Who is catching what?

A survey of recreational fishing effort and success on taiāpure and mātaitai management areas

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Abstract

Marine recreational fishing is a highly developed activity and has an increasingly global following. In New Zealand, over 30 % of the population participate in recreational fishing and the annual harvest of some species is larger than the commercial catch. It is therefore vital for resource management to include data on recreational take. Since marine recreational fishing and charter boat fisheries in New Zealand are managed outside the Quota Management System (QMS), Area Management Tools (AMT) such as taiapure (local fishery), mataitai (reserves) rahui (temporary closures) can be used to ensure sustainability of certain coastal areas affected by fishing and other activity. The Akaroa Harbour Taiapure was established in 2006 and is currently the only taiapure in Canterbury. The main objective with this study was to characterise the recreational fishery in the Akaroa Harbour Taiapure in order to provide management solutions for this area. Three surveys were set up whereby two were specifically designed to record the recreational take landed on the four most frequently used slipways in Akaroa Harbour. A third survey was to gauge local resident's perception on recreational fisheries over time. Both qualitative and quantitative methods were used and appropriate statistical analysis applied. Over 451 intercept interviews were conducted on slipways on Banks Peninsula and 138 trip records were returned. Main findings include significant differences in target and landed species, also a shift in areas mostly fished since the previous survey in 1997 by the Ministry of Fisheries. The most frequently landed fish in this study included blue cod, flounder, rock lobster and perch. The perception survey revealed a strong community bond to recreational fishing and a need for increased local input in the management of the Akaroa Harbour Taiapure. The three surveys are recommended to be continued over time in order to create a data base on recreational fishing and also to document local and indigenous knowledge on marine conservation.

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It truly does take a village

This thesis is dedicated to my grandfather Prof. Ivar Källqvist, M.D. and my grandmother Maj Källqvist. Both greatly missed and loved.

Tēnā koe

Ko Kebenekaise te maunga

Ko Holmsjön te awa

No Sverige ahau

Ōtautahi ahau e noho ana

Ko Åke tōku matua

Ko Emma Maj Louise Åkesdotter Källqvist tōku ingoa

Nō reira, tēnā koe

Chapter 1: Introduction

1.1 Background

Marine recreational fishing is a highly developed activity and has a large global following. The main reasons are pleasure, sport and supplement of personal food supply (Cooke & Cowx 2006). Recreational fishing is defined as "fishing of aquatic animals that do not constitute the individual's primary resource to meet nutritional needs and are not generally sold or otherwise traded on export, domestic or black markets" (European Inland Fisheries Advisory Commission 2008). Recreational harvest has been estimated at about 12 % of the global fish harvest (Arlinghaus & Cooke 2008). Most studies concerning fishing impacts deal with commercial fisheries. Marine recreational fishing has turned out to contribute an extensive amount of social and economic benefits to countries local and national economies (Lewin *et al.* 2006). This has led to concerns that only managing the effects of commercial fishing may be insufficient to protect stocks from over-exploitation (McPhee *et al.* 2002).

The management of recreational fishing has received widespread interest from researchers but has not been scientifically discussed to the same extent as commercial fishing. It has been argued that recreational fishing may hinder recovery for certain fish species or even deplete populations (Coleman *et al.* 2004). There is also a growing concern that technological advances in fishing gear, Global Positioning Systems (GPS) and fish sounding equipment may have caused increase activity in the global recreational fishing community (Kearney 1991). Marine recreational fishing and charter boat fisheries in New Zealand are managed outside the Quota Management System (QMS) and do not require licenses or permits (Bess & Rallapudi 2007). However, recreational fishing rules are set by the Ministry of Fisheries and include bag limits, size restrictions, closed off areas to fishing, seasons, fishing methods and gear restrictions (Yandle 2007).

Over 30 % of the New Zealand population take part in some form of marine recreational fishing and harvests can be substantial compared to commercial catch (Sutinen and Johnston 2003, Ministry of Fisheries 2009). For example, recreational blue cod (*Parapercis colias*) harvests in the Marlborough Sounds have been estimated to be more than ten times the reported commercial harvest (Kerr *et al.* 2003).

The South Australian Centre for Economic Studies (1999) looked at the value of recreational fishing in New Zealand and defined the objectives of fisheries management to include the protection of fish stock, utilising resources in the best possible way and incorporating all interest groups. It was also argued that fishery management requires constant monitoring with an analytical framework in order to assess the impact of policy decisions.

1.2 Area Management Tools

Area Management Tools (AMT) such as taiapure (local fishery), mataitai (reserves) rahui (temporary closures) and marine protected areas (MPAs) can be used to ensure sustainability of certain coastal areas affected by fishing and other activity. Taiapure, rahui and matatai are tools to manage traditional customary fishing grounds and holds significance to the Maori community. Marine protected areas (MPAs) are statutory tools that are established under the Marine Reserves Act 1971, for the purpose of "preserving marine life for scientific study" (Ministry of Fisheries 2008). Lubchenco *et al.* (2003) defines MPA as "areas of ocean designated to enhance conservation of marine resources". This type of reserve is found worldwide typically in estuaries, reefs and grass-sea beds (Cooke *et al.* 2006).

In New Zealand, Department of Conservation (DoC) are responsible for managing protected areas and species, under the Marine Reserves Act. Ministry of Fisheries (MFish) are responsible for managing fishing, its effects, and fisheries resources under the Fisheries Act, where jurisdiction extends out to 200 nautical miles (MFish 2008).

The taiapure concept originated as tool to improve necessities for Tangata Whenua (People of the Land) and was created under the Maori Fisheries Act 1989.The primary purpose of a taiapure is to enable local parties to protect and enhance inshore waters and to sustainably mange marine life, habitats and customary fishing. A taiapure proposal from a local community must go through a public consultation process before it is approved (Te Rūnanga o Ngāi Tahu 2007). A committee is nominated by the local Iwi and approved by the Ministry of Fisheries. The main goal of the committee is to advise the Minister of Fisheries on regulations to sustainably manage all types of fishing within the local area (Department of Conservation, 2009). Regulations within a taiapure cannot discriminate against people on the grounds of colour, race, or ethnic or national origins (Ministry of Agriculture and Fisheries, 1993). There are eight established taiapure in New Zealand, ranging from 3km^2 (Palliser Bay in Southern Wairapa) to 137km^2 (Kawhia, Waikato) (Centre for the Study of Agriculture, Food and Environment, CSAFE 2007).

A matatai reserve is an area of importance for customary food-gathering. Bylaws are required and set up by a selected committee and approved by the Ministry of Fisheries. These bylaws apply to all parties and are comparable to taiapure regulations. The overall aim of a Matatai is customary management to ensure the sustainability of the fisheries resources and surrounding environment (Te Rūnanga o Ngāi Tahu 2007). A matatai reserve excludes commercial fishing but recreational fishing and public access is permitted. There is no specific size limit set for mataitai reserves (Bess & Rallapudi 2007). A rahui is a short-term closure and only applies if the Minister of Fisheries considers it likely to assist the restoration of fish stock or recognises a customary practice. An area can be closed off to fishing for a period up to two years (Pirker 2008).

1.3 Study Site

Banks Peninsula is located in the middle of the east coast of the South Island and is a prominent volcanic feature about 80 kilometres from Christchurch (Reynolds-Fleming & Reynolds 2005) (Figure 1.1). Akaroa Harbour is a 17 km tidal inlet from the Pacific ocean and the coastal environment is strongly influenced by dominant southerly winds (Heuff *et al.* 2005).

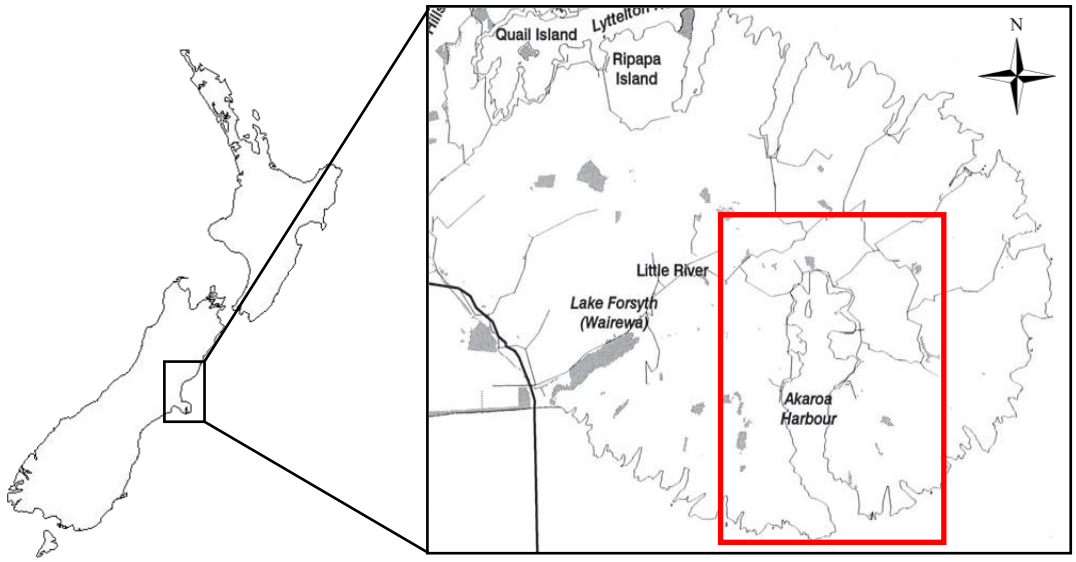


Figure 1.1) New Zealand (left) Banks Peninsula, with Akaroa Harbour highlighted in red (right).

Four main study sites were identified as most frequently used by recreational fishers; the slipway by the recreational ground in Akaroa and Daly's Wharf as well the slipway in Wainui and Duvauchelle (Figure 1.2 a-d). All above areas are used throughout the year by recreational fishers, both local and non-residents, with peak season between December and February. The areas were decided upon with consultation from the Taiapure committee and local residents.

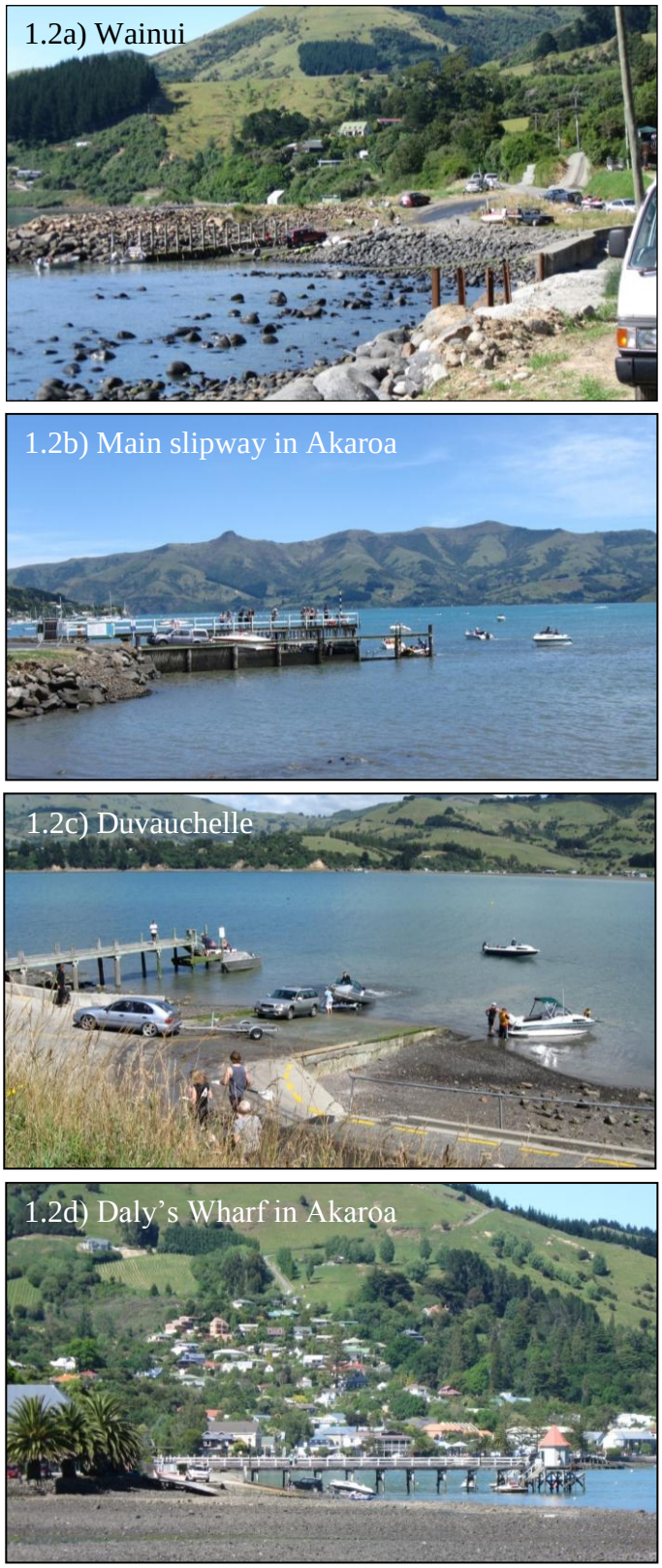


Figure 1.2a) Wainui slipway 1.2b) Main slipway in Akaroa 1.2c) Duvauchelle slipway 12.d) Daly's Wharf in Akaroa.

1.4 Akaroa Harbour Taiapure

The Akaroa Harbour Taipaure was established in early 2006 and is the only taiapure in Canterbury (Figure 1.3). It covers over 90 % of the waters within Akaroa Harbour, Haylocks and Damon's Bay, except the waters in Dan Rogers Reef (found in the eastern harbour entrance and is subject to a marine reserve application) (Pirker 2008). There is one marine reserve on Banks Peninsula (Pohatu Marine Reserve) and holds a "No take" status (DoC 2009). Three smaller areas on the western side of the harbour are excluded from the taiapure since they are marine farms (salmon and paua) already in existence when the taiapure came into affect. The Akaroa Harbour Taiapure committee is represented by several local groups such as recreational and commercial fishers, marine farmers and tourism operators. The committee also has representatives from the Ministry of Fisheries, Department of Conservation and scientific advisors from universities.

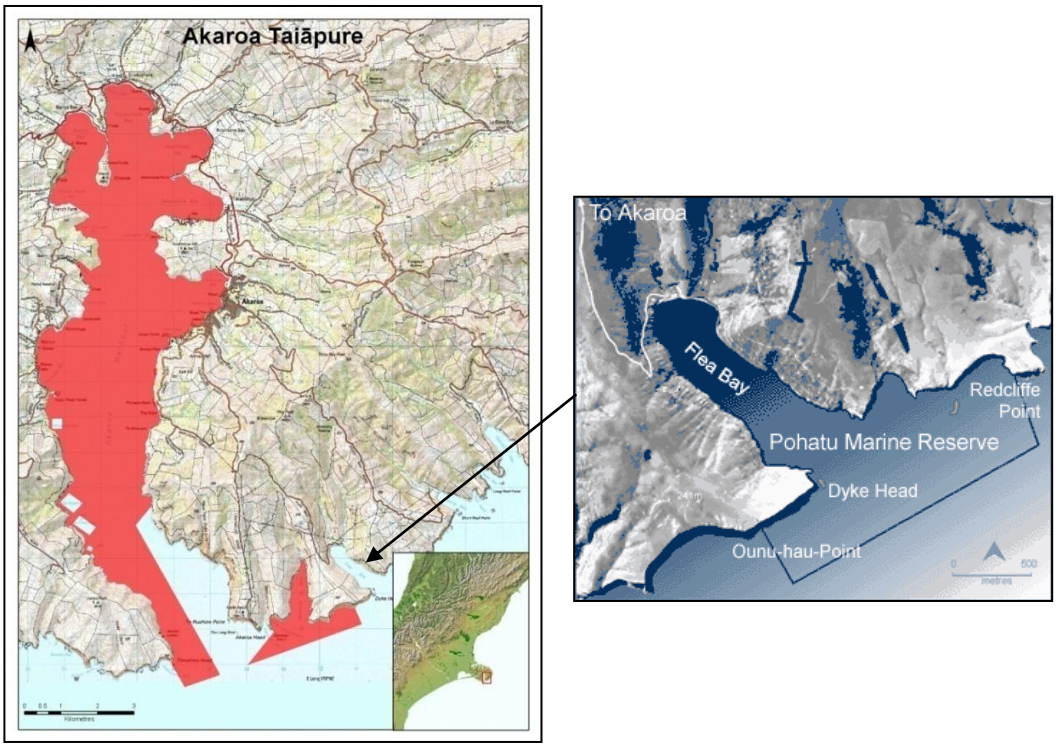


Figure 1.3) (Left) Akaroa Harbour Taiapure; the red area represents the taiapure while the boxed small blue areas within the taiapure are commercial ventures (Source: Nigel Scott) (Right) The location of Pohatu marine reserve (Source: Department of Conservation 2009).

1.5 Objectives of the Akaroa Harbour recreational fishing survey

The main objective with the survey was to characterise the recreational fishery on the Akaroa Harbour Taiapure. Therefore, the following goals were set:

(I) Determine the frequency of the fishing methods used by recreational fishers during trips.

(II) Investigate the size and distribution of fish and shellfish being harvested from different areas of the management area over 12 months.

(III) Establish the number of fish and shellfish being taken from Akaroa Harbour.

(IV) Investigate the number and species of fish being caught and released and their potential survival.

(V) Ascertain the level of compliance with Area Management Tools (AMT) and Fishery bylaws.

(VI) Create a profile of the fishers who utilize the harbour, place of residence, awareness of the AMT management approach.

(VII) Investigate local residents' perceptions of the way fish species and fishing has changed in the Banks Peninsula area in recent decades.

(VIII) Incorporate local and indigenous knowledge in order to improve marine and coastal resource management.

Several of the locals have extensive knowledge of fishing in the harbour. Anecdotal evidence may assist in a better understanding of the fishing history and issues that are associated with harbour activity and recreational fishers. The objectives set for this research concern local involvement and managing fisheries resources correlate with the ones set in the Akaroa Harbour Taiapure proposal in 1997. Akaroa Harbour is popular for recreational fishing but also has commonly occurring activities such as diving, hand gathering of shellfish and set netting for flounder. Recreational fishing is undertaken by numerous locals but the harbour is also frequently used by visitors from Christchurch, Ashburton and wider Canterbury.

The outcome of this recreational fishing survey will provide fishery managers with data on fish take, key target species and "fishing hotspots". The findings from this study may aid in implementing multiple strategies to ensure overall management success for recreational fishing.

1.6 Community based management as a tool for marine conservation

Recently published studies emphasise the importance of community based management, stating it is gaining momentum as a management tool in marine and coastal conservation (Boyd & Charles 2006, Arlinghaus 2008, Thomson & Gray 2009, Wiber *et al.* 2009, Nursey-Bray & Rist 2009).

Many marine researchers do not consider the local community as a source of information that can be coupled with scientific data (Poizat & Baran 1997). Recreational fishers represent a group that has potential to become involved in conservation issues and increase management success (Granek *et al.* 2008). Community based management allows residents in a coastal area to take a responsible and active role in the decision process on the resources they depend on (Rodriguez-Martinez 2007). The debate then becomes what is the best way to involve the community and other stakeholders in local fisheries management? It has been documented that residents in small communities do not necessarily share attitudes and concerns about marine conservation in the area they live in (Matzke 1997, Suckall *et al*. 2009). Also, research has shown that public participation in an open forum is not sufficient enough for long-term decisions and changes. Instead, organized groups consisting of stakeholders with interest in a specific area can work with governmental agencies in order to decide on sustainable management of marine resources (Larson & Lach 2008). Community based management has re-emerged and seems to now exist in the form of co-management whereby decision making is shared between local authorities and community groups (Pomeroy 1995). Focus needs to be on collaborative work with attention to networks and in order to understand community based management there needs to be an on-going dialog within the community and the stakeholders (Wiber *et al*. 2009).

An example of recreational fishers partaking in the management process is found in a paper by Granek *et al.* (2008). Due to an apparent decline in rockfish (*Sebastes spp*) from commercial lingcod (*Ophiodon elongatus*) fishing, recreational fishers organised practical ways of following the Canadian Department of Fisheries set goals for inshore fisheries management. Part of the goals set by the government required direct input from recreational fishers concerning, fish harvest, new bag limits and the establishment of a stock assessment framework. Once the ling cod closure re-opened, further recommendations where made to extend the closure for the following year. By continuous monitoring of the rockfish, stock was after a few years within the desired limit. The ownership given to the recreational fishers gave them the incentive to protect the same species they target.

Community based work is a tool not only suitable for managing recreational fishing. It can also be implemented for the growing commercial demand on smaller countries and its marine resources. There is an increasing awareness by governments in Southeast Asia that a possible solution to increasing global demand of marine resources is to improve locally managed fisheries and include resource users in the decisions and implementation process. Local participation in fisheries management has been part of the development process for the past four decades. The success of community based management in Southeast Asia depends on functional legal and governmental framework that considers social and economic issues of a specific area thus incorporating the fisher in their own livelihood (Pomeroy 1995).

Local participation coupled with additional input from scientist in fisheries management is found in an example from Bangweulu swamps in Zambia. Due to the inconsistence in governmental funding for research on local fisheries, a group of professional fishers carried out a year long sampling of fish. Scientific input was incorporated on a regular basis but the main part of the survey was done by locals. The fishers kept their own catch to a minimum and were required to record all sampled and landed fish. Based on the work done by the local fishermen, scientists received substantial baseline data on fish take whereby management strategies were implemented in order to sustain the fishery (Danielsen 2008).

Nursey-Bray and Rist (2009) describe effective indigenous community based management at the Great Barrier Reef World Heritage Park in Australia. The aim was to implement a process that is continues, whereby goals are set along the way. In the process of establishing frameworks clashes between culture and government was evident. However, through communication, problems were overcome and parties discovered shared views on marine protection. Giving resource users and interest parties the power to engage in the decision–making process is paramount for the success of co-management. One of the contributing factors of the co-management success of the area was the opportunity for indigenous community to participate in policy making. However, in order to establish a successful community based management strategy local governments and the residents of an area need to have financial and political means. The lack of support from the local community in countries such as Kenya and Uganda stems from poverty and political instability. Mistrust of the government, few funds or practical means equals a difficult work arena when trying to establish sustainable small scale fisheries (Cowx *et al.* 2003).

1.6.1 Integrating social science into marine recreational fishing research

Turner (2000) emphasises the importance of "modelling key environmental and socio-economic processes" in order to properly manage coastal areas. The best design of this type of research is by collaboration with local resource managers and recreational and commercial fishers with scientific input and research. Margerum (2007) defines collaboration as "an approach to addressing natural resources and public policy problems in which stakeholders build consensus and work jointly on solving complex problems". Combining social and biological sciences in local marine and coastal management is necessary for defining small scale fisheries such as recreational fishing (Lackey 1998). Marine and coastal resource management is influenced by the recreational fishers and the ownership should be placed on those who actively use the area thus giving them the incentive to create practical frameworks to ensure sustainable fisheries (Salomon *et al*. 2001, Klein *et al*. 2008).

Characteristics to be mindful of when integrating social science include cultural and community values but also peoples perceptions of their surroundings. These variables play a role in understanding the recreational fisher and the impact they may have (Tzanatos *et al.* 2006).

To avoid adverse affects on the marine environment, the local community can follow a sustainable management model, thus allowing opportunity for local communities to work both with ecological issues as well as social. For example, in Australia, state and local governments are benefiting from research on the demographic profile of fishers, motivations for fishing, perceptions on government initiatives and the economic impact of recreational fishing (Smith *et al.* 2008). This type of information is now commonly gathered as part of management programs and has enhanced regional planning, recreational fishing opportunities and tourism development. By including an indigenous survey the local knowledge was recorded thus providing an understanding of traditional methods for sustainable recreational fisheries (Henry & Lyle 2003). Furthermore, to understand the motivational and practical factors between different types of recreational fishing groups enables decision makers to predict fishing behaviour (Ormsby 2004).

1.6.2 Perceptions of resource users

Research shows interviewing local resource users regarding issues concerning them will provide a useful tool in marine resource management (Wolfenden *et al.* 1994, Scholz *et al.* 2004, Lepesteur *et al.* 2007, Silvano & Valbo-Jorgensen 2008, Begossi 2008). Understanding the perceptions of resource users can facilitate in recreation management solutions and tools such as personal interviews can reveal important information on fishing trends (Priskin 2003). In a study by Nies *et al.* (1999), local fishermen in Canada were interviewed after an announcement of a moratorium on Atlantic cod (*Gadus morhua*). Finding ways to compare fishermen's observations and data drawn from science can significantly improve the comprehension of recreational fisheries management.

Perez-Sanchez and Muir (2003) interviewed fishermen in the Mecoacan Estuary (Mexico) as an approach for community involvement and co-operation. Fishermen were positive towards the opportunity to be involved in the decision-making process and also improved co-operation between relevant parties and reorganisation of institutions in order to create sustainable solutions for the area. Holding open meetings is one approach to gauge the local communities' perceptions of fishing issues. However, incorporating local input through surveys and interviews has proved to be far more effective in the management decision process. This was mainly due to better representation from the local community and an opportunity to elaborate on comments and perceptions (Larson & Lach 2008). By ensuring representation from the local community, decision makers will get an opportunity to incorporate the full scope of perceptions and information when deciding on management strategies (McComass 2001).

1.7 Recreational fishing surveys in New Zealand and Australia

It has been recognized by the Ministry of Fisheries since the early 1990's that surveying recreational fishing is an important part of inshore fisheries management (Teirney & Kilner 2002). The lack of quantitative information of marine recreational fishing has gradually become more of an issue in marine and coastal management. In order to improve fisheries management several recreational surveys on both national and regional levels, have been conducted since the early 1990's in New Zealand by The Ministry of Fisheries and the National institute of Water & Atmospheric Research (NIWA).

1.7.1 New Zealand recreational fishing surveys

Marine recreational fishing surveys have been conducted by Ministry of Fisheries since the beginning of 1990's (Tierny & Keller 2002, Bradford 1996a 1996b, 1997, 1999, 1998a 1998b, Bell 1997). The early surveys relied solely on a fishing diary recorded by recreational fishers. The purpose of these surveys was to collect quantitative data on distribution of effort, methods, species caught and total harvest. Bradford (1998b) added the component of recruiting survey participants using the telephone directory.

The first large-scale national survey of marine recreational fishing was carried out in 1995/96. A second national survey was carried out in 1999/2000 by Boyd & O'Reilly, and used revised and improved survey methods which meant that the harvest estimates were considered more accurate than previous survey results (those undertaken by the Ministry of Fisheries). Key improvements included improved methods for weighing up diarists harvests using extensive demographic data and a more appropriate method for estimating coefficients of variation.

Numerous regional recreational surveys have been conducted (Bell *et al.* 1998, Carbines 2000, Bell 2000a 2000b, Bradford 2001, Hart & Walker 2008) but with different objectives and methods. Bradford *et al.* (2001) surveyed the recreational fishing activity at the Maketu Taiapure (established in 1996 in the Bay of Plenty), covering a full year, but formed a two-year study to establish methods for local volunteers to use in determining annual recreational harvest in the taiapure. The two objectives for the survey were to "establish the methods for estimating the recreational harvest of paua (*Haloitis iris*), rock lobster (*Jasus edwardsii*) and other species in the Maketu Taiapure on an on-going basis" and "to train local volunteers in a survey data collection and analysis to maintain on-going monitoring of the recreational harvest in the Maketu Taiapure". In order to obtain information on fishing effort, the day-to-day boat ramp interviews and roving interviews were conducted by local volunteers. Bradford *et al.* (2001) recognises the fact that the methods used for this survey were very labour intensive and requires "an understanding of the importance of random observations for achieving unbiased estimates of harvest". It is also noted that the local participation is crucial in the success of monitoring of harvest rates.

1.7.2 Australian recreational fishing surveys

Australia has extensive research on its marine recreational fishing (Lyle & Smith, 1998, Sumner 1999, Sumner & Williamson 1999, Malseed & Sumner 2001, Malseed *et al.* 2000, Williamson *et al.* 2006,). Results from a year long recreational fishing survey done in the Gascoyne bioregion (Western Australia) showed that in order to improve stock assessments a time series of recreational catch was needed. Due to the high costs involved it proved unpractical to survey all regions on an annual basis. The recommendations were to implement comprehensive surveys once every five to six years. Recreational fisher log books and surveys carried out by trained interviewer added information on catch rates in different regions. The survey also produced findings on angler awareness and knowledge of species identification (Sumner *et al.* 2002).

1.7.3 Main species investigated in this research

The current study focused on red cod, rock lobster and blue cod which had been brought up as species of concern by the Akaroa Harbour Taipaure Committee. During the research it became evident that perch was caught in large numbers and it was also included in the main analysis.

The blue cod (*Parapercis colias*) is endemic to New Zealand and found throughout the shallow coastal waters and over the inner continental shelf (Doak 2003). Blue cod is the most important recreational fish in the South region and is usually caught with rod and line (MFish 2002, Carbines 2004). The length varies between 30 and 40 cm but can reach a length of 60 cm and weigh up to three kg (Hirt-Chabbert 2006) (Figure 1.4a). Red cod (*Pseudophycis bachus*) is found on the continental shelf and upper slope around New Zealand and is highly targeted in the South region (MFish 2002). In 2002, over 50 % of all catch in the South region targeting red cod was on Banks Peninsula (MFish 2002) The length may vary 40-60 cm but can reach 80 cm and weight up to 2 kg (Hirt-Chabbart 2006) (Figure 1.4b). Sea Perch (*Helicolenus percoides*) is found throughout New Zealand waters to depths of 100 m. The average length is 25-35 cm (Paul & Moreland 1993).

The sea perches are a very large and diverse group with over 300 species throughout the world (Figure 1.4c) (Paul 2000, Paulin *et al.* 1989). Even though it has been found that perch is not necessarily targeted is if often one of the more common landed fish in New Zealand. Red rock lobster (*Jasus edwardsii*) is one out of three species of lobster found in New Zealand (Figure 1.4d) (Paul 2000). According to the Ministry of Fisheries recreational surveys, it has been found that rock lobster in highly targeted throughout the country and also commonly harvested. The ownership is placed on those who actively use the area thus giving them the incentive to create practical frameworks to ensure sustainable fisheries.

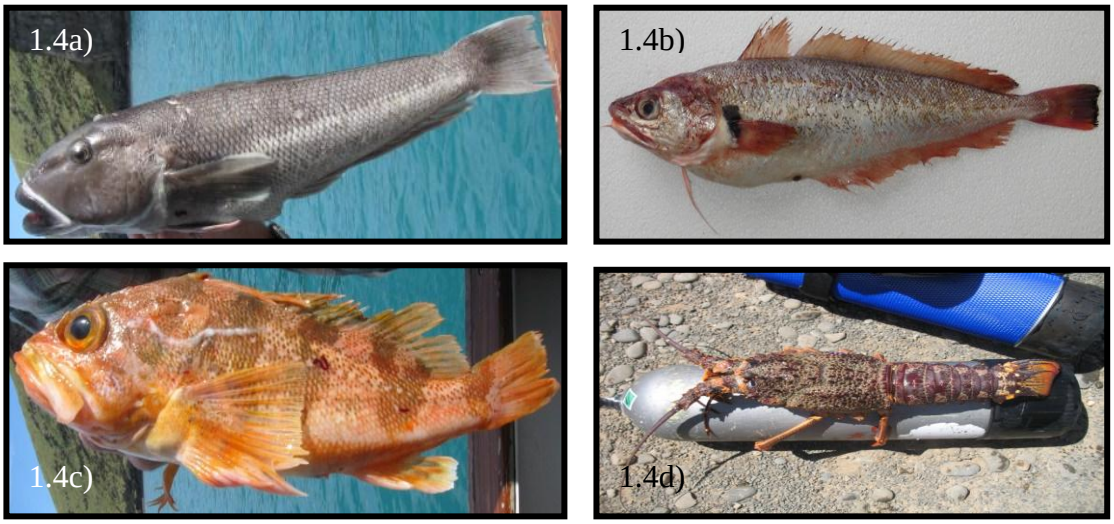


Figure 1.4a) Blue cod (*Parapercis colias*) 1.4b) Red cod (*Pseudophycis bachus*) 1.4c) Sea perch (*Helicolenus percoides)* 1.4d) Red rock lobster (*Jasus edwardsii*).

1.8 Catch and release

Catch-and-release is a handling technique that can either reduce or increase post-release mortality in fish. The condition of the fish, maturity, size and the environment are variables that limit the recreational fisher's control over the catch and the handling process. However, the fisher does have control over some aspects such as the removal of the hook, handling of the fish, exposure to air, also the type and size of hook used (Cooke *et al.* 2006, Cooke & Sneddon 2007). Hooks that have pierced vulnerable areas such stomach and the gills will most certainly lead to death while hooks found in less sensitive areas are more likely to improve the survival rate (Alós *et al.* 2008).

1.9 Structure of Thesis

The outline of the thesis is as follows: Chapter one includes the introduction, the taiapure concept, importance of community-based management, research objectives, the study site and a literature review of recreational fishing surveys. Chapter two describes the survey design, field work, data management and statistical analyses. The results of the intercept interviews and the trip records are found in chapter three, while the results of the perception survey is described in chapter four. Discussions on survey results, overall research and recommendations are covered in chapter five.

Chapter 2: Methods

2.1 Introduction

A literature review of all similar surveys was undertaken in the initial stages of the research and templates of survey designs already available (Ministry of Fisheries and The National Institute of Atmosphere and Water (NIWA) were assessed. Several meetings with local members of the Akaroa fishing community were conducted in order to identify key locations, such as slipways frequently used. There was an on-going dialog with the local community throughout the research in order to ensure successful collaboration. In order to provide additional information to the fishers (and other interested parties), a pamphlet was designed using the Rakiura Fishing Survey (Stewart Island) as a template (Appendix I). In addition to recording fish take, the weather was recorded daily including sea-temperature, air-temperature, wind-speed, wind-direction and cloud cover. The weather data were based on the Marine Beaufort Wind Scale (Appendix II).

Both qualitative and quantitative methods were used in this study. The qualitative method was used for the perception survey (Appendix III) whereby Likert-scale questions and open-ended questions concerning rules, regulations and changes through time could be summarized. The snowball sampling technique is commonly used to locate hidden populations and was used to identify both trip record and perception survey participants (Frank & Snijders 1994). This technique involved asking the participants for any other suitable people to take part in the survey. The development of methods for measurement of variables, modeling and analysis of data included the intercept survey, trip records, trailer count data and slipway data and Mount Bossu observations (Appendix IV). Name tags were worn by all field workers (Appendix V). All survey designs and questionnaires were approved by the Akaroa Taiapure Committee. The information collected from intercept interviews, perception survey and trip records were confidential. The sampling methods, survey design, statistical analyses and data management were specifically tailored for this research.

2.2 Safety procedures for field work

Before any of the surveys were taken to the public, several safety measurements were negotiated with the supervisors. Daily contact with one supervisor was implemented to ensure safety of the field workers when operating on slipways. It was advised to stay clear of abusive members of the public when encountered. The local police and the Harbour Master in Akaroa were informed of the research and interviewers presence on slipways. Under no circumstances were the interviewer allowed to accept offers of boat trips. All slipways were very hectic, especially during Christmas and Easter. It was therefore paramount to keep out of the way of moving cars with trailers to ensure no interviewer got injured. Since all surveys undertaken were confidential, none of the survey data or early results was revealed to members of the public, recreational clubs or organisations.

2.3 Survey design and development

According to Gartside *et al.* (1999), recreational catch has not been recorded in the same way as commercial, thus observing historical trends are often not possible. The most common approach to obtain information on recreational fishing is to conduct surveys generally over a short period of time. The results are limited as they only give a snapshot of the recreational fisheries. However, if continued over several years a more comprehensive database is established and trends can be detected.

Different types of surveys include mail, telephone, diary, logbook and intercept. Recreational fishing surveys often aim to obtain information on the fish catch, fishing effort, catch rate, species diversity and size of fish (Pollock *et al.* 1994). To successfully set up the Akaroa Harbour recreational fishing surveys, the following steps are outlined in the flowchart below were carried out (Figure 2.1).

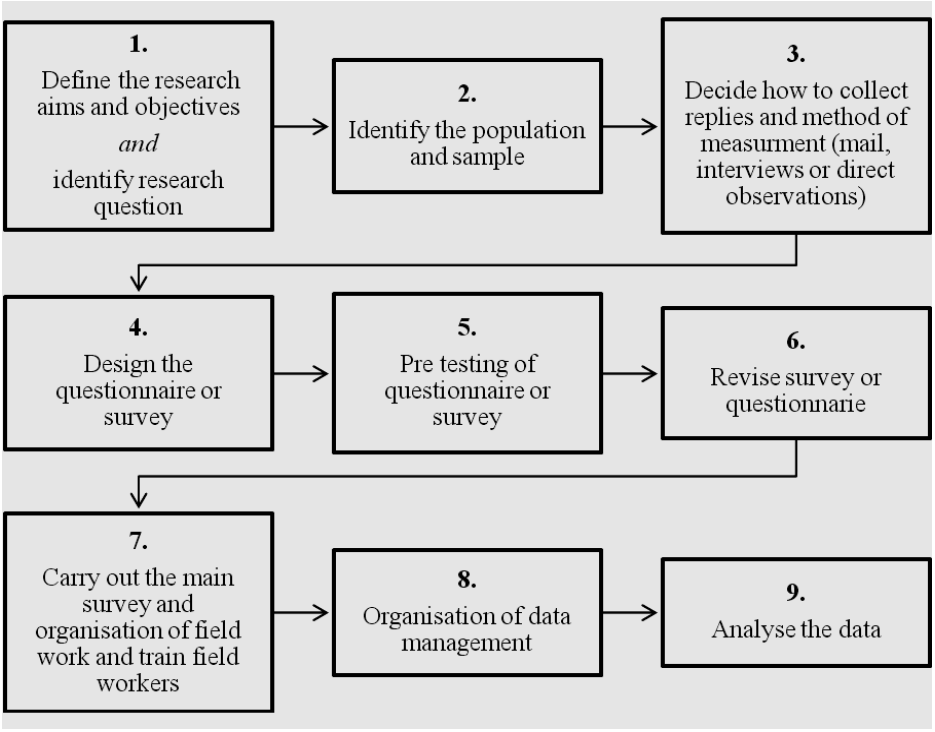


Figure 2.1) Flowchart of survey design and implementation. Modified from Burgess (2001) and Scheaffer *et al.* (2006)

2.3.1 Description of flowchart steps

Decisions regarding research topic outline were equally made by members from University of Canterbury, University of Otago, the Akaroa Harbour Taiapure committee and Ngai Tahu.

1. The research question needs to be established and objectives of the research must be decided upon (Saris & Gallhofer, 2007). The research plan should include a definition of the target population, the sample size, the research overall aims, time frames and adequate literature on previous surveys (Dorofeev & Grant (2007).

2. Identify the population, the sample size that will be used and what group will provide the most accurate information (Czaja & Blair, 2005). For this survey, the sample population chosen included all recreational fishers, divers and shellfish collectors actively harvesting seafood in the Akaroa Harbour Taiapure and nearby coastal areas area during a specific time. The representativeness of both the intercept survey and the trip record participants was not random since the target was active fishers in the Akaroa Harbour area.

3. Choosing an appropriate method of data collection and measurement which is most efficient in order to collect reliable data is paramount. Based on previous surveys done by Ministry of Fisheries and NIWA, it was decided to use an intercept questionnaire, dairies (to minimize the risk of missing people on the slipways) and a survey that would gauge people perceptions on recreational fishing over time.

4. Design the questionnaire in a way where best response will be obtained (i.e. fish take and locations). It was important to keep all questionnaires short and concise, especially for recording fish take. The diaries (trip records) had to be clear and precise since they were self-administered. The perception survey was a face-to-face interview, administered by the same person.

5. Pre-testing of the questionnaire and pilot survey is of great importance in order to establish if the questions are easy to understand and are time efficient. This applies especially to the type of questionnaire used in this research whereby the survey had to be completed in two minutes. Pre-testing the questionnaire also gives the opportunity to 'clean' the questions by removing the ones that do not work and do not add anything of significance to the research. Pre-testing was conducted on the main slipways in Akaroa and Duvauchelle.

6. Revise survey or questionnaire and remove questions that do not give reliable or useful data. All three of the surveys were revised and altered in order to obtain the necessary information.

7. Carry out the main survey and organisation of field work and train field workers. There is great importance in trained staff in order to minimize the risk of missing data. Initially, the surveys were carried out by one person. For the second season of data collection, two assistants were trained to carry out the intercept survey.

8. Data management included editing, coding and data entry. *Microsoft Excel* was used for creating the data bases and a code book was created in order to manage conversion from the raw data.

9. Statistical analyses were performed once the cleaning and the coding of the data were completed. For this study, SPSS and STATISTICA were used for the statistical analysis and the graphs were created in *Microsoft Excel*.

2.4 Survey areas

Bell (1997) divided the harbour into a number of areas (1-18) both inside and the immediate outside. Area 19 was Flea Bay (Pohatu marine reserve) and was not part of the areas surveyed. The same map is used in this survey in order to be able to compare the results from 1997 (Figure 2.2). The four slipways chosen for this research allowed the interviewer to visit all the boat ramps 2-3 times a day. When it was not possible for recreational boats to go fishing due weather conditions, the survey was not conducted and it was assumed that there was no landed catch and zero fishing effort for that day. The survey interviewer made this decision on the day after assessing the weather conditions. The slipways monitored are found in areas 8 (Akaroa), 1 (Duvauchelle) and 9 (Wainui).

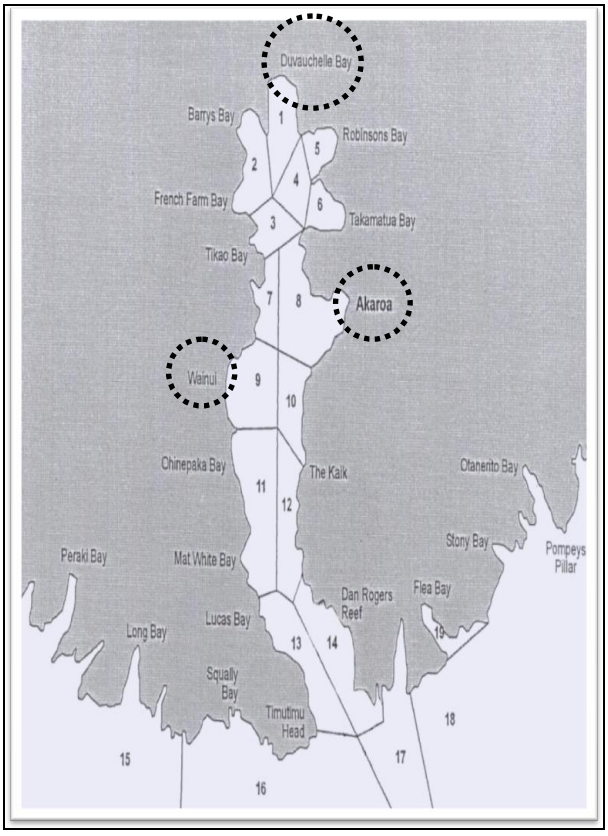


Figure 2.2) Bell's (1997) map for his survey on the Akaroa harbour. The same map was used in this thesis in order to make comparisons with the results from the 1997 survey.

2.5 Akaroa Harbour recreational fishing survey

The Akaroa Harbour recreational fishing survey was gradually developed through a two-phase process between November 2007 and June 2009. The initial work done on the intercept and perception survey was undertaken for the Stewart Island recreational fishing survey in 2007 and included collaboration with Otago University. At this early stage, the intercept and the perception survey were combined. When implemented on Stewart Island, the actual interview time proved to be too long. For the survey implementation phase in Akaroa Harbour (and second phase), the intercept interview was separated from the perception survey. This allowed for more efficient interviews on the slipways. It also meant more time for the perception survey which was needed, considering the final version of the interview took one hour to conduct. The basic structure of the trip record (Diaries) was based on previous the Ministry of Fisheries recreational fishing surveys. Three different types of surveys had been implemented by the end of the development stage.

2.5.1 Akaroa Harbour Taiapure Surveys

The data collection phase in Akaroa harbour was conducted from December 2007 through to February 2009, and encompassed four primary techniques:

1. Intercept interviews to sample fishers who return from fishing trips on four slipways (Akaroa main slipway and Daly's Wharf, Wainui and Duvauchelle)

2. Trip Records kept by charter boat operators and private fishers who fish on a regular basis, all year round.

3. Perception survey to gauge long term changes in Akaroa Harbour as perceived by people fishing in the area for more than five years. Participants of this survey include individuals from local iwi, recreational fishing/diving community and commercial ventures (active and retired).

4. Observations from Mount Bossu in order to gauge out-going and in-coming boats and direction they are heading in order to determine the distribution and number of boats, and methods used by boat fishing parties around the harbour and outside the

entrance. This information was then correlated with slipway interviews. Observation days included both weekdays and weekends.

2.5.2 Intercept Interviews

Intercept surveys are often used to collect data on recreational fishing. By using this type of survey a trained interviewer records the catch, rather than the recreational fisher, thus increasing accuracy of species identification and measurements (Reid & Montgomery 2005). Between December 2007 and February 2009, 451 intercept interviews were conducted on four slipways. The intercept interview was divided into two sections. The first section covered demographics, time spent fishing, targeted species, type of boat, method and total number of people on trip. The second section covered measurements of fish/shellfish, identification of species, location where actively fishing or diving (map taken from the 1997 Akaroa survey by Bell), and finally the number of species caught and released. According to MFish (2009) the tail width of the rock lobster is measured between the tips of the two primary spines on the segment of the tail. Finfish length is measured from the tip of the nose to the rear end of the middle ray of the tail fin. All incoming boats were approached, however only the ones that had been actively fishing or diving or attempted fishing or diving partook in the survey. Only one person per boat was interviewed and was over the age of 15. All approached people that had been partaking in any fishing activity were then asked to participate in a 2 minute prepared. On completion of the questionnaire, the catch was the identified and measured (Figure 2.3a-b).

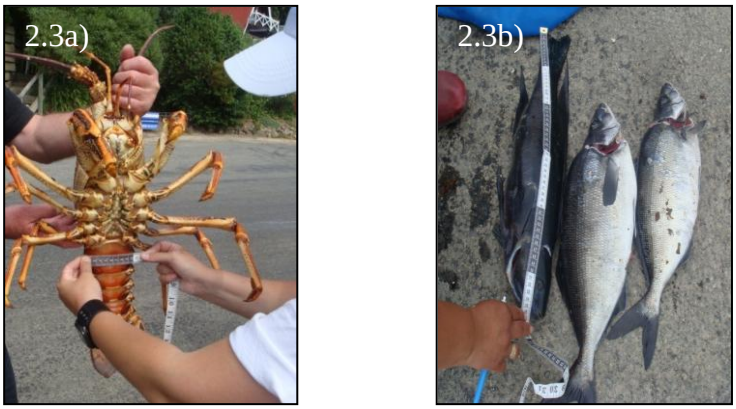


Figure 2.3a) Rock lobster (*Jasus edwardsii*) being measured on Duvauchelle slipway 2.3b) moki (*Latridopsis ciliaris*) and butterfish (*Odax pullus*) measured on the main slipway in Akaroa.

When numerous boats returned to the ramp at the same time it was not always possible to measure all the catch. When this happened, a random sample of the landed catch was measured. The same method also applied when fishers were in a rush to leave the slipway. All interviews were conducted during the day, normally between 9am and 5pm, weather permitting. Boat trailers on the slipways were counted at 9am, noon and 3pm (Figure 2.4). Other data collected included the number of people talked to and how many of them had been fishing. Between December 2008 and February 2008 data were also collected on total number of people that declined an interview, how many jet skis and sailing boats were out on the water, how many of the approached fishers were partaking in the trip record diaries and finally how many boats were missed.

Figure 2.4) Trailer counts on the main slipway in Akaroa

The region is a popular tourist destination between December and March and local residents participate in recreational fishing throughout the year. Due to logistical and safety issues, surveying did not occur at night time. Most recreational fishing boats had returned by 6pm, even during peak season. Late arriving boats were assumed to have gone off-shore or far up the coast well outside the research area.

The survey was undertaken seven days a week (weather permitting) during peak season (December-February). During off-season (March-November) the intercept survey was concentrated on weekends and public holidays**.** For the main part of the field work, one person carried out the intercept survey. In order to obtain a greater number of interviews and cover all study sites at the same time, two assistants joined the research in November 2009. The interviewers were identified by white t-shirts with the University of Canterbury logo. Name badges were also used and displayed the University of Canterbury logo and the interviewer's name. A folder was provided for the assistants containing the Ministry of Fisheries rules and regulations on recreational fishing, intercept surveys sheets, pens, measuring tape x2, trailer count data sheet, slipway data sheet and a fish chart for quick species identification. The assistants also received a four page summary covering the background of the research, possible issues in the field and safety regulations and they were specifically trained for collection of data in the field.

2.5.3 Trip Records

Recreational fishers and commercial recreational fishers (charter boat operators) were asked to keep a diary of their Akaroa Harbour fishing activities. They were approached individually on separate occasions mainly on the slipways but also from prior knowledge of their fishing activity. Trip records were evaluated in late December 2007 in order to determine the quality and usefulness of the survey and several changes were initially made to ensure relevant information was obtained.

The information given on the trip records disclosed the areas fished, species caught, fishing method, number of people on board (male and female), caught and released fish and the number of caught and killed fish. For the purpose of this study, customers on fishing charters boats were included as recreational fishers. Several fishing charter companies in Akaroa provide this service to people who are either novices to fishing or do not have access to a boat. With customer numbers reaching over ten people on regular basis, the recreational fishing pressure from these activities are important to monitor.

The inclusion of charter boats in the Akaroa Recreational Fishing Survey 2007/09 was justified by NIWA's acknowledgment of how increasingly important this type of activity is becoming, noting that little is known of the fleet and even less of the catch (James *et al.* 1997).

Participants were given three to five trip records (diaries) initially. As time went on, the trip records were picked up and replaced with new ones. This method was an attempt of minimizing the risk of people losing the trip records. The participants were also given a measuring tape, pencils and an instruction sheet to the trip records. In the attempt of getting a 100 percent return on the trip records regular contact was kept with the fishers. When a trip record had been filled out the participant either phoned or emailed whereby the diary was picked up. By picking up the diaries, instead of having them sent by email or post, additional feed back was collected. 200 trip records were handed out to 35 participants whereby 138 were returned. The returned trip records were all filled out properly with no missing data. The trip record participants were encouraged to measure their catch on the boat instead of waiting until arriving back to the slipway (Figure 2.5a-b).

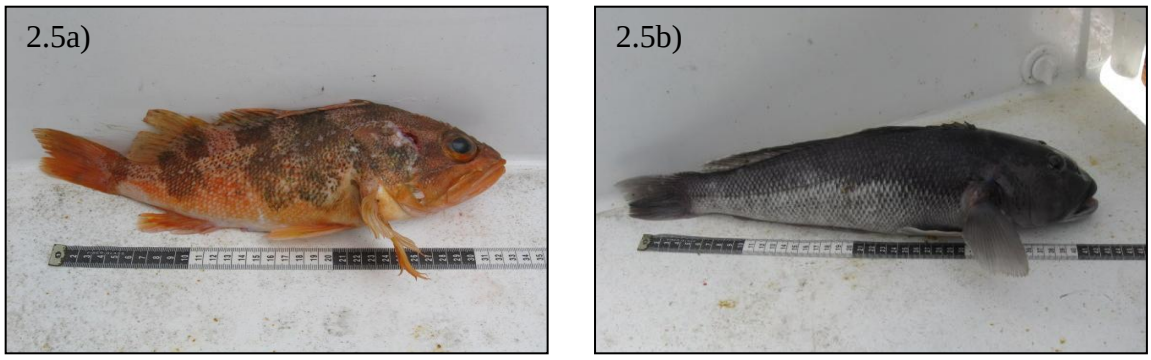


Figure 2.5a) Perch (*Helicolenus percoides)* measured for Trip records 2.5b) Blue cod (*Parapercis colias*) measured for trip records.

By immediately measuring the fish after it was caught, the risk or forgetting to fill out the trip record or filleting the fish (without measure) was minimised. A drop-box was placed on the slipway in Wainui in early 2008 for participants to hand in their trip records. The initial concept was to hand out trip records to fishers in the morning and then to ask them to put it in the drop box when returning from the trip. Ten trip records were handed out to fishers during several weekdays and weekend mornings. Only one trip record was found in the drop box during the entire phase of data collecting.

2.5.4 Perception Survey - A pilot study

The aim of the perception survey was to interview a minimum of 20 people with extensive knowledge of the fishing activity in Akaroa Harbour and on Banks Peninsula. Twenty two people were interviewed between September 2008 and January 2009. The desired population were fishers that had been fishing in Akaroa Harbour area for more than five years. The target population was chosen based on the assumption that a fisher with less than five years experience would not be able to detect significant changes over time. Snowball sampling technique was used to identify most of the participants. To understand the different facets of the fishing community, I sought to interview local iwi, recreational fishers/divers, and individuals from commercial ventures (both active and retired). A range of questions were designed to assess awareness and opinions about fishing regulations, management issues, research, rules and regulations and their motivation for recreational fishing. The survey contained both Likert-scale and open-ended questions and the interviews ranged from 45 minutes to 90 minutes. The variation in time was due to some respondents adding comments to their answers and giving long answers to some of the questions. To make the interview process efficient, flash-cards were created in order to aid the interviewee in answering. The survey was divided into four sections whereby the first sections look at compliance and knowledge of harbour rules and regulations. This section also covered species abundance over time. The last section covered more extensive questions on paua and mussels.

The majority of interviews were conducted in the respondent home, with the exception of a few that were conducted in public places. The identities of the participants were kept confidential.

2.5.5 Mount Bossu boat observation

The Ministry of Fisheries have used aerial over flights to estimate recreational harvest (Davey *et al.* 2006). The observations made from the air can then be correlated with slipway data. For this research, the observation point was Mount Bossu.

By observing boats on an elevated area such the road to Mount Bossu, it was possible to visually follow boats as they leave the slipway and proceed throughout the harbour. However, it was found that when many boats are on the area it became increasingly difficult to establish what boats came from where and their fishing destination. By using binoculars, it was possible to identify larger Stabi-crafts from smaller speed boats. The method decided upon in order to as accurately as possible identify fishing boats, was to follow observe incoming boats from the harbour entrance and observe that particular boat back to the slipway. When there was low boat activity, it was possible to follow vessels from slipway to entrance and back. The time was recorded for each boat as it approached the harbour entrance. The direction (north, south, west or east) was also recorded.

2.6 Changes to survey procedures

After the first season of surveying (December 2007-February 2008), it became evident that several changes needed to be made to procedures and components to the survey were added to ensure sufficient data collection. The main issue at hand was logistics, whereby it was obvious that assistants were needed for the 2008/09 season. The main reason for this was the considerable number of recreational fishers that were assumed missed due to having only one interviewer. During the winter months (April–October), the monitoring and surveying of the slipways was without difficulty done by one person. It also became obvious there was a need for a surveying schedule (even for one person). Initially, the coverage of all slipways only ended as the last boat came in regardless of what time. This quickly became labour intensive and time consuming.

For the 2008/09 season, a time plan was worked out. The main surveying took place between 9am and 5pm during weekends and weekdays (weather permitting). The surveying time was extended in cases when there were more than ten trailers still on a slipway. At no point was there surveying after dark. The added components for 2008/09 also included structured trailer counts, slipway data sheets (to record number of people talked to, people fishing and not fishing, missed boats, encountered trip record participants, declined interviews and the number of water-skiers/sailing boats visible) and Mount Bossu observations.

2.7 Data management and Statistical Analysis

2.7.1 Intercept interviews and Trip records

All data were coded and cleaned by visual and systematically computerized checks. The fish-take and demographic data were analysed with SPSS and STATSTICA. The intercept survey and the trip records were analysed separately apart from fishing methods, catch and release and mean lengths of main species. ANOVA was used to analyse mean lengths compared to season and location. Regression analysis was used for both surveys to determine relationships between fishing time and number of catch. The total number of each main species caught (as recorded by the current surveys) was scaled up using the adjustment factor of 2.9 and analysed by chi square goodness of fit and test of independence. The adjustment factor was calculated by the differences between the total number of trips of the Bell study (1997) and the current surveys and then multiplied with the number of each species total catch. The calculation of the adjustment factor (2.9) was specific to this study and it is acknowledged that additional work is needed in order to obtain more accurate results.

No fish weights were recorded in this study due to time constraints. To estimate biomass of the main species landed, the catch in numbers were converted to mean weight using calculations already established in previous work done by Dr. Glen Carbines (pers. comms. 2009). By using these calculations it was then possible to determine the biomass for blue cod, red cod, perch, paua and flatfish. Each species biomass were then scaled up using an overall adjustment factor of 68.8 The adjustment factor was based on work done by Teirney and Kilner (2002) in the Marine Recreational Fishing Survey in the Ministry of Fisheries South Region, 1991-

92. Their calculations were based on reported catch in numbers for all fishers in the South region. The adjustment factor of 68.8 was based on a telephone survey that established the average number of fishers in the households. This was then calculated taking into account the total households in the South region and supported estimating the factor used to scale the diary harvest to the total harvest. It is acknowledged that the adjustment factor of 68.8 may need to be re-evaluated in order to better suit the Akaroa Harbour recreational fishing results.

2.7.2 Perception survey

Because of the small sample size of the perception survey (n= 22), the answers to the open-ended questions were easily transcribed onto a *Microsoft Word* sheet whereby key comments were analysed and principal issues were identified. SPSS was used to generate frequency tables the majority of survey analysis. The Likert-scale questions were analysed using SPSS and STATSTICA. The small sample size made it difficult to analyse the data with enough accuracy to draw meaningful conclusions. All data was coded and cleaned by visual and systematically computerized checks.

The measurement of attitude data was quantified by using a five point Likert scale (Dawes 2008):

- To determine perceptions on changes in species abundance: 1 = Decreased substantially 2 = Decreased slightly 3 = No change 4 = Increased slightly 5 = Increased substantially
- To gauge perceptions on bag limit success: 1 = Never 2 = Rarely 3 = Undecided 4 = Sometimes 5 = Every time fishing
- To determine overall catch success: 1 = Very poor 2 = Poor 3 = Ok 4 = Good 5 = Very Good.

2.8 Limitations of the Akaroa Harbour recreational fishing survey

Weather was the main cause of disruption to the interviewing process, with often strong winds and rain minimizing the time spent with fishers. The reliability of fishers was a limitation where species caught and released could have been incorrectly identified as this was done on the boat without a trained interviewer.

A small number of fishers (four trips) returned to the slipway with their catch already gutted and it was not possible to positively identify the fish.

Covering all locations on busy holidays and weekend was a logistical problem and a limitation when trying to obtain as many interviews as possible. At least two field assistants were needed to maximise coverage on slipways. In addition, a third assistant was needed for Mount Bossu boat observations. Weighing the landed catch was initially a part of the survey. However, this procedure was time consuming and since fishers stopped voluntary it was difficult to weigh the catch and finish the survey within two minutes. The only slip way that proved difficult to survey was Duvauchelle. A narrow road leading to and from the actual slipway, during busy times proved it difficult for boats to stop for the two minute survey. This problem was solved by intercepting the boats further down the road (by the camping ground). However, this method meant that several boats were missed due to them not stopping at all (Figure 2.6 a-c).

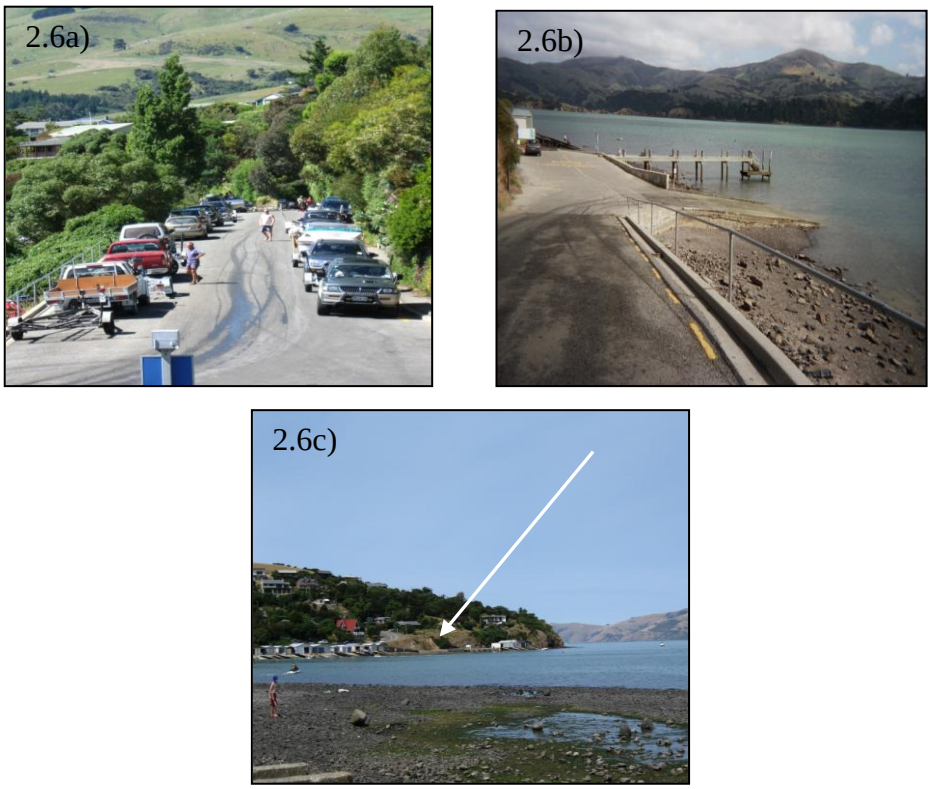


Figure 2.6a) The narrow road leading to and from Duvauchelle slipway. 2.6b) Duvauchelle slipway seen from opposite way from picture 2.6c) View from the camping ground looking over Duvauchelle slipway. White arrow indicating location of slipway.

Chapter 3: Results of the Intercept survey and the Trip records

The intercept survey generated 451 recorded trips over a 14-month period (January 2008-February 2009). From these trips, 3920 fish and shellfish were identified and measured and represented by a total of 28 species. The trip records (diary) resulted in 138 returned diaries with 35 people responding over a 14-month period (December 2007-January 2009). The total number of fish recorded for these trips was 1618. The identification and measurement of these fish was carried out by the diarist. A total of 23 different species were caught. For the purpose of this study, mussels refer both the blue (*Mytilus edulis*) and green (*Perna canaliculus*) and flatfish (*Rhombosolea* spp) is referred to as yellow belly flounder.

Firstly, the demographic frequencies and summaries of the intercept survey respondents are illustrated. Secondly, the overall catch of fish and shellfish over 14 months for both the intercept survey and the trip records are displayed. Thirdly, the results of trends in fishing and fish over 14 months for both intercept survey and trip records are presented. Lastly, the results from statistical analysis and comparisons to the Bell survey findings in 1997 are displayed. During the 14 months of the intercept survey 73 % of the people said they had not been approached on the slipway before. Almost 85 % caught fish or/and collected shellfish successfully while 15 % said they did not catch or successfully collect anything. Of these, 9.5 % said they had been fishing or/and diving outside the harbour and 5.1 % said they had been inside the harbour. Of the 135 trip records returned only 2.2 % stated no catch with two trips outside the harbour and one inside. Of the 135 trips made, 70 % were from private boats while 30 % were fishing trips on charter boats (commercial recreational fishing).

Of the respondents intercepted on the slipways, the main age group for both male and female was 41-50 (Figure 3.1). The majority (88 %) of the respondents were male.

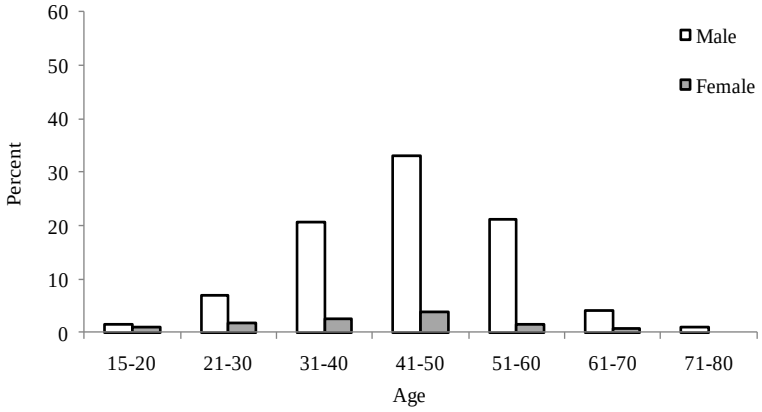


Figure 3.1) Distribution of age groups of respondents intercepted on slipways.

The age group distribution of people (including the survey participant) indicated a high participation rate of children (0-15 years of age). The principal age for both male and female was 41-50 years of age (Figure 3.2).

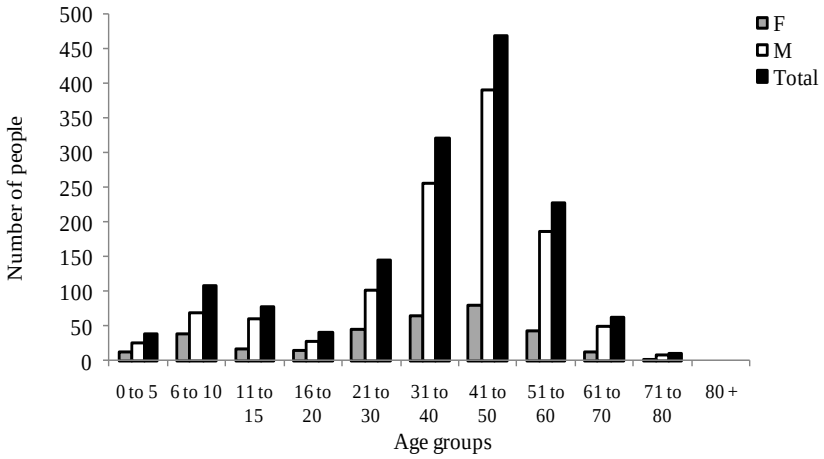


Figure 3.2) Distribution of age groups of all people on intercepted trips on slipways.

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 Maori (Figure 3.3).

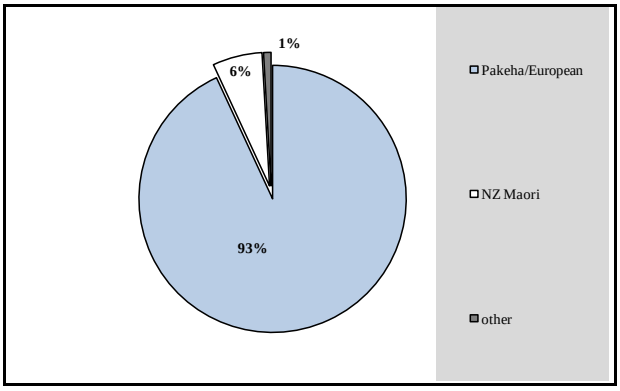


Figure 3.3 Ethnicity for respondents of the intercept surveys.

Over 65 % of respondent listed residence in Christchurch, followed by Canterbury (12 %). Recreational fishers from Akaroa and the Banks Peninsula total 16 %, less than half a percent stated they lived 'Overseas' (Figure 3.4).

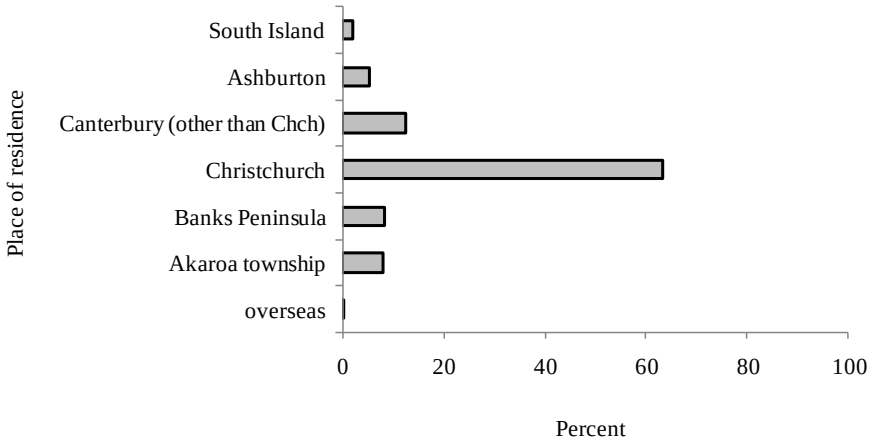


Figure 3.4) Place of residence for the respondents of the intercept survey.

Of the boats intercepted on the slipway, almost 72 % were cabin boats with a length of 5-7 meters. These boats were almost exclusively Stabi-crafts or large speedboats (such as Haines Hunter).

The majority of the boats were privately owned (over 99 %). 'Other' included charter boats and hired boats (Table 3.1).

Table 3.1 Summary of boat data from intercept survey

Summary	Frequency	Percent
Boat type		
runabout	113	25.1
cabin boat	324	71.8
dinghy	11	2.4
yacht	1	0.2
charter boat	2	0.4
Ownership		
private	450	99.8
other	1	0.2
Boat size (m)		
1-2.9	2	0.4
3-4.9	70	15.5
5-6.9	332	73.6
7-8.9	40	8.9
9-10.9	6	1.3
Over 11	1	0.2

The majority of the intercept survey coverage was recorded on the main slipway in Akaroa, where 47 % of all respondents were intercepted. The second most covered slipway was Duvauchelle were 35 % of all respondents were interviewed (Figure 3.5).

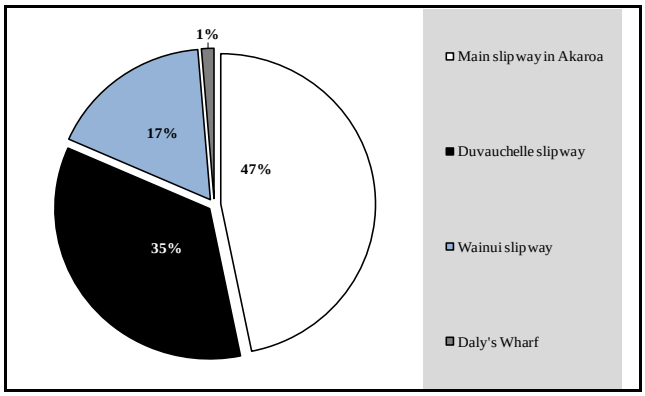


Figure 3.5) Departure locations for intercept survey respondents trips (n=451).

The principal departure location was the main slipway in Akaroa, closely followed by the main wharf in Akaroa (Figure 3.6). The departure locations with the lowest usage include French Farm and fishers departing from their mooring in Akaroa (figure 3.6).

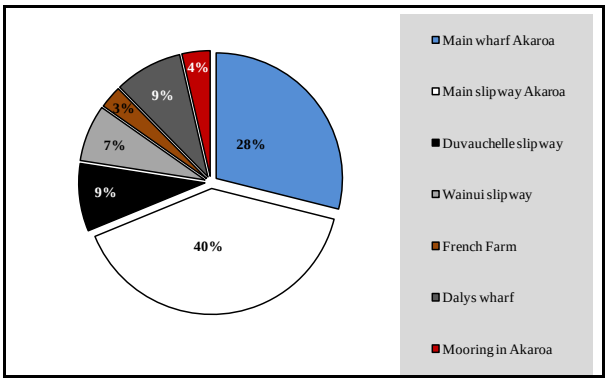


Figure 3.6) Departure location for the trip record participants trips (n=138).

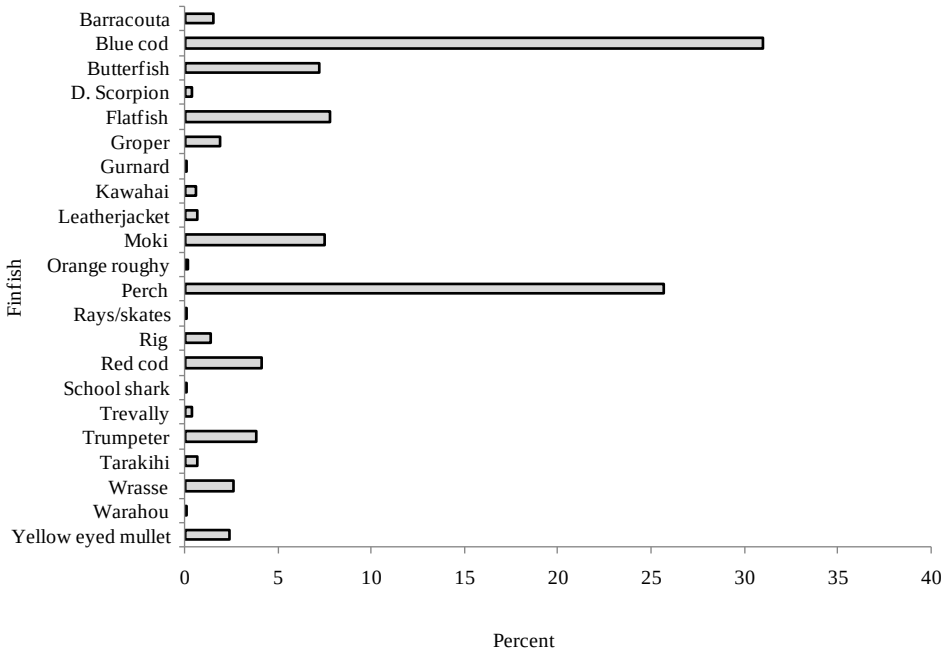
Blue cod was the main target for the trip record participants (50 % of all trips) and the intercept survey respondents (38 % of all trips). Rock lobster was highly targeted in both intercept surveys and trip record trips but was surpassed by flounder for the trip records. A relatively high percentage of the respondents (26 %) of the intercept survey stated to have a "Non Specific" target when fishing. Perch was targeted by 5 % of the trip record participants but less than half a percent of the intercepted fishers on slipways (Table 3.2).

Table 3.2 Target species for Trip records (n=138) and Intercept survey (n=451)

Survey	Target species	Frequency	Percent
Intercept survey	Blue cod (*Parapercis colias*)	172	**38.1**
Trip record	Blue cod (*Parapercis colias*)	69	**50**
Intercept survey	Butterfish (*Odax pullus*)	10	**2.2**
Trip record	Butterfish (*Odax pullus*)	3	**2.2**
Intercept survey	Cockles (*Austrovenus stutchburyi*)	2	**0.4**
Intercept survey	Rocklobster (*Jasus edwardsii*)	112	**24.8**
Trip record	Rocklobster (*Jasus edwardsii*)	15	**10.9**
Intercept survey	Flounder (*spp Rhombosolea*)	7	**1.6**
Trip record	Flounder (*spp Rhombosolea*)	39	**28.3**
Intercept survey	Groper (*Polyprion oxygeneios*)	2	**0.4**
Trip record	Gurnard (*Chelidonichthys kumu*)	1	**0.7**
Intercept survey	Moki (*Latridopsis ciliaris*)	7	**1.6**
Trip record	Moki (*Latridopsis ciliaris*)	1	**0.7**
Intercept survey	Green mussel (*Perna canaliculus*) Blue mussel (*Mytilus edulis*)	5	**1.1**
Trip record	Green mussel (*Perna canaliculus*) Blue mussel (*Mytilus edulis*)	2	**1.4**
Intercept survey	Non specific	117	**25.9**
Intercept survey	Paua (*Haliotis iris*)	9	**2**
Trip record	Paua (*Haliotis iris*)	1	**0.7**
Intercept survey	Sea Perch (*Helicolenus percoides*)	2	**0.4**
Trip record	Sea Perch (*Helicolenus percoides*)	7	**5.1**
Intercept survey	Red cod (*Pseudophycis bachus*)	5	**1.1**
Trip record	Rig (*Mustelus lenticulatus*)	1	**0.2**
	Target for	Frequency	**Percent**
	Total Intercept survey trips	n = 451	**100**
	Total Trip Records trips	n = 138	**100**

Blue cod was the most caught species for the intercept survey, with over 30 % of all catch, closely followed by perch with a take of 27 % (Figure 3.7a). Rock lobster was the majority of the shellfish catch with over taken over 40 % taken (Figure 3.7b).

3.7a)



3.7b)

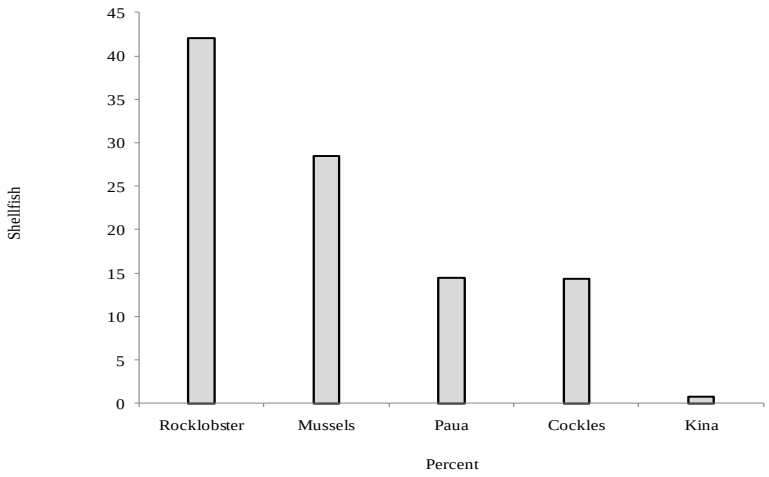
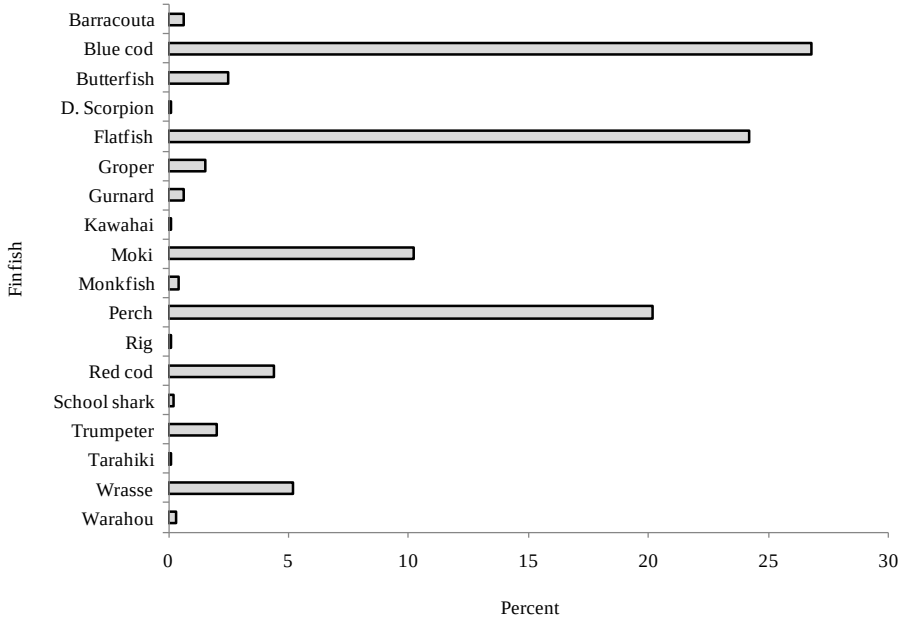


Figure 3.7a) Total take of finfish recorded on slipways 3.7b) Total take of shellfish and crayfish take recorded on slipways.

The most frequently caught finfish was blue cod 27 % (382 fish), followed by flatfish 24 % (344 fish). Even though perch was only targeted by 5 % of the trips, 288 fish were caught which was the third highest (Figure 3.8a). Of the shellfish landed (n=198), over half of catch was rock lobster resulting in 112 individuals taken (3.8b).

3.8a)



3.8b)

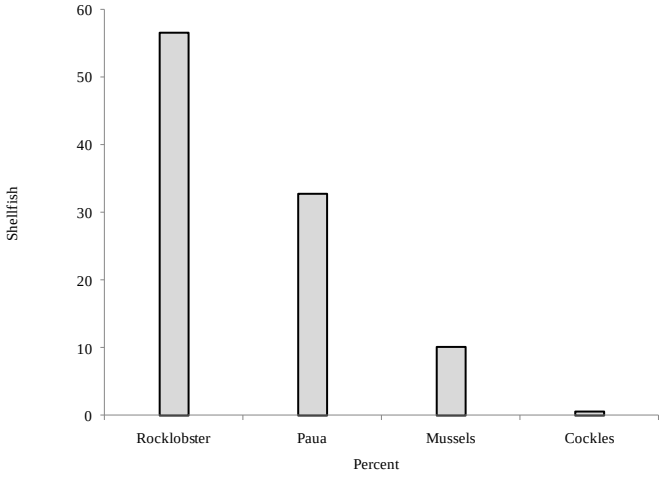


Figure 3.8a) The total take of finfish as recorded by participants of the trip record 3.8b) Total take of shellfish as recorded by participants of the trip record.

Rod/line from a boat was the most popular method of fishing. Set-netting was mainly carried out by trip record participants. Diving with tanks and using rod/line was popular with the respondents of the intercept survey where 16 % stated they used both methods on their trip (Figure 3.9).

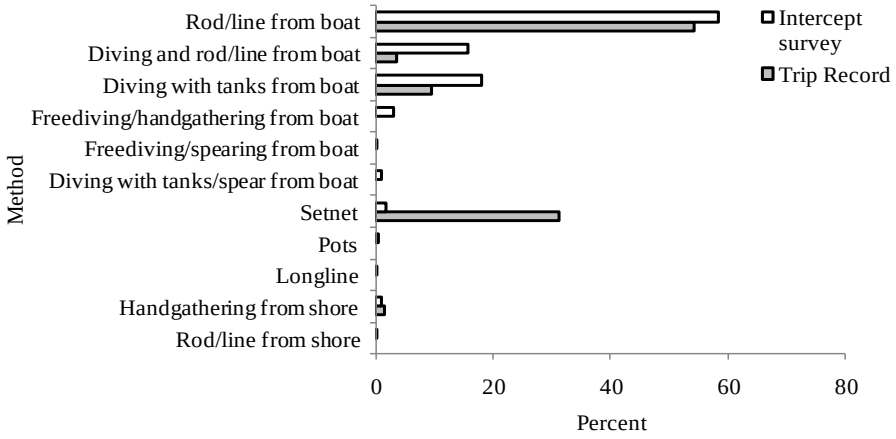


Figure 3.9) Main methods of fishing used for trip records (n=138) and intercept surveys (n=451).

Of all red cod caught, 25 % was released. Also, of the rock lobster collected only 2% were released (Figure 3.10). Several species such as spiny dogfish (*Squalus acanthias*) barracouta (*Thysites atun*), dwarf scorpionfish (*Scorpaena papillosus*) and banded wrasse (*Notolabrus fucicola*) were often discarded as soon as they were caught.

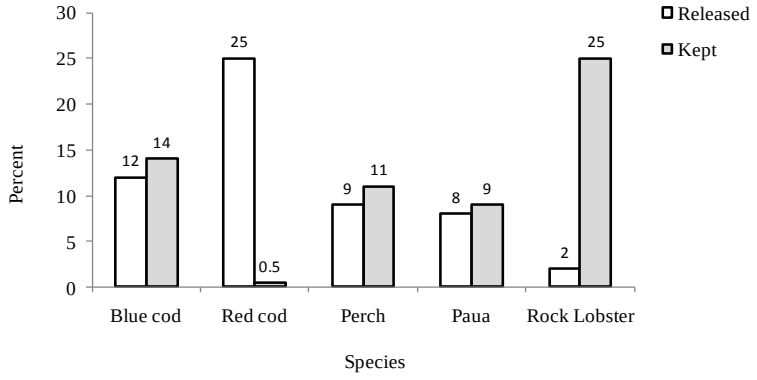
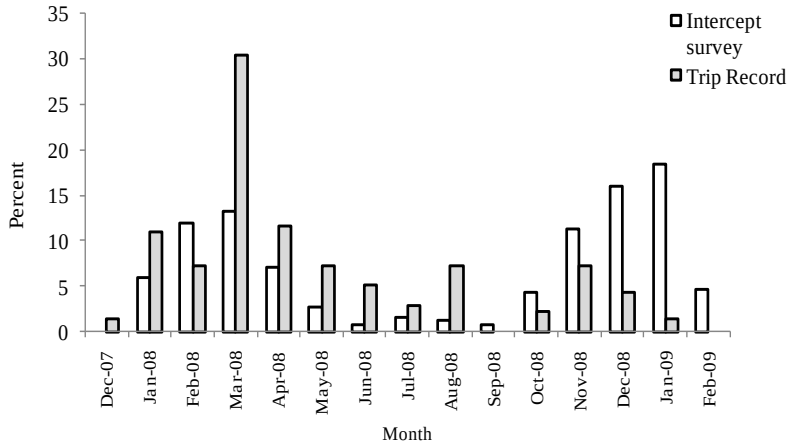


Figure 3.10) Caught and released main species for both trip records and intercept surveys.

The trip record participation rate decreased over the duration of the study with its lowest (0 %) in February 2009 (Figure 3.11a). Fishers were predominantly fishing in areas outside the harbour (16-18) and offshore. Set-netting activity mainly occurred in area 8 (Akaroa) during March due to the start of the floundering season. Over 25 % of the trips made by trip record participants were in area 18 (Figure 3.11b).

3.11a)



3.11b)

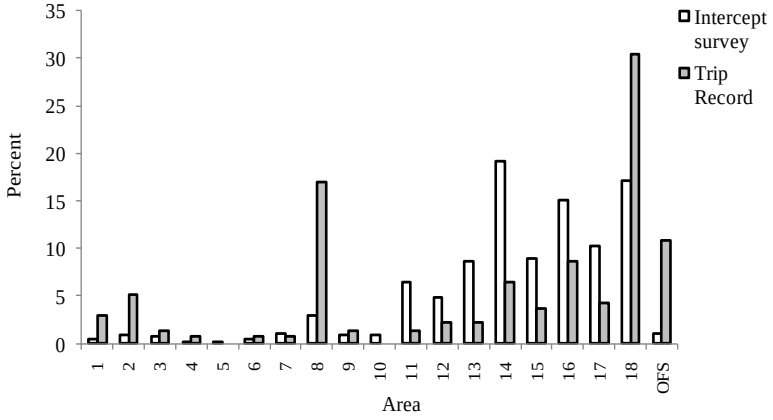
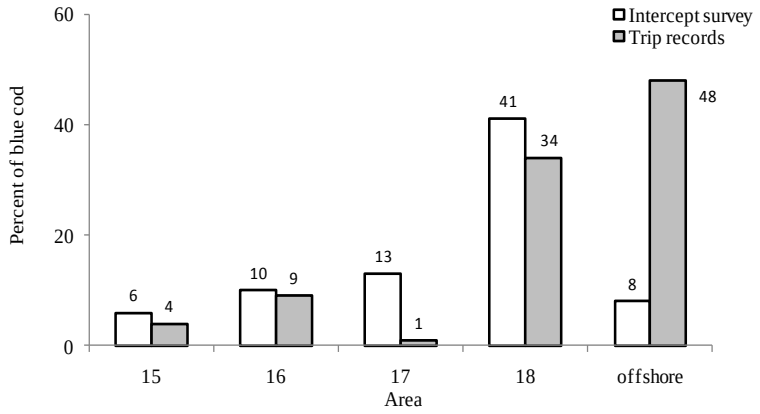


Figure 3.11a) Total percentage of trips by the respondents of both surveys over 14 months. 3.11b) Total number of trips in all areas by the respondents of both surveys (OFS = offshore).

Blue cod was mainly caught offshore (over 45 %) and in area 18 (over 40 %) by the trip record participants while only about 8 % of the intercept survey respondents ventured offshore (Figure 3.12a).

Instead, they fished closer to the harbour entrance in area 15-18. Results showed that blue cod inside the harbour were mainly caught in area 14 (Dan Rogers Reef). Over 50% of the intercept survey respondents said they caught blue cod in area 14 while the trip record participants report a 75 % catch rate of blue cod when fishing inside the same area (Figure 3.12b).

3.12a)



3.12b)

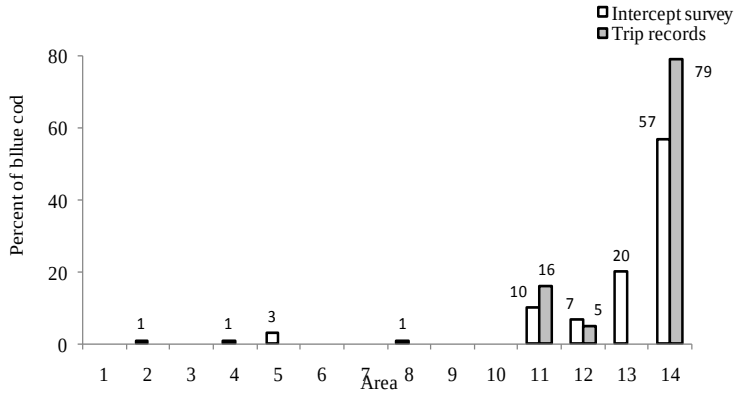
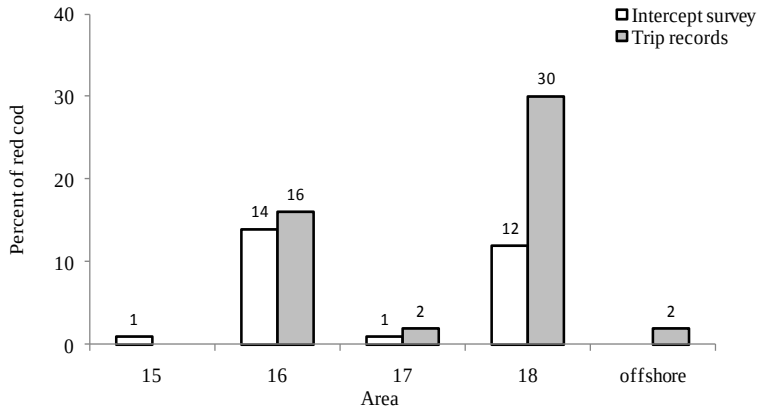


Figure 3.12a) Blue cod caught outside the harbour 3.12b) Blue cod caught inside the harbour.

Red cod was caught predominantly in area 18 by 30 % of the trip record participants and 12 % of the intercept survey respondents. Both surveys resulted in a relatively equal catch per trip in area 16 (Figure 3.13a). Less than five percent of red cod were caught inside the harbour. The results of both surveys indicated most were red cod was caught in area 14 (Figure 3.13b).

3.13a)



3.13b)

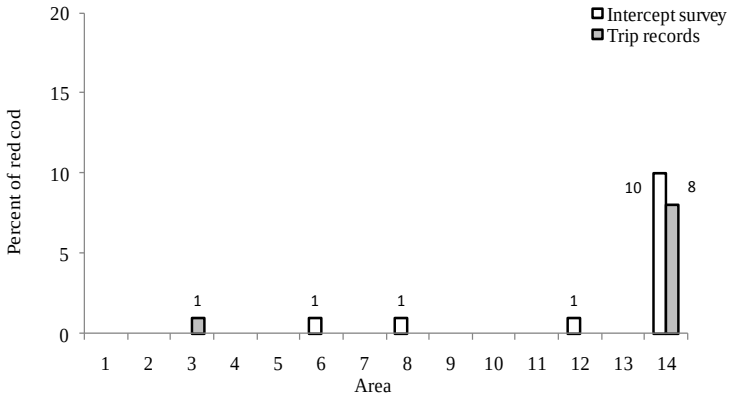


Figure 3.13a) Red cod caught outside the harbour 3.13b) Red cod caught inside the harbour

During the winter months (April - September) the mean length was 35-40 cm. The result showed an increase in mean length whereby the blue cod reaches 45-50 cm in summer (December – March) (Figure 3.14).

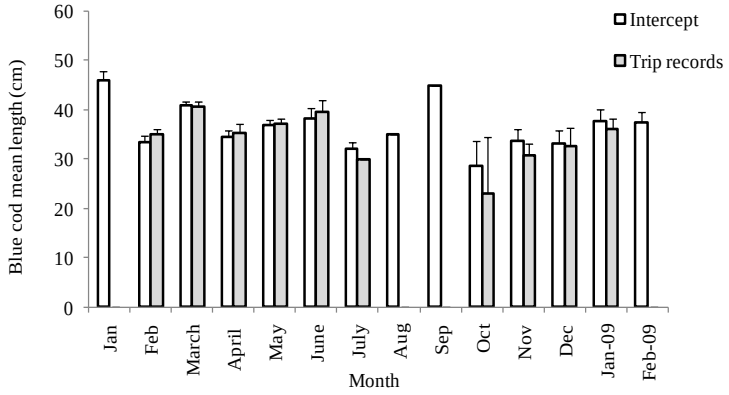


Figure 3.14) Mean lengths of blue cod (±1 SE) from both trip records (n=381) and intercept survey (n=329).

Results indicated that blue cod mean length (based on results from both surveys) was unevenly spread in all the surveyed areas. Blue cod > 45 cm were found outside the harbour while smaller sized fish (< 40cm) were found inside the harbour (Figure 3.15).

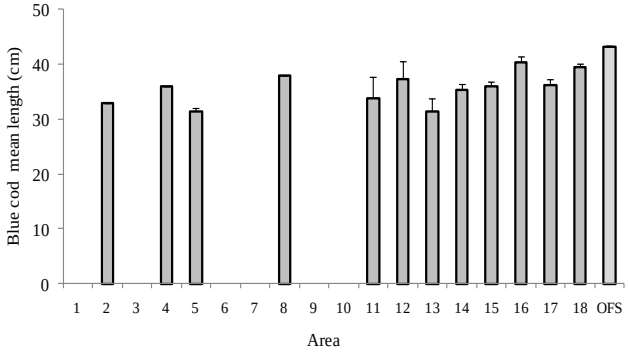


Figure 3.15) Mean lengths of blue cod (±1 SE) an all areas. Results from both trip records and intercept survey (n=710).

Results from the intercept survey indicated a red cod mean length over 45 cm during summer (2007/08) with a steady decline beginning in February. The low mean length continued through the winter with a very low catch rate during summer season 2008/09. The results from the trip records showed a different pattern of mean length over a year. Summer season 2007/08 recorded a larger mean length than summer season 2008/09 for both surveys (Figure 3.16).

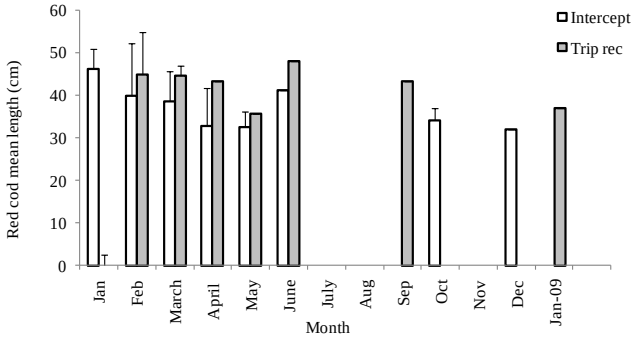


Figure 3.16) Mean lengths of red cod (±1 SE) from both trip records (n=44) and intercept survey (n=63) over 13 months.

Red cod over 45 cm were found outside the harbour in area 16 and offshore while smaller fish (<40cm) are found inside the harbour in areas 14 and 15. There are recorded catch of red cod inside the harbour (areas 2, 6 and 8) however this was represented by very few trips and low catch (Figure 3.17).

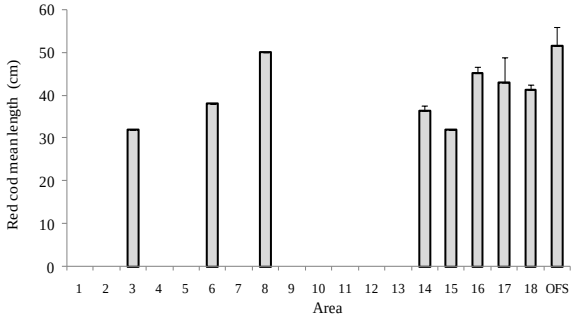


Figure 3.17) Mean lengths (±1 SE) of red cod in all areas for both trip records and intercept survey (n=107).

The overall mean width for landed male rock lobster was 81.3 mm. The results from the intercept survey indicated a mean width of >60 mm during summer 2007/08. An increase in mean length was seen for summer 2008/09 (>80 mm) (Figure 3.18).

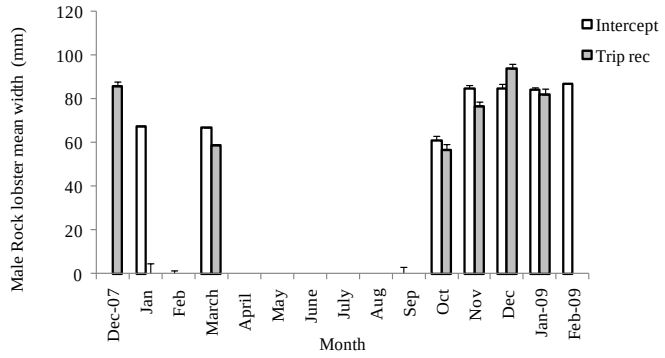


Figure 3.18) Mean widths (± 1SE) for male rock lobster over 15 months for both intercept survey (n=757) and trip records (n=67).

The majority of male rock lobsters were collected in areas adjacent to the harbour entrance and the immediate areas outside. The results indicated large male rock lobster were found inside the harbour (area 11) and larger than 90 mm (Figure 3.19).

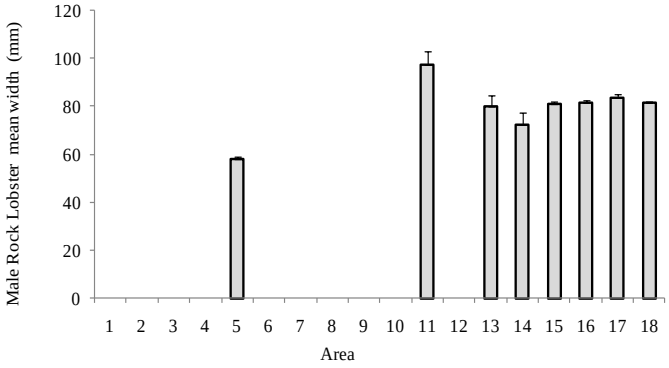


Figure 3.19) Mean widths (± 1SE) of male rock lobster in all areas over 15 months. Results from both trip records and intercept survey (n=824**).**

The overall mean width of landed female rock lobster was 83.4 mm. Although gaps in the data collection for female rock lobster (especially during winter months) the results from the summer months demonstrated large females being collected (>90 mm) by the intercept survey respondents (Figure 3.20).

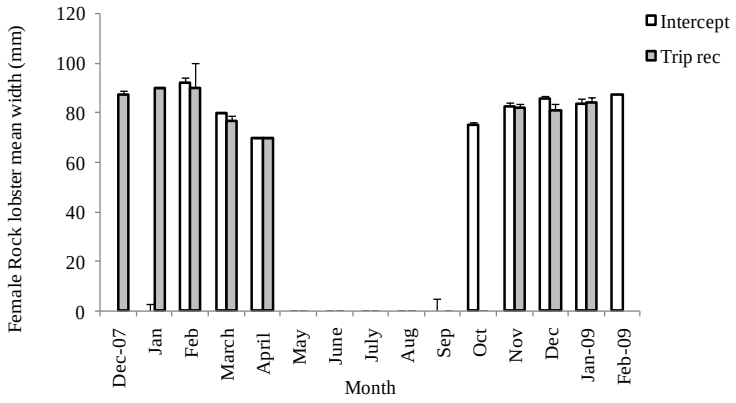


Figure 3.20) Mean widths (±1 SE) for female rock lobster over 15 months. Results from the intercept survey (n=427) and trip records (n=45).

Female rock lobster found inside the harbour (areas 5 and 11-14) were relatively small (65-70mm) with the exception of area 11. Larger females were harvested outside the harbour and the taiapure (areas 15-18). No catch of female rock lobster was recorded for areas 1-4 and 6-10 (Figure 3.21).

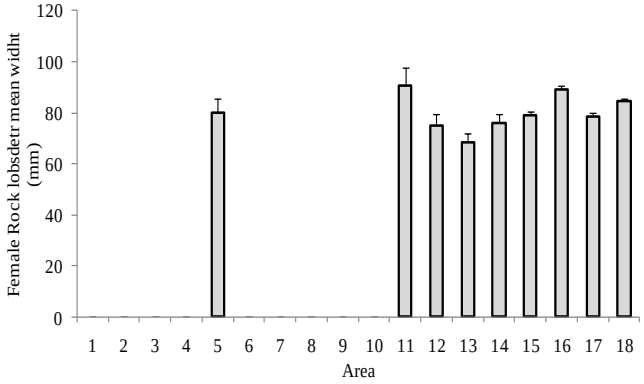


Figure 3.21) Mean widths (±1 SE) for female rock lobster in all areas for both surveys (n=468) over 15 months.

Smaller perch were expected during winter months (30-35 cm) with a slight increase in length during the summer months (35-40 cm) (Figure 3.22). No recorded catch of perch occurred in October. The lowest mean length of perch occurred in June. Perch caught in areas adjacent to the harbour entrance (area 13-14) had a mean length of >35 cm. Perch caught outside the harbour varied in mean length from 30-35cm (Figure 3.23).

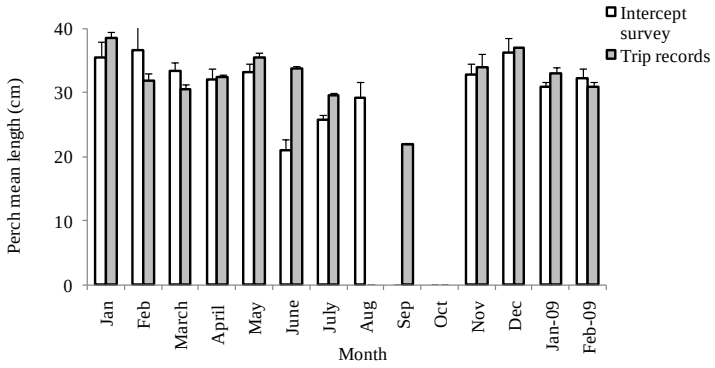


Figure 3.22) Mean lengths (±1 SE) of perch over 14 months for intercept survey (n=273) and trip records (n=287)

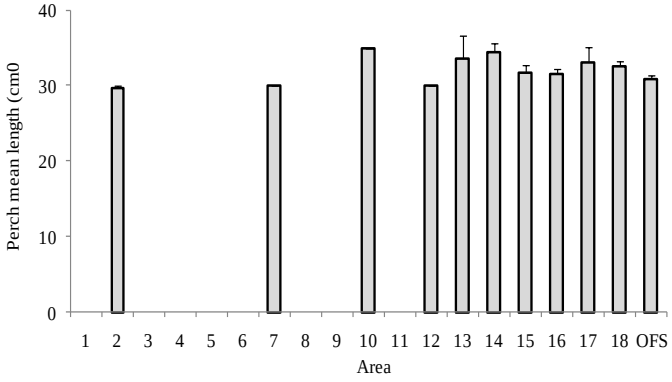


Figure 3.23) Mean lengths (±1 SE) of perch for all areas as recorded by both surveys (n=560).

A two-way ANOVA ($p<0.05$) showed a significant difference ($F= 57.616$, $df = 1$, $p<0.001$) between season and location of mean length of total catch (Table 3.3). The mean length of catch is larger outside the harbour during summer than during winter. The mean length was similar inside the harbour (areas 1-14) during both seasons (Figure 3.24).

Table 3.3 ANOVA ($p<0.05$) comparing seasons and locations (inside/outside harbour) mean length of catch.

Source	Sum of squares	Degrees of freedom	Mean square	F-ratio	p-value
Month/Area	38309.128	1	38309.128	57.616	p<0.001
Total	1773293.176	2667	664.902		

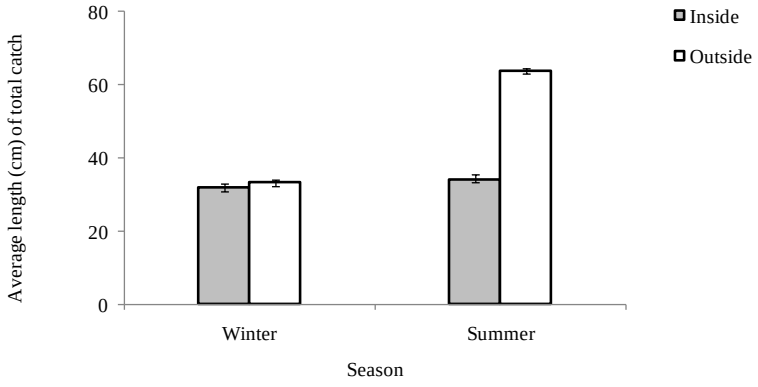


Figure 3.24) The mean length (± 1 SE) of catch depend on season (winter/summer) and location (inside/outside harbour).

A regression analysis of trip record fishing activity showed no significant relationships between time spent fishing/diving/collecting and fish number caught or collected. The main fishing activity was within 0-4 hours with the majority of fish caught in the third hour (Figure 3.25).

Rock lobsters were collected within 0.5-2 hours, mussels and paua collected were within 0.5-1 hour.

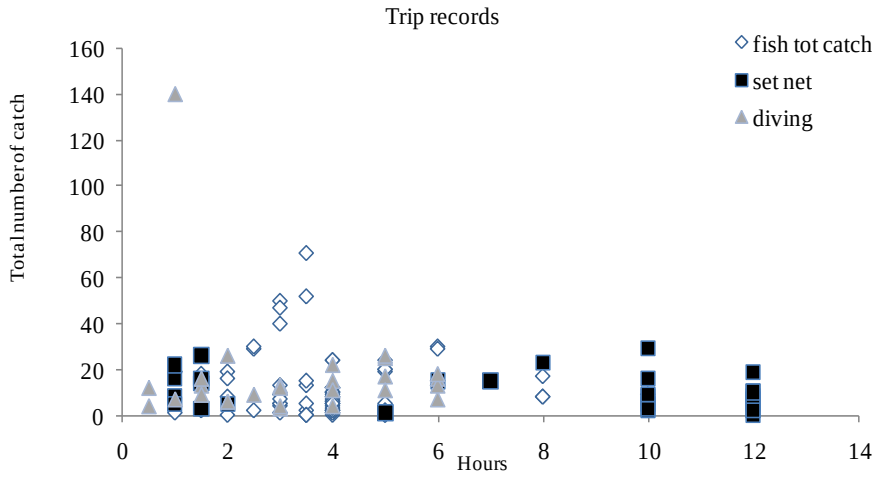


Figure 3.25) Regression analysis showing no relationship between fishing hours and number of fish caught (trip records).

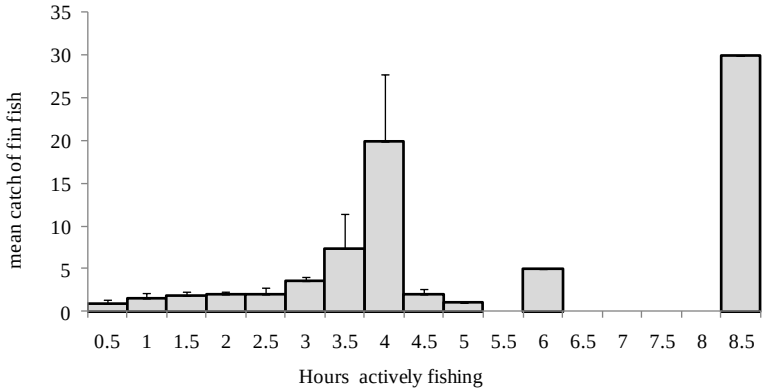
The results of a regression analysis on fishing effort and number of catch by the intercept participants indicate similar results as the trip records (Table 3.4). No significant relationships were found for shellfish and lobster collecting. A correlation between fishing hours and number of fish caught was found ($p<0.001$).

Table 3.4 A linear regression analysis on fishing hours and total catch (intercept survey).

Type of activity	r^2	Degrees of freedom	F-ratio	P-value
Fishing	0.115	1	43.447	p<0.001
Shellfish	0.011	1	0.295	p<0.592
Set net	0.531	1	11.335	p<0.007
Rock lobster	0.016	1	1.894	p<0.171

Mean catch of finfish (Figure 3.26a) increase with hours spent fishing for up to 4 hours. The regression analysis indicated that the first 6 hours of set-netting (3.26b) are the most productive in terms of mean catch of flatfish.

3.26a)



3.26b)

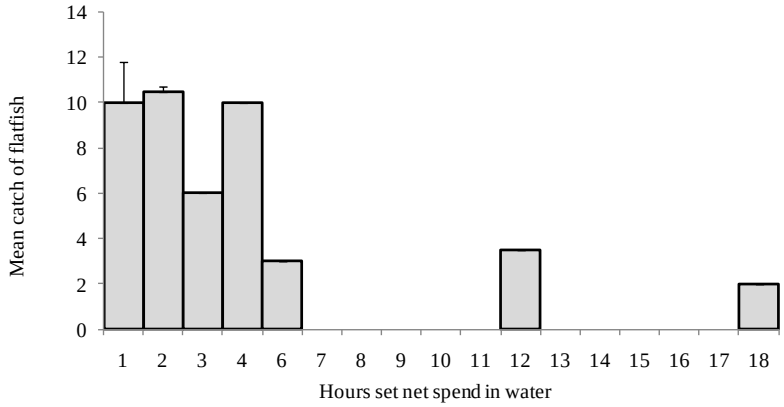


Figure 3.26a) Hours actively fishing with rod/line on trip 3.25b) Hours set net spent in water.

In 1997 (Bell), CPU for red cod was 1.75 individuals caught per hour. In the current surveys, results showed 0.4 individuals caught per hour when targeted (intercept survey) and 0.2 (trip records). Results also indicated an increase in CPU for blue cod for both intercept survey and trip records sine 1997 (Bell) (Table 3.5).

Table 3.5 Catch per unit effort for the intercept surveys and the trip records with the Bell survey CPU results in brackets.

Survey/ Species	Number of trips targeting the species	Total number of hours spent targeting the species	Total number of individuals caught when targeted	Number of individuals caught per hour when targeted
Intercept survey				
Blue cod	9 (281)	220 (559)	258 (502)	1.2 (0.90)
Trip records				
Blue cod	**69**	**153**	**359**	**2.4** (0.90)
Intercept survey				
Red cod	2 (777)	5 (1778)	2 (3110)	**0.4** (1.75)
Trip records				
Red cod	**10**	**37**	**9**	**0.2** (1.75)

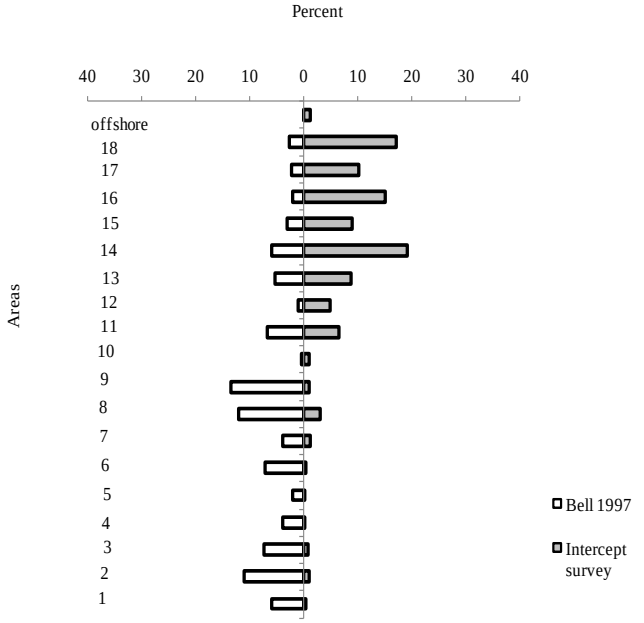
CPU for rock lobster in 1997 (Bell) was 2.01 individuals caught per hour. The current surveys indicated 2.4 individuals caught per hour for the trip records and 8.5 for the intercept survey. Results also indicated a decrease in CPU for flatfish both intercept survey and trip records. It is acknowledged that the number of flatfish caught was most likely to be higher than recorded in the surveys (Table 3.6).

Table 3.6 Catch per unit effort for rock lobster and flatfish for intercept surveys and trip records with Bell survey (1997) CPU results in brackets.

Survey/ Species	Number of trips targeting the species	Total number of hours spent targeting the species	Total number of species caught when targeted	Number of individuals caught per hour when targeted
Intercept survey				
Rock lobster	123 (63)	125 (114)	1056 (230)	8.5 (2.01)
Trip records				
Rock lobster	**14**	**20**	**359**	**2.4** (2.01)
Flatfish	**37** (538)	**318** (6801)	**344** (4365)	**1.1** (0.64)

Comparisons to the Bell survey revealed a significant difference (chi-square goodness of fit χ^2 = 259.8075 df =18 p<0.001) in areas fished by intercept survey participants. Results showed an increase in fishing activity in areas 14 to 18. Areas inside the upper harbour (areas 1 to 9) showed lower fishing activity than in 1997 (Bell) (Figure 3.27a). A significant difference (chi-square goodness of fit (χ^2 = 339.2144 df =18 p<0.001) was also found in areas fished by trip record participants. Akaroa (area 8) had not changed significantly in fishing frequency since 1997. The main differences between Bell (177) and the trip records were an increase outside the harbour (especially in area 18). Over 15 % of the trip record participants stated that they fished offshore. This area was not surveyed in 1997 (Figure 3.27b).

3.27a)



3.27b)

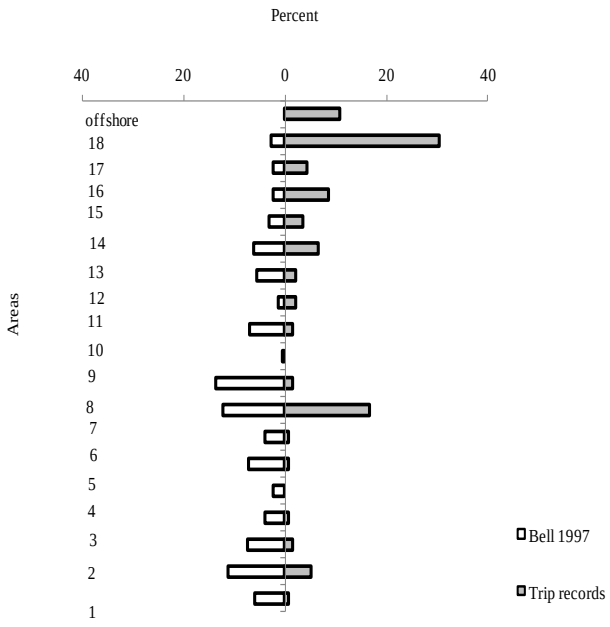
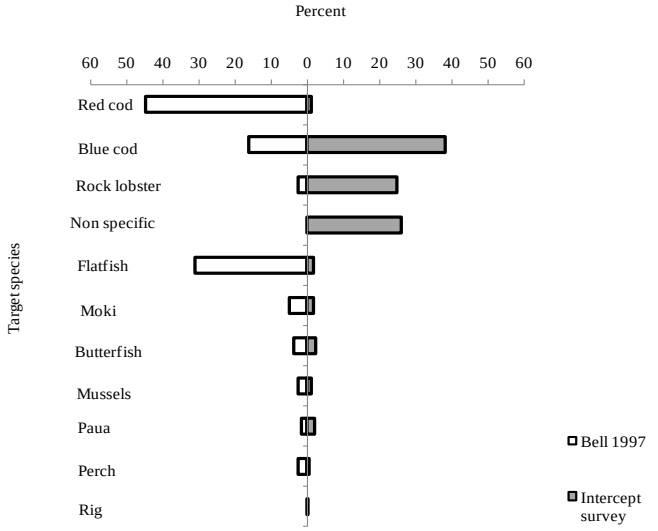


Figure 3.27a) Comparison between Bell (1997) areas fished and the intercept survey areas fished areas fished 3.27b) Comparison between Bell (1997) areas fished and the trip records areas fished.

A significant difference was found (chi-square goodness of fit χ^2 = 2309.393 df =10 <0.001) in target species. Significant changes included just over 1 % of the respondents of the intercept survey stated red cod as the target species compared to almost 45 % of all trips 1997 (Figure 3.28a). A significant difference was also found (chi-square goodness of fit χ^2 = 150.8967 df = 9 p <0.001) in target species for the trip records compared to the Bell survey (Figure 3.28b).

3.28a)



3.28b)

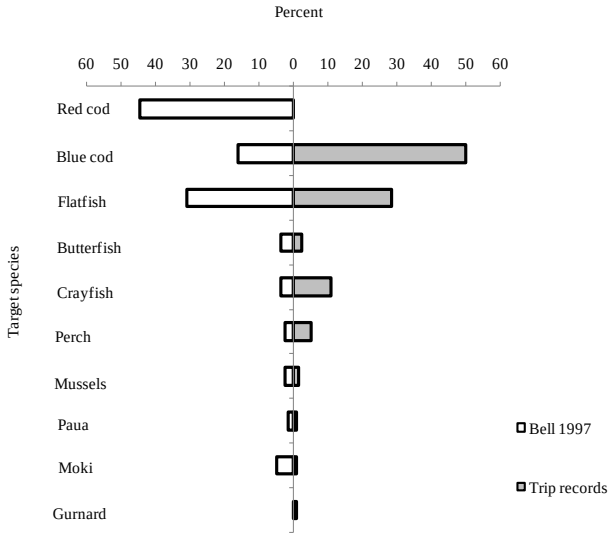
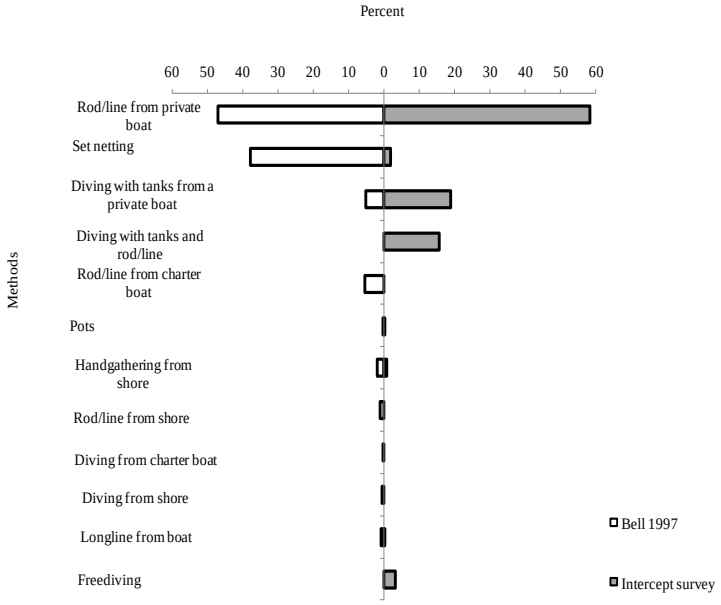


Figure 3.28a) Target species comparisons between the Bell survey (1997) and the intercept survey 3.28b) Target comparisons between the Bell survey (1997) and the Trip records.

A significant difference was found between (chi-square goodness of fit χ^2 = 82.6900 df =11 p<0.001) fishing methods comparing intercept respondents and Bell (1997) (Figure 3.29a). Also, a significant difference was found between (chi-square goodness of fit χ^2 = 136.5658 df =10 p<0.001) fishing methods comparing trip records and the Bell survey (Figure 3.29b).

3.29a)



3.29b)

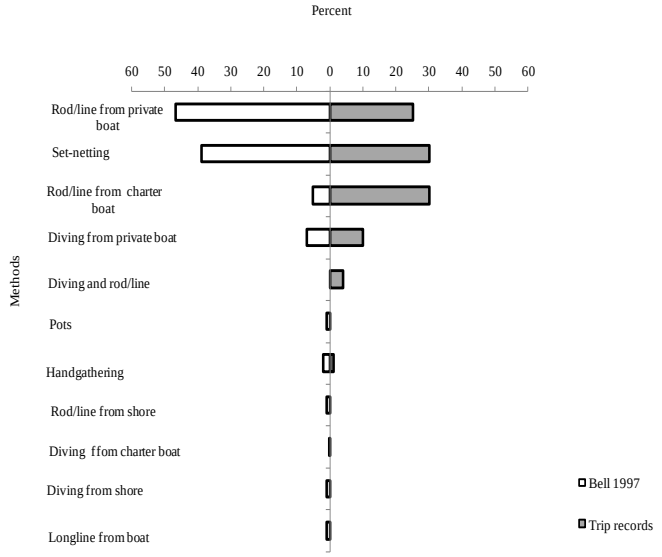


Figure 3.29a) Comparison between methods used in Bells survey and the intercept survey respondents 3.29b) Comparison between methods used in Bells survey and the trip record participants methods.

Total numbers of each species from the current surveys were scaled up with the adjustment factor of 2.9. There were significant differences (chi-square goodness of fit χ^2 = 3924.4 df = 5 p<0.001) in the frequency of catch. Red cod and flatfish catch has declined since 1997. The results indicated that all the other main species had an increase in catch since 1997 (Figure 3.30).

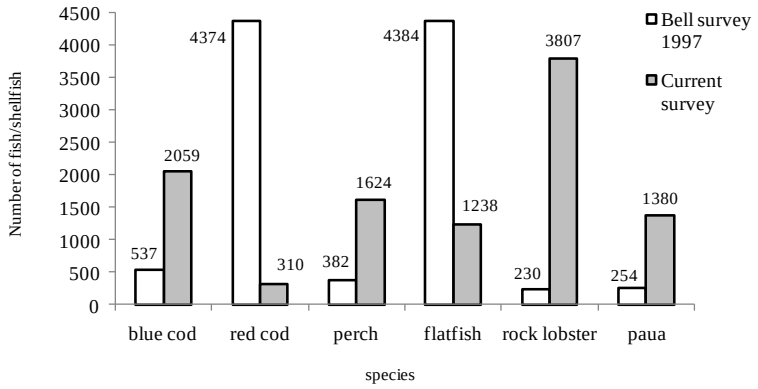


Figure 3.30) Total catch of main species compared between Bell (1997) survey and the intercept survey and trip records combined.

The calculated biomass for each of the main species was less than one tonne. Individual biomass for each species was scaled up by the overall adjustment factor of 68.8 (calculated for this study) and gave an estimated total weight of each main species landed (Table 3.7).

Table 3.7 Biomass for main species

Species	Biomass for current study (kg)	Biomass scaled up (t)
Blue cod	750	52
Red cod	21	1.5
Perch	290	20
Paua	194	13
Flatfish	280	19

Chapter 4: Results of the Perception survey – *a pilot study*

The results of the perception survey are divided into two parts. Part I shows results of demographics and Likert scale questions covering changes over time and also perception and awareness responses. Part II covers the open-ended questions posed to the respondents (n=22), these interviews included a series of specific questions. The respondents represented groups from recreational fishers and divers, the Maori community and commercial fishing sector (both active and retired). All respondents had five or more years experience of fishing in the Akaroa Harbour area. Catch success was as defined as catching at least one fish of the target species on any give trip.

PART I

Of the 22 people interviewed approximately half of the respondents were between 51-60 years of age (10 people). These respondents were still active in the work force full time and mainly spent their weekends and public holidays fishing with or without their families. The age groups between 61-80 years of age were represented by seven people, all retired and living on Banks Peninsula at the time of the survey. Age group 41-50 and 31-40 years of age were represented by five people (Figure 4.1). Main place of residence were Akaroa and wider Banks Peninsula (Figure 4.2). Results indicated a high level of fishing experience among the respondents whereby 59 % (13 respondents) stated they had been fishing in the area for more than 41 years (on and off as well as fulltime). Seven respondents (32 %) stated five to twenty one years of fishing experience (Figure 4.3).

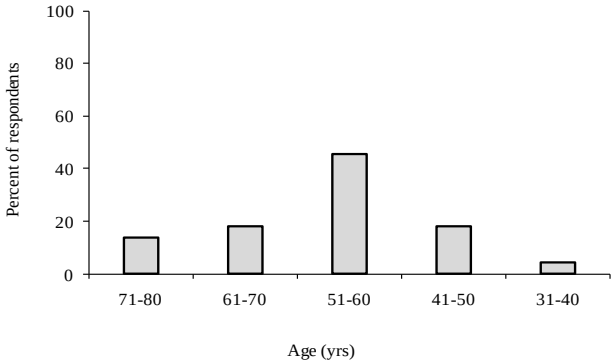


Figure 4.1) Distribution of age groups of the respondents (n=22).

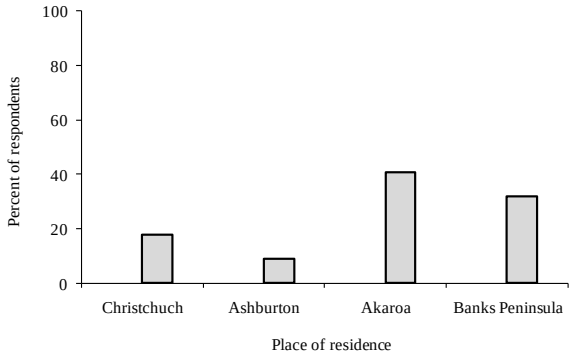


Figure 4.2) Distribution of place of residence of the respondents (n=22).

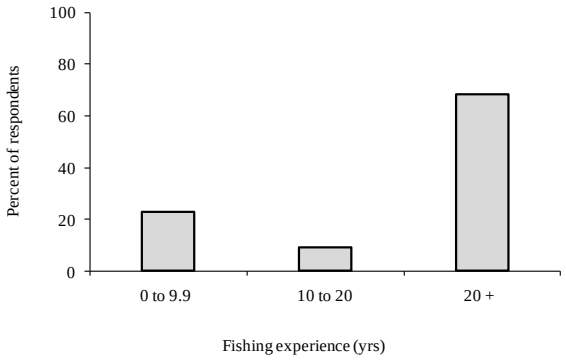


Figure 4.3) Respondents fishing experience (in years) (n=22).

Over 60 % of the respondents had been fishing, diving and shellfish collecting between 0-20 times in the past 12 months (Figure 4.4). Results indicated most respondents stated they divided the catch between the fishers, friends and family. Only two respondents stated to keep the catch for themselves while four said that they give all their catch away to neighbours and extended family (Figure 4.5).

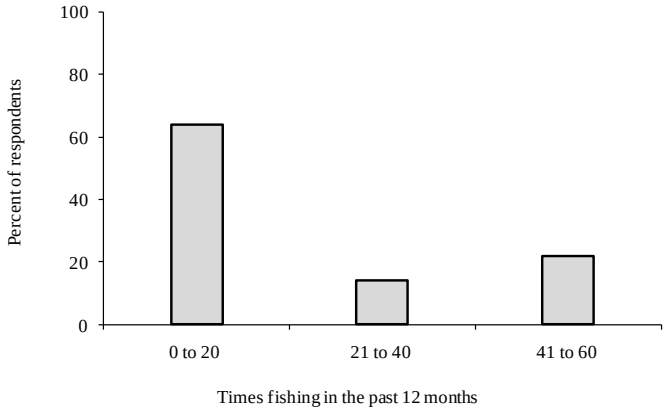


Figure 4.4) Fishing activity by the respondents in the past 12 months (n=22).

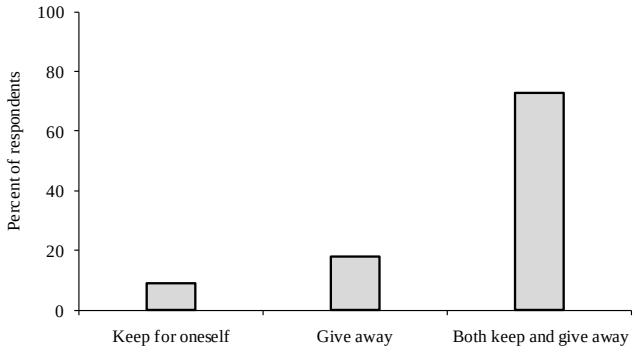


Figure 4.5) Intentions with catch by the respondents (n=22).

Nearly all (21 respondents) knew of the set net ban, 22 respondents were aware of Pohatu marine reserve (Flea Bay) and could point out the correct location when shown a 'blind map' of the harbour.

Nineteen (86 %) of the respondents were aware of the Akaroa Harbour Taiapure and fifteen (68 %) were aware of the proposed reduction in bag limits (Figure 4.6).

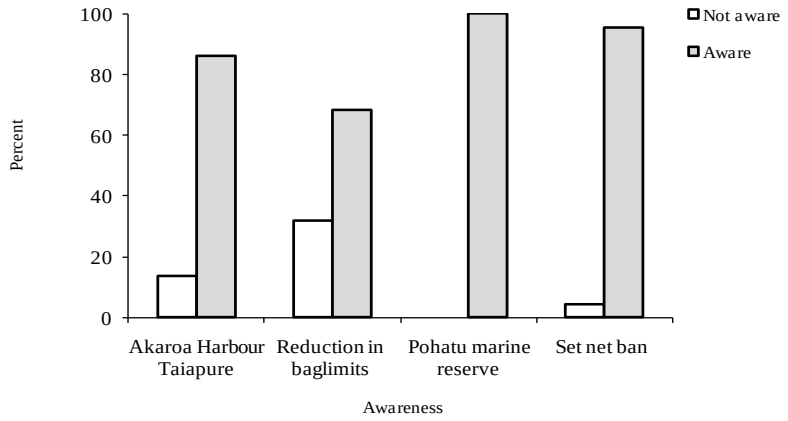


Figure 4.6) Respondent's awareness on four harbour issues (n=22).

Respondents were presented with a five-point Likert scale and asked to rate the fishing activity in Akaroa Harbour in the last five years. Fifty percent of the respondents perceived overall recreational fishing activity inside and areas adjacent to the harbour entrance had increased slightly in the past five years (Figure 4.7).

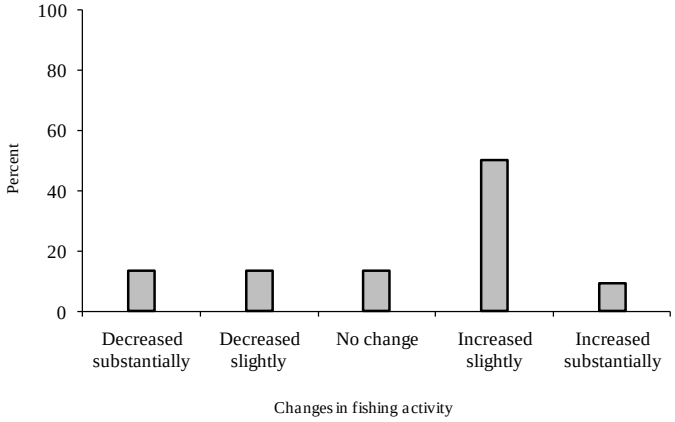


Figure 4.7) Respondents perceptions (n=22) on fishing activity in Akaroa harbour in the last five years.

Changes to abundance of species inside the harbour but also directly adjacent to the harbour entrance in the past five years was gauged using the Liker scale. There was a significant difference found in perceived abundance of red cod (chi square goodness of fit $\chi^2 = 18.000$ df = 3 $p<0.001$) (Figure 4.8). No significant differences were found in the perceived abundance for blue cod and flatfish (Figure 4.8). There was no statistical significant difference found in the perceived abundance of rock lobster, paua and mussels (Figure 4.9).

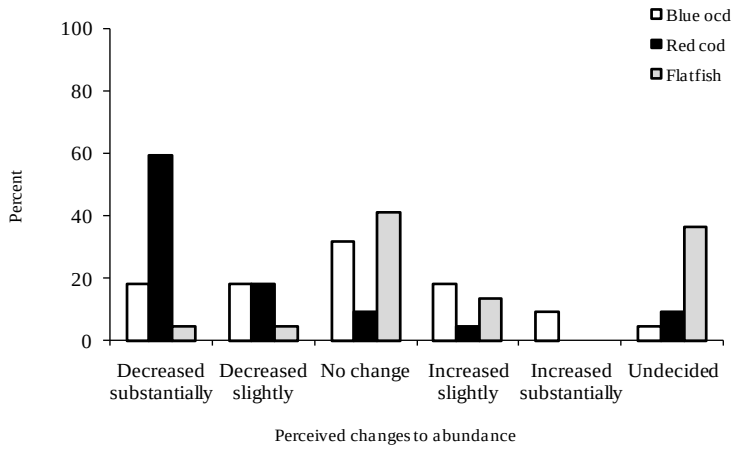


Figure 4.8) Perception of changes in abundance of blue cod (respondents n=21), red cod (respondents n=20) and flounder (respondents n=20) over the past five years as perceived by the respondents.

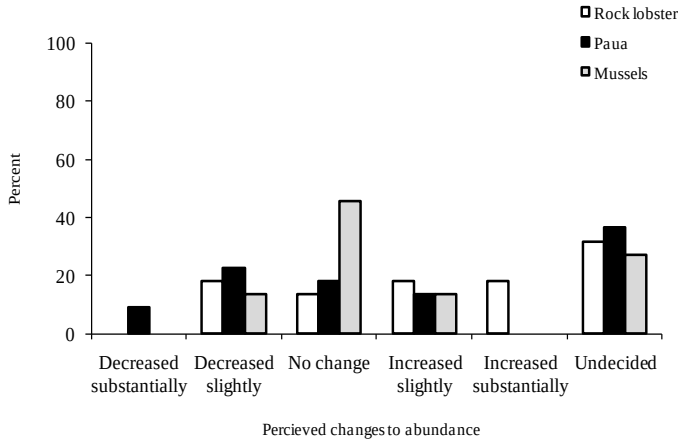


Figure 4.9) Perception of changes in abundance by respondents (n=16) of mussels, paua (respondents n=14) and rock lobster (respondents n=15) over the past five years.

The Likert scale was also used to determine how often the respondents would catch their bag limit on any given fishing trip. A significant difference was found in perceived ability to catch the bag limit for blue cod (chi square goodness of fit χ^2 = 12.250 df = 1 p<0.001). Over half of the respondents (15) stated they 'never' caught the blue cod bag limit (30 per person/day). Similar, a significant difference was also found in perceived ability to catch the bag limit red cod (chi square goodness of fit χ^2 = 11.636 df = 2 p<0.003). Nine respondents stated they 'never' caught the bag limit (10 per person/day). There was no significant difference found in perceived bag limit success for paua and rock lobster (Figure 4.10).

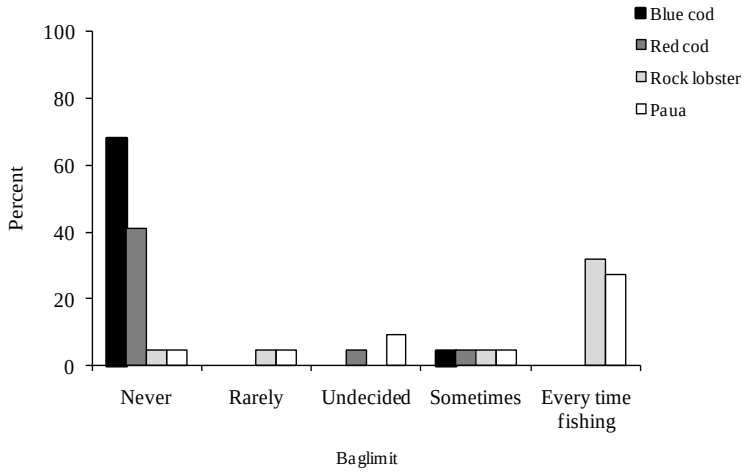


Figure 4.10) Perception of respondent ability to catch the bag limit for certain species. Blue cod (respondents n=16), Red cod (respondents n=11), Rock lobster (respondents n=10), Paua (respondents n=11).

The dominant method for collecting mussels for the past 20 years was 'hand gathering from shore' followed by 'diving from shore'. A chi square test of independence showed no significant difference between methods over the past 20 years. 'Diving from shore' has progressively decline in the past 20 years while 'Hand gathering from shore has increased slightly in the past 20 years. Results indicated that methods are related to time and a significant association was found when comparing the past 12 months with five years ago (chi square test of independence χ^2 = 19.961 df = 6 p<0.003) (Figure 4.11).

Similar significant results was also found for methods used 12 months ago and 20 years ago (chi square test of independence $\chi^2 = 24.790$ df = 6 $p<0.001$) (Figure 4.12).

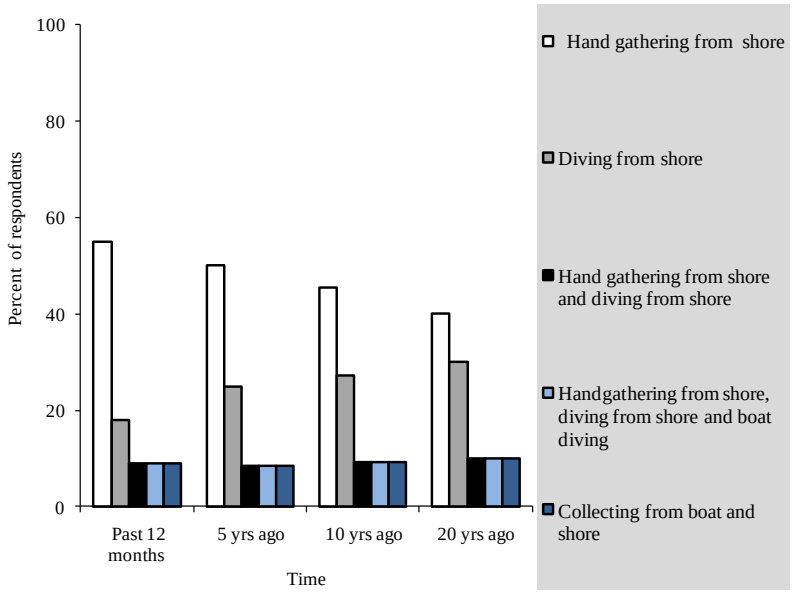


Figure 4.11) Methods of collecting mussels compared between the past 12 months, five years, ten years and 20 years ago.

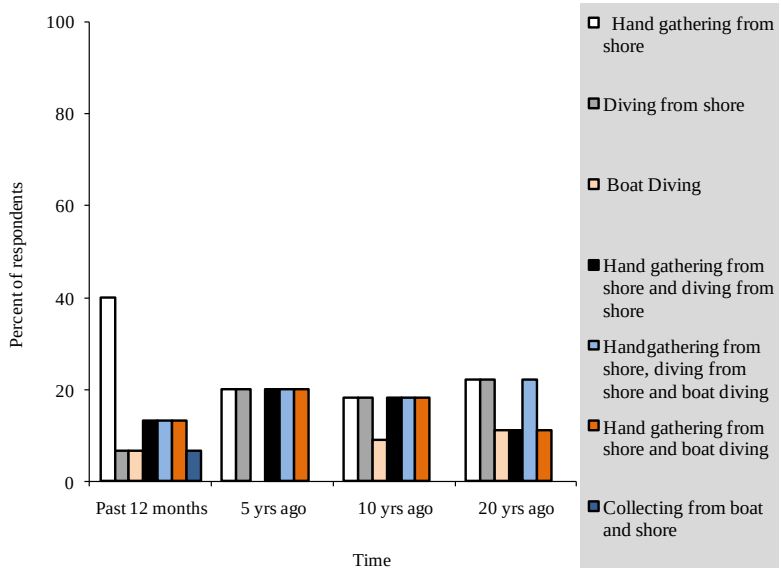


Figure 4.12) Methods of collecting paua compared between the past 12 months, five years, ten years and 20 years ago.

Six respondents predominantly fished within the harbour and would set nets and collect mussels or paua (Figure 4.13). Thirteen respondents stated they found the current recreational fishing rules in Akaroa Harbour 'not satisfactory' (Figure 4.14).

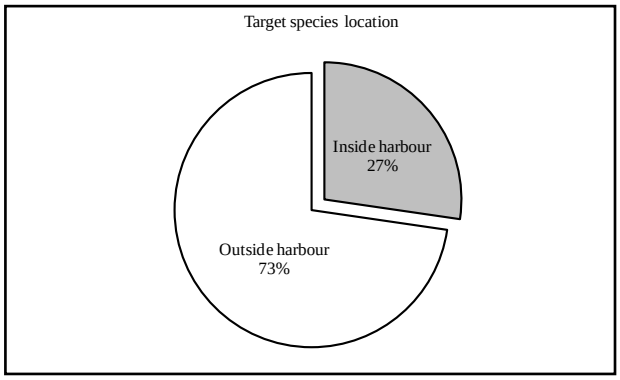


Figure 4.13) Location chosen by respondents for target fishing (n=22).

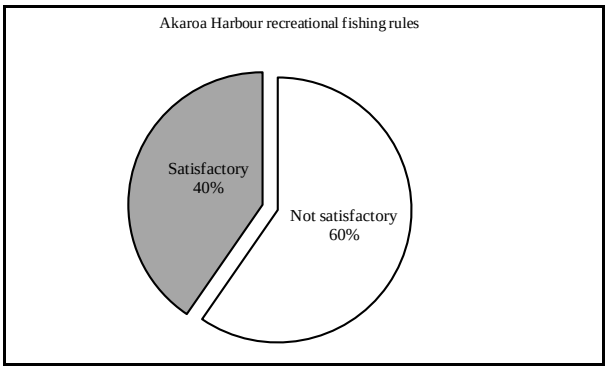


Figure 4.14) Satisfaction of the respondents with the current recreational fishing rules in Akaroa harbour (n=22).

The Likert scale was used to gauge perception on overall catch success inside and outside the harbour in the last five years. Results showed nine respondents considered their overall catch success to be poor. Eight respondents said that they thought their overall catch success was good to very good (Figure 4.15).

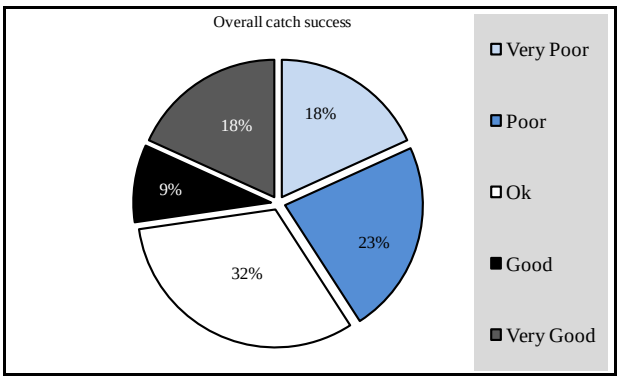


Figure 4.15) Satisfaction of current recreational fishing rules in Akaroa harbour (n=22).

PART II

The open-ended questions complemented the perception survey in the way of recording comments and opinions in-depth in order to gauge perceptions and attitudes regarding recreational fishing in Akaroa Harbour.

Question 1: Are you aware of the Akaroa Harbour Taiapure committee?

Nineteen respondents were aware of the Taiapure Committee. The majority of these expressed a concern over lack of public insight into the committee decision making process. Comments were made from five respondents that the committee needs representation from a cross-section of harbour users and more exposure as to what a taiapure is. Eight respondents stated the Taiapure Committee members had not been in Akaroa to talk to the locals and expressed the need to have an open forum so all can have input and access to information and exercise user's right.

Question 2: Are you aware of the proposed reduction in bag limits inside the Akaroa Harbour Taiapure?

Fifteen respondents stated they were aware of the reduction in bag limits. The general consensus was the bag limits needs to be 'tidied up" for all species i.e. lowered in order to sustain fish populations. Majority of the respondents raised the issue of who will be "policing" bag limits and the locations being fished. Four recreational divers were concerned about the reduction in bag limits for rock lobster (six to three) and stated that they [recreational divers] were not a threat to rock lobster population. Five respondents stated there had been an increase of families and groups coming over to Akaroa in the past few years and "take what they can get and then leave".

Question 3: Are you aware of the set net ban enforced by The Ministry of Fisheries in October 2008?

All but one respondent (n = 22) knew of the set net ban. The respondent that did not know of the ban stated he "was not even aware of the ban and would welcome more information from Ministry of Fisheries". One of the respondents commented "the government should not be influenced by facts and figures supplied by scientists with an agenda" referring to the decision making process and scientific input that led to the ban. However, not all respondents were against the set net ban and one person stated it is still possible to spear moki and butterfish.

Ten respondents claimed the social impact of set net bans and other recreational restrictions were of great concern and also commented that local knowledge being a good indicator on what was going on in the harbour. One respondent said it was "more productive to talk to individuals than big meetings". The older (over 70 years of age) respondents felt it had almost become pointless to take their grandchildren out fishing "due to all the rules and regulations constraining recreational fishing".

Question 4: What are your views on charter boat companies operating around Akaroa harbour?

Ten respondents mentioned issues concerning charter boat companies operating on Banks Peninsula. Five respondents stated there should a compulsory registration for this type of venture and also a limit on the number of boats operating in a certain area. According to two respondents, four to five boats will struggle to keep their business viable while one will do really well. According one respondent there has been certain charter companies that operate temporarily out of Akaroa and have no regard for the fishing rules or bag limits. Several respondents expressed concern regarding the current fishing charter operations in Akaroa Harbour. One company in particular was mentioned a number of times as being unprofessional and misleading in its advertising and with little knowledge of fish species and fish handling. According to these respondents, this particular charter operator has been in business in Akaroa for several years.

Question 5: Do you have any additional comments?

The majority of respondents mentioned the importance of anecdotal evidence and comments from local fishermen when researching issues concerning the harbour. Several respondents stated even though it would be difficult to get all commercial and recreational fishermen together at once, they felt it was necessary to discuss issues with people who have fished on Banks Peninsula for a long time.

There was also a request from the majority of respondents to have an increased presence by the Ministry of Fisheries on Banks Peninsula, especially during the summer months. According to these respondents, this request was motivated by a growing concern that “many of the people from other places than Banks Peninsula come and fish without knowledge of rules on species length and bag limits". This point was mentioned several times during the interviews. However, the overall perception was not to minimise the number of “outsiders’ fishing in Akaroa but rather to increase publicity on recreational fishing information such as rules and regulations on the slipways and in petrol stations on Banks Peninsula and the camping grounds in Akaroa and Duvauchelle.

Chapter 5: Discussion and Recommendations

5.1 Main findings

Concern has been expressed by the Akaroa Harbour Taiapure committee regarding the sustainability of the recreational fisheries in the area. This study has provided a framework for three types of recreational fishing surveys and will reduce set-up time for future surveying and ensure the data collected can be statistically analysed. This is the second study on recreational fishing activity in Akaroa Harbour and differs from previous recreational fishing surveys in the way of an approach consisting of biological science as well as social science in order to characterising fishing activity. It is an approach that has not been taken before in New Zealand but is gaining global momentum for management of recreational fisheries.

Between the initial survey done by Bell in 1997 and present 2007/09 surveys, there have been a number of significant changes in fishing activity. Although a larger sample was obtained in 1997, key findings from the current survey were a considerable decrease in trips targeting red cod and a decline in the red cod catch. Recreational fishing trips shifted from top of the harbour (areas 1-10) to the harbour entrance and the immediate areas outside, mainly due to limited fishing success inside the harbour. Charter boats were not included in Bells survey (1997) and the results of the current survey showed a noticeable increase of fishing trips in area 18 (outside the harbour to the East). Respondents fishing offshore were not recorded by Bell (1997) thus no comparison can be made with the current survey.

The main target species for fishers recorded in the intercept survey and the trip records was blue cod, a total of 710 individuals was recorded during 14 months. This result does not differ greatly from the Ministry of Fishery research showing blue cod as the most frequently landed finfish on the South Island (Beentjes & Carbines 2006). Perch was not identified as a main target for either of the surveys, but results showed it was the second highest take of finfish with a total of 560 individuals.

Rock lobster was highly targeted in both surveys, totalling 1313 individuals with twice as many male rock lobsters taken than female rock lobster. Perch and rock lobster were found to be most landed finfish and shellfish in the Kaikoura Recreational Fishing Survey 1998/99, while the most targeted were blue cod and rock lobster (Carbines 2000). The survey by Carbines used a roving-access survey with intercept surveys on four main slipways. A similar approach was taken in the Nuggets and Shag Point recreational fishing surveys whereby fishers were intercepted at key locations and asked about their fishing habits (Bell 2001).

From the 586 trips surveyed, rod and line from private boat was the most common method of fishing. This method has been found to be the most popular in several recreational fishing surveys in New Zealand (Bell *et al.* 1998 1999, 2000, Tierny & 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 tanks. Several methods used by fishers in Bell's survey were not recorded in the current surveys. For example, long line from a boat, diving from shore, diving from charter boat and rod/line from shore were all absent in the trip records.

November to February was the most concentrated fishing period. A decline in fishing activity was apparent during the winter and spring months (June-October) probably due to rough seas and bad weather. A peak in fishing activity in March (2008) was the result of increased fishing due to the start of the set-netting season for flatfish. As hypothesised, the favoured areas for any fishing activity (apart from set-netting) were outside the harbour. Shellfish collecting was centred predominantly around areas 15 and 16 while area 18 and offshore areas were popular areas for catching groper, blue cod and red cod. Charter boats and recreational fishers with larger vessels (>7 meters) were often found in these areas. The results from the trip records indicated participants tend to venture further out than the intercept survey respondent to catch blue cod. Most respondents fishing inside the harbour was close to the harbour entrance, mainly due to vessel size, the presence of family onboard, previous fishing success and dependent on weather.

Dan Rogers Reef (Area 14) was favoured by the intercept respondents mainly because it gives shelter from prevailing winds and has a good catch success of species such as blue cod. Seven percent of all landed blue cod recorded in 1997 was from area 14, the highest catch rate inside the harbour. This study showed over 8 % of all landed blue cod was caught in area 14. These catch rates indicate that recreational fishers have relied on this particular area for fishing for numerous years. The benefit of staying close to the harbour entrance is two-fold. Firstly, if there is a change in the weather the distance to the slipways is within a reasonable distance. Secondly, larger fish may be caught near the harbour entrance due to the closeness of the coast and proven larger sized landed fish.

Mean lengths for all species landed and their distribution differed between location and season. The mean length of all catch in winter, both inside and outside the harbour, was less than 35 cm. The mean length of all catch during summer inside the harbour was greater than 35 cm and outside the harbour mean length was over 60 cm. A possible reason for the decrease in overall mean size over winter is the limitation of fishing activity due to adverse weather. Recreational fishers were reluctant to venture far from the harbour entrance during the winter months. As results have shown, many species have a larger mean size further out from the harbour. The change in mean size can also reflect seasonal changes which are individual to each species. Beentjes and Carbine (2005) found several variables that influence size in blue cod populations on Banks Peninsula such as offshore and in deeper waters which may provide a more prolific environment. The fishing pressure on inshore reefs may also reflect size composition. The present study found larger blue cod taken off-shore than closer to the coast. This result may indicate a high fishing pressure from fishing charter companies and recreational fishers along the inshore coast.

On average, 73 % of the intercepted fishers on the slipways stated they had never been interviewed previously. This indicates a large proportion of the intercepted fishers had been missed and catch could not be recorded.

To determine a more realistic biomass for each species an overall adjustment factor of 68.8 was applied. The biomass calculated without the overall adjustment factor led the biomass to be considerably underestimated. It is acknowledged that this adjustment factor may not be suitable for this study. However, it does give some estimate of the biomass for the main species. Further research is needed to create a working biomass formula for the Akaroa Harbour Taiapure and its surrounding fishing areas in order to establish an accurate weight of landed species. Total numbers of each species were scaled up with the adjustment factor of 2.9 in order to compare Bell's (1997) results. The results from the current study suggest that catch of red cod and flatfish has decreased in numbers while there has been an increase in catch for blue cod, perch, paua and shellfish. However, the results may not be accurate and only serve an indicator of a possible trend in catch differences. Long term monitoring of catch success is needed for more reliable results.

Catch per unit effort varied between trip records and the intercept survey. Blue cod recorded on the slipways had a catch rate of 1.2 fish an hour. The catch per unit effort was twice as high for the trip records. This may be the result of several of the charter boats specifically targeted blue cod. Red cod catch was very low for both surveys with between 0.2 and 0.4 fish per hour. This suggested a small population since only a few red cod were caught and killed. Rock lobster catch recorded by the intercept survey indicated a large population with 8.5 individuals caught per hour. CPU for rock lobster was three times less for the trip records. The reason is most likely fewer trips targeting rock lobster but also because there were only 138 trips recorded compared to the intercept survey with 451 trips. A greater number of trip record participants would possibly resulted in higher CPU for rock lobster. Comparisons between CPU for flatfish could not be done due to too few intercept survey trips targeting and catching flatfish.

The Maketu Taiapure recreational fishing survey by Bradford *al*. (2001) used a similar methodology to this study. It would seem that slipway intercepts, even though labour intensive, is one useful way of recording recreational catch. This method should be coupled with trip records (diaries) and the additional component of counting trailers and/or boat observations (aerial or otherwise).

Ditton (2002) states the importance of including questions concerning catch-and-release activity in recreational surveys, moreover, the need for the questions to be clear and concise in order to establish useful data. None of the surveys undertaken by Ministry of Fisheries has a social component whereby local knowledge has been recorded.

5.1.1 Intercept survey

The research provided an up-to-date profile of fishers in the Akaroa Harbour area. The main group that undertook recreational fishing in were males, 41-50 years of age, living in Christchurch. Several of the Ministry of Fisheries surveys report that this is the most frequent age group undertaking recreational fishing. The most common length of a vessel was 5-7 meters and classified as a cabin boat.

Research by Richardson *et al.* (2005) has shown that behaviour of fishers is paramount when planning resource management since attitudes varies greatly depending on age and vessel size. One in four respondents of the intercept survey stated to have a "Non Specific" target when fishing, which indicated a high participation rate without expectations of catching a specific species. The result of landed catch showed blue cod and perch as the main catch while rock lobster and mussels were the main shellfish collected. The result also showed an increase in catch of finfish for the first four hours then a drastic decrease in catch rate after this.

5.1.2 Trip Records

The trip record participants main catch was blue cod and flatfish, closely followed by perch. One in four trip record participants would set nets on a regular basis during the flounder season. March (2008) had increased fishing activity due to the start of the set net season. As the month progressed the fishing intensity for set-netting subsided. Paua (65 individuals landed) and rock lobster were the main shellfish collected. Largely Banks Peninsula residents where involved in trip record process and result showed that their fishing habits have not greatly since 1997. The recruitment of trip record participants resembles several Ministry of Fisheries research such as the Otago and Bluff Harbours recreational fishing survey in 1998.

Fishers were intercepted on slipways and asked to participate in recording their catch over time. For the current survey, while undertaking the intercept interviews some of the respondents were asked if they would be interested in recording their catch for the trip records.

By using this method, at least ten respondents were recruited as trip record participants. When they were later encountered on the slipways they did not have to respond to the intercept survey but instead would fill out a trip record. Four charter boats initially participated in the trip records, however, for the 2008/09 season there was only one company was actively filling out records. The reason for the charter companies not participating in the 2008/09 season is unknown. Similar to Bell's survey 1997, the trip records were mainly carried out by residents of Banks Peninsula who seem to have a more realistic view on what fish can be caught and where.

5.2 Key findings for main species

5.2.1 Blue cod

Results from the intercept survey suggested that the mean length of blue cod changed over the study with larger individuals caught between January and March. Larger individuals (>35 cm) were caught outside the harbour and offshore while mean lengths inside the harbour varied between 30-35 cm. Carbines *et al.* (2008) also found inshore blue cod to be smaller than the ones caught offshore. The three main areas for catching blue cod were area 14 (inside the harbour), area 18 (outside the harbour) and offshore (12 nautical miles). Beentjes & Carbines (2006) state that blue cod catch does not seem to be affected by the time of day but more so by tidal movement. Carbines *et al.* (2008) found blue cod were largely independent sub stocks and are vulnerable to population changes due to increased fishing pressure from both commercial and recreational fishing.

5.2.2 Red cod

There has been a significant decline in trips targeting red cod since 1997 whereby Bell found 44 % of all trips targeted red cod. The current survey found less than two percent target red cod, an indication that recreational fishers were aware of the apparent decline in red cod catch success and no longer target it.

Catch per Unit Effort (CPU) for red cod dropped from 1.75 in Bell's survey to 0.2 for the trip records and 0.4 for the intercept survey. The sample size in Bell's survey was much greater (n = 1741 trips) than the current surveys, however, results indicate a trend of decreased catch of red cod for the Akaroa Harbour area.

Apart from the occasional catch inside the harbour (in areas such 3, 6, and 8) the main catch of red cod was concentrated in area 14 (Dan Rogers Reef). Larger individuals (>45 cm) were found, as with the blue cod, in areas further out from the harbour entrance in areas 18 and offshore (12 nautical miles). The trip records and the intercept survey showed similar red cod mean lengths during the entire study. Studies on red cod have found that landings will fluctuate widely between years. According to Horn (1996) the fluctuations on the south-east coast of the South Island are related to yearly biomass rather than changes to fishing effort and is likely dependent on fast growth, high mortality and inconsistent recruitment.

Beentjes and Renwick (2001) found strong correlations between catch and surface temperature whereby cooler sea surface temperature would generate greater catch of red cod. Ministry of Fisheries (2008) research shows that red cod are seasonally abundant, appearing in large abundance in the Canterbury Bight and on Banks Peninsula around November but not found in these areas after June. Based on their catch, both commercial and recreational fishers have expressed concern at the continued decline in the red cod stock in the Banks Peninsula area over the past seven years (MFish 2009).

5.2.3 Perch

The Marine Recreational Fishing Survey in the Ministry of Fisheries South Region, 1991-92 (Tierny & Kilner 2002) showed perch as the third most caught species (after blue cod and flatfish) but not frequently targeted. These results are similar to the findings in this study, where the mean length of perch varied during the 14 months. Larger individuals (>35 cm) were caught during December and January with a drop in mean length over winter. Main areas for catch success were in the immediate areas (areas 14-17) around the harbour entrance. Fishing offshore did not automatically result in catching larger sized fish.

5.2.4 Rock lobster

In the present survey male rock lobster had an average width of 81.3 mm. Male rock lobster mean width is relatively evenly spread in areas 13–18 with the greatest mean tail width found in area 11 (inside the harbour). Lobsters with the largest mean tail width were found during December and January (>80mm). The smallest individuals were caught in areas 5 and 14 (inside the harbour) with mean tail width between 60-72 mm (March and October). Because few male rock lobsters were recorded on the slipways, especially during winter, it was not possible to determine a pattern over a year. Collecting rock lobster is dependent on the skill and experience of the diver but also weather, which was one of the main reasons for the gap in data between April and September (2008). For most part of the winter season (May to September) large swells at the harbour entrance, fog, strong southerly winds and snow restricted recreational fishing activity, especially diving.

Female rock lobster landed in the present study had an average tail width of 83.5 mm well above the legal size which is 60 mm. Sexual maturity in females is reached the width of 60-120 mm depending on the location (MFish 2009, Annala *et al*. 1980). The width of female rock lobsters caught was similar in areas 13 to 18 with the largest tail width (91 mm) found in area 11. Intercept respondents and trip records participants mean width results are similar in female catch over the duration of the study. As with the male rock lobster, few female rock lobsters were recorded on the slipways, especially during winter, and thus not possible to determine a pattern over a year. This may be due to fishing pressure on larger rock lobster over the summer months. The weather recorded during the present study showed mainly strong winds and rain during the winter months thus inhibiting any diving activity.

Iacchei *et al.* (2005) state that pressure from recreational fishing on the spiny lobster (*Panulirus interruptus*) in California clearly decreased the abundance of individuals of legal size. In a study by Mislan & Babcock (2008), commercial sized rock lobster were found to have a greater chance of increasing in numbers in marine reserves more than fished areas.

Shears *et al.* (2006) found that legal sized rock lobster (*Jasus edwardsii)* in north eastern New Zealand was over ten times more abundant in a marine protected area but no change was detected in abundance or size in the area with limited protection. The results were taken from 28 years of data which emphasises the importance of long-term data collecting in order to detect trends on abundance and size.

On Banks Peninsula, Pohatu Marine Reserve is located in area 19 thus close to areas where rock lobsters are frequently collected. The result of study has shown large (>80mm) rock lobster (both male and female) harvested from areas surrounding area 19 i.e. areas 17-18. Research has shown that spill over from marine reserves may compensate displaced fishing effort in adjacent areas and a 20 % movement rate has been observed across the borders of Leigh Marine Reserve in New Zealand (Hobday *et al.* 2005).

5.3 Catch and release as a management tool in recreational fishing

One of the aims of the present study was to establish the number and species of fish being caught and released. In order to establish potential survival, additional research needs to be conducted. The main reason for releasing red cod and blue cod was undersized catch as stated by the trip record participants and intercept survey respondents. Perch was released mainly for not being the targeted species (intercept survey) and undersized (trip records).

This study showed several species such as barracuda (*Thysites atun*), dwarf scorpionfish (*Scorpaena papillosus*) and banded wrasse (*Notolabrus fucicola*) were discarded as soon as they were caught because they were not the targeted species. Even though the method of catch and release is regarded as a management tool, the general assumption that most released fish will survive. However, Cooke & Wilde (2007) state that the mortality rates for released marine fish range from 0 % to 89 %. Minimum catch length for species is a common tool in recreational fisheries management. However, if the caught species is just under the required length and discarded, the mortality rate of these small fish could potentially be high and therefore limiting the number of individuals reaching allowable length (Coggings *et al.* 2007).

Another management issue is the harvest of rock lobster (*Jasus edwardsii*). Rock lobster go blind very quickly when exposed to sunlight, therefore it is imperative to measure them as soon as they are taken out of the water. If the individual is undersized it is paramount that it is immediately returned to the water. The same applies to female bearing eggs. Ideally, these variables should be assessed before the rock lobster is taken to the surface (MFish 2009).

5.3.1 Other management strategies

The types of hooks selected by recreational fishers can be used to minimise the damage and improve survival of fish that are released. According to Davey & Kopf (2006) hook size plays a crucial role in fish post release mortality. Larger hooks tend to cause greater damage and hook size should suit the morphology of the targeted species in order to minimise damage. Hook type and shape are also important and studies have shown circle hooks reduce mortality by 50 % compared to J-hooks. In a study by Mapleston *et al.* (2008), larger hooks and J-hooks did more damage and increased bleeding than the smaller hooks that decreased injury and lowered mortality rate after release. Studies on circle hooks in Spanish marine recreational fisheries have shown that these types of hooks were more repetitively hooked in shallow body areas than those fish captured with conventional hooks (Alós *et al.* 2008). Lewin *et al.* (2006) found that barbed hooks cause severe injuries when hooked in gills and eyes thus increasing handling time and exposure to air. Cooke and Wilde (2007) stated that research on barbless hooks in the Gulf of Mexico showed a significant reduced handling time and non lethal injuries in recreationally caught fish. Carbines (1999) argued that larger hooks would lower mortality of released blue cod and therefore recommended for management purposes. The removal of hooks and its associated mortality rate has been shown to be specific to what species is caught thus an important variable to consider for future research on post morality rates from catch and release.

During this study, several recreational fishers mentioned gas bladder expansion in fish that are rapidly brought to the surface. In this event, some species are not able to swim and will float on the surface. Fishers intercepted on the slipways stated they sometimes puncture the gas bladder of the fish with a sharp object to improve post–release mortality. Davey and Kopf (2006) state that this only worked for some species and did not recommend it for anyone without previous experience since incorrect handling may cause additional injury or death.

Drastic measures to protect specific species such as blue cod can be seen within the enclosed Marlborough Sounds area. The recreational fishery has been closed since October 2008 and is recommended to remain so until 2012. This decision was based on scientific data showing a decline of over 50 % of juvenile blue cod across Marlborough Sounds. The decision to close off the blue cod fishery was supported by the local community that have expressed concern over the dwindling stock (MFish 2009).

5.3.2 Recreational bag limits and size limits

The Ministry of Fisheries have set bag limits and size restrictions on fish species in an attempt to control the numbers of fish and shellfish taken by recreational fishers. In the South East area, there is a combined daily bag limit of 30 finfish per person. Akaroa Harbour Taiapure Committee has suggested lowering the finfish bag limits to ten and rock lobster bag limit to three per diver. The Ministry of Fisheries report that some of the highest take off recreational perch occurs on Banks Peninsula and currently there is no bag limit. The present study has shown that the second highest take (after blue cod) was perch yet there is no readily available scientific information on the abundance of this fish species. One concern with bag limits and size restrictions is that even though it prevents the recreational fisher from taking high numbers of certain species, it does not restrict the effort, mainly due to non-compliance and catch and release methods (Post *et al.* 2002).

Research has also indicated that older individuals of fish have a better survival rate and potential higher fecundity than younger fish (Birkeland & Dayton 2005). This has implications for the recreational fishing sector as it adheres to size restrictions such as blue cod (minimum size of 30 cm). Even so, small sized fish such as wrasse and blue cod were still landed so bylaws tailored to each protected area and species need to be clearly displayed on slipways and readily available in places where visitors have access to the information.

5.3.3 Marine conservation tools

In New Zealand, over 30 % of the population participate in recreational fishing and the annual harvest of some species has been recorded to be larger than in some commercial catch. For example, recreational blue cod (*Parapercis colias*) harvests in the Marlborough sounds have been estimated to be more than ten times the reported commercial harvest (Kerr *et al.* 2003). It is therefore vital for marine resource managers to include data on recreational take. Marine Protected Areas (MPAs) with a "no take" status is a tool well used in order to conserve marine habitats and marine organisms (such as fish).

Taiapure, matatai reserves and rahui are customary management tools that can be applied to areas in order ensure the sustainability of fisheries resources (Te Rūnanga o Ngāi Tahu 2007). Community based management is becoming a valuable tool in marine conservation and it is paramount to be aware of possible problems that may arise. These issues include cultural differences, miss-trust against local governmental bodies and resource users of not having power to participate in the decision making process. When all parties involved acknowledge potential co-operation issues, it makes it easier to identify possible problems. A great deal has been written about the management and conservation strategies concerning recreational fishing worldwide, especially in the last decade (Kirkegaard 1998, Gartside 1999, Sutinen 2003, Arlinghaus 2005, 2006, 2008, Cooke and Cowx 2006, Pawson 2008, Pomeroy 2008).

Boyd (2006) suggests a systematic approach involving the establishment of a framework of indicators when monitoring sustainable development in fisheries at local community level. Initially, probable indicators for general use in fisheries need to be identified; secondly, these indicators need to be suitable for the local community in question. This approach will ensure that the indicators are relevant to the local area, where before, large scale monitoring did not apply to smaller communities. Akaroa is a small community that sustains a large recreational fishing population both local and from other places on the South Island. It is also an important area for the commercial recreational fishing that depends on areas outside the harbour for its fishing. It must be determined whether the current fishing pressure on the Akaroa Harbour Taiapure and the coastal areas near the harbour entrance from the recreational sector is sustainable.

This present study included the perception survey which was especially developed to gauge the local resident's knowledge and awareness of recreational fishing and it s possible effects on fish stocks. This approach in very useful when establishing indicators for a small community. The overall opinion of many local residents on Banks Peninsula was that they would welcome a more collaborative relationship with the Akaroa Harbour Taiapure Committee. Social indicators in small scale fisheries are also essential for proper management of marine recreational fisheries. Research has shown that both positive and negative feed-backs on both community based management and marine protected areas (MPA). Research by Taylor and Buckenham (2003) showed that local residents near New Zealand's first marine reserve, Cape Rodney Okakari Point, had developed a strong bond to the area and demonstrated a strong sense of ownership. The local residents took it upon themselves to observe poachers and the researchers found a greater awareness of the marine environment since implementation of the reserve in 1975. Taylor and Buckenham (2003) also investigated the negative social impacts of marine reserves. The main predicament was local residents and other interest groups opposing locations of marine reserves.

Research showed that there is a notion among local residents that a marine reserve will negatively affect their fishing and shellfish harvesting whether it is recreational, customary or commercial. Such a situation arose with the establishment of Pohatu Marine Reserve on Bank Peninsula in the late 1990's. An extensive debate involving local residents and other interest groups on the location of the marine reserve took place, whereby the solution resulted in the establishment of a marine protected area in Flea Bay, east of the Akaroa Harbour entrance (Taylor & Buckenham 2003).

By using both the scientific and social approach coupled with the involvement of the local community in marine conservation a sense of ownership is prevalent (Ban *et al.* 2009). Once these tools have been implemented the need for continuous monitoring of restricted fishing areas is paramount and this strategy have been found to aid in marine conservation of fish (Westera *et al.* 2003). Berkes (2006) states community based management needs input from external drivers (such as local government and scientific knowledge) in order to make the appropriate decisions that are most beneficial to the environment. Davis (2008) found in a study on collaborative fisheries management in Canada that local community participation and involvement in the decision making process enabled small scale conservation measures to be implemented. The successful management depended on facilitation from the community and co-operation with local governmental bodies.

5.4 Perception survey

One of the aims of this thesis was to gauge long term user's perceptions of Akaroa Harbour on recreational fishing over time. The level of experience was a good indicator of knowledge on changes over time as was their current fishing activity.

5.4.1 Perception and profile of local residents in Akaroa Harbour

One of the key findings was the perception of never catching the bag limit for red cod or blue cod. A significant proportion of the respondents stated that the bag limits were too high for both species and the bag limit for blue cod (30 per person/day) was heavily criticised by all respondents. Bag limits for rock lobster (6 per person/day) and paua (10 per person/day) were considered to be collected most trips when targeted.

Another major finding was the perception of substantial decrease in red cod abundance. Other investigated species such as flatfish and blue cod were not thought to have undergone any drastic changes in the past five years. There were no major changes in shellfish abundance according to the respondents with many stating 'undecided' due to few trips targeting rock lobster, paua and mussels. The results indicated that less than half of the respondents were satisfied with the current recreational fishing rules. It was also shown that almost half of the respondents considered their overall catch success as poor and only 27 % stated they perceived it as good. The respondents were asked about their awareness of certain topics such as the set net ban enforced by The Ministry of Fisheries in 2008, the location of Pohatu Marine Reserve and the proposed reduction in bag limits for Akaroa Harbour as recommended by the Taiapure Committee. Overall, the respondents displayed a satisfactory level of awareness of issues in Akaroa Harbour. Information on the new set net ban seemed to have reached most of the respondents. The fact that all respondents knew the location of Pohatu marine reserves is a good indicator of community awareness and perhaps even 'police' the area if harvesting of marine organism is detected.

The community profile of fishers showed the majority of respondents had over 40 years experience of fishing and go out on a boat one to twenty times a year. The majority of the respondents were in their mid to late 50's, living on Banks Peninsula (including Akaroa). This study showed that respondent's main intention with their catch was to give it away to friend, family or neighbours. Many of the active fishers would often give their catch to members of the community that no longer have the ability to go fishing themselves. It was also found that the majority of respondents perceived the number of fishers in past five years had increased slightly. Commercial trips were not included in the results, however, the recreational fishing activity of commercial fishers were recorded Research has shown that understanding resource users and their relationship with their environment may generate and reinforce support for conservation programmes (Rogan *et al.* 2005).

An understanding of community perceptions will undoubtedly create a sense of ownership and stewardship among users of the harbour, which will then lead to a greater appreciating and hopefully an active role within groups of recreational fishers and divers (Arlinghaus *et al.* 2005). Recording perceptions of resource users in order to determine the reliability of local knowledge is becoming increasingly important in marine conservation and community–based management. Resource users believe that management without the consideration of local input will only offer a limited solution (Stump & Kriwoken 2006). Research by Larson and Lach (2008) has shown that gauging local perceptions is far more beneficial when done in a setting with fewer people rather than open meetings. The current survey showed that this point of view was shared among many of the respondents. Further research on this topic is recommended in order to gauge resident perception on recreational fishing issues such as change in abundance of species, efficiency of bag limit and size restrictions and traditional knowledge of marine conservation methods.

5.4.2 Methods of shellfish collection over time

The main method of collecting mussels over the past 20 years was hand-gathering from shore followed by diving from shore (refers to snorkelling). Multiple methods of collection have over the years also been popular. The multiple methods were not used on one single trip but rather over several trips. Very little information exists on the mussel abundance in the Banks Peninsula area and the Ministry of Fisheries state their data from previous surveys is unreliable because of a methodological error (MFish 2009). Mussels are found low on intertidal shores where they are relatively easy to access. Anthropogenic activities may cause damage through trampling or bag limits being exceeded (50 per person/day) (Smith *et al.* 2008). The main differences in collecting paua methods over the past 20 years appeared to be an increase in hand gathering, a decrease in diving from shore and a decrease in multiple methods used (hand gathering from shore, diving from shore, boat diving). The respondents were mainly in their 50’s and this may factor into decisions on collecting shellfish. It may be that these respondents know the area where to most successfully collect shellfish and do not require a boat to get there.

Since the sample size for the perception survey was only 22 it is likely that the results may have been different with an increased number of interviews. Rock lobster collecting over time data was not analysed since the sample size was >5. There is a potential bias in the results of the shellfish survey considering the target population were residents of Banks Peninsula or Christchurch residents with longstanding fishing experience in Akaroa Harbour.

5.4.3 Responses to the open-ended questions

According to Ministry of Fisheries (2007), anecdotal evidence from both the commercial and recreational sector indicates concerns about the sustainability of red cod stocks off the east coast of the South Island. Similar anecdotal evidence was found in the perception survey. The majority of respondents mentioned the decrease in red cod abundance in the Akaroa Harbour as a major problem. Reasons for the decline in red cod were not investigate in this study and in order to manage the stock it is paramount that the decline is understood. The research on this is sparse and there is little information on possible reason for the decline in red cod abundance elsewhere in New Zealand.

The Ministry of Fisheries enforced a national ban on set netting on 1st October 2008 which applied to both commercial and recreational fishers. This new regulation meant a total ban on moki and butterfish netting for the whole year in Akaroa Harbour. Many respondents of the perception survey had strong opinions on the ban and how it was implemented. The respondents stated the main problem with the decision and implementation process was the lack of local knowledge recorded by the scientific advisors in charge of the research. The main reason for the ban was the protection of the Hectors dolphin (*Cephalorhynchus hectori*).

There has long been concern from the Ministry of Fisheries and NIWA of the number of fish taken on charter trips in New Zealand. Inadequate regulations could result in adverse effects on fish stocks and the marine ecosystem. The Australian Ministry of Agriculture proposed a management plan for the charter boat fishery operating in South Australia in 2003 (Presser & Mavrakis 2005).

Management tools included limited entry, licenses, limits on catch, implementing log book of caught species and also registration of the charter boat. In New Zealand, all charter vessels will be required to be registered with the Ministry of Fisheries from July 2009. There will be a voluntary requirement to complete logbooks from 1st of July 2009 which then will become compulsory in 2010 (the Ministry of Fisheries pers comm. 2009).From the perception interviews it was clear there was a slight resistance from certain fishing charter operators to the Ministry of Fisheries new regulations. This is of course highly concerning from a resource management perspective and indicates an unwillingness to co-operate with local government in order to sustain recreational and commercial recreational fishing. Akaroa Harbour could be subject to several fishing charter companies competing for the same spots thus increasing pressure on fish stock. There is also the potential of conflict between fishing charter companies, commercial vessels and recreational fishers utilizing the same areas and targeting the same species. The perception survey revealed that fishing charter companies have in the past followed commercial vessels to fishing spots only to then use them for their own business thus increasing the risk of putting pressure on certain areas and may cause adverse effects on fish populations.

5.6 Research summary

The flowchart summarises the work undertaken for the Akaroa Harbour recreational fishing survey 2007-2009. The below summarised steps enables future researchers to successfully re-create the survey in the format used for this thesis (Figure 5.1). Creating a community based management framework with interdisciplinary tools makes possible to successfully manage marine recreational fisheries and its associated environments.

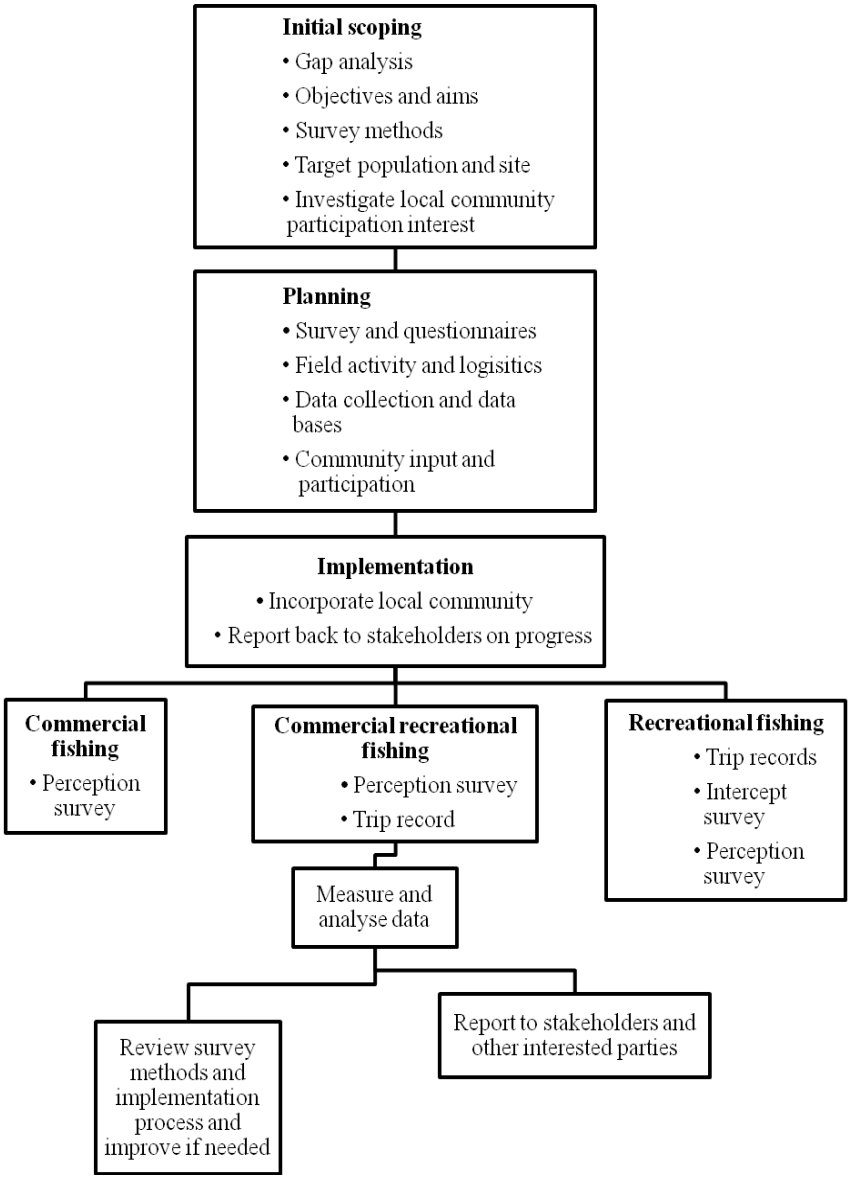


Figure 5.1 Flowchart of steps taken in the research process

5.7 Recommendations

(i) Integrating tools such as MPAs and a taiapure with community based management should in theory provide a full proof management strategy. With the Akaroa Harbour Taiapure and a marine reserve just outside the harbour entrance (Pohatu marine reserve) it seems imperative to get the local community involved in conservation management. The literature shows that allowing the local community access to the decisions making process will in turn create a sense of ownership. In order to create a greater sense of community it would be desirable to make the Taiapure committee more visible on Banks Peninsula. Creating a sub-group to the committee whereby active and retired members of the community can serve as a 'middle persons' may increase involvement of locals. It may also generate public interest and drive future improvements in angling gear and practices. Utilizing the Akaroa Mail may also aid in communicating to the local community resource management and Taiapure committee progress that concern the harbour.

(ii) The need for increased presence of Department of Conservation and the Ministry of Fisheries both on the water and on the slipways is prevalent. This is obviously a financial and logistical issue within the ministries.

(iii) Need for further research on recreational fishing and the use of local knowledge. There is a tremendous opportunity in Akaroa Harbour to create successful local participation coupled with scientific input and governmental assistance. In order to create a data base of recreational fish take to detect trends, continuous surveying is paramount. The three surveys created for this thesis can be used again preferably within the next couple of years. Because this work was labour intensive and logistically difficult at times, the preparation for the field work needs to be carefully coordinated in order to ensure most efficient method and time to survey recreational fishers. The importance of a clear definition of success and associated means of measurement are very important and the objectives need to be in terms of testable hypotheses. The aim for both the trip records and intercept survey should be an increase in sample size and should include hook type and size.

Volunteer surveyors must have prior knowledge of fish for easy and quick identification. The perception survey should also be done again with larger sample size.

(iv) Review bag limits as it seems redundant to set limits when the abundance of the some species in a certain areas is not satisfactorily recorded. In order to sustainably manage stocks it is imperative to create a framework that accurately assesses the fish populations and a quota system (instead of bag limits) that will sustain these.

(vi) It is paramount to create public awareness and information should be readily available on slipways and other outlets (such as petrol stations, motels, camping grounds and pubs). Information that need to be include catch and release procedure, fish species identification, bag limits and size restrictions as well as information also deep sea fish since these are sometimes caught by recreational fishers.

(vii) Follow up on charter boat operator skills and knowledge. Under the Ministry of Fisheries new regulations on registration it will undoubtedly become more important to implement continuous monitoring on charter operators. Ideally, the operators should be aware of current rules and regulations, fish species identification, safety at sea, fish handling (alive and landed) and actively cooperate with local government and the Taiapure Committee. Information provided by charter operators should include, a part from the catch; water temperature, wind speed and direction and catch/release data. If possible, observers will make random visits on trips, specifically to monitor the catch and release rate of species of interest (such as red cod, blue cod and perch).

(vii) Further research on catch and release mortality. This is paramount for the main recreational fishing targets (blue cod, perch, flounder, red cod, paua and rock lobster). In addition, minimum and maximum sizes of main fish species investigated in this study needs to be revised by Ministry of Fisheries and possible maximum width for rock lobster should be investigated.

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So long and thanks for all the fish

Appendix I

IMPORTANT:

We are **NOT** here to police your catch!
We just want to get as much info about fishing in the Akaroa area as we possibly can.
That will help the Akaroa Taiāpure Committee to make sure that the fishery remains healthy for your future.

All the information we gather is
100% CONFIDENTIAL

This research has been funded by Te Rūnanga o Ngāi Tahu, with additional support from University of Otago and University of Canterbury

UC UNIVERSITY OF CANTERBURY

UNIVERSITY OF OTAGO

Te Rūnanga o NGĀI TAHU

This research effort is part of Te Tiaki Mahinga Kai, a national coalition of customary fisheries managers and researchers. The vision of the coalition is for enhanced and sustained customary fishing through Aotearoa – New Zealand. The project is non-profit making and could do with your donations. You can read about the project on www.mahingakai.org.nz

Te Tiaki Mahinga Kai

Where to find the results of this survey

We will do this survey for a complete year– continuously over peak summer months and then intermittently at other times. The results will be written up in a report and available on Te Tiaki Mahinga Kai website in September 2009.

www.mahingakai.org.nz

Any questions ?
If so, please contact Dr. John Pirker
Email: john.pirker@canterbury.ac.nz
or phone:
Tel: 03 366 7001
University of Canterbury
Private Bag 4800

Akaroa Harbour Recreational Fishing Survey 2008/09

If kiwis want to be able to catch big, healthy fish in the future, then we all need to learn as much as we can about managing them wisely, starting now!

Akaroa Harbour Taiapure

- The Akaroa Harbour Taiapure was gazetted on the 31st March 2006, as a result of a required legislative process.
- The primary purpose of the Taiapure is to enable local parties to protect and enhance inshore waters and to sustainably manage marine life, habitats and customary and recreational fishing.
- A Taiapure makes provisions for a management committee to be established to give advice and recommendations to the Minister of Fisheries.
- Members of the Taiapure Committee are nominated by tangata whenua and can include commercial interest groups, boating clubs, recreational fishers and aquaculture representatives.
- Regulations within Taiapure areas cannot discriminate against people on the grounds of colour, race, or ethnic or national origins.

What is going on?

If you've got this brochure, we have most likely already been asking you some questions about your fishing.

Who are we?

Kia ora! We are researchers working for the Akaroa Taiāpure Committee. The survey is undertaken by students from University of Canterbury and University of Otago in order to establish management strategies for local sustainable fisheries. These strategies will ensure good numbers of fish for years to come.

… and what do we want?

We want your help to learn about:

- Fish stocks and whether they are changing.
- Fishing effort and catch success
- Who's using Akaroa Harbour and what for?
- What do people want to see as the main opportunities and threats to good fishing in Akaroa harbour?
- How aware are people about the Akaroa harbour fishing regulations, and how do fishers feel about them?

Our fishy questions

- Numbers and size of finfish, shellfish and crayfish you caught?
- The species you caught?
- Where you caught them?
- What you caught them with?
- How long did it take you?
- How many you put back?
- How you think the fish and fishing has changed here over the years?

If you had the time, we might have asked questions about:

- Where you come from
- Why you like to fish in the Akaroa area
- How you feel about the management in Akaroa harbour and current fish stocks

These figures give a **benchmark** — The Akaroa Taiāpure Committee will repeat this survey in 3-5 years so they can gauge whether your fishing experience is slipping or improving. Remember that the survey is confidential and we would just like you to be as accurate and honest as possible about your catch!

Appendix II

Date: / /2009 1.Weekend 2.Weekday

Marine wind scale (Knots):

1. Calm	(0-3)
2. Light	(4-10)
3. Moderate	(11-21)
4. Strong	(22-33)
5. Gale	(34-47)
6. Storm	(48-55)

Water (Knots) (*m*):

1. Calm /Smooth	(0-10)	*(0-1.0)*
2. Slight	(1-16)	*(1.0-2.0)*
3. Moderate	(17-21)	*(2.1-3.0)*
4. Rough	(22-27)	*(3.1-5.0)*
5. Very Rough	(28-33)	*(5.1-12)*

Direction: 1. N 2. NE 3.E 4.SE 5.S 6.SW 7.W 8.NW 9. No wind

Rainfall:	Nil	Light	Mod	Heavy
	1	2	3	4

Air temp (°C): 1) -2 – 0 2) 1-5 3) 6-10 4) 11-20 5) 21-30 6) 31-40

Cloud cover (%): 1) 0-20 2) 21-50 3) 51-80 4) 81-100

COMMENTS:

Appendix III

Perception Survey of Recreational Fishing in Akaroa Harbour 2008

Survey number: **Date :** **Location:**

1. Age: (1) Under 20 years (2) 21-30 (3) 31-40 (4) 41 -49 (5) 51-60 (6) 61-70
(7) 705= 20-25+

2. Gender: (M) Male (F) Female

3. Where do you live: Akaroa Banks Peninsula Chch Ashburton

Canterbury N.I S.I Overseas:_____

4. Ethnic group: Pakeha/European NZ Maori Pacific Other: _____

5. How many years fishing in Akaroa harbour?

(1) Less than 5 years (2) 5-9 (3) 10-14 (4) 15-19 (5) 20-24 (6) 25 or more

6. How often did you go fishing/handgathering/diving in the harbour in the past 12 months?

1) 0-5 2) 6-10 3) 11-20 4) 21-30 5) 31-40 6) 41-50

7) 51-60 8) 61-70 9) 70+

7. Are you aware of the Akaroa Harbour Taiapure? Yes No

Comment_____

8. Are you aware of the reduction in bag limits proposed for Akaroa Harbour by the Akaroa Harbour Taiapure Commitee? Y / N

_____

9. Are you aware of the new set net restrictions in Akaroa Harbour as decided by Ministry of Fisheries? Y/ N ----------

1. Age: (1) Under 20 years (2) 21-30 (3) 31-40 (4) 41 -49 (5) 51-60 (6) 61-70 (7) 705= 20-25+

2. Gender: (M) Male (F) Female

3. Where do you live: Akaroa Banks Peninsula Chch Ashburton Canterbury N.I S.I Overseas:_____

4. Ethnic group: Pakeha/European NZ Maori Pacific Other: _____

5. How many years fishing in Akaroa harbour?

(1) Less than 5 years (2) 5-9 (3) 10-14 (4) 15-19 (5) 20-24 (6) 25 or more

6. How often did you go fishing/handgathering/diving in the harbour in the past 12 months?

1) 0-5 2) 6-10 3) 11-20 4) 21-30 5) 31-40 6) 41-50

7) 51-60 8) 61-70 9) 70+

7. Are you aware of the Akaroa Harbour Taiapure? Yes No

Comment_____

8. Are you aware of the reduction in bag limits proposed for Akaroa Harbour by the Akaroa Harbour Taiapure Commitee? Y / N

_____

9. Are you aware of the new set net restrictions in Akaroa Harbour as decided by Ministry of Fisheries? Y/ N ----------

17. In you opinion, are the recreational fishing rules in the Akaroa area:

A) Satisfactory B) Not Satisfactory

Please comment: _____

18. In your opinion, should all set-netting in Akaroa harbour be banned? Yes No

Please comment: _____

_____

19. What do you do with your catch?

a) Eat fresh/freeze yourself b) Give friends to eat fresh/freeze

c) Both d) other (please specify) _____

20. Do you find that you have to go *outside* the harbour to catch you target species? Yes No

If YES, please state target species and location: _____

_____

(SHOW LAMINATED MAP)

21. In the past *5 years*, do you consider the number of people fishing in Akaroa has...

Decreased substantially 1 2 3 4 5 Increased substantially

Comment: _____

22. Are you aware of the location of Pohatu marine reserve? Y / N If yes, please state location:

_____

23. Paua abundance: **Card no.2**

(a) How many years have you collected paua? *Or* Do not collect paua _____

(1) Less than 5 years (2) 5-9 (3) 10-14 (4) 15-19 (5) 20-24 (6) 25 or more

(b) What fishing method(s): **Card no. 3**

	(1) Hand gatheri from shore	(2) Diving from shor	(3) Boat Diving	(4) Other
A) Past 12 months				
B) 5 yrs ago				
C) 10 yrs ago				
D) 20 yrs ago				

(c) On how many days each year did you collect paua? **Card no. 4**

Time	(1) Less than 10 days /year	(2) 10- days/year	(3) 20- days/year	(4) 30- days/year	(5) 40- days/years	(6) 50 or more days per year
A) Past 12 month						
B) 5 years ago						
C) 10 years ago						
D) 20 years ago						

(d) Please indicate locations on **MAP** where you have collected in the last 20 years.

AREA INSIDE: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

AREA OUTSIDE: 15 16 17 18

(f) How would you rate the ability to fish in each of these sites in over the past 20 years? **Card no.6**

Area number	A)12 months ago	B) 5 Years ago	C) 10 Years ago	D) 20 years ago

(g) Have you ever commercially harvested paua?

1. 20 years ago Y / N

2. 10 years ago Y / N

3. 5 years ago Y / N

4. Now Y / N

(h) Abundance of paua in the last 5 years has:

Decreased significantly 1 2 3 4 5 Increased significantly

Appendix IV

INTERCEPT SURVEY:

AKAROA RECREATIONAL FISHING 2008-2009

Date: / / **Interviewer Name**: **Interview Number:**

1. Location: Main Wharf Main slipway in Akaroa Duvachelle slipway Wainui slipway

Other (specify):_____

7. Ownership: Charter Private Hired Other (specify):_____

8. Boat or Charter Name: _____

9. Length: _____m _____Ft

10. Type: Runabout Cabin boat Dinghy Yacht Charter-boat

11. Day trip? Yes No

12. Intentions with your catch? REGARDLESS if you caught something today or not!

A Keep yourself	**B** Give away
C Both	**D** Other (specify)

13. Time (am/pm) left: _____

14. Location where left: Main Wharf Main slipway in Akaroa Duvachelle slipway Wainui slipway

15. Main species targeted: _____

16. Method:

A. Rod and line from boat		Hooks per line	
B. Rod and line from shore		Hooks per line	
C. Diving w tanks (handgathering)		No. divers	
D. Diving w tanks (spearing)		No. divers	
E. Free diving (hand gathering)		No. divers	
F. Free diving (spearing)		No. divers	
G. Hand-gathering from shore		No. of people	
H. Pots		No. pots	
I. Set nets		No/size/mesh	
J. Hand nets		No/size/mesh	
K. Dredging		No/size	
L. Set line		No/hooks	
M. Long line		No/hooks	
N. Other (specify)			

17. Time landed: _____

18. Location where landed: Main Wharf M ain slipway in Akaroa Duvachelle slipway Wainui slipway

19. Hours actually fishing (*not* travelling) _____ hr(s) Diving _____ Min

20. Total number of people on trip: _____

Age	**Fishing**	
	Male	Female
0-5		
6-10		
11-15		
16-20		
21-30		
31-40		
41-50		
51-60		
61-70		
71-80		
80+		

10. If you have been fishing in Akaroa for the <u>past 5 years</u> has the catch success in your opinion for *(species)...*

Decreased substantially 1 2 3 4 5 Increased substantially

Blue Cod:_____ Paua: ___ Mussels: ____

Crayfish:_____ Flounder: ___ Moki ____

Red Cod:_____ Groper :___ Butterfish ____

If changed, please state why_____

11. Within the Taiapure over past 12 months, how regularly would your catch meet the bag limit for *Blue cod*?

Never 1 2 3 4 5 Every time fishing

12. Within the Taiapure over the past 12 months, how regularly would your catch meet the bag limit for *Crayfish*?

Never 1 2 3 4 5 Every time fishing

13. Within the Taiapure over the past 12 months, how regularly would your catch meet the bag limit for *Paua*?

Never 1 2 3 4 5 Every time fishing

14. Within the Taiapure over the past 12 months, how regularly would your catch meet the bag limit for *Red cod*

Never 1 2 3 4 5 Every time fishing

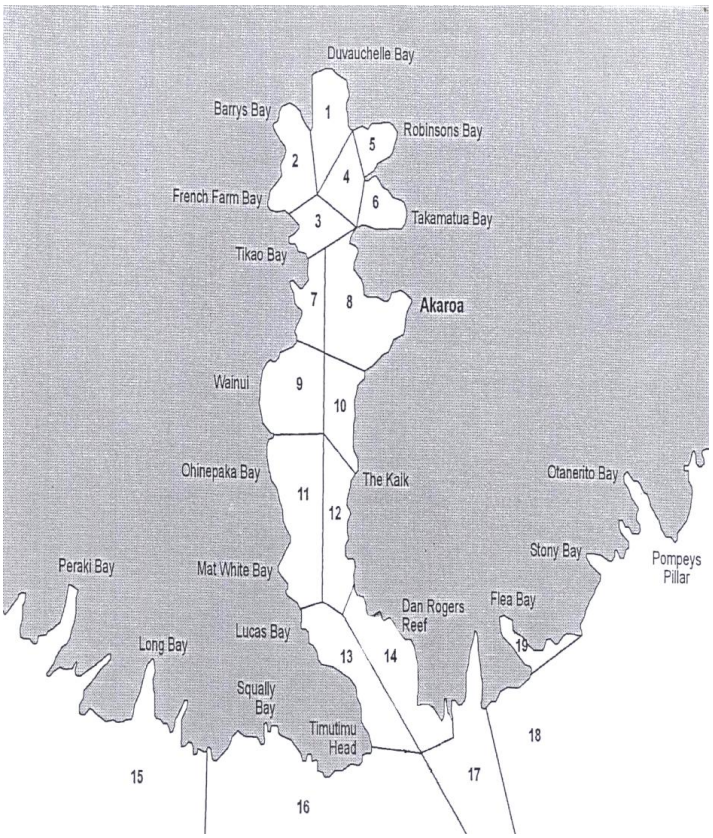
15. In the past 12 months do you consider your overall catch success for all species you target in the Taiapure to be: Very poor 1 2 3 4 5 Very good

16. Do you have a regular target number of catch you want to catch each trip? Yes No

If yes, please state main reason: _____

21. Please put X where you were <u>actively</u> fishing today and correlate it with the fish species you caught. Please record number of each species in the column to the right. ***Landed ONLY!***

(a) Blue Cod	
(b) Red Cod	
(c) Rays	
(d) Flatfish (specify)	
(e) Greenbone/ Butterfish	
(f) Kawahai	
(g) Barracouta	
(h) Moki	
(i) Mussel	
(j)Rock lobster	
(k) Paua	
(L) Groper /Hapuku	
(m) Tarahiki	
(n) Wrasse	
(o) Trevally	
(p) Perch	
(q) Gurnard	
(r) Dwarf Scorpfish	
(s) Trumpeter	
(t) Other	



Caught and Released

Species: Number of fish:_____Why:_____

Species: Number of fish:_____Why:_____

Species: Number of fish:_____Why:_____

Trip record

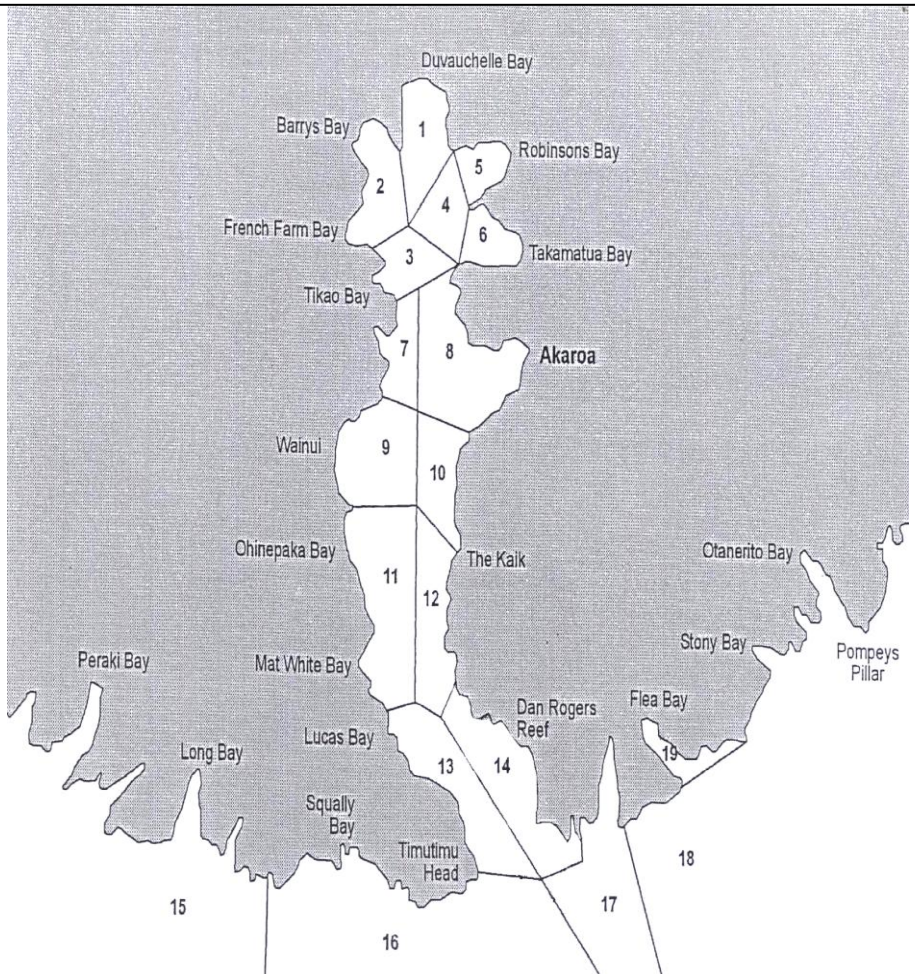
Date of Trip:
Departure location:

Survey Number:

Please use a separate trip record for each trip

Hours spent actively fishing/diving/hand gathering etc: **Hrs**	
Type of fishing method (rod/line, diving, hand gathering, nets, pots etc):	
Type of boat (private, charter, hired):	(POB) M: F:
Species targeted:	
In the table below, please record species and length (Cm). Please note the number of the area with the species you caught. **Please note Male/Female for Rock lobster AND <u>width in mm</u>.**	

Species caught & killed	**Length (Cm)**
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	



Species caught and killed	Length (Cm)
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	

"Catch and release" information: Please list what species was released, length and why using the abbreviations in the index below:

US= Undersized D= Damaged NTS= Not Targeted Species O= Other reason (please specify)

Species	Why released

Instructions to TRIP RECORD

1. *Date of trip:* Please state the date the trip took place with DD/MM/YY.

2. *Departure location:* Please state one of the following: Main Wharf, Launching ramp by the Recreation ground, Wainui, Duvauchelle launching ramp or Other (please specify).

3. *Hours spent actively fishing*: Please state as accurately as possible in hours. If fishing less than 1 hr, please state minutes.

4. *Type of fishing*: Please state you method i.e. line, hand gathering from shore, diving etc. If more than one method was used, please state ALL methods.

5. *Type of boat*: Please state if the boat you were fishing from was Charter, Private, Rented or Other (please specify).

6. State how many *People On Board (POB),* also how many females and males.

7. The following is an **example** of how to fill out the *species caught list.* This list continues on the back of page 1 (45 rows).

Species caught and killed	**Length (Cm)**
1. Blue Cod	34
2. Blue Cod	35
3. Gurnard	36
4. Rock Lobster (M)	54 mm (width)
5.Flatfish (Yellowbelly flounder)	40

8. *Catch and release information:* Please list the species released and why using the following abbreviations: Undersized (US), Damaged (D) i.e. hook through eye etc, Not Targeted Species (NTS), Other reason (O) please specify.

If you have any questions please contact:

Emma Kallqvist

Email: emk26@student.canterbury.ac.nz

Trailer count data

Indicate Weekend (WKD) or Weekday (WKY) in the date section

Date:	Main slipway in Akaroa	Daly's Wharf Akaroa	Duvauchelle slipway	Wainui slipway
9am				
Noon				
3pm				
6pm				

Date:	Main slipway in Akaroa	Daly's Wharf Akaroa	Duvauchelle slipway	Wainui slipway
9am				
Noon				
3pm				
6pm				

Date:	Main slipway in Akaroa	Daly's Wharf Akaroa	Duvauchelle slipway	Wainui slipway
9am				
Noon				
3pm				
6pm				

Date:	Main slipway in Akaroa	Daly's Wharf Akaroa	Duvauchelle slipway	Wainui slipway
9am				
Noon				
3pm				
6pm				

Mount Bossu observations

11-01-09

6am-4pm

East = (towards area 17 and 18)

North = (inside the harbour)

West = (towards area 15 and 16)

South = (area17/16 and offshore)

Time out	Time in	Direction at heads when leaving	Depart from	Arrived at	Came from on return	Type of boat	Comments

Date	slipway	name							
23/01/2009	main	trish							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
3	9		3	4	11	0	0	0	

Date	slipway	name							
24/01/2009	wainui	trish							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
0	0	1	7		9	1	4	0	

Date	slipway	name							
25/01/2009	wainui	trish							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
4	1	1		4	6		2	0	

Date	slipway	name							
25/01/2009	main	jennifer							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
1	14	12	3	1	15		2	0	

Date	slipway	name							
25/01/2009	wainui	jennifer							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
2	11	10	3	2	13		5	0	

Date	slipway	name							
26/01/2009	main	emma							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
1	4	1	1	1	5		1	0	

Date	slipway	name							
26/01/2009	duvauchelle	emma							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
1	2		0	1	3		0	0	

Date	slipway	name							
12/01/2009	duvauchelle	emma							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
2	2		0	2	4		0	0	

Date	slipway	name							
22/01/2009	duvauchelle	emma							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
3	9	0	0	3	9		1	1	

Date	slipway	name							
23/01/2009	duvauchelle	emma							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
1	4	1	0	1	5		2	0	

Date	slipway	name							
11/01/2009	wainui	jennifer							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
0	2	0	2	0	2		0	0	

Date	slipway	name							
18/01/2009	wainui	jennifer							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
3	9	7	5	3	12	0	5	0	

Date	slipway	name							
19/01/2009	duvauchelle	emma							
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined	
1	4	0	0	1	6	1	2	0	

Date	slipway	name						
22/01/2009	duvauchelle	emma						
Fished/dive	Not fished	Ysch/sailing	Jetski	Interviewd	Tot. People talked to	trip rec	missed	declined

Appendix V

EMMA Källqvist

AKAROA FISH SURVEY 2007-2009