2009, and 2012–13. However, the 2003 and 2009 surveys did not consider rock lobster and were limited to the January–April (late summer) season. The 2012–13 survey was expanded to cover the entire fishing year and included rock lobster. Therefore, comparisons involving blue cod and sea perch across all four surveys are limited to the late summer (January–April) season. Comparisons involving lobster are limited to the two most recent surveys (2012–13 and 2021–22) but include data for the full fishing year in both surveys. It should be noted that at the time of writing this report, the data used here from the 2012–13 study (Kendrick & Hanley 2021) had not been finalised by Fisheries New Zealand's Research Data Manager.

3. RESULTS

3.1 Kaikōura

3.1.1 Sampling activity

Sampling took place as planned from 03 October 2021 to 24 September 2022 with 92 sample days achieved at Kaikōura (Table 6). The number of sample days as a proportion of available days, expressed as sampling intensity, was greater on weekends than on weekdays in all three seasons and greater in summer than in winter. Overall, there were 1747 boats encountered at the Kaikōura ramps and 67% of these were interviewed (Table 7).

Table 6: Sampling coverage of the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

Season	Day type	Days in stratum	Days sampled	Sampling intensity
Early summer (October–December)	Weekday	59	17	0.29
	Weekend	33	13	0.39
Late summer (January–April)	Weekday	76	21	0.28
	Weekend	44	17	0.39
Winter (May–September)	Weekday	107	14	0.13
	Weekend	46	10	0.22
	Total	365	92	0.25

Table 7: Number of interviews by interview outcome for the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

		Kaikōura	
Interview outcome	Description	n	%
I	Interviewed	1 169	67
O	Other activity	232	13
N	Not interviewed	263	15
R	Refused	18	1
F	Fishing but refused	65	
X	Charter boat		
Z	Incomplete outing		
	Total	1 747	

At the Kaikōura ramps, lobster potting was the dominant activity in all three seasons, followed by line fishing for blue cod or sea perch, and then lobster diving using either snorkel or scuba (Table 8). Lobster potting was undertaken on 37–48% of outings, being highest during October–December. Line fishing for blue cod or sea perch was undertaken on 29–37% of outings, being highest during January–April. Diving for lobster, using either snorkel or scuba, was undertaken on less than 5% of outings in all seasons.

Boat ramp interviewers measured landed individual fish where possible (Table 9). At the Kaikōura ramps, measurements were taken from 299 blue cod (22% of observed individuals), 715 sea perch (32%), and 336 rock lobster (14%). This varied among seasons at the Kaikōura ramps with a notably high proportion of observed fish and lobster measured during May–September.

Table 8: Number of interviews by outing type for the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 – 24 September 2022. BCO - Blue cod, SPE - sea perch, CRA - rock lobster. Data before imputation.

			BCO/SPE line fishing interviews		CRA diving interviews		CRA potting interviews	
Season	Days sampled	Interviews	n	prop.	n	prop.	n	prop.
October–December	30	1 483	434	0.29	54	0.04	708	0.48
January–April	38	1 117	408	0.37	40	0.04	428	0.38
May–September	24	309	105	0.34	2	0.01	113	0.37
Total	92	2 909	947		96		1 249	

Table 9: Number of length measurements as a proportion of all observed fish (n) in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. BCO - Blue cod, SPE - sea perch, CRA - rock lobster. Measurements refer to observations of retained individuals only. Data before imputation.

	BCO		SPE		CRA	
Season	n	prop. measured	n	prop. measured	n	prop. measured
October–December	501	0.01	733	0.00	1 283	0.04
January–April	576	0.16	918	0.29	945	0.20
May–September	288	0.71	613	0.73	199	0.50
Total	1 365	0.22	2 264	0.32	2 427	0.14

3.1.2 Descriptive statistics

At the Kaikōura ramps, interviewed fishers were mostly male (88%), and there were notably fewer female fishers during the May–September season (Table 10). The numbers of interviewed fishers aged 50–59 (22%) and 60–69 (22%) were higher than for any other age groups (Table 11). More broadly, 73% of fishers were aged 30–69.

Blue cod and sea perch were targeted exclusively by line fishing (100%), while rock lobster were targeted predominantly using pots (94%) with very few fishers diving for lobster (Table 12). Of the interviews of fishing events that targeted species other than blue cod, sea perch, or rock lobster, most were using the line method (66%), but some were diving (34%).

At the Kaikōura ramps, there were 20 882 fish caught, of which 52% were retained (Table 13). Sea perch was the most commonly caught species, contributing 39% to the total catch, with 56% of the individuals retained by fishers. Next was rock lobster, contributing 33% of the catch, with 41% of individuals retained. Blue cod contributed 15% of the catch, with 48% of individuals retained. Although not a focal species of this report, pāua contributed less than 1% at the Kaikōura ramps, with 96% of individuals retained.

Table 10: The number and proportion of fishers by sex in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

	Male		Female	
Season	n	prop.	n	prop.
October–December	1 102	0.88	150	0.12
January–April	838	0.86	134	0.14
May–September	256	0.99	3	0.01
Total	2 196	0.88	287	0.12

Table 11: The proportion of fishers by age group in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

	Age group									
Season	<15	15–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	Total
October–December	0.01	0.05	0.10	0.15	0.13	0.23	0.23	0.09	0.01	1 225
January–April	0.01	0.06	0.10	0.15	0.14	0.22	0.21	0.11	0.00	947
May–September	0.02	0.03	0.07	0.21	0.14	0.16	0.22	0.14	0.00	283
Total	0.01	0.05	0.10	0.16	0.14	0.22	0.22	0.10	0.01	2 455

Table 12: The proportion of interviews by fishing method and target species in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

	Fishing method				
Target species	Line	Potting	Dive	Other	Total
BCO	1.00	0.00	0.00	0.00	869
SPE	1.00	0.00	0.00	0.00	143
CRA	0.00	0.93	0.07	0.00	1 349
Other (all other spp.)	0.66	0.00	0.34	0.00	548
Total	0.47	0.43	0.10	0.00	2 909

Data were imputed for those boats that were counted but the fishers not interviewed (Table 14). This resulted in the imputation of data for 886 additional interviews and 2596 length measurements for the Kaikōura ramps.

Table 13: The number of fish caught, their contribution to the total catch and the proportion retained, in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

Species	Scientific name	Total catch (n)	Contribution	Prop. retained
Sea perch	*Helicolenus percoides*	8 068	0.39	0.56
Rock lobster	*Jasus edwardsii*	6 947	0.33	0.41
Blue cod	*Parapercis colias*	3 063	0.15	0.48
Kina	*Evechinus chloroticus*	826	0.04	1.00
Butterfish	*Odax pullus*	358	0.02	0.99
Spiny dogfish	*Squalus acanthias*	328	0.02	0.05
Wrasse	Labridae	167	0.01	0.28
Pāua	*Haliotis* spp.	155	0.01	0.96
Barracouta	*Thyrsites atun*	145	0.01	0.54
Tarakihi	*Nemadactylus macropterus*	145	0.01	0.90
Other		680	0.03	0.67
Total		20 882		0.52

Table 14: The number of observations (boats, interviews, lengths) in the dataset before and after imputation for the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Data before imputation.

		Kaikōura	
Data type	Outcome	Before	After
Boats	I - Interviewed	1 169	1 463
	F - Fishing but refused	65	28
	O - Other activity	232	254
	N - Not interviewed	263	2
	R - Refused	18	
	Total	1 747	1 747
Interviews		2 909	3 795
Lengths		7 187	9 756

3.1.3 Harvest rate

Estimates of harvest rate presented here for the Kaikōura ramps include data imputed for boats that were counted, but the fishers were not interviewed. The harvest rates are calculated as the ratio of the means (mean retained catch / mean effort) and consider only targeted outings. Here finfish refers only to blue cod and sea perch. For blue cod and sea perch, the metric of effort is mean angler hours per trip (Table 15, Table 16), and, for rock lobster, the metric of effort is mean number of fishers per trip (Table 17, Table 18).

The overall harvest rate for blue cod in finfish-targeted line fishing outings was 0.56 fish per hour (Table 15). Harvest rates were highest during the May–September season (0.66 fish per hour), and lowest during January–April (0.50 fish per hour). Weekdays at the Kaikōura ramps had a higher harvest rate than weekends for blue cod in all seasons.

The overall harvest rate for sea perch in finfish-targeted line fishing outings was 1.35 fish per hour (Table 16). Harvest rates were highest during the May–September season (2.08 fish per hour), and lowest during January–April (1.21 fish per hour). Weekdays at the Kaikōura ramps had a higher harvest

rate than weekends for sea perch during October–December and January–April, but not in May–September.

The overall harvest rate for rock lobster in lobster-targeted diving outings was 2.86 lobster per fisher (Table 17). Harvest rates were highest during the October–December season (3.42 lobster per fisher), and zero during May–September. Weekends at the Kaikōura ramps had a higher harvest rate than weekdays for lobster during October–December but lower rate in January–April.

The overall harvest rate for rock lobster in lobster-targeted potting outings was 1.99 lobster fish per fisher (Table 18). Harvest rates were highest during the October–December season (2.06 lobster per fisher), and lowest during May–September (1.78 lobster per fisher). Weekdays at the Kaikōura ramps had a higher harvest rate than weekends for lobster during October–December and January–April, but not in May–September.

Table 15: Harvest rate of blue cod (mean number of fish retained / mean angler hours per trip) for finfish targeted outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Kaikōura	555	2.50	5.81	3.23	5.11	0.56
October–December	248	2.62	5.32	3.12	5.08	0.59
Weekday	62	2.02	4.55	2.94	3.94	0.65
Weekend	186	2.82	5.58	3.18	5.41	0.57
January–April	234	2.55	6.42	3.21	5.47	0.50
Weekday	99	2.35	6.29	4.14	5.84	0.66
Weekend	135	2.69	6.52	2.53	5.09	0.39
May–September	73	1.95	5.53	3.64	3.91	0.66
Weekday	34	2.03	6.21	4.62	4.56	0.74
Weekend	39	1.87	4.94	2.79	3.05	0.57

Table 16: Harvest rate of sea perch (mean number of fish retained / mean angler hours per trip) for finfish targeted outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Kaikōura	555	2.50	5.81	7.87	8.86	1.35
October–December	248	2.62	5.32	6.90	8.41	1.30
Weekday	62	2.02	4.55	6.98	8.45	1.53
Weekend	186	2.82	5.58	6.87	8.42	1.23
January–April	234	2.55	6.42	7.76	8.80	1.21
Weekday	99	2.35	6.29	8.29	8.13	1.32
Weekend	135	2.69	6.52	7.37	9.28	1.13
May–September	73	1.95	5.53	11.51	9.69	2.08
Weekday	34	2.03	6.21	12.50	10.26	2.01
Weekend	39	1.87	4.94	10.64	9.22	2.15

Table 17: Harvest rate of rock lobster (mean number of lobster retained / mean number of fishers per trip) for lobster targeted dive outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Kaikōura	50	2.54	5.94	7.26	6.46	2.86
October–December	29	2.48	6.92	8.48	6.31	3.42
Weekday	5	1.40	1.35	1.40	1.67	1.00
Weekend	24	2.71	8.08	9.96	5.89	3.68
January–April	20	2.65	4.76	5.85	6.47	2.21
Weekday	6	2.83	6.29	9.17	7.49	3.24
Weekend	14	2.57	4.10	4.43	5.69	1.72
May–September	1	2.00	1.00	0.00	NA	0.00
Weekday	0	NA	NA	NA	NA	NA
Weekend	1	2.00	1.00	0.00	NA	0.00

Table 18: Harvest rate of rock lobster (mean number of lobster retained / mean number of fishers per trip) for lobster targeted potting outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Kaikōura	788	1.95	19.35	3.87	3.56	1.99
October–December	425	1.97	19.07	4.05	3.62	2.06
Weekday	208	1.78	17.29	4.49	3.94	2.52
Weekend	217	2.15	20.77	3.63	3.25	1.69
January–April	290	1.96	20.10	3.78	3.60	1.93
Weekday	142	1.83	18.79	3.81	3.73	2.08
Weekend	148	2.07	21.36	3.74	3.48	1.80
May–September	73	1.77	17.97	3.15	2.97	1.78
Weekday	39	1.64	17.96	2.62	2.79	1.59
Weekend	34	1.91	17.97	3.76	3.10	1.97

3.1.4 Length composition

The length measurements presented here are from all boats interviewed at the Kaikōura ramps, irrespective of targeting. Also, the lengths are based on retained catch only, but include data imputed for boats that were counted, but not interviewed.

Overall, 397 blue cod were measured from line fishing outings, with an overall mean total length (TL) of 39.1 cm (Table 19, Figure 2). Less than 3% of the fish were smaller than the minimum legal size (33 cm TL). Of the fish measured, only 1% were caught in October–December, 34% in January–April, and 65% in May–September.

Overall, 1036 sea perch were observed and measured from line fishing outings, with an overall mean TL of 29.9 cm (Table 20, Figure 3). Less than 1% of the fish were smaller than 25 cm TL. Of the fish measured, less than 1% were caught in October–December, 39% in January–April, and 61% in May–September.

Among diving outings, 111 rock lobster were observed and measured (Table 21, Figure 4). Of the lobster measured, 65% were caught in October–December, 35% in January–April, and none in May–September. More specifically, 32% of the measured lobster were male, 65% were female, and 3% were not sexed. The mean tail width of female lobster (65.3 mm) was larger than that of the males (58.6 mm). Only one measured male lobster has a tail width below the minimum legal size (54 mm), while 6% of the female lobster had a tail width below the minimum legal size (60 mm).

Among potting outings, 335 rock lobster were observed and measured (Table 22, Figure 5). Of the lobster measured, 10% were caught in October–December, 54% in January–April, and 36% in May–September. More specifically, 67% of the measured lobster were male, 29% were female, and 4% were not sexed. The mean tail width of female lobster (62.2 mm) was larger than that of the males (56.8 mm). Among the measured male lobster, 7% had a tail width less than the minimum legal size (54 mm), while 6% of the female lobster had a tail width less than the minimum legal size (60 mm).

Table 19: Measurements of blue cod retained from line fishing outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Mean weight calculated from individual lengths.

	Number of fish measured	Mean total length (cm)	SD total length (cm)	Calculated mean weight (kg)
Kaikōura	397	39.1	5.4	0.659
October–December	4	35.8	2.1	0.466
January–April	134	37.6	4.9	0.578
May–September	259	39.9	5.5	0.704

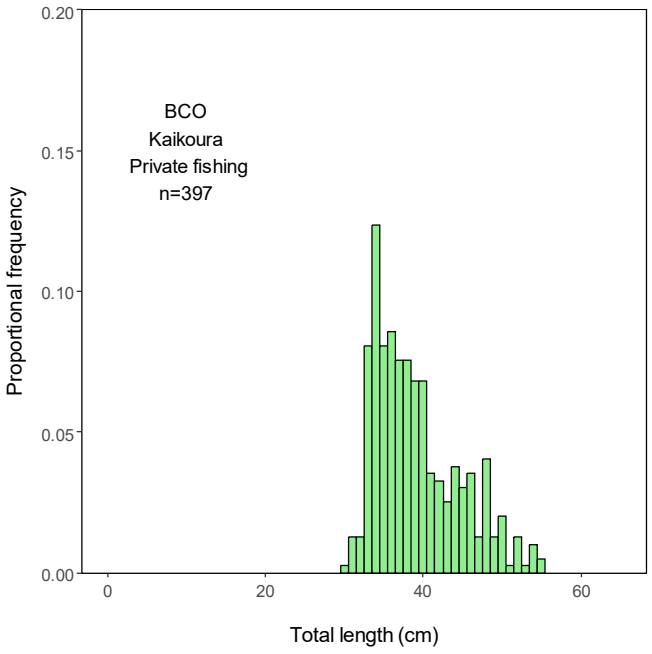

Figure 2: Length frequency distribution of blue cod retained from line fishing outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022.

Table 20: Measurements of sea perch retained from line fishing outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Mean weight calculated from individual lengths.

	Number of fish measured	Mean total length (cm)	SD total length (cm)	Calculated mean weight (kg)
Kaikōura	1 036	29.9	2.8	0.453
October–December	1	26	NA	0.280
January–April	404	29.8	3.1	0.449
May–September	631	30.0	2.7	0.456

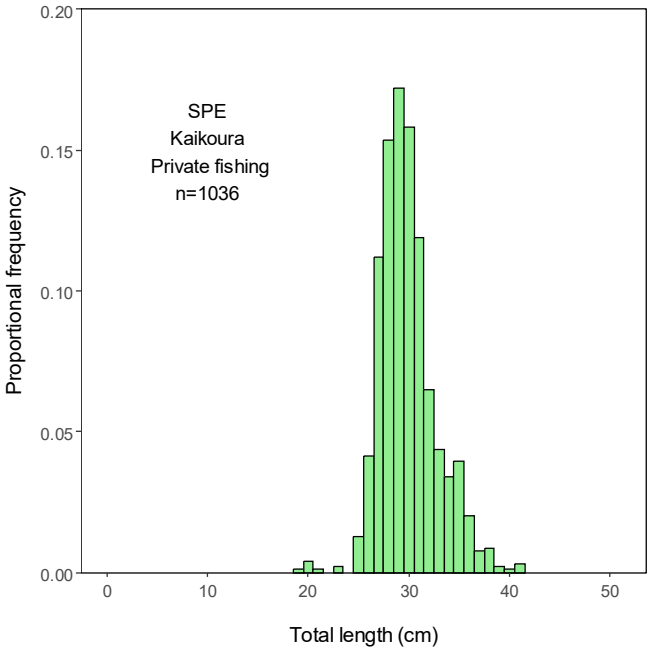

Figure 3: Length frequency distribution of sea perch retained from line fishing outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022.

Table 21: Measurements of rock lobster retained from diving outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Mean weight calculated from individual lengths. SD = standard deviation.

	Overall				Males				Females			
	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)
Kaikōura	111	63.0	6.7	0.586	36	58.6	5.0	0.656	72	65.3	6.5	0.550
October–December	72	64.8	6.9	0.553	4	55.0	0.0	0.533	68	65.4	6.7	0.554
January–April	39	59.5	4.8	0.651	32	59.1	5.1	0.671	4	62.8	1.5	0.489
May–September	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA

Table 22: Measurements of rock lobster retained from potting outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. Mean weight calculated from individual lengths. SD = standard deviation.

	Overall				Male				Female			
	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)
Kaikōura	335	58.4	4.1	0.559	226	56.8	3.4	0.593	98	62.2	2.9	0.480
October–December	35	59.7	5.1	0.559	20	57.0	3.7	0.598	15	63.5	4.4	0.507
January–April	180	58.9	4.1	0.537	103	56.5	3.3	0.582	77	62.1	2.6	0.478
May–September	120	57.4	3.4	0.594	103	57.1	3.5	0.603	6	60.2	0.4	0.439

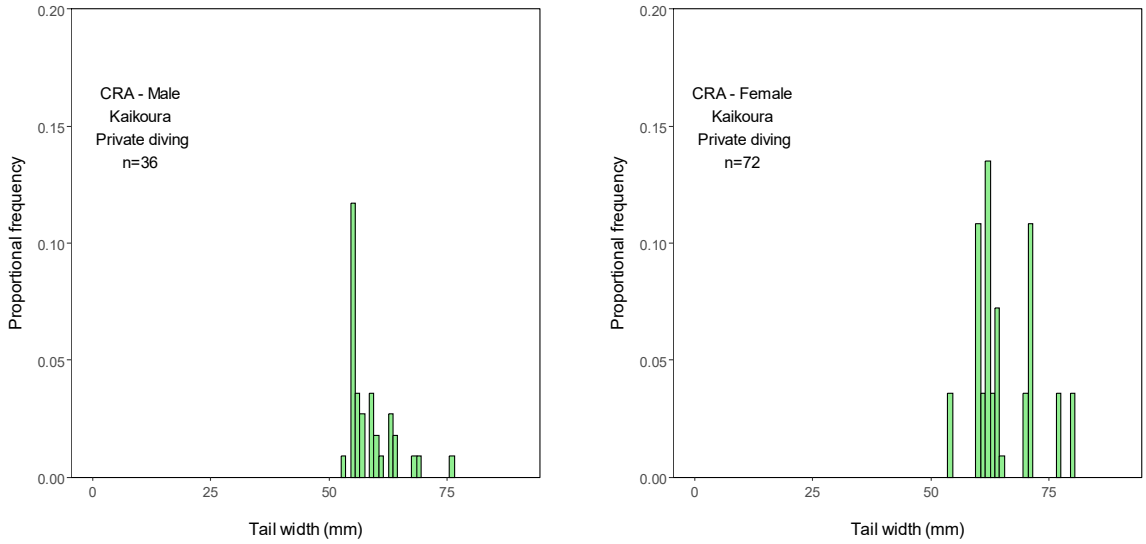

Figure 4: Length frequency distribution of rock lobster retained from diving outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022.

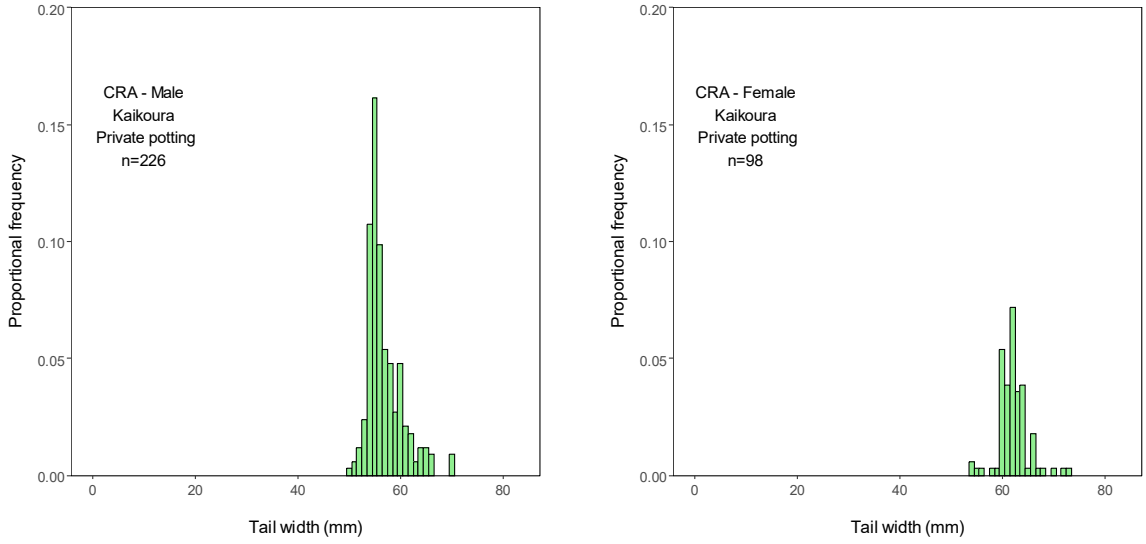

Figure 5: Length frequency distribution of rock lobster retained from potting outings in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022.

3.1.5 Total harvest

The estimates of total harvest presented here are from all outings, irrespective of targeting. Also, the harvest is based on retained catch only, but includes data imputed for boats that were counted but not intercepted.

It was estimated that 20 555 (11 862 kg) blue cod were harvested in the Kaikōura fishery during the 2021–22 fishing year (Table 23). More individuals were harvested during each of the summer seasons, October–December (34%) and January–April (36%), than during winter, May–September (30%). Overall, there were more blue cod harvested at the Kaikōura ramps on weekdays (56%), than on weekends (44%).

It was estimated that 54 134 (21 862 kg) sea perch were harvested in the Kaikōura fishery during the 2021–22 fishing year (Table 24). More sea perch were harvested during the winter season, May–September (37%), than the summer seasons, October–December (28%) and January–April (35%). Overall, there were nearly as many sea perch harvested at the Kaikōura ramps on weekdays (51%) as on weekends (49%).

It was estimated that 42 992 (24 103 kg) rock lobster were harvested in the Kaikōura fishery (diving and potting combined) during the 2021–22 fishing year (Table 25). More lobster were harvested during each of the summer seasons (54% in early summer, and 31% in late summer) than in winter (14%). Overall, there were more lobster harvested at the Kaikōura ramps on weekdays (57%) than on weekends (43%). Method-specific harvest estimates are also shown separately for dive-caught (Table 26) and pot-caught lobster (Table 27).

Table 23: Total estimated harvest as numbers of blue cod in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Kaikōura					20 555	3 886.5	0.19		11 862
October–December					7 038	2 197.3	0.31	0.466	3 280
Weekday	17	59	38.8	56.5	2 288	764.3	0.34		
Weekend	13	33	143.9	236.8	4 750	2 047.2	0.43		
January–April					7 409	2 114.4	0.29	0.578	4 282
Weekday	21	76	65.6	129.8	4 985	2 094.2	0.42		
Weekend	17	44	55.1	71.2	2 423	716.7	0.29		
May–September					6 108	2 313.6	0.38	0.704	4 300
Weekday	14	107	39.9	77.2	4 266	2 086.8	0.49		
Weekend	10	46	40.1	62.7	1 843	857.4	0.47		

Table 24: Total estimated harvest as numbers of sea perch in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Kaikōura					54 134	7 970.8	0.15		21 862
October–December					15 293	2 358.7	0.15	0.280	4 282
Weekday	17	59	95.0	91.1	5 604	1 228.7	0.22		
Weekend	13	33	293.6	230.1	9 688	1 964.4	0.20		
January–April					18 773	3 435.6	0.18	0.449	8 429
Weekday	21	76	137.6	175.8	10 459	3 011.8	0.29		
Weekend	17	44	189.0	220.3	8 314	2 205.1	0.26		
May–September					20 068	6 544.2	0.33	0.456	9 151
Weekday	14	107	106.6	181.5	11 409	5 111.5	0.44		
Weekend	10	46	188.2	306.3	8 659	4 167.1	0.49		

Table 25: Total estimated harvest as numbers of rock lobster (all methods) in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Kaikoura					42 992	4 893.7	0.11		24 103
October–December					23 339	3 723.0	0.16	0.555	12 953
Weekday	17	59	239.9	238.8	14 156	3 346.4	0.24		
Weekend	13	33	278.3	212.1	9 182	1 828.0	0.20		
January–April					13 466	2 077.5	0.15	0.556	7 487
Weekday	21	76	90.8	98.7	6 901	1 604.2	0.23		
Weekend	17	44	149.2	132.0	6 565	1 384.6	0.21		
May–September					6 187	2 266.7	0.36	0.592	3 663
Weekday	14	107	33.2	67.2	3 557	1 846.6	0.52		
Weekend	10	46	57.2	79.7	2 630	1 095.5	0.42		

Table 26: Total estimated harvest as numbers of dive caught rock lobster in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area and method-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Kaikōura					4 039	1 148.7	0.28		2 370
October–December					2 650	1 009.1	0.38	0.553	1 465
Weekday	17	59	1.3	3.8	78	52.2	0.68		
Weekend	13	33	77.9	111.8	2 572	971.0	0.38		
January–April					1 389	545.4	0.38	0.651	904
Weekday	21	76	9.4	27.4	714	452.1	0.63		
Weekend	17	44	15.3	33.1	675	345.3	0.50		
May–September					0	NA	NA	NA	NA
Weekday	14	107	0.0	NA	0	NA	NA		
Weekend	10	46	0.0	NA	0	NA	NA		

Table 27: Total estimated harvest as numbers of pot caught rock lobster in the survey of the private-vessel recreational fishery at boat ramps in Kaikōura from 03 October 2021 to 24 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area and method-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Kaikōura					38 909	4 448.8	0.11		21 700
October–December					20 683	3 459.3	0.17	0.559	11 562
Weekday	17	59	238.6	238.9	14 078	3 348.5	0.24		
Weekend	13	33	200.1	137.7	6 605	1 195.3	0.18		
January–April					12 077	1 909.8	0.15	0.537	6 486
Weekday	21	76	81.4	86.0	6 188	1 379.3	0.22		
Weekend	17	44	133.9	128.3	5 890	1 340.2	0.23		
May–September					6 149	2 207.8	0.35	0.594	3 652
Weekday	14	107	33.1	67.1	3 540	1 819.3	0.51		
Weekend	10	46	56.7	80.0	2 609	1 112.6	0.42		

3.1.6 Daily monitoring of boat traffic (camera)

The camera installed at the Kaikōura South Bay Club ramp was operational for 236 days providing only 65% coverage of the 2021–22 fishing year (Table 28). Although it was intended that the camera would monitor the boat ramp for the entire fishing year, repeated vandalism prevented images from being recorded on 129 days. During the 236 operational days, there were 3431 vessels counted. The highest usage of the South Bay Club ramp was recorded during late summer (January–April), particularly on weekends with 28.5 boats crossing the ramp per day. High ramp usage was also recorded on early summer (October–December) weekends with 27.7 boats per day. The lowest ramp usage was recorded during winter (May–September), particularly on weekends with only 5.5 boats per day. Within seasons, the boat traffic also varied by month (Figure 6).

Table 28: The total number of boats and boats per day recorded by the camera at the Kaikōura South Bay Club ramp from 01 October 2021 to 31 September 2022. Note that the camera was not active for all days due to repeated vandalism.

Season	Day type	Total days in stratum	Camera active	Camera not active	Number of boats	Average boats per day
October–December	Weekday	59	31	28	545	17.6
	Weekend	33	12	21	332	27.7
January–April	Weekday	76	41	35	719	17.5
	Weekend	44	34	10	968	28.5
May–September	Weekday	107	81	26	665	8.2
	Weekend	46	37	9	202	5.5
Total		365	236	129	3 431	14.5

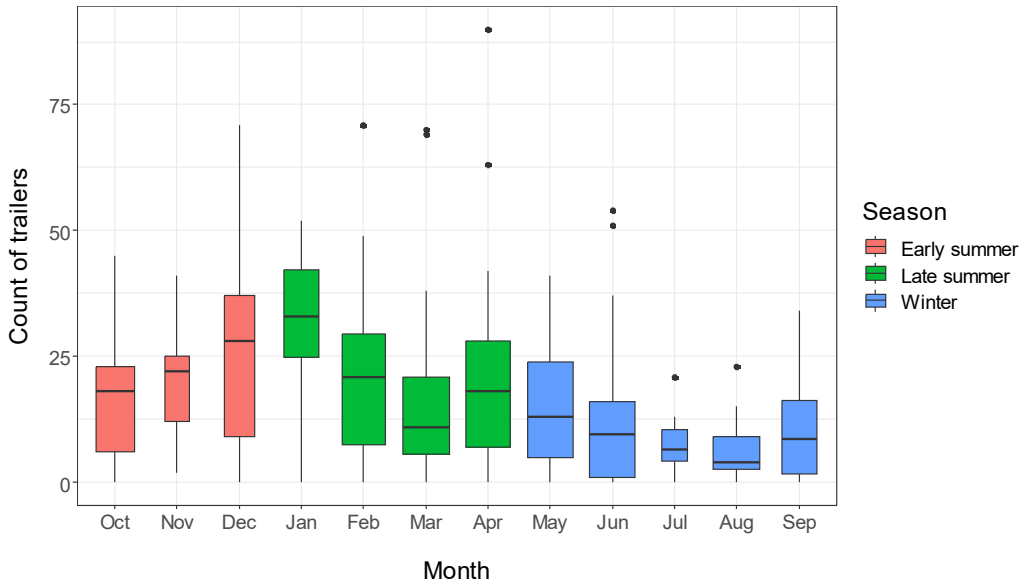

Figure 6: Daily boat traffic by month and season at the Kaikōura South Bay Club ramp from 01 October 2021 to 31 September 2022. Note that the camera was not active for all days due to repeated vandalism. Box width indicates the number of days that the camera was active.

3.1.7 Comparison of results with other surveys

Comparisons of finfish total length (January–April)

Blue cod mean total length at the Kaikōura ramps decreased by over 4 cm from 2002–03 to 2008–09, but appeared relatively stable between 2008–09 to 2021–22 (Table 29, Figure 7). Sea perch mean total length at the Kaikōura ramps decreased by over 4 cm from 2003 to 2009, but also appeared stable from 2009 to 2021–22 (Table 30, Figure 8).

Comparisons of lobster tail width (October–September)

The mean tail width of dive-caught rock lobster at the Kaikōura ramps in 2012–13 (63.3 mm) was nearly the same as that recorded in 2021–22 (Table 31, Figure 9).

The mean tail width of pot-caught rock lobster decreased at the Kaikōura ramps by 5% from 61.4 mm in 2012–13 to 58.4 mm in 2021–22 (Table 32, Figure 10).

Table 29: Comparison of blue cod mean total length measured in the 2003, 2009, 2012–13, and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data limited to late summer (January–April) observations for comparison with earlier surveys. SD = standard deviation.

Survey	Number of fish measured	Mean total length (cm)	SD total length (cm)
2003	258	40.9	5.7
2009	168	36.0	4.1
2012–13	32	38.7	6.3
2021–22	134	37.6	4.9

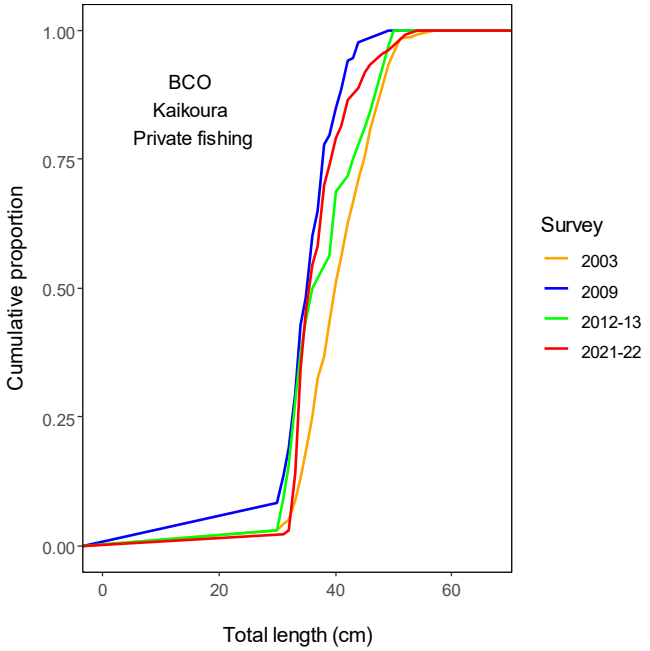

Figure 7: Empirical cumulative distribution function plot comparing length frequency of blue cod measured in the 2003, 2009, 2012–13, and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data limited to late summer (January–April) observations for comparison with earlier surveys.

Table 30: Comparison of sea perch mean total length measured in the 2003, 2009, 2012–13, and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data limited to late summer (January–April) observations for comparison with earlier surveys. SD = standard deviation.

Survey	Number of fish measured	Mean total length (cm)	SD total length (cm)
2003	618	31.8	3.7
2009	280	27.7	4.8
2012–13	116	28.9	3.9
2021–22	404	29.8	3.1

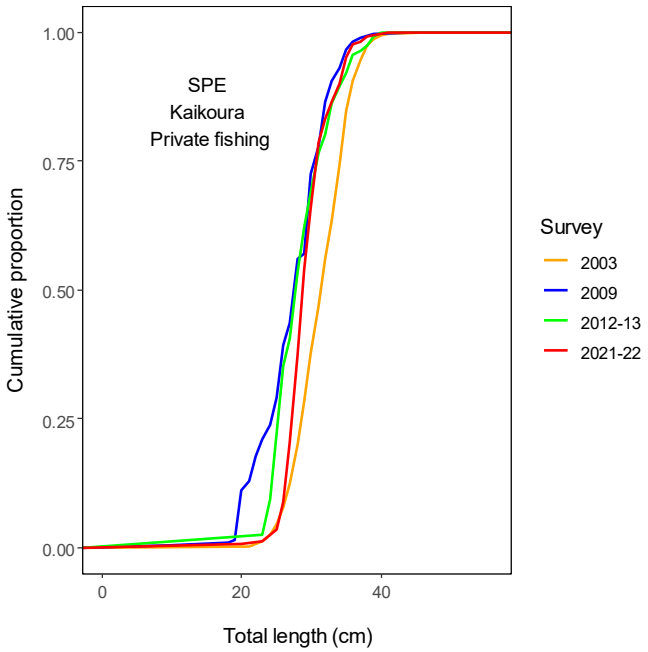

Figure 8: Empirical cumulative distribution function plot comparing length frequency of sea perch measured in the 2003, 2009, 2012–13, and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data limited to late summer (January–April) observations for comparison with earlier surveys.

Table 31: Comparison of dive-caught rock lobster tail width measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data include observations from the full fishing year (October–September). SD = standard deviation.

Survey	Number of lobsters measured	Mean tail width (mm)	SD tail width (mm)
2012–13	77	63.3	7.6
2021–22	111	63.0	6.7

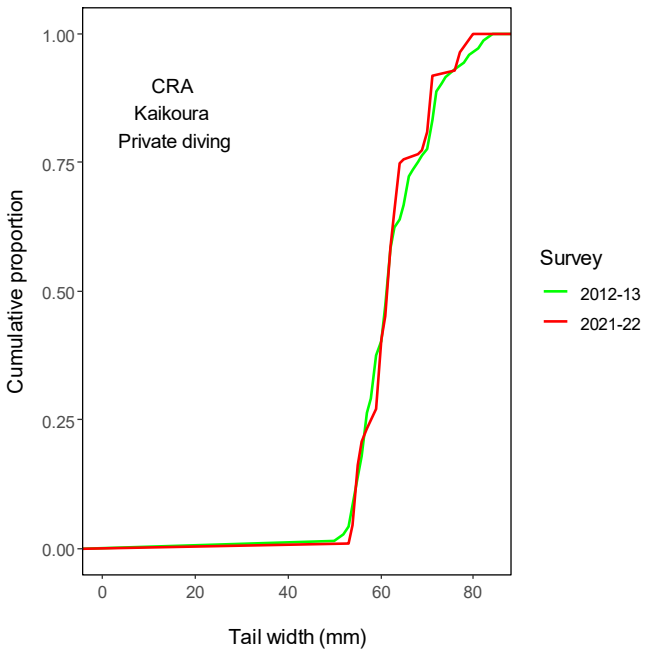

Figure 9: Empirical cumulative distribution function plot comparing length frequency of dive-caught rock lobster measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data include observations from the full fishing year (October–September).

Table 32: Comparison of pot-caught rock lobster tail width measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data include observations from the full fishing year (October–September). SD = standard deviation.

Survey	Number of lobsters measured	Mean tail width (mm)	SD tail width (mm)
2012–13	487	61.4	5.2
2021–22	335	58.4	4.1

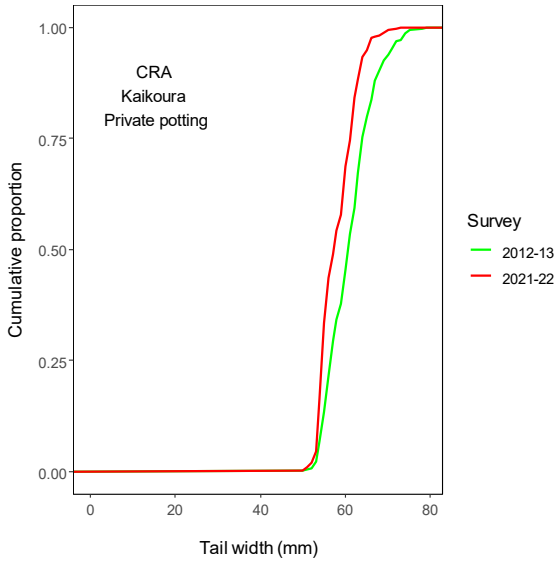

Figure 10: Empirical cumulative distribution function plot comparing length frequency of pot-caught rock lobster measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at boat ramps in Kaikōura. Data include observations from the full fishing year (October–September).

Total harvest estimates

The harvest estimates from the four surveys of the Kaikōura private-vessel recreational fishery are presented here for comparative purposes (Table 33, Table 34). These estimates are based on retained individuals only.

The number of blue cod harvested during late summer (January–April) was successively higher from 2003 to 2021–22 (Table 33). Sea perch harvest was also successively higher from 2003 to 2012–13, but the 2021–22 harvest was the lowest over all four surveys. The 2021–22 late summer harvest of rock lobster was substantially lower than that in 2013 for both the dive and potting fisheries.

A comparison between the 2013 and 2022 surveys can be made for the full fishing year at Kaikōura and can include rock lobster (Table 34). The harvest of blue cod increased markedly as did sea perch harvest and dive-caught rock lobster. However, the lobster potting harvest decreased substantially.

Table 33: Comparison of total harvest estimates in number of individuals for the four surveys of the Kaikōura private-vessel recreational fishery. Earlier surveys did not include counts of rock lobster. Data limited to January–April (late summer). Estimates provided here for 2003 and 2009 surveys taken directly from original reports.

			Harvest	
Survey	BCO	SPE	CRA (Dive)	CRA (Pot)
2003	2 675	21 047	NA	NA
2009	5 008	21 570	NA	NA
2012–13	6 590	27 070	2 768	22 501
2021–22	7 409	18 773	1 389	12 077

Table 34: Comparison of total harvest estimates in number of individuals for the two most recent surveys of the Kaikōura private-vessel recreational fishery. Data for full fishing year.

			Harvest	
Survey	BCO	SPE	CRA (Dive)	CRA (Pot)
2013	11 466	50 242	3 902	53 862
2022	20 555	54 134	4 039	39 909

3.2 Motunau

3.2.1 Sampling activity

Motunau surveying took place from 05 October 2021 to 20 September 2022 with 57 sampling days achieved (Table 35). The number of sampling days as a proportion of available days, expressed as sampling intensity, was greater on weekends than on weekdays in all three seasons and greater in summer than in winter.

Overall, there were 393 boats counted at Motunau and fishers were interviewed for 57% of these (Table 36). At Motunau, line fishing for blue cod or sea perch was the dominant activity in all seasons, followed by lobster potting, and then lobster diving using either snorkel or scuba (Table 37). Line fishing for blue cod or sea perch was undertaken on 49–65% of outings and was highest during May–September, when only 51 interviews were conducted. Lobster potting was undertaken on 35–42% of outings and was highest during October–December. Diving for lobster, using either snorkel or scuba, was undertaken on less than 7% of outings in all seasons with no lobster diving recorded during May–September.

Boat ramp interviewers measured retained individuals where possible (Table 38). At Motunau, measurements were taken from 440 blue cod (59%), 30 sea perch (81%), and 665 rock lobster (84%). At Motunau, there was low seasonal variation in the proportion of fish and lobster being measured.

Table 35: Sampling coverage of the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Data before imputation.

		Motunau		
Season	Day type	Days in stratum	Days sampled	Sampling intensity
Early summer (October–December)	Weekday	59	6	0.10
	Weekend	33	13	0.39
Late summer (January–April)	Weekday	76	6	0.08
	Weekend	44	17	0.39
Winter (May–September)	Weekday	107	6	0.06
	Weekend	46	9	0.20
	Total	365	57	0.16

Table 36: Number of outings by interview outcome for the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Data before imputation.

		Outings	
Interview outcome	Description	n	%
I	Interviewed	225	57
O	Other activity	46	12
N	Not interviewed	121	31
R	Refused	1	0
F	Fishing but refused		
X	Charter boat		
Z	Incomplete outing		
	Total	393	

Table 37: Number of interviews by outing type for the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. BCO - blue cod, SPE - sea perch, CRA - rock lobster. Data before imputation.

			BCO/SPE line fishing interviews		CRA diving interviews		CRA potting interviews	
Season	Days sampled	Interviews	n	prop.	n	prop.	n	prop.
October–December	19	225	111	0.49	9	0.04	95	0.42
January–April	23	393	199	0.51	26	0.07	151	0.38
May–September	15	51	33	0.65	0	0.00	18	0.35
Total	57	669	343		35		264	

Table 38: Number of length measurements as a proportion of observed fish in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. BCO - blue cod, SPE - sea perch, CRA- rock lobster. Measurements refer to observations of retained individuals only. Data before imputation.

	BCO		SPE		CRA	
Season	n	prop. measured	n	prop. measured	n	prop. measured
October–December	243	0.61	7	0.29	302	0.76
January–April	439	0.58	22	0.91	457	0.90
May–September	65	0.55	8	1.00	32	0.78
Total	747	0.59	37	0.81	791	0.84

3.2.2 Descriptive statistics

Interviewed fishers were mostly male at Motunau (82%), and there were notable fewer female fishers during the May–September season (Table 39).

The number of interviewed fishers aged 60–69 was higher than for any other age group (Table 40). At Motunau, 39% of fishers were aged 60–69, and 78% were aged 30–69.

At Motunau, blue cod and sea perch were targeted exclusively by line fishing (100%), while rock lobster were targeted predominantly using pots (88%) with few fishers diving for their lobster (Table 41).

At Motunau, there were 2424 fish caught, of which 57% were retained (Table 42). Blue cod was the top species, contributing 56% of the catch, with 79% of individuals being retained. Next was rock lobster, contributing 35% of the catch, with 94% of individuals being retained. Pāua and sea perch each contributed 2% of the catch, all of which was retained at Motunau.

Data was imputed for those boats that were counted but not intercepted at Motunau (Table 43). This resulted in the imputation of data for 405 additional interviews and 1061 length measurements.

Table 39: The number and proportion of fishers by sex in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Data before imputation

	Male		Female	
Season	n	prop.	n	prop.
October–December	162	0.83	33	0.17
January–April	238	0.80	58	0.20
May–September	43	0.91	4	0.09
Total	443	0.82	95	0.18

Table 40: The proportion of fishers by age group in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Data before imputation.

	Age group									
Season	<15	15–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	Total
October–December	0.09	0.05	0.05	0.14	0.12	0.12	0.41	0.01	0.02	194
January–April	0.02	0.08	0.05	0.10	0.12	0.18	0.35	0.08	0.02	294
May–September	0.02	0.09	0.00	0.06	0.13	0.09	0.60	0.02	0.00	47
Total	0.05	0.07	0.04	0.11	0.12	0.15	0.39	0.05	0.02	535

Table 41: The proportion of interviews by fishing method and target species in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Data before imputation.

Target species	Line	Potting	Dive	Other	Total
BCO	1.00	0.00	0.00	0.00	341
SPE	1.00	0.00	0.00	0.00	2
CRA	0.00	0.88	0.12	0.00	299
Other (all other spp.)	0.48	0.00	0.41	0.11	27
Total	0.53	0.39	0.07	0.00	669

Table 42: The number of fish caught, their contribution to the total catch and the proportion retained, in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Data before imputation.

Species	Scientific name	Total catch (n)	Contribution	Prop. retained
Blue cod	*Parapercis colias*	1 365	0.56	0.79
Rock lobster	*Jasus edwardsii*	855	0.35	0.94
Pāua	*Haliotis* spp.	47	0.02	1.00
Sea perch	*Helicolenus percoides*	42	0.02	1.00
School shark	*Galeorhinus galeus*	21	0.01	1.00
Kina	*Evechinus chloroticus*	20	0.01	1.00
Wrasses	Labridae	18	0.01	1.00
Kahawai	*Arripis trutta*	12	0.00	1.00
Tarakihi	*Nemadactylus macropterus*	9	0.00	1.00
Red cod	*Pseudophycis bachus*	8	0.00	1.00
Other		27	0.01	0.89
Total		2 424		0.57

Table 43: The number of observations (boats, interviews, lengths) in the dataset before and after imputation for the survey of the private-vessel recreational fishery at from 05 October 2021 to 20 September 2022. Data before imputation.

		Motunau	
Data type	Outcome	Before	After
Boats	I - Interviewed	225	347
	F - Fishing but refused		
	O - Other activity	46	46
	N - Not interviewed	121	
	R - Refused	1	
	Total	393	393
Interviews		669	1 074
Lengths		1 686	2 747

3.2.3 Harvest rate

Estimates of harvest rate presented here include data imputed for boats that were counted, but not intercepted. The harvest rates are calculated as the ratio of the means (mean retained catch / mean effort) and consider only targeted fishing events. Here finfish refers only to blue cod and sea perch. For blue cod and sea perch, the metric of effort is mean angler hours per trip (Table 44, Table 45), and the metric of effort for rock lobster is mean number of fishers per trip (Table 46, Table 47).

At Motunau, the overall harvest rate for blue cod in finfish-targeted line fishing outings was 1.01 fish per hour (Table 44). This was highest during the October–December season (1.50 fish per hour) and lowest during May–September (0.65 fish per hour). Weekdays at Motunau had a higher harvest rate than weekends for blue cod during October–December and May–September, but not during January–April.

At Motunau, the overall harvest rate for sea perch in finfish-targeted line fishing outings was low at 0.07 fish per hour (Table 45). This was highest during the May–September season (0.13 fish per hour) and lowest during January–April (0.05 fish per hour). Acknowledging very low numbers, weekends at Motunau had a higher harvest rate than weekdays for sea perch during October–December and January–April, with little difference in May–September.

Table 44: Harvest rate of blue cod (mean number of retained fish / mean angler hours per trip) for finfish targeted outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Motunau	218	2.66	3.67	3.69	2.79	1.01
October–December	84	2.80	2.69	4.02	3.12	1.50
Weekday	5	2.00	1.40	2.80	1.79	2.00
Weekend	79	2.85	2.77	4.10	3.17	1.48
January–April	113	2.66	4.48	3.74	2.63	0.84
Weekday	9	2.67	3.39	1.89	2.71	0.56
Weekend	104	2.66	4.57	3.90	2.57	0.85
May–September	21	2.05	3.24	2.10	1.61	0.65
Weekday	5	1.40	1.45	2.40	1.14	1.66
Weekend	16	2.25	3.80	2.00	1.75	0.53

Table 45: Harvest rate of sea perch (mean number of retained fish / mean angler hours per trip) for finfish targeted outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Motunau	218	2.66	3.67	0.27	0.80	0.07
October–December	84	2.80	2.69	0.27	0.72	0.10
Weekday	5	2.00	1.40	0.00	0.00	0.00
Weekend	79	2.85	2.77	0.29	0.74	0.11
January–April	113	2.66	4.48	0.23	0.79	0.05
Weekday	9	2.67	3.39	0.00	0.00	0.00
Weekend	104	2.66	4.57	0.25	0.82	0.05
May–September	21	2.05	3.24	0.43	1.12	0.13
Weekday	5	1.40	1.45	0.20	0.45	0.14
Weekend	16	2.25	3.80	0.50	1.26	0.13

Among diving outings targeting rock lobster at Motunau, the overall harvest rate for rock lobster was 4.79 lobster per fisher, but there very only 23 outings (Table 46). The harvest rate in October–December was similar to that in January–April, but zero in May–September.

Among potting outings targeting rock lobster at Motunau, the overall harvest rate for lobster was low at 2.17 lobster per fisher (Table 47). This was highest during the October–December season (2.61 lobster per fisher) and lowest during May–September (1.47 lobster per fisher). Weekends at Motunau had a higher harvest rate than weekdays for lobster during October–December and May–September, but not for January–April.

Table 46: Harvest rate of rock lobster (mean number of retained lobster / mean number of fishers per trip) for lobster targeted dive outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Motunau	23	2.26	3.41	10.83	4.48	4.79
October–December	5	2.20	1.52	10.60	3.97	4.82
Weekday	0	NA	NA	NA	NA	NA
Weekend	5	2.20	1.52	10.60	3.97	4.82
January–April	18	2.28	3.94	10.89	4.71	4.78
Weekday	2	2.50	2.13	7.50	6.36	3.00
Weekend	16	2.25	4.17	11.31	4.56	5.03
May–September	0	NA	NA	NA	NA	NA
Weekday	0	NA	NA	NA	NA	NA
Weekend	0	NA	NA	NA	NA	NA

Table 47: Harvest rate of rock lobster (mean number of retained lobster / mean number of fishers per trip) for lobster targeted potting outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022.

	Number of trips	Mean number of fishers per trip	Mean angler hours per trip	Mean number of fish retained	SD retained catch	Harvest rate
Motunau	193	2.05	24.41	4.45	3.88	2.17
October–December	69	1.99	22.18	5.19	3.93	2.61
Weekday	8	1.63	15.03	2.88	4.26	1.77
Weekend	61	2.03	23.12	5.49	3.81	2.70
January–April	111	2.16	26.37	4.25	3.94	1.97
Weekday	11	1.82	21.52	4.45	4.34	2.45
Weekend	100	2.20	26.90	4.23	3.91	1.92
May–September	13	1.46	19.51	2.15	1.41	1.47
Weekday	4	1.50	23.56	1.00	1.41	0.67
Weekend	9	1.44	17.71	2.67	1.12	1.85

3.2.4 Length composition

The length measurements presented here are from all Motunau outings, irrespective of targeting. Also, the lengths are based on retained catch only, but include data imputed for boats that were counted but not intercepted.

For blue cod there were 800 individuals observed and measured from line fishing outings, with an overall mean total length of 36.2 cm (Table 48, Figure 11). Less than 0.5% of the fish were smaller than the minimum legal size (33 cm TL). Of the fish measured, only 42% were caught in October–December, 52% in January–April, and 6% in May–September.

Table 48: Measurements of blue cod retained from line fishing outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Mean weight calculated from individual lengths.

	Number of fish measured	Mean total length (cm)	SD total length (cm)	Calculated mean weight (kg)
Motunau	800	36.2	2.2	0.488
October–December	338	36.2	1.8	0.485
January–April	418	36.3	2.5	0.494
May–September	44	35.6	1.6	0.458

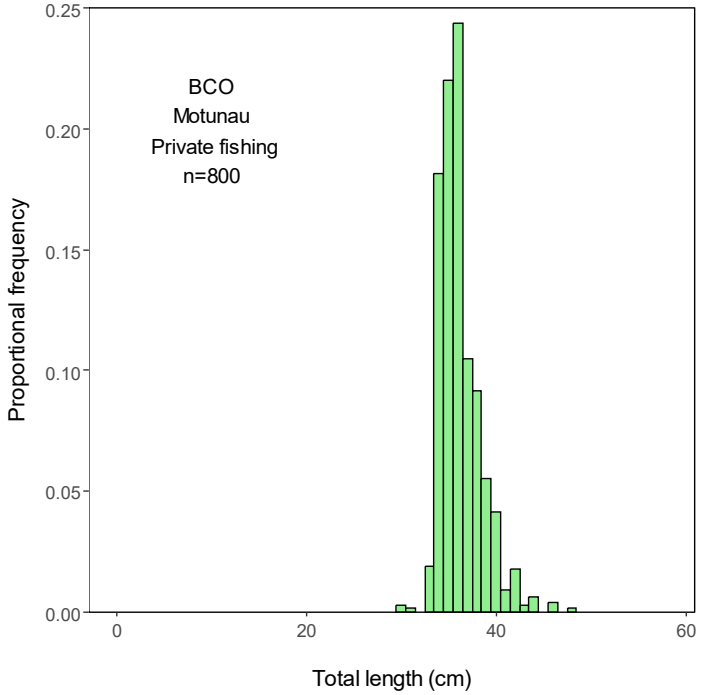

Figure 11: Length frequency distribution of blue cod retained from line fishing outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022.

Only 41 sea perch were observed and measured from line fishing outings, with an overall mean total length of 29.1 cm (Table 49, Figure 12). None of the fish were smaller than 25 cm TL. Of the fish measured, 42% were caught in October–December, 52% in January–April, and only 6% in May–September.

Among diving outings there were 214 rock lobster were observed and measured (Table 50, Figure 13). Of the lobster measured, 14% were caught in October–December, 86% in January–April, and none in May–September. More specifically, 68% of the measured lobster were male, 32% were female. The mean tail width of female lobster (64.8 mm) was larger than that of the males (61.6 mm). All measured male lobster had a tail width greater than the minimum legal size (54 mm); however, 7% of the female lobster had a tail width less than minimum legal size (60 mm).

Among potting outings there were 809 rock lobster were observed and measured (Table 51, Figure 14). Of the lobster measured, 38% were in October–December, 58% in January–April, and 4% in May–September. More specifically, 45% of the measured lobster were male, 55% were female, and one lobster was not sexed. The mean tail width of female lobster (65.8 mm) was larger than that of the males (60.1 mm). Less than 1% of measured male lobster had a tail width less than the minimum legal size (54 mm); however, 5% of the female lobster had a tail width less than the minimum legal size (60 mm).

Table 49: Measurements of sea perch retained from line fishing outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Mean weight calculated from individual lengths.

	Number of fish measured	Mean total length (cm)	SD total length (cm)	Calculated mean weight (kg)
Motunau	41	29.1	2.5	0.413
October–December	2	30.0	0.0	0.444
January–April	29	29.7	2.5	0.440
May–September	10	27.2	1.8	0.328

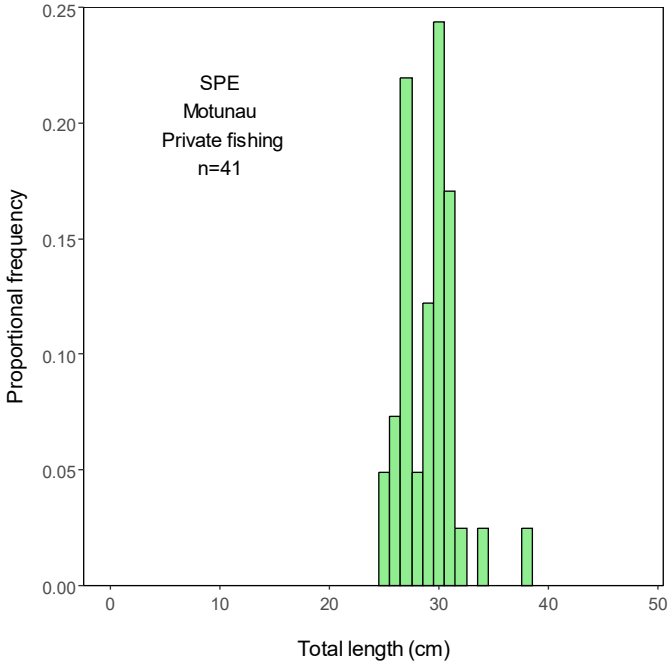

Figure 12: Length frequency distribution of sea perch retained from line fishing outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022.

Table 50: Measurements of rock lobster retained from diving outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Mean weight calculated from individual lengths. SD = standard deviation.

	Overall				Males				Females			
	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)
Motunau	214	62.6	5.2	0.686	145	61.6	5.2	0.758	69	64.8	4.6	0.534
October–December	30	63.1	4.5	0.582	10	59.4	3.2	0.674	20	64.9	3.9	0.536
January–April	184	62.5	5.3	0.703	135	61.7	5.3	0.764	49	64.7	4.8	0.534
May–September	0	NA	NA	NA	0	NA	NA	NA	0	NA	NA	NA

Table 51: Measurements of rock lobster retained from potting outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. Mean weight calculated from individual lengths. SD = standard deviation.

	Overall				Male				Female			
	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)	Number of fish measured	Mean tail width (mm)	SD length (mm)	Calculated mean weight (kg)
Motunau	809	63.3	5.8	0.624	361	60.1	4.7	0.705	447	65.8	5.3	0.559
October–December	310	63.2	6.0	0.637	150	60.5	5.3	0.722	159	65.7	5.6	0.556
January–April	471	63.6	5.7	0.616	187	60.0	4.4	0.700	284	65.9	5.2	0.561
May–September	28	59.5	3.2	0.627	24	58.5	2.1	0.640	4	65.8	0.5	0.550

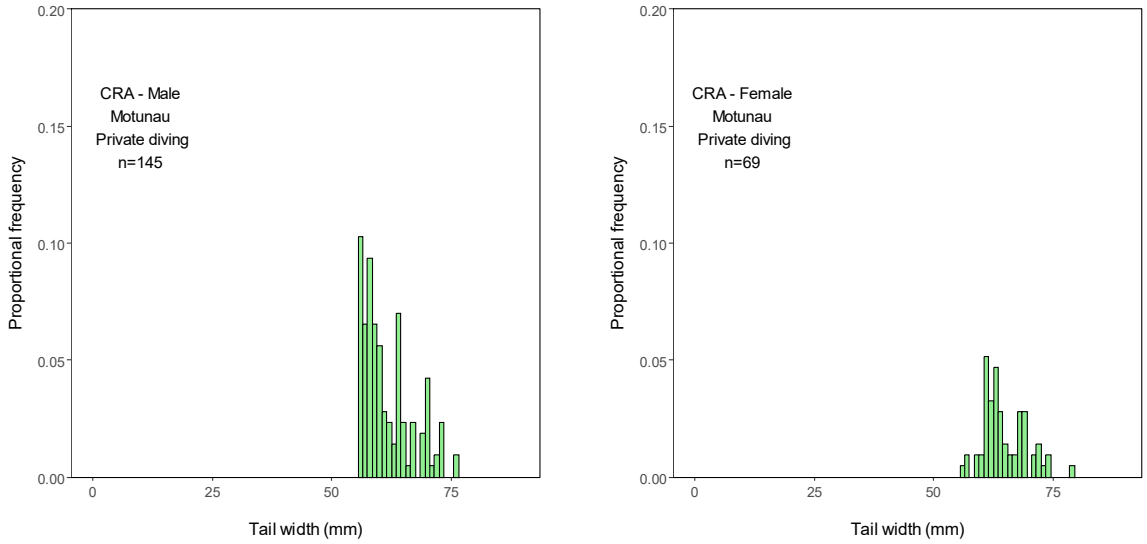

Figure 13: Length frequency distribution of rock lobster retained from diving outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022.

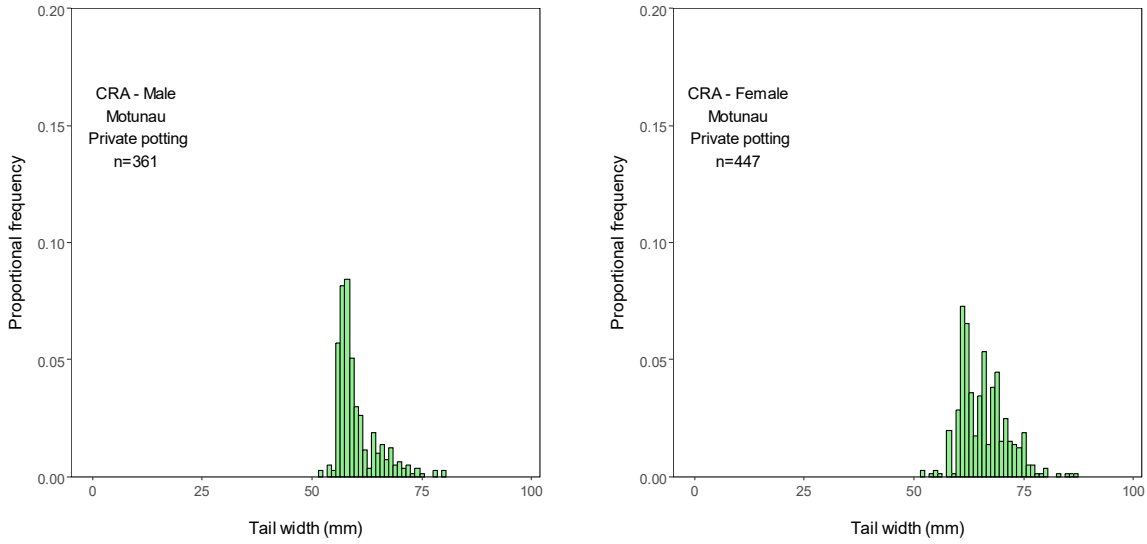

Figure 14: Length frequency distribution of rock lobster retained from potting outings in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022.

3.2.5 Total harvest

The estimates of total harvest presented here are from all private-vessel recreational fishing outings at Motunau, irrespective of targeting. Also, the harvest is based on retained catch only, but includes data imputed for boats that were counted but not intercepted.

The blue cod harvest was estimated at 2629 individuals (1276 kg) during the 2021–22 fishing year (Table 52). More blue cod were harvested during each of the summer seasons, October–December (37%) and January–April (48%), than during winter, May–September (14%). Overall, there were more blue cod harvested at Motunau on weekends (78%), than on weekdays (22%).

The sea perch harvest was estimated at only 208 individuals (84 kg) during the 2021–22 fishing year (Table 53). More sea perch were harvested during late summer, January–April (41%), than during winter, May–September (31%) or early summer (28%). Overall, there were more sea perch harvested at Motunau on weekends (91%), than on weekdays (9%).

The rock lobster harvest (diving and potting combined) was estimated at 3779 individuals (2355 kg) during the 2021–22 fishing year (Table 54). More rock lobster were caught in each of the summer seasons, October–December (32%) and January–April (63%) than during winter, May–September (5%). Overall, there were more lobster harvested at Motunau on weekends (71%), than on weekdays (29%). Method-specific harvest estimates are also shown separately for dive-caught (Table 55) and pot-caught lobster (Table 56).

Table 52: Total estimated harvest as numbers of blue cod in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Motunau					2 629	522.40	0.19		1 276
October–December					978	384.20	0.39	0.485	474
Weekday	6	59	2.5	6.1	148	135.4	0.94		
Weekend	13	33	25.2	41.1	830	353.9	0.43		
January–April					1 274	323.83	0.24	0.494	629
Weekday	6	76	2.8	6.9	215	201.2	0.93		
Weekend	17	44	24.1	26.1	1 059	266.0	0.25		
May–September					378	152.44	0.41	0.458	173
Weekday	6	107	2.0	3.3	214	132.6	0.61		
Weekend	9	46	3.6	5.4	164	78.6	0.49		

Table 53: Total estimated harvest as numbers of sea perch in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Motunau					208	57.7	0.27		84
October–December					58	34.7	0.59	0.280	16
Weekday	6	59	0.0	0.0	0	0.0			
Weekend	13	33	1.8	4.0	58	34.7	0.60		
January–April					85	32.6	0.35	0.449	38
Weekday	6	76	0.0	0.0	0	0.0	NA		
Weekend	17	44	1.9	2.9	85	31.4	0.36		
May–September					64	30.2	0.48	0.456	29
Weekday	6	107	0.2	0.4	18	16.2	0.90		
Weekend	9	46	1.0	1.8	46	25.3	0.56		

Table 54: Total estimated harvest as numbers of rock lobster (all methods) in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Motunau					3 779	655.0	0.17		2 355
October–December					1 211	321.4	0.27	0.637	771
Weekday	6	59	3.8	6.3	226	138.8	0.61		
Weekend	13	33	29.8	31.9	985	268.9	0.27		
January–April					2 374	584.2	0.25	0.616	1462
Weekday	6	76	10.7	15.9	811	462.9	0.57		
Weekend	17	44	35.5	34.4	1 563	356.1	0.23		
May–September					194	70.5	0.37	0.627	122
Weekday	6	107	0.7	1.2	71	48.0	0.67		
Weekend	9	46	2.7	3.6	123	52.5	0.42		

Table 55: Total estimated harvest as numbers of dive caught rock lobster in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Motunau					793	286.9	0.36		541
October–December					135	79.8	0.59	0.582	78
Weekday	6	59	0.0	NA	0	NA	NA		
Weekend	13	33	4.1	9.2	135	81.7	0.61		
January–April					658	275.4	0.42	0.703	463
Weekday	6	76	2.5	6.1	190	177.5	0.93		
Weekend	17	44	10.6	21.1	468	211.3	0.46		
May–September					0	NA	NA	NA	NA
Weekday	6	107	0.0	NA	0	NA	NA		
Weekend	9	46	0.0	NA	0	NA	NA		

Table 56: Total estimated harvest as numbers of pot caught rock lobster in the survey of the private-vessel recreational fishery at Motunau from 05 October 2021 to 20 September 2022. SD = standard deviation, SE = standard error, CV = coefficient of variation. Mean weight of individuals calculated from area-specific length measurements recorded in this study. CV estimated for harvest in numbers can be applied to harvest biomass assuming relatively negligible variance in measured mean weight.

			Numbers of fish					Biomass (kg)	
	Sampled days	Stratum days	Mean catch	SD catch	Harvest	SE	CV	Mean weight of individuals	Harvest
Motunau					2 986	608.9	0.18		1 864
October–December					1 077	309.1	0.29	0.637	686
Weekday	6	59	3.8	6.3	226	138.8	0.61		
Weekend	13	33	25.8	30.4	850	257.0	0.30		
January–April					1 715	503.8	0.25	0.616	1 057
Weekday	6	76	8.2	11.0	621	319.2	0.51		
Weekend	17	44	24.9	25.3	1 095	266.4	0.24		
May–September					194	73.2	0.38	0.627	122
Weekday	6	107	0.7	1.2	71	49.1	0.67		
Weekend	9	46	2.7	3.6	123	53.7	0.44		

3.2.6 Comparison of results with other surveys

Comparisons of finfish total length (January–April)

Blue cod mean total length at Motunau showed minor fluctuations from 2003 to 2021–22 (Table 57, Figure 15). Similarly, sea perch mean total length showed only minor fluctuations across the four studies (Table 58, Figure 16).

Comparisons of lobster tail width (October–September)

There was a 12% reduction in the mean tail width of dive-caught rock lobster at Motunau from 71.1 mm in 2012–13 to 62.6 mm in 2021–22 (Table 59, Figure 17).

The mean tail width of pot-caught rock lobster decreased at Motunau by 10% from 70 mm in 2012–13 to 63.3 mm in 2021–22 (Table 60, Figure 18).

Table 57: Comparison of blue cod mean total length measured in the 2003, 2009, 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data limited to late summer (January–April) observations for comparison with earlier surveys. SD = standard deviation.

Location	Survey	Number of fish measured	Mean total length (cm)	SD total length (cm)
Motunau	2003	329	34.5	3.5
	2009	126	35.1	3.0
	2012–13	99	34.2	3.5
	2021–22	418	36.3	2.5

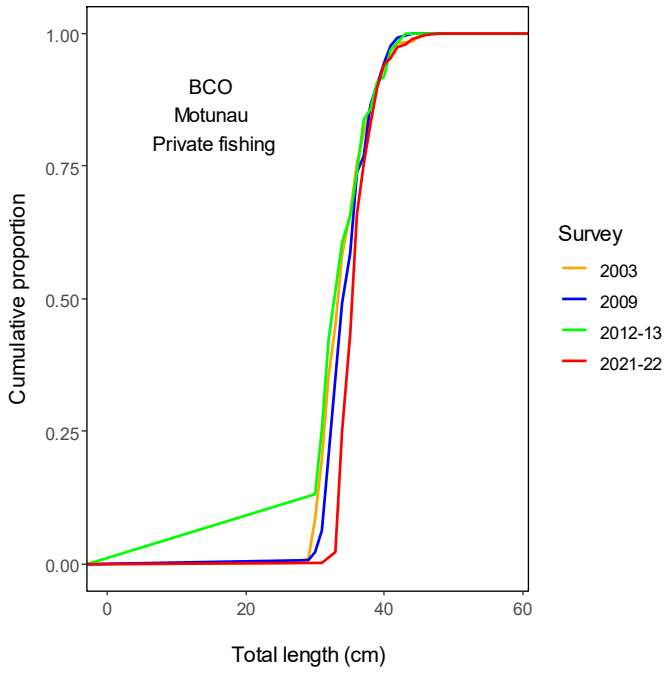

Figure 15: Empirical cumulative distribution function plot comparing length frequency of blue cod measured in the 2003, 2009, 2012–13, and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data limited to late summer (January–April) observations for comparison with earlier surveys.

Table 58: Comparison of sea perch mean total length measured in the 2003, 2009, 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data limited to late summer (January–April) observations for comparison with earlier surveys. SD = standard deviation.

Location	Survey	Number of fish measured	Mean total length (cm)	SD total length (cm)
Motunau	2003	61	29.9	3.9
	2009	17	32.5	3.5
	2012–13	8	30.4	4.1
	2021–22	29	29.7	2.5

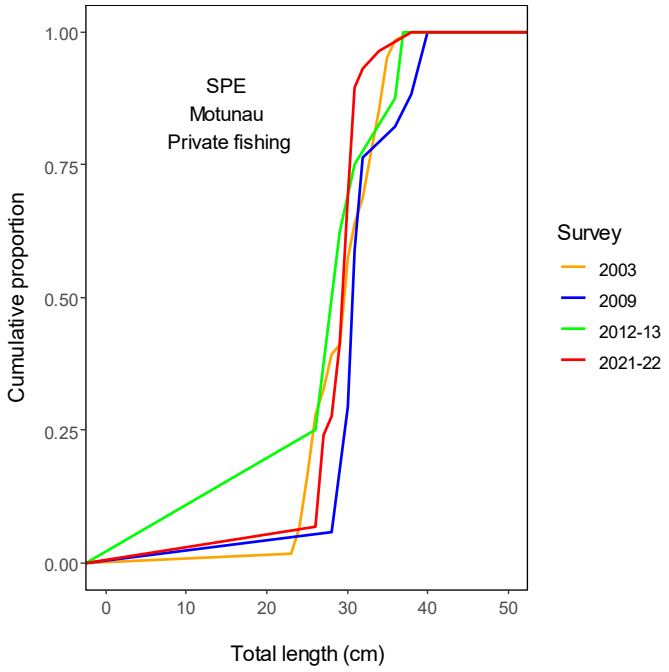

Figure 16: Empirical cumulative distribution function plot comparing length frequency of sea perch measured in the 2003, 2009, 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data limited to late summer (January–April) observations for comparison with earlier surveys.

Table 59: Comparison of dive-caught rock lobster tail width measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data include observations from the full fishing year (October–September). SD = standard deviation.

Location	Survey	Number of lobsters measured	Mean tail width (mm)	SD tail width (mm)
Motunau	2012–13	124	71.1	8.7
	2021–22	214	62.6	5.2

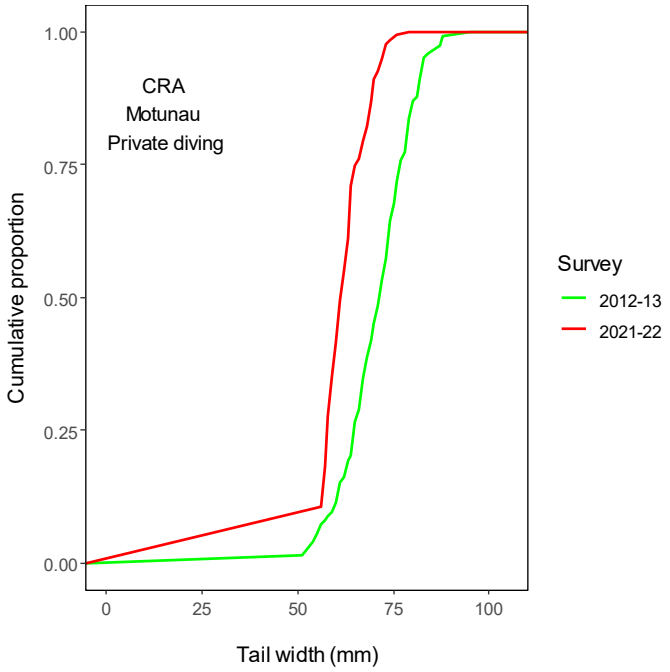

Figure 17: Empirical cumulative distribution function plot comparing length frequency of dive caught rock lobster measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data includes observations from the full fishing year (October–September).

Table 60: Comparison of pot-caught rock lobster tail width measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data include observations from the full fishing year (October–September). SD = standard deviation.

Location	Survey	Number of lobsters measured	Mean tail width (mm)	SD tail width (mm)
Motunau	2012–13	29	70.0	7.3
	2021–22	809	63.3	5.8

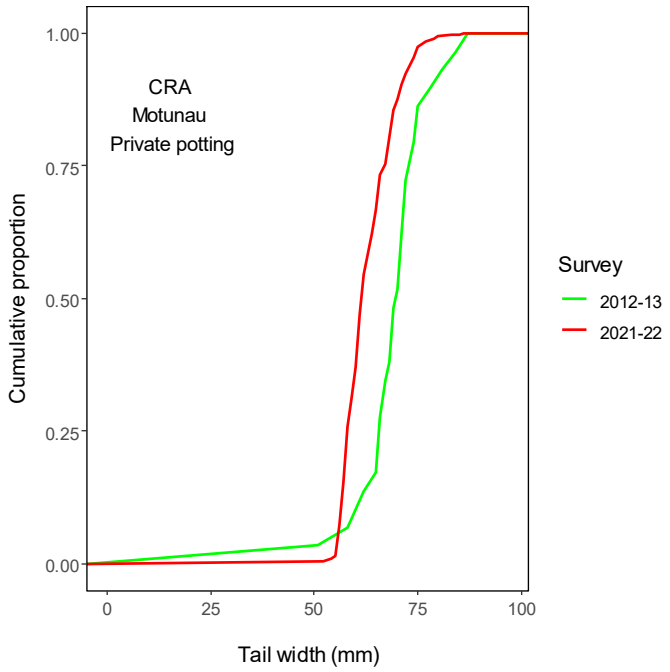

Figure 18: Empirical cumulative distribution function plot comparing length frequency of pot caught rock lobster measured in the 2012–13 and 2021–22 surveys of the private-vessel recreational fishery at Motunau. Data include observations from the full fishing year (October–September).

Harvest estimates

The harvest estimates from the four surveys of the Motunau private-vessel recreational fishery are presented here for comparative purposes (Table 61, Table 62). These estimates are based on retained individuals only.

The number of blue cod harvested during late summer (January–April) was successively higher from 2003 to 2012–13 (Table 61). However, the 2021–22 late summer harvest was substantially lower than the 2009 and 2012–13 harvests. Sea perch showed a similar pattern with a sharp decrease in harvest for the 2021–22 fishing year. The 2022 late summer harvest of rock lobster was substantially lower than that in 2012–13 for the dive fishery but increased in the potting fishery.

Table 61: Comparison of total harvest estimates in number of individuals for the four surveys of the Motunau private-vessel recreational fishery. Earlier surveys did not include counts of rock lobster. Data limited to January–April (late summer). Previous estimates taken directly from reports published for 2003 (Hart & Walker 2004), 2009 (Kendrick et al. 2011), and 2012–13 (Kendrick & Hanley 2021) surveys. BCO = blue cod, SPE = sea perch, CRA = rock lobster.

			Harvest	
Survey	BCO	SPE	CRA (Dive)	CRA (Pot)
2003	4 705	1 165	NA	NA
2009	7 550	1 162	NA	NA
2012–13	7 728	1 209	5 003	1 202
2021–22	1 274	85	658	1 715

A comparison between the 2012–13 and 2021–22 surveys can be made for the full fishing year and can include rock lobster (Table 62). In this case, the harvest of blue cod, sea perch and dive-caught rock lobster changed markedly with large decreases at Motunau. The harvest of pot-caught rock lobster also decreased, but to a lesser degree.

Table 62: Comparison of total harvest estimates in number of individuals for the two most recent surveys of the Motunau private-vessel recreational fishery. Data for full fishing year. Estimates for the 2012–13 survey taken from Kendrick & Hanley (2021). BCO = blue cod, SPE = sea perch, CRA = rock lobster.

			Harvest	
Survey	BCO	SPE	CRA (Dive)	CRA (Pot)
2012–13	16 649	2 840	12 489	3 443
2021–22	2 629	208	793	2 986

3.3 Total harvest in the amateur charter vessel fishery

There were six charter vessels that operated in Statistical Areas 018 and 020 in 2021–22 with their area of origin recorded as Kaikōura. No vessels had Motunau recorded as their port of departure. Through the AFCV-ACR reporting system, a total of 1745 fishing events were registered over this fishing year. The number of people onboard per trip ranged from 1 to 19.

These events (all target species included) reported caught and retained numbers of 13 107 blue cod, 41 475 sea perch, and 3647 rock lobster. Using the concurrent onsite creel survey estimates of mean weight, the harvest estimates determined from the charter vessels were 7348 kg for blue cod, 16 078 kg for sea perch, and 2050 kg for rock lobster caught by potting. No dive-caught rock lobster were reported in the AFCV-ACR records.

4. DISCUSSION

This survey monitored the private-vessel recreational fisheries at Kaikōura and Motunau during the 2021–22 fishing year. Using boat ramp creel surveys, catch and effort data were collected with a focus on three key species: blue cod, sea perch, and rock lobster.

The primary objectives of this study were to estimate harvest rates, size composition, total harvest, and daily effort levels and to compare the results with three previous studies. Unfortunately, there are some differences in the way these surveys have been undertaken, which limits their comparability and thus the establishment of a consistent time series.

The first two studies undertaken in 2003 by Hart & Walker (2004) and in 2009 by Kendrick et al. (2011) surveyed the fisheries at Kaikōura and Motunau during late summer (January–April) only and did not include rock lobster in the analyses. These fisheries were again surveyed in 2012–13 by Kendrick & Hanley (2021), who expanded the survey to cover the entire fishing year (October–September) and included rock lobster in the analyses. All three previous surveys recorded angler effort as the outing duration, from the time the vessel left the boat ramp until the vessel returned. The current study covered the entire fishing year and included rock lobster, for consistency with the 2012–13 survey. However, unlike the three previous studies, the current study recorded angler effort specifically as the time spent fishing. This excluded all peripheral time, such as travelling from the boat ramp to a fishing location, time spent on the water not fishing, and time travelling from a fishing location back to the boat ramp. This is the methodology used in all boat ramp surveys conducted by NIWA and is consistent with the structure of the '*rec_data*' database (Fisher & Dick 2020). Therefore, any analyses involving effort in angler hours are not strictly comparable. This includes the harvest estimates because the previous studies combined the estimate of total effort and catch rate.

Another major change, suggested by the Marine Amateur Fisheries Working Group, was the introduction of the direct expansion methodology used in the bus route survey (Pollock et al. 1994). Direct expansion involves estimating the total daily harvest directly from the retained catch observed at each boat ramp along the bus route. In the three previous surveys, total harvest was estimated by the time interval count method. Using the time interval count method, estimates of effort and catch per unit effort were calculated independently and then combined to produce a total harvest for each species. The first two studies in 2003 and 2009 estimated total effort for each stratum and multiplied it by the average catch rate per stratum to get the total harvest per stratum. Kendrick & Hanley (2021), however, changed the approach, as suggested by the MAFWG, and estimated the total daily harvest by multiplying total daily effort by the average catch rate across all ramps on the sample day, also reworking the estimates for the earlier surveys for comparison. This change in approach provided considerably more precise estimates. In the current study, direct expansion was expected to further improve the precision of harvest estimates for the Kaikōura and Motunau fisheries. However, the coefficients of variation produced in this study were no better than that produced in the 2012–13 study (Kendrick & Hanley 2021). For some, the harvest estimates were substantially lower in the current study, which may have contributed to a more variable harvest index. However, this was not always the case.

The primary fishing activity of the private-vessel recreational fishery in Kaikōura was potting for rock lobster, followed by line fishing for blue cod and sea perch. Fishing was mainly undertaken by males between the ages of 50–69. Fishers may undertake more than one activity during an outing, and fishers often set or retrieved pots and then undertook line fishing for other species during the same outing. Consequently, the incidence of one activity can decline without a proportional increase in another activity. In Kaikōura it appears that while line fishing for blue cod or sea perch was as popular in 2021–22 as it was in 2012–13, potting for rock lobster has declined in importance, although it was still the primary activity. Diving for rock lobster appeared to be the least popular activity, like that observed in 2012–13. The harvest of the three key species by charter vessels at Kaikōura provided a more complete account of the recreational fisheries harvest. Comparisons with previous years cannot be made as those surveys were carried out prior or during implementation of the AFCV-ACR reporting system and used a form of optional logbooks.

At Motunau, the primary fishing activity of the private-vessel recreational fishery was line fishing for blue cod and sea perch, followed closely by potting for rock lobster. Fishing was undertaken mostly by males between the ages of 60–69. Line fishing for blue cod or sea perch appears to be as popular as it was in 2012–13; however, there has been an apparent switch from lobster diving to lobster potting at Motunau.

Blue cod

The total number of blue cod harvested in the Kaikōura private-vessel recreational fishery has nearly doubled since 2012–13, now exceeding the harvest at Motunau, which has fallen dramatically. Considering only the later summer period (January–April) at Kaikōura, the harvest of blue cod has increased steadily over the four surveys, whereas the harvest at Motunau increased initially from 2003 to 2012–13, but then fell by 84% in 2021–22. The maximum daily limit (MDL) for blue cod has been reduced since 2012–13 from 10 fish. The boat ramps around the Kaikōura Peninsula and at Oaro lie within the Kaikōura Marine Area, which now implements an MDL of six fish. Although there is a taiāpure around the peninsula with an MDL of two blue cod, fishers can land six fish each if caught beyond the taiāpure (Howard Reid, Fisheries New Zealand compliance, pers. comm. 2023). The MDL at Motunau is two fish. Therefore, the increased harvest at Kaikōura has happened despite a reduction in the MDL. At Motunau, in addition to a significant MDL reduction, the minimum legal size (MLS) increased from 30 cm to 33 cm since 2012–13. Whereas the proportion of blue cod returned to the water at Kaikōura exceeded the number retained, at Motunau the number of fish retained far exceeded the number returned to the water. The dramatic downturn in harvest at Motunau is likely associated with the increased MLS, decreased MDL, and years of overexploitation among the larger size classes.

The harvest rates recorded in 2021–22 were higher at Motunau than at Kaikōura. The ramp at Motunau is tidally limited, which restricts outing duration and thus fishing time. Yet, on these shorter fishing trips at Motunau, the mean retained catch was comparable with that in Kaikōura, resulting in a higher harvest rate at Motunau. It seems that there were still sufficient legal-sized blue cod at Motunau for a fisher to achieve their MDL during the short outings, although this may have come at the cost of a decrease in overall effort, which has likely shifted to Kaikōura.

Sea perch

The harvest of sea perch in the private-vessel recreational fishery at Kaikōura increased marginally in 2012–13, whereas the harvest at Motunau fell dramatically over this period to an estimated 208 fish for the year. Considering only the late summer period (January–April) at Kaikōura, the harvest of sea perch appeared stable between 2003 and 2009, but then an appreciable increase in 2012–13 was followed by a decrease of a similar magnitude in 2021–22. At Motunau, the late summer catches appeared stable from 2003 to 2012–13, but then fell dramatically in 2021–22 to just 85 fish. At Kaikōura, where there is an MDL of 20 sea perch and an MLS of 26 cm, the number of sea perch returned to the water was close to the number retained. Contrastingly, at Motunau, there is an MDL of 30 sea perch, and no MLS. However, no sea perch were recorded being returned to the water, suggesting a localised shortage. Corroborating this is the relatively low harvest rate of sea perch at Motunau. Also, the size of sea perch does not appear to have changed much over the years at Motunau and so a size preference is unlikely to be the cause of the low harvest.

Rock lobster

The private-vessel recreational rock lobster fishery has two distinct facets in the Kaikōura and Motunau area. Rock lobster potting is by far the larger fishery, but divers also harvest an appreciable amount of lobster in both areas. These two fisheries differ vastly in how they operate, which is why they were treated separately in this report. Diving for lobster, using either scuba or snorkel is constrained to daylight hours and by exposure to cold, whereas pots are often set over night. During winter (May–September), there was no lobster diving recorded at either Kaikōura or Motunau in the current study, but the 2012–13 survey did record some winter diving at both locations. When pooling the catch for both methods, less than half of the rock lobster catch at Kaikōura was retained, presumably indicating a shortage of legal-sized individuals, whereas at Motunau, 94% of the catch was retained.

The dynamics of the lobster fishery have changed since 2012–13, particularly in the diving facet. Despite an absence of winter diving at both locations, there was still a modest increase in lobster harvest at Kaikōura. The dramatic downturn at Motunau is difficult to explain. It appears that Motunau lobster fishers are abandoning diving in favour of the potting method even though diving outings recorded higher harvest rates than potting. Motunau diving also had higher lobster harvest rates than Kaikōura diving. Furthermore, the size difference in lobster between Kaikōura and Motunau was less pronounced than it was in 2012–13.

The dynamics of the lobster potting fishery have also changed. The large downturn in the Kaikōura harvest may be related to the lowered incidence of potting, which has likely led to the lower total harvest, but the underlying reason could be low lobster availability. The harvest rates (lobster per fisher) were not comparable with the 2012–13 study, which reported lobster per potlift. It was therefore difficult to evaluate any temporal change in lobster availability. However, the potting harvest rate at Kaikōura was lower than that at Motunau during the summer months, but not during winter, like the 2012–13 survey. Perhaps, the downturn in harvest is due to the availability specifically of legal-sized lobster, which were more prevalent at Motunau.

There may be some lobster harvest taken while scuba diving or snorkelling from the shore, but that harvest is not considered in this report. The extent of shore-based effort and harvest is not known.

5. CONCLUSIONS

Several factors have led to a change in the dynamics of the recreational boat fishery along the Kaikōura-North Canterbury coastline. A severe earthquake in 2016 altered the accessibility of certain access points, particularly at Barney's Rock and Oaro. Access to the Oaro ramp from the nearby campsite was also restricted. The South Bay Club ramp was lengthened and widened following the earthquake. It is now the most popular ramp, but only accessible to paying members. The introduction of the Kaikōura Marine Management Act 2014 and the Blue Cod Strategy along with changes to regulations have altered the MLS and MDL permissible for blue cod—the key target species in this area. Currently, the Kaikōura-North Canterbury region features a spatially variable suite of regulations, which have been complicated by transit rules through the local taiāpure reserve. Also, there has likely been localised depletion of the key species over time, leading to variable success during fishing outings. Fishery-independent potting surveys have found substantial declines in blue cod biomass at Kaikōura, between 2007 and 2019 and, at Motunau, between 2005 and 2020 (Beentjes & Miller 2021, Beentjes & Page 2021, Fisheries New Zealand 2022). There thus appears to be little incentive for fishers to travel to the Kaikōura-North Canterbury coastline from other areas, where dwindling stocks and tighter regulations have discouraged fishers. More restrictive regulations for sea perch are likely warranted at Motunau, which may serve as an example of what is to be expected at Kaikōura.

6. ACKNOWLEDGEMENTS

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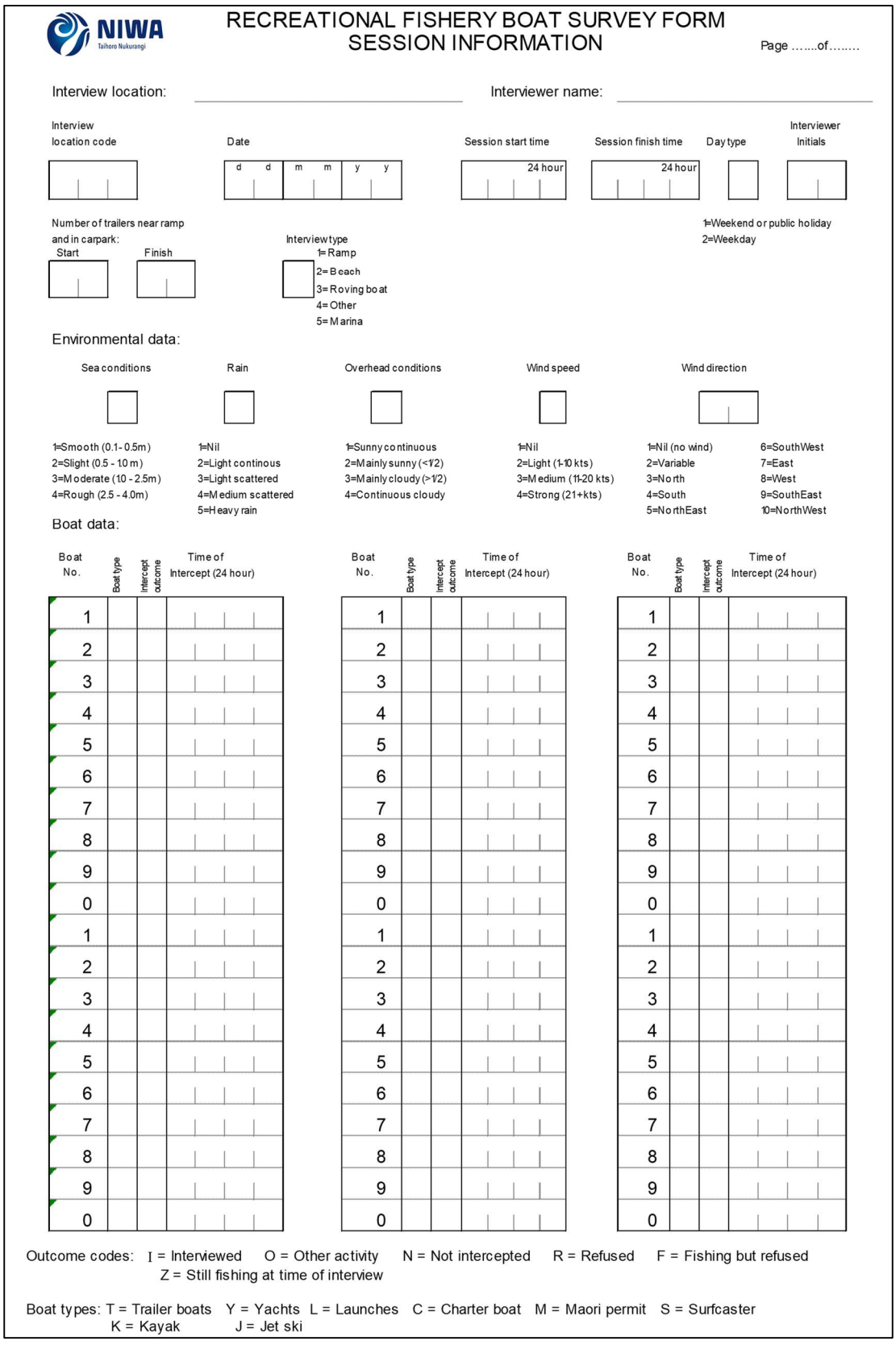
APPENDIX 1: SESSION FORM



NIWA
Taihoro Nukurangi

RECREATIONAL FISHERY BOAT SURVEY FORM
SESSION INFORMATION

Page .....of.....

Interview location: _____ Interviewer name: _____

Interview location code | Date (d d m m y y) | Session start time (24 hour) | Session finish time (24 hour) | Day type | Interviewer Initials

Number of trailers near ramp and in carpark: Start | Finish

Interview type
1= Ramp
2= Beach
3= Roving boat
4= Other
5= Marina

1=Weekend or public holiday
2=Weekday

Environmental data:

Sea conditions
1=Smooth (0.1- 0.5m)
2=Slight (0.5 - 1.0 m)
3=Moderate (1.0 - 2.5m)
4=Rough (2.5 - 4.0m)

Rain
1=Nil
2=Light continous
3=Light scattered
4=Medium scattered
5=Heavy rain

Overhead conditions
1=Sunny continuous
2=Mainly sunny (<½)
3=Mainly cloudy (>½)
4=Continuous cloudy

Wind speed
1=Nil
2=Light (1-10 kts)
3=Medium (11-20 kts)
4=Strong (21+kts)

Wind direction
1=Nil (no wind)
2=Variable
3=North
4=South
5=NorthEast
6=SouthWest
7=East
8=West
9=SouthEast
10=NorthWest

Boat data:

Boat No.	Boat type	Intercept outcome	Time of Intercept (24 hour)	Boat No.	Boat type	Intercept outcome	Time of Intercept (24 hour)	Boat No.	Boat type	Intercept outcome	Time of Intercept (24 hour)
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
0				0				0			
1				1				1			
2				2				2			
3				3				3			
4				4				4			
5				5				5			
6				6				6			
7				7				7			
8				8				8			
9				9				9			
0				0				0			

Outcome codes: I = Interviewed O = Other activity N = Not intercepted R = Refused F = Fishing but refused
Z = Still fishing at time of interview

Boat types: T = Trailer boats Y = Yachts L = Launches C = Charter boat M = Maori permit S = Surfcaster
K = Kayak J = Jet ski

APPENDIX 2: BOAT INFORMATION FORM

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Taihoro Nukurangi

RECREATIONAL FISHERY BOAT SURVEY FORM
BOAT INFORMATION (2019)

Page .....of.....

Interview location code	Date (d d m m y y)	Boat no.	Page no.	Boat type	Intercept outcome	Time of intercept (24 hour)

Fisher name: (optional) _____ Fisher phone: (optional) _____

Fisher No.	Combo	Fishing location	Fishing method	Depth fished (m)	Target species	Time start (24 hour)	Time finish (24 hour)	Time not fishing Hrs	Time not fishing Mins	Bird ?	Hook site	Days/year	Sex M / F	Age group

Fisher No.	Combo	Species	Length (cm)	Meas method	Count	Observed*

Fisher No.	Combo	Species	Length (cm)	Meas method	Count	Observed*

Don't forget to ask "Did any of your group catch any fish that were…
...filleted (including headed fish)? = **F**
…used as bait? = **B**
…of legal size but thrown back ? = **L**
…undersized but thrown back ? = **U**
If yes to any of these, which species, how many and by which fisher ?

*Observed 1 = measured 2 = counted 3 = observed 4 = not observed 5 = head removed (for otoliths) F=fish filleted B=fish used for bait U=thrown back - undersized (dead or alive) L=thrown back - legal size (dead or alive)

All rock lobster must be sexed - Measurement method is W for CRA and L for PHC - write M or F to indicate sex in margin beside the Observed column for these fish

APPENDIX 3: BUS ROUTE DESIGN

Ramp identification and effort weighting used.

			Effort weighting			
ID	Boat ramp	Ramp code	2004	2009	2012–13	2021–22
1	Pier Slipway	KPR	0.02	–	–	0.04
2	Armers Beach	ARM	0.08	0.06	0.06	0.08
3	South Bay (club ramp)	STP	0.35	0.27	0.27	0.50
4	South Bay (public ramp)	STB	0.45	0.4	0.40	0.34
5	Boat Harbour (Oaro)	OAR	0.02	0.25	0.25	0.04

Travel times between ramps going in different directions. Wait times varied with time of the year.

	Direction 1			Direction 2		
Link	From ramp	To ramp	Travel time	From ramp	To ramp	Travel time
A	1	2	00:05	5	4	00:15
B	2	3	00:10	4	3	00:05
C	3	4	00:05	3	2	00:10
D	4	5	00:15	2	1	00:05
E	5	1	00:35	1	5	00:35