

Assessment of Recreational Fishing within the Akaroa Harbour Taiāpure Management Area, South Island Te Waipounamu, New Zealand

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Abstract

In New Zealand marine recreational fishing is controlled mainly by bag limits and size restrictions, together with Area Management Tools (AMT) such as Taiāpure (local fishery reserve areas established under the Māori Fisheries Act 1989). We undertook a survey of recreational fishing within the Akaroa Harbour Taiāpure, Banks Peninsula, after its establishment in 2006. The aim was to determine the demographic of fishers, the fishing methods utilised and the species targeted and caught. Two types of fishing surveys were undertaken monthly between December 2007 and February 2009. Intercept surveys (451) were conducted from four of the most frequently used slipways and 138 trip records were returned by 35 people who regularly fished in the area. The catch information from 19 locations in the Harbour showed that the most frequently landed fish were blue cod (*Parapercis colias*), flatfish (*Rhombosolea* spp.), rock lobster (*Jasus edwardsii*) and sea perch (*Helicolenus percoides*). Since a previous survey undertaken in 1997, the fish species targeted have changed, the catch per unit effort (CPUE) for red cod (*Pseudophycis bachus*) has declined, and recreational fishing trips have shifted from the inner harbour to the harbour entrance and the immediate area outside. Following changes in the management status of this area, we recommend that the surveys be continued over time in order to create a data base on recreational fishing to assess the effectiveness of current controls in protecting fisheries resources.

Keywords: marine recreational fishing; area management tools; Akaroa Taiāpure; community based management

Introduction

Over the last decade recreational fishing has increased in some parts of the world, perhaps due to improved fishing gear and technological advances (Kearney 2001; Coleman et al. 2004; Veiga et al. 2013). Over 30% of the New Zealand population take part in some form of recreational fishing (Sutinen & Johnston 2003) which is regarded as an “open access fishery” (Borch 2010, Bosch 2010) with few controls. Recently there has been concern raised that increased recreational fishing pressure could deplete natural populations (Zischke et al. 2012).

Marine recreational fishing and charter boat fisheries in New Zealand are managed outside the Quota Management System (QMS) (Bess & Rallapudi 2007). Rules and regulations are set by the Ministry for Primary Industries (previously known as the Ministry of Fisheries) and include bag limits, size restrictions, areas closed off to fishing, seasons, fishing methods and gear restrictions; methods that are used worldwide (Yandle 2007, Tetzlaff et al. 2013). The introduction of the Māori Fisheries Act of 1989 allowed for Taiāpure to promote sustainability in certain coastal areas affected by fishing. It allowed for the management of traditional customary fishing grounds and holds significance to the Māori community. In 2006 a Taiāpure was established in Akaroa Harbour for the protection of fish and shellfisheries with a management committee made up of representatives from Ngāi Tahu, local community, recreational and commercial fishing groups. No special restrictions were placed on recreational fishing at the time; however, a combined maximum daily bag limit of 30 finfish per person, consisting of any combination of the

species listed, was enacted.

In New Zealand very little research has been conducted on recreational fishing, contrasting with Australia where there have been many studies (Sumner & Williamson 1999; Sumner et al. 2002; Malseed et al. 2000; Malseed & Sumner 2001; Williamson et al. 2006, Leite & Gasalla 2013). Irregular local recreational fishing surveys have been conducted in New Zealand by the Ministry of Fisheries since the beginning of 1990s (Bradford et al. 1998; Bell 1998, 1999, 2000; Carbines 2000a,b; Tierney and Kilner 2002), with the most recent nationwide survey undertaken in 2011-2012, which has not yet been published. There have been no surveys of recreational fishing in Akaroa since 1997.

In the Canterbury Region of New Zealand bottom trawls reveal a fish diversity exceeding 100 species at shallow depths and about 15 invertebrate shellfish species. There are commercial fisheries for spiny dogfish, barracouta, red cod, tarakihi and flatfish, and in recent years catch rates for some species such as red cod have declined (Hart et al. 2008). Because of its closeness to the City of Christchurch and its popularity as a tourist centre, concerns have been expressed about the potential of exploitation of the natural fisheries resources. Several companies in Akaroa provide fishing charter trips for up to ten fishers. Fishing pressure from these activities have become increasingly important to survey since little is known of the fleet and even less of the catch (James et al. 1997).

The aims of this study were to collect quantitative data on recreational fishing methods, species caught and catch rates in the Akaroa Harbour Taiāpure management area on Banks Peninsula. This information was needed to inform

future management decisions on catch limits, fishing methods and the location of proposed marine reserves in Akaroa Harbour.

Methods

Study Area

Banks Peninsula is located in the middle of the east coast of the South Island and is a prominent volcanic feature about 80 km from Christchurch (Reynolds-Fleming & Reynolds 2005). Akaroa Harbour lies on the south of peninsula, a 17 km tidal inlet open to the south (Heuff et al. 2005). The Taiāpure reserve was established in early 2006, covering over 90% of the waters within Akaroa Harbour (areas 1-13)

Haylocks and Damons Bay, except the waters in the proposed Dan Rogers marine reserve area (area 14) (Fig.1) (Pirker 2008). To evaluate the effectiveness of the Taiāpure, we conducted intercept surveys at five main sites, Daly's Wharf, a slipway close the sports ground in Akaroa, the main slipway, and those in Wainui and Duvauchelle. These areas are used throughout the year by recreational fishers, both local and non-residents, with peak season between December and February. To allow comparison with previous research we used the same 19 divisions (Fig. 1) used by Bell (1998). We also included an offshore area, defined as 12 nautical miles of the coast, because this was an area identified by some local fishers. Area 19 is the Pohatu Marine

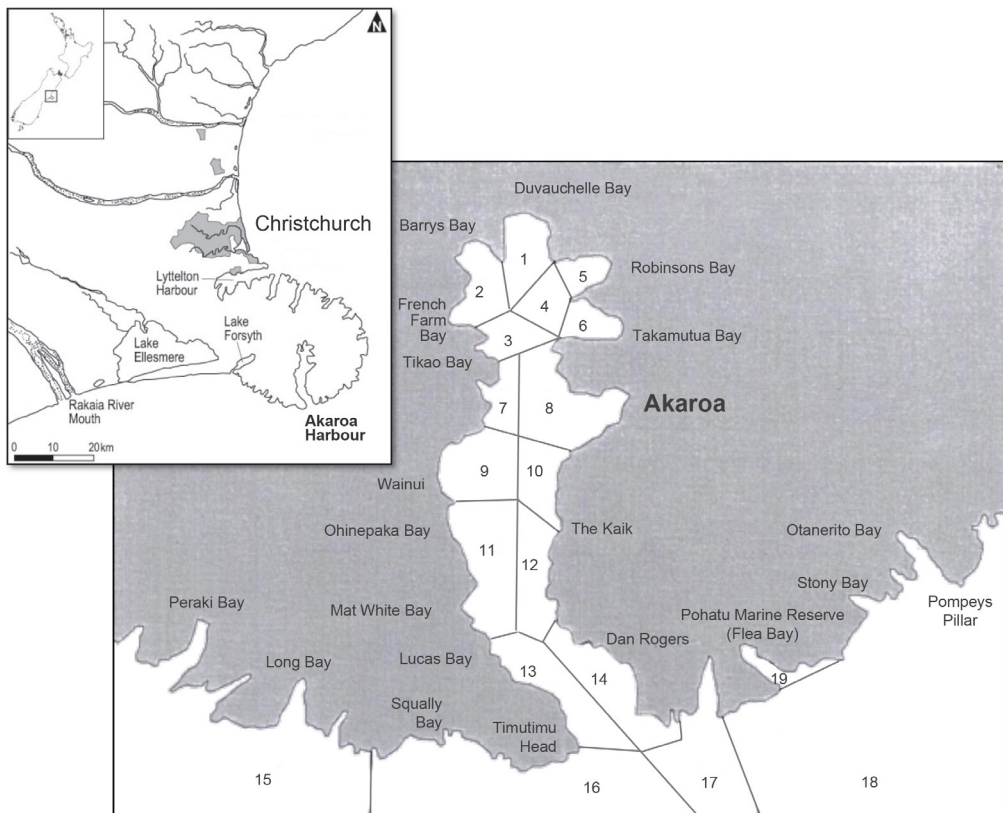


Fig. 1 Map of Canterbury and Akaroa Harbour divided up into fishing areas. The four slipways used for intercept surveys were in Akaroa (2 locations), Duvauchelle and Wainui

Reserve and no fishing was conducted or found in this area during the present study.

Survey Design

The most common approach to obtain information on recreational fishing or fish stocks is to conduct surveys, either over a short period of time (e.g., Gartside et al. 1999; Veiga et al. 2013; Gardner & Struthers 2013) or a longer time frame (e.g., Jansen et al. 2013; Wise et al. 2012). We used an intermediate time frame for the current research. The questionnaire and trip record reports used in the present study were based on previous surveys done by Ministry for Primary Industries (MPI) and the National Institute for Water and Atmospheric research (NIWA) (Bell 1998, 2000). The population sample included all recreational fishers, divers and shellfish collectors actively harvesting seafood in the Akaroa Harbour Taiāpure and the offshore area described above.

Intercept Surveys

In this survey type, a trained interviewer rather than the recreational fisher recorded the catch, thus increasing accuracy of species identification and measurements (Reid & Montgomery 2005). Intercept interviews were conducted between December 2007 and February 2009, on four slipways, two in Akaroa, one near the sports ground and the other on the main wharf, and the other two at slipways in Duvauchelle and Wainui. The questions in the first section of the fishing survey covered demographics and usual place of residence, time spent fishing, targeted species, type of boat (divided into charter, private, hired or other), fishing method (14 categories) and total number of people on the trip (Kallqvist 2009). The second section covered measurements of fish/shellfish, identification of species, fishing or diving location (map taken from the Akaroa survey by Bell (1998)), and the number of individual species

Table 1. Catch per unit effort (CPUE) for selected species targeted and recorded in intercept surveys and trip records.

Species	Survey	Number of trips targeting the species	Total number of hours targeting the species	Total number of individuals caught when targeted	CPUE
Blue cod	Intercept	162	220	258	1.2
	Trip records	69	153	359	2.4
Red cod	Intercept	2	5	2	0.4
	Trip records	10	37	9	0.2
Rock lobster	Intercept	123	125	1,056	8.5
	Trip records	14	20	359	2.4
Moki	Intercept	4	7	10	1.4
Flatfish	Trip records	37	318	344	1.1
Butterfish	Intercept	5	12	20	1.7

caught and released. All incoming boats were approached, however only those where people had been actively fishing or diving or had attempted fishing or diving took part in the survey. One person per boat was asked to answer questions in the two-minute questionnaire and then the catch was sorted, species identified, counted and measured.

All interviews were conducted in daylight, normally between 8:30 am and 6 pm, weather permitting. For the purpose of this study, mussels included both the blue (*Mytilus edulis*) and green-lipped mussel (*Perna canaliculus*), and flatfish (*Rhombosolea* spp) include several species, including the yellow-belly flounder.

Trip Records

Recreational fishers and charter fishing boat operators were asked to keep trip records of their Akaroa Harbour fishing activities. They were approached individually at the slipways or contacted directly as a result of local information about their fishing activity. The format of the trip record report was evaluated in late December 2007 to determine the quality and usefulness of the survey. The information on the trip record disclosed the areas fished, species caught, fishing method, number of people on board (male and female), and the number of caught, killed and released fish. Customers on fishing charters were included as recreational fishers. At the time of the survey, several companies in Akaroa provided fishing charters and numbers often reached ten individuals. Fishing pressure from these activities have become increasingly important to survey since little is known of the fleet and even less of the catch (James et al. 1997).

Data Analyses

The data were tested for normality using standard techniques but some data were unable to be transformed. Non-parametric analyses were used for the fish-take and demographic data with the significance level set at $\alpha = 0.05$. ANOVA was used to compare the effects of season and location on the mean lengths of the fish catch. Regression analysis was used for both surveys to test for relationships between fishing time and number of catch. These analyses did not reveal significant effects or patterns, and are therefore not included. The intercept survey and the trip records were analysed separately from fishing methods, catch and release and mean lengths of main species. A simple catch per unit effort (CPUE) for each boat was calculated as in Bell's survey (1998), which was the number of fish caught/ number of hours fished. All statistical analyses were conducted using SPSS Version 15.0 and STATSTICA 7.0.

Results

The intercept survey generated 451 records over a 14-month period (January 2008 - February 2009). Of these, 47% were recorded from the main slipway in Akaroa, with 35% from Duvauchelle. The majority of the boats (72%) were cabin boats with a length of 5-7 m. Apart from two charter boats, all were privately owned and had on average 3-4 people aboard ranging in age from less than 5 to 80 m. On these trips, 3,920 fish and shellfish from 28 species groupings were identified and measured.

The trip records resulted in 138 returns from 35 people responding over a 14-month period (December 2007 -

January 2009). The total number of shellfish and fish caught on these trips was 1,618 from 24 different groups.

Demographics

Intercept survey participants were mostly males (88%) aged between 41 and 50; however, the age ranged from 15 to 80. Of the 451 fishers intercepted on the slipways, 93% identified themselves as Pakeha/European, 1% said “other” (British and Scandinavian) and 6% identified themselves as NZ Māori. Over 65% of the respondents resided in Christchurch, followed by Canterbury (12%). Recreational fishers from Akaroa and the Banks Peninsula comprised 16%, and less than half a percent lived overseas. The participants who filled out the trip reports were volunteers from recreational and charter boat owners from the local community.

Fish Targeted

Blue cod (*Parapercis colias*) was the main target fish for the trip record participants

(50% of all trips) and the intercept survey respondents (38% of all trips) (Fig. 2). Rock lobster (*Jasus edwardsii*) was also highly targeted by both groups, whereas flatfish (*Rhombosolea* spp.) were targeted more by the trip record participants. Interestingly, a relatively high percentage of the respondents (26%) of the intercept survey targeted non-specific fish species. Sea perch (*Helicolenus percoides*) was targeted by 5% of the trip record participants but less than half a percent of the intercepted fishers on slipways. Similarly, few fishers targeted red cod (*Pseudophycis bachus*).

Fishing Methods

Rod and line from private boats was the most common method of fishing (>55%) reported in both surveys. Many recreational fishers used multiple fishing methods, such as rod and line and diving with tank. Set-netting was mainly carried out by 32% trip record participants. Diving with tank and rod and line fishing were popular with the respondents of the intercept survey where 16% stated

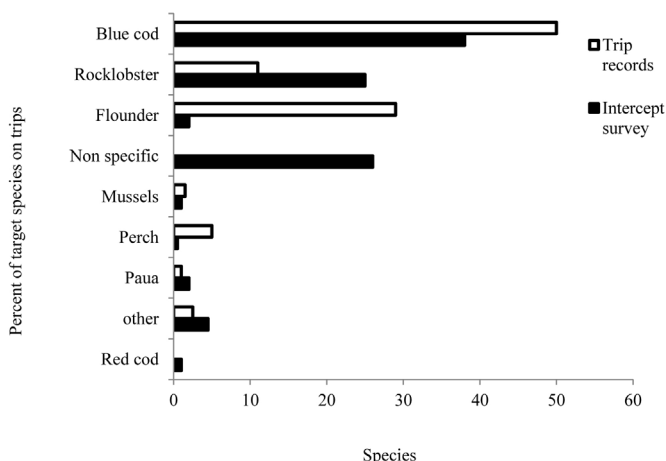


Fig. 2 Species targeted (%) in trip records (n = 138) and intercept surveys (n = 451)

they used both techniques on their trip. Few fishers used longlines or undertook spearfishing.

Fish Catch

A wide diversity of fish was caught from 21 or more species including bottom dwelling and pelagic fish (Fig. 3). For the majority of fish, a similar proportion of the take was recorded from both the intercept and trip record surveys. The most frequently taken finfish was blue cod (when targeted), representing 27% of the take for trip survey and 31% intercept survey. Even though sea perch

was targeted on only 5% of the trips, 560 fish were taken which represented more than 20% of the take. Flatfish of various species formed 24% (344 fish) of the take recorded in trip reports, while butterfish (*Odax pullus*) was recorded more from intercept surveys than the trip records. Rock lobsters (total = 1,168) (Fig.3) comprised more than half of the non-fish catch for the trip records and just over 40% in the intercept survey. There were considerable differences in the proportions of targeted species collected in the two surveys, with a wider range of shellfish species collected by the intercept survey participants. Trip record

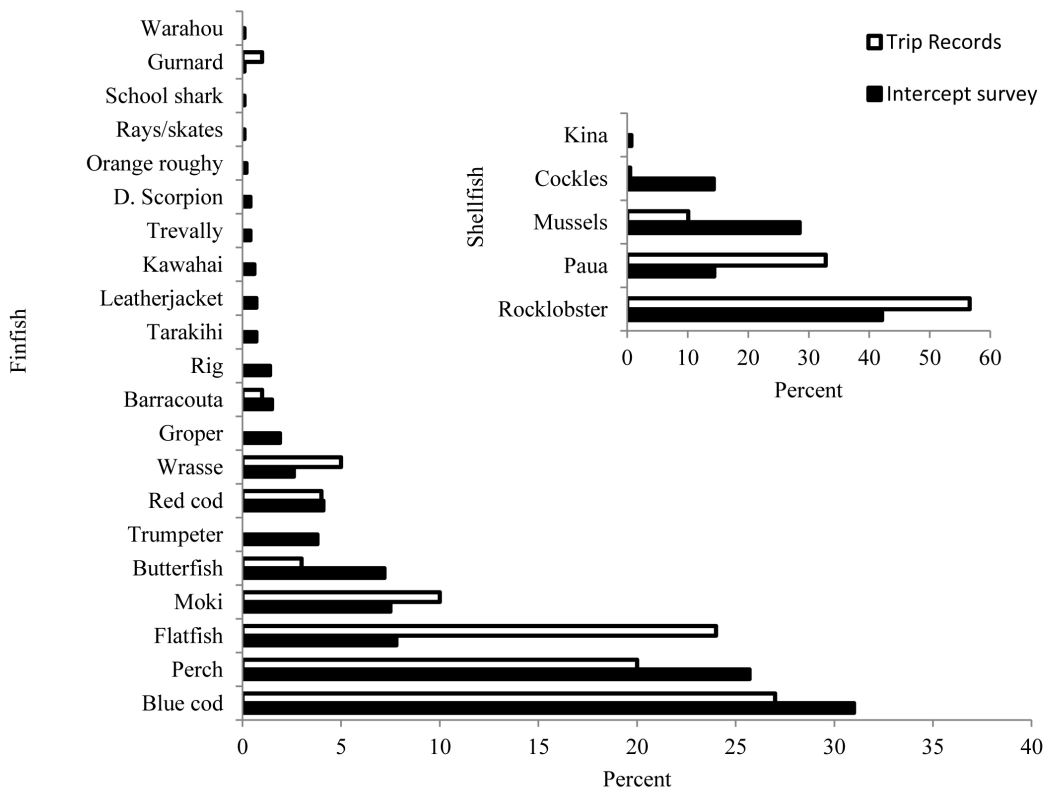


Fig. 3 Percent of total take of finfish and shellfish recorded on all slipways

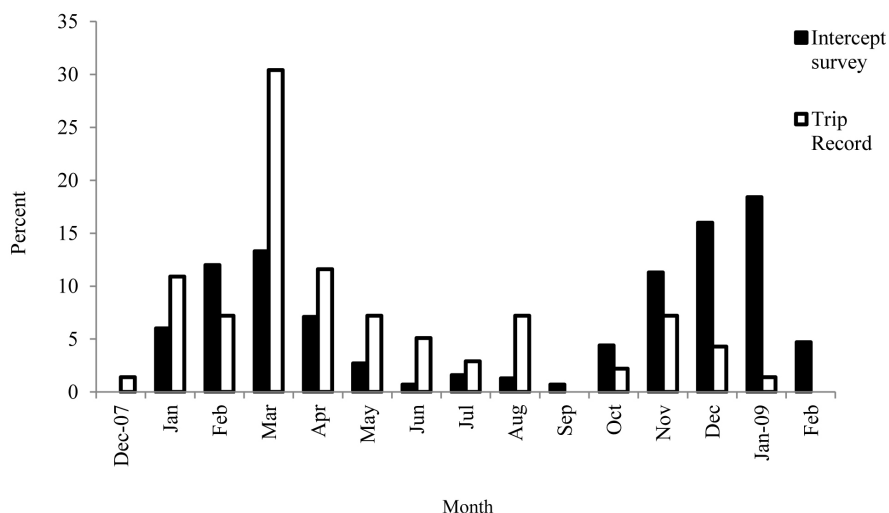


Fig. 4 Seasonality of fishing trips made by the respondents of both surveys over a period of 14 months

participants targeted rock lobsters, paua (abalone) and mussels.

Not all the fish that had been caught were retained, for example 25% of the red cod and 12% of the blue cod catch were returned or discarded, together with spiny dogfish, barracouta, dwarf scorpion fish and banded wrasse.

Fishing Pressure

Most fishing was recorded in the summer months, November to March and the lowest number of fishing trips occurred during winter and spring, May to September (Fig.4). The peak in March was the result of the start of the floundering season, which finished in April. Fishing occurred predominantly in areas outside the main harbour (areas 16 -18) and offshore (OFS) (Fig.5). Set-netting activity mainly occurred in area 8 (Akaroa) during the seasonally permitted period between April and September. Areas around the harbour entrance, such

as area 14 and 15, were used mainly by the intercept survey respondents. Shellfish collecting was centred predominantly around areas 15 and 16 while area 18 and offshore areas were popular for catching groper, blue cod and red cod. Charter boats and recreational fishers with larger vessels (> 7 m) often fished these areas.

Fish Size

For blue cod, which was the most frequently caught fish, the range in the mean length caught by the respondents of both surveys was between 25-45 cm and where comparisons can be made, the length was similar for both surveys. Overall the mean length recorded from the intercept surveys (36.8 cm) was less than the trip reports (41.4 cm) (two sample t-test $T = 8.98$, $P < 0.001$). During the winter months (April - September) the range for the mean length for blue cod was 35-40 cm, increasing to 45-50 cm in summer (December -

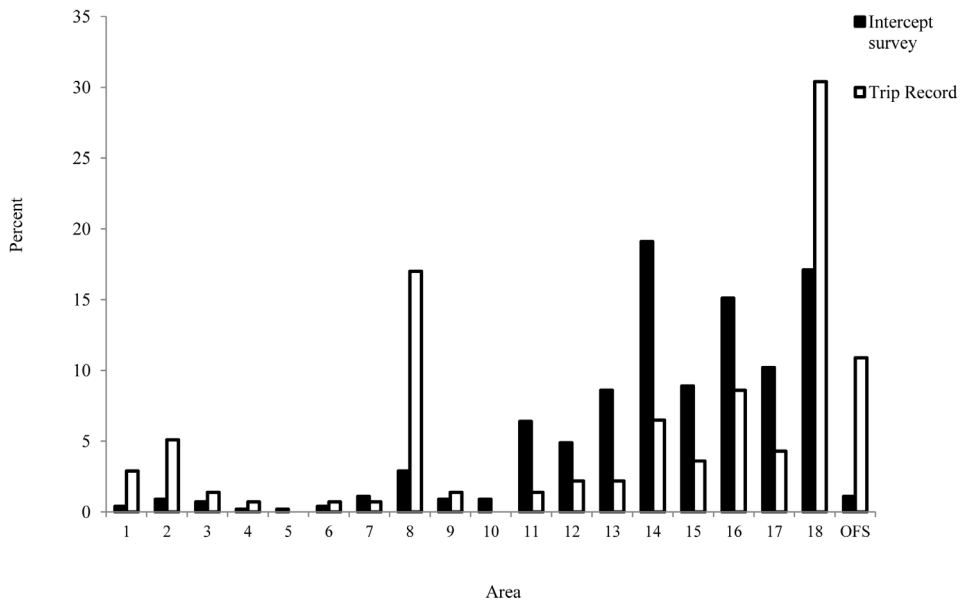


Fig. 5 Areas selected for fishing trips made by the respondents of both surveys (See Fig. 1 map, OFS = offshore)

March). Fewer blue cod were captured in the inner harbour than in the outer harbour. Sea perch mean length ranged between 20–30 cm during the winter, increasing to 30–40 cm in the summer. Although perch were generally absent from the inner parts of the harbour, they were captured in 11 areas where the mean length (30–35 cm) was similar ($n = 560$). Flatfish were only caught by trip records. The mean length of red cod was similar from intercept and trip surveys, ranging between 30 and 48 cm, with larger fish caught near the mouth of the harbour and in the nearshore coastal areas (Fig. 1, 14–OFS). More red cod were caught at the start of the survey period (January to June) than the last 7 months of surveying. Most rock lobsters were captured between October and April, with mean abdomen width (measured as the width between the spines on the second abdomen segment) for males and females being 81.3 and 83.4 mm, respectively. They were caught

mainly in areas 11 to 18 (Fig. 1).

The mean length of the combined finfish catch inside the Harbour was close to 30 cm in winter and summer. In the outer Harbour, values were similar to this during winter, but in summer the length of the catch was 65 cm (ANOVA $F = 57.6$, $P < 0.001$).

Catch Per Unit Effort (CPUE)

Most fishing trips were short, with a duration of less than 12 h. The highest fish catch (70) was for an intercept respondent after 3.5 h of fishing, but there was no significant increase in catch with fishing duration (data not included). Fishers using a rod and line fished for up to 8.5 h with those fishing for 4 h catching an average of about 20 fish. Set nets, which were used by trip record fishers were mostly deployed for less than 6 h and yielded a catch rate of about 9 fish. Fishing trips targeting

shellfish (including rock lobsters) were shorter, ranging from 0.5 to 3.5 h with maximal catch between 1 and 2 h. Most rock lobsters were collected by diving; the catch rates were unimodal of duration up to 3.5 h with maximum at 2.5 h where the catch rate was just under 13 per trip. The CPUE values for selected fish and shellfish species differed between trip reports and intercept records (Table 1). For blue cod, the CPUE was higher (2.4) for participants who completed trip records than those who took part in the intercept survey (1.2), whereas, for red cod the CPUE was similar in both groups (0.2 for trip record respondents and 0.4 for intercept respondents). For rock lobsters the CPUE for fishers completing the intercept surveys was higher (8.5) than those completing the trip records (5.6). The CPUE value for butterfish (1.7) exceeded moki (1.4) and flatfish (1.1).

Discussion

This study from the Taiāpure reserve in Akaroa Harbour, was undertaken because fisheries regulations were being considered to maintain fisheries resources. Fishing practices reported here suggest that the major recreational fishing practices have remained the same over the 10-year period up to 2009, but there were changes in the locations fished and the species targeted.

Demographics

The main group of recreational fishers in the Akaroa Harbour area were males, aged 41-50, living in Christchurch. Several of the MPI surveys from New Zealand have found that is the most frequent age group undertaking recreational fishing (Carbines 2000a,b) and this finding is

consistent with sports fishing statistics from Australia (Zischke et al. 2012). It is important to understand the attitudes and behaviour of these fishers so that effective resource management can be achieved (Richardson et al. 2005; Yochum et al. 2011).

Fishing Methods

The most common length of a vessel was 5-7 m and classified as a cabin boat, which is the typical size of a family boat in this part of Canterbury. Rod and line fishing from private boat was the most common method of fishing in the present study and has been found to be the most popular in several recreational fishing surveys in New Zealand (Bell 1998, 1999, 2000; Tierney & Kilner 2002). The current study found that many recreational fishers used multiple methods on a fishing trip such as rod and line and diving with tank. Of the 14 methods used by fishers in Bell's survey (1998), some, including long line from a boat, diving from shore, diving from charter boat and rod and line from shore were not recorded in the current survey.

Fish Catch

Blue cod is a prized fish species in New Zealand. It was the most targeted species for all fishers in the present study, and the most preferred target species of the South Island (Henderson 2009). Flounder and rock lobster were also highly targeted in the intercept surveys, reflecting their iconic and cultural value. Species targeted by fishers appear to have changed over time - in Bell's survey (1998), red cod was the most targeted species followed by flatfish and blue cod which corresponded closely with the species caught. MPI research suggests that blue cod is the most

frequently landed finfish on the South Island (Beentjes & Carbines 2006), and this was the case in the present study. Flounders formed a major part of the catch of the trip respondents and perch was caught regularly by all fishers. Of the rock lobsters caught, in the current surveys, twice as many males were taken than females. This may reflect the availability of habitat and different behaviour patterns of individuals (Booth & Breen 1994).

Fishing Trends

Bell's recreational fishing survey (1998) in Akaroa Harbour had an impressively large sample size ($n > 1,700$), and comparison with the present study reveals that fishing motivation has changed since then. This includes a decrease in fishing trips targeting red cod and a decline in the red cod catch. Comparisons with Bell's survey (1998) revealed a similar proportion of all fishers selecting to fish in Akaroa (area 8) but reduced proportions of people fishing in the inner harbour from 2007-2009. In the present study, 15% of the trip record participants stated that they fished offshore, showing an increased fishing activity outside the harbour (especially in area 18).

As expected, in the present study, there was a distinct seasonal pattern to fishing activity in Akaroa Harbour. November to February was the most concentrated fishing period with a decline in fishing activity over the winter months (June-October), mainly due to rough seas and bad weather. A peak in fishing activity in March (2008) was likely due to the start of the set-netting season for flatfish. The favoured areas for any fishing activity (apart from set netting) were outside the harbour. The results from the trip record participants showed they tended

to venture further out than the intercept survey respondent to catch blue cod. Most respondents fishing inside the harbour were close to the harbour entrance, mainly due to vessel size, the presence of family on-board, previous fishing success and weather conditions. Thus, since 1997 recreational fishing trips have shifted from the upper harbour (areas 1-10) to the harbour entrance and the immediate areas outside. This may be due to limited fishing success inside the harbour or perhaps due to increased capability of the recreational fishing fleet.

Length of Fish Caught

There were no previous records of the length of fish caught in Akaroa harbour by recreational fishers and it is therefore not possible to evaluate if maximal length has changed over time. The current study found that the largest fish (red and blue cod) were found in the summer in the outer parts of the harbour, rather than the inner harbour. For sea perch however, fish of similar length were captured from a variety of locations, most likely reflecting the wide range of this species, which lives in water depths from a few metres down to 200 m (Hart et al. 2008).

CPUE

For two of the three major species there were differences in the catch per unit effort (CPUE) between catch rates recorded in the intercept and trip records. The four times higher CPUE for rock lobster catch from the intercept surveys compared with the trip records may reflect a combination of contributing factors, including the expertise of the fishers, different fishing locations and better gear. Similarly, the increased CPUE for blue cod of participants from the trip records cannot

be determined without better information about this group. The trip records were local volunteers including charter boat owners, whereas the intercept survey participants were mostly holidaymakers from the Christchurch area. It is well known that fishers possess considerable ecological knowledge (Leite et al. 2013) which could explain differences in the catch rates between the participating groups. In contrast, the CPUE for red cod for both groups was similar, perhaps reflecting a less intensive targeting of this species.

In Bell's 1998 report on recreational fishing in Akaroa Harbour CPUE values were not separated for different survey methods. In addition, some of the areas previously fished are no longer allowed, and in the previous survey, charter boats were not sampled. Nevertheless, it is of interest to compare a few of the major species. For blue cod the catch rate recorded by intercept survey participants in the current survey was similar (close to 1.0) to records from 1997. Similarly, the catch rate recorded here for rock lobsters from trip records (2.4) was similar to the 2.0 reported by Bell (1998). In contrast with these values, the CPUE values for red cod in the present study had dropped considerably (0.2 and 0.4) since 1997, when Bell recorded CPUE values of 1.75. The lower values most likely reflect reduced fish stocks and are consistent with stock evaluations from the Canterbury region where numbers are known to have decreased since 2002/2003 and fluctuated in recent years due to irregular recruitment (Kemp et al. 2013, Ministry for Primary Industries 2013).

Management Implications

The present study provided a framework

for recreational fishing surveys that will reduce set-up time for future surveys and ensure the data collected can be statistically analysed. It is an improvement on interview-based recall surveys such as those used by Bochenek et al. (2012) and Sparrevohn (2013), who investigated recreational harvest based on numbers and weight, a feature used in Europe to assess the recreational harvest of overfished species. That study recommended that numbers and not weight be recorded and we would support this with the additional feature of recording length of targeted fish to follow population trends.

Since this survey, from October 2009, within the Taiāpure there have been reductions in maximum daily bag limits for most species to three for blue cod, blue moki, butterfish, red cod and sea perch, and a combined daily catch of ten overall. Also, in 2013, new fisheries regulations were introduced requiring charter boats carrying recreational fishers to file reports on areas fished, target species, time of fishing and the number of passengers on board. In addition an application for a marine reserve comprising 10% of Akaroa harbour has been approved by the Minister of Conservation. These new initiatives mean that it is important to continue assessing fish and shellfish populations throughout the harbour, record catch rates and regularly review the bag limits. There is also a need for increased public awareness and visibility of the Ministry for Primary Industries on the water and on the slipways to ensure that the regulations are being followed (Fujitani et al. 2012).

The present research has highlighted the usefulness of catch records from intercept and trip reports made by fishers in assessing changes in the fish and shellfish populations in a local reserve. As businesses and tourist boat activities

in the Taiāpure increase, there may be increased pressure on resources. There will, however, be the opportunity for greater involvement in monitoring of fish and shellfish abundances and studies on capture and release of key species. A combination of such approaches will be needed in order to determine the effectiveness of the Taiāpure and marine reserve in protecting fisheries resources in Akaroa Harbour.

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