PEST OR PASTIME?

COARSE FISH IN

AOTEAROA/NEW ZEALAND

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KATHRYN SARAH CARTER

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The charm of fishing is that it is the pursuit
of what is elusive but attainable,
a perpetual series of occasions for hope (John Buchan).

Coarse anglers fishing at Lake Hakanoa, Huntly (photograph by Brendan Hicks).

ABSTRACT

Freshwater ecosystems are extremely important, both socially and ecologically, in Aotearoa/New Zealand. However, through detrimental practices of land-use change and the introduction of non-indigenous aquatic species, the health of freshwater areas is increasingly under threat. Coarse fish are one group of non-indigenous fish that are largely perceived to have a negative effect on freshwater biodiversity and water quality. Despite this, there are people in New Zealand that value coarse fish highly, and consider their lives to be enriched through the practice of coarse angling.

This thesis examines the diversity of perceptions and values ascribed to coarse fish by a variety of different environmental managers and resource users to understand how these multiple meanings influence approaches to freshwater biodiversity management in Aotearoa/New Zealand. As coarse anglers are often considered responsible for deliberate translocation of coarse fish, a space for communication and compromise between these stakeholder groups is also identified. Additionally, appropriate and effective educational methods to raise awareness of freshwater ecosystem restoration and non-indigenous invasive fish are discussed.

Social factors are often the primary determinants of whether conservation efforts succeed or fail. Grounded in the theoretical perspectives of social construction, environmental perception, political ecology, and critical environmental adult education, this thesis provides an important contribution to the practice of interdisciplinary research by demonstrating the ways in which social science complements scientific approaches to environmental management. Utilising semi-structured interviews with multiple stakeholder groups and an internet survey targeted at coarse anglers this research found that, while a multitude of perceptions of coarse fish exist, there is also willingness on both sides to engage in communication and develop effective practices to aid in managing the freshwater environment. A number of suggestions for improving legislation that addresses invasive freshwater fish, and several ideas regarding education and compliance, also emerged.

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CHAPTER 1: INTRODUCING THE RESEARCH

1.1 The research

Restoring indigenous ecosystems and biodiversity has become a key focus in New Zealand conservation in recent years. One of the projects that has emerged as a result of this, funded by the Foundation for Research, Science and Technology (FRST), is entitled 'Restoring Freshwater Ecosystems and Resurrecting Indigenous Lake Biodiversity' (FRST contract UOWX0505). This research targets Milestone 11 of this project: 'overcoming human behavioural barriers to successful 'pest' fish management' (Appendix I). This thesis will fulfil the requirements of a Master in Social Science, and a modified report will be produced to address the FRST milestone.

1.1.1 The research objectives

The original aim of this research, based upon the desired outcome of Milestone 11, was to identify the most effective methods to reduce the chances of 'pest' fish species further increasing their geographical range through human activity, and to understand the reasons for the deliberate translocation of coarse fish species in particular. Additionally, the perceptions of various public stakeholder groups regarding the use of eradication and control techniques were to be investigated. The final aim was to identify effective educational methods and incentives to help discourage the further spread of non-indigenous invasive fish, and to raise awareness of the freshwater ecosystem restoration programme in general.

I attempted to approach the above research questions situated as they were within a scientific framework by utilising social geography perspectives. However, this was problematic as the questions as they stood did not easily lend themselves to investigation by social science understandings and methodologies. Additionally, the assumption that coarse fish should be considered pests (despite evidence of people valuing them highly), and that coarse anglers behave in an undesirable manner, were based on value judgements that conflicted with my own world view. Subsequently, the research questions were reframed.

Thus, the following five research objectives were investigated: (1) To examine the diversity of perceptions and values ascribed to coarse fish by a variety of different environmental managers and resource users; (2) To understand how these multiple meanings influence approaches to freshwater biodiversity management in Aotearoa/New Zealand; (3) To identify a space for communication and compromise between environmental management agencies and coarse anglers, in order to promote the effective and just management of coarse fish and freshwater environments; (4) To identify opportunities for improving the ways in which the different agencies and stakeholder groups currently operate and interact; and (5) To investigate appropriate and effective educational methods to help discourage the further spread of non-indigenous invasive fish, and to raise awareness of the freshwater ecosystem restoration programme in general.

1.1.2 The importance of the research

There is a high level of concern for indigenous species in Aotearoa/New Zealand, as their isolated evolution means they are particularly susceptible to the impacts of non-indigenous invasive species. Functioning freshwater ecosystems are an essential part of New Zealand's environment, yet they have been identified as particularly vulnerable to the impacts of invasive species. The freshwater fish most commonly introduced tend to be those stocked for sports fishing, in particular salmonid and coarse fish, which have also proven to be among the most damaging of the introduced fish species (de Winton et al., 2003; Fuller, 2003; discussed further in Chapter 2). This research addresses the values associated with coarse sports fish and coarse angling to develop effective and socially just practices for managing coarse fish in New Zealand's freshwater environment.

Additionally, the research makes an important contribution to understanding the ways in which social science influences and compliments scientific approaches to environmental management. The 'environment' has been identified as a socio-political construct as much as it is a physical reality, and it is important to bring the understanding that the social sciences (such cultural geography) can provide to research into environmental issues. Mascia et al. (2003) identify that while biology provides theoretical and analytical tools to recognise rare or endangered ecological systems, social factors are often the primary determinants

of the success or failure of conservation efforts. As humans are ultimately responsible for the transportation and introduction of invasive species to New Zealand, as well as their naturalisation, establishment, and spread (Lee et al., 2006: 3), it is vitally important to include socio-political perspectives in research that examines these processes.

1.1.3 Research approach

Semi-structured interviews were carried out with key personnel from a variety of stakeholder groups and resource users. Following this, an internet survey was implemented to gain a more comprehensive understanding of the practices and perspectives of coarse anglers. Concurrently, a review of relevant literature was undertaken to situate this study within its broader context, enabling the theoretically-based social aspects of the research to be investigated effectively, as well as aligning the more practical, science-based facets with current debates.

It was originally intended that this be a preliminary study carried out in the Waikato region, to keep it at a manageable level for a Master's project. While the major focus is still on the Waikato region, informants from Auckland, Rotorua, and Christchurch were also contacted, giving this research a slightly wider application. It is hoped that the methods trialled in this project will provide a base for further research to be carried out in the wider New Zealand region.

The specific stakeholder groups studied were Environment Waikato, Auckland Regional Council, the Department of Conservation, the Ministry of Fisheries, the Auckland/Waikato and Eastern Regions of the Fish and Game Council of New Zealand, and a freshwater scientist from the National Institute of Water and Atmospheric Research. The New Zealand Federation of Coarse Anglers and individual coarse anglers were interviewed as key resource users. The opinions and perceptions of local iwi (Waikato-Tainui) – obtained through a semi-structured interview and utilising secondary sources – are also taken into account in this research, but are not classified as either a 'stakeholder group' or a 'resource user', as many Māori would consider themselves kaitiaki (guardians of the environment) and both ecologists and fishers.

1.2 Positioning myself within the research

I have undertaken this research from a unique position. Although this has proven extremely valuable, it has also resulted in a persistent sensation of discomfort and constant re-evaluation of my beliefs. I am at home in the worlds of both science and social science, having completed a bachelor's degree in biological sciences in 2006 and an honours degree in (social) geography in 2007, and was surprised to find that the distance between the two disciplines was deeply entrenched. I could see the value that ecology and geography offered each other, particularly in regard to issues relating to the environment, and was inspired to undertake research that spanned to the two fields to help demonstrate this. However, the undertaking proved much more challenging than I anticipated (see Chapter 4).

With regards to the specific focus of this study, I again sit in an unusual position. I love Aotearoa and the exceptional indigenous and endemic species that she is home to. I care deeply about the state of the environment and its destruction for commercial gain, and have been involved in several restoration projects at both a practical and a research level. However, until his relatively recent death, I was also the proud owner of Tumtum, my very own pet ferret (Figure 1.1).

Figure 1.1 Tumtum, author's pet ferret (author's photograph).

It was during Tumtum's life that I began to contend with issues relating to the distinctions between pet/pest, valued species/reviled species, and native/other, and

the ways in which these divisions were incorporated into New Zealanders' understandings of their environment. Caring deeply about a ferret – an animal considered 'vermin' by many New Zealanders – triggered a critical examination of these binaries. In turn, this generated my interest in the multiple ways in which the 'natural' world can be understood.

1.3 Definitions

There are several terms integral to this research which will be defined in this section. As this research is multidisciplinary in nature, a Glossary of Terms (p121), including synonyms, has been included in an attempt to ensure this research remains accessible to scientists, social scientists, management agencies, and coarse anglers alike.

1.3.1 Non-indigenous invasive fish

I have used Chaddertons' (2003) interpretation of Owen's (1998) definition of 'invasive' to define the term 'invasive fish' as follows:

> An invasive fish is any species that can significantly adversely affect the long-term survival of native species, the integrity or sustainability of natural communities or genetic variation within indigenous species (Chadderton, 2003: 74).

Native species can be included under the definition 'invasive', as some native species can also act in an invasive manner when they are out of their natural biogeographical range. However, this research will focus on non-indigenous invasive species.

Conservationists and environmental managers largely consider coarse fish to be pests based on the view that they negatively affect native biodiversity and valued introduced species in New Zealand. However, to the coarse anglers, these fish are valuable species and an important part of their way of life. The fish themselves are not inherently 'pests', nor are they inherently valuable; their classification is socially constructed and derived from the way they, and their effects, are interpreted by diverse groups of people at different times and at different locations (see Chapter 3). It is important to understand that the term 'pest' is problematic.

Thus, from this point on, the phrase ‘non-indigenous invasive species’ will be used in its place.

1.3.2 Coarse fish

Coarse fish are a group of fish with larger scales than salmonid species. In New Zealand, coarse fishing usually means fishing for perch (*Perca fluviatilis*) or tench (*Tinca tinca*). Koi carp (*Cyprinus carpio*) and rudd (*Scardinius erythrophthalmus*) are also fished in the Auckland/Waikato region. Other coarse fish species include brown bull-headed catfish (*Ameiurus nebulosus*, commonly just called catfish) and goldfish (*Carassius auratus*), although these are not usually popular with coarse anglers. Mosquito fish (*Gambusia affinis*, commonly called gambusia) are also coarse fish, but tend to be considered a ‘pest’ by most New Zealanders. Images of the four most commonly fished species are included below, and more information on these and other freshwater fish mentioned in this thesis are included in Appendix II, Glossary of Fishes.

Perch (Figure 1.2) are native to Europe and Asia, and were liberated throughout New Zealand in the late 1860s or 1870s (McDowall, 1990). Although many coarse anglers cite their fighting quality as a key attribute, they are relatively easy to catch. This, and their small size, meant that they did not become as popular with anglers as salmonids (NIWA, 2008a). Perch are piscivorous (survive by eating other fish), and can have an effect on the populations of small native fish in some lakes, although they may provide valued fisheries in others (Rowe, 2004).

Tench (Figure 1.3) were introduced to New Zealand in 1867. Native to Europe and Asia, they are considered a beautiful shoaling fish, but received relatively little attention from anglers until recently (NIWA, 2008a). There has not been much research conducted into the possible effects of tench and current concerns centre on their potential to reduce lake water quality (Rowe, 2004).

Koi carp (Figure 1.4), believed to have originated from the Caspian Sea, were introduced to New Zealand as an ornamental fish, but now breed in natural waterways (Environment Waikato, 2002). They have only become popular with anglers in New Zealand relatively recently, and are classified as a ‘noxious fish’

under the Freshwater Fisheries Regulations 1983 and as an 'unwanted organism' under the Biosecurity Act. The main ecological concerns regarding koi carp are that, in high-density populations, they may degrade freshwater ecosystems by uprooting aquatic plants and increasing turbidity (Rowe, 2004).

Rudd (Figure 1.5) were illegally brought into New Zealand from Europe in 1967 and were released widely with the intention of creating new fisheries; they are now well established in many waterways in the North Island (NIWA, 2008a). It is only legal to fish for rudd in the Auckland/Waikato region, but anglers from other locations where rudd are present also regularly fish for them. Rudd have been implicated in the ruin of trout fisheries and are likely to have a role in the decline of native aquatic plants (Rowe, 2004).

Figure 1.2 Perch (NIWA, 2008a; photograph by S.C. Moore).

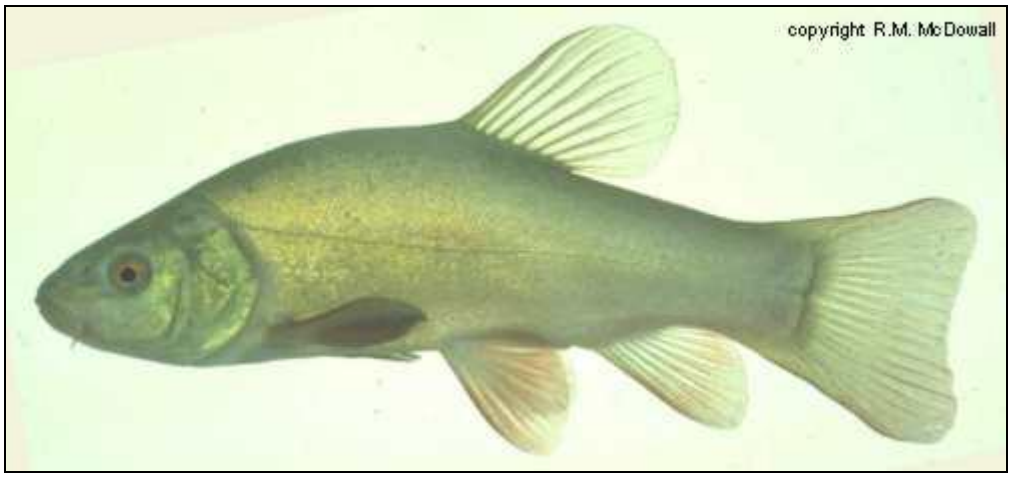

Figure 1.3 Tench (NIWA, 2008a; photograph by R.M. McDowall).

Figure 1.4 Koi carp (NIWA, 2008a; photograph by D.K. Rowe).[1]

Figure 1.5 Rudd (NIWA, 2008a; photograph by D.K. Rowe).[2]

Coarse fish are often considered invasive as they can reach high population numbers and can severely reduce native fish populations through competition for food and the predation of their young. Some species reduce water quality by stirring up sediment as they feed, and others have an effect on native plant populations (e.g. see de Winton et al., 2003; McDowall, 2000). Further potential impacts include habitat alteration, trophic and spatial alteration, gene pool deterioration, and transmission of parasites and disease (Dean, 2003). Anglers require a licence from Fish and Game New Zealand to fish for these species and the movement of perch, tench, and rudd to new areas is highly regulated. Despite this, there is evidence that coarse fish are being liberated throughout New Zealand waterways, both accidentally and deliberately, and it is for this reason that coarse fish will be the major focus of this study.

[1] Reproduced with permission from the photographer, D.K. Rowe

[2] Reproduced with permission from the photographer, D.K. Rowe

1.4 The thesis structure

This thesis begins with an introduction to the background and context of this study. Chapter 2 examines the current legislation and management context within which management of the freshwater environment and coarse fish currently takes place. Further, the central aims of restoration and biodiversity conservation are summarised, and several alternative values and perceptions that are rarely taken into account in conservation efforts are discussed. Chapter 3 outlines the theoretical framework engaged with during this research; the theoretical perspectives of social construction, environmental perception, political ecology and power, and a critical form of environmental adult education form the basis of the research conducted.

From here, the approach taken and findings obtained during the research are examined, and the implications of the research findings are discussed. The rationale, implementation, and a critique of the methodological approach employed to address this study is outlined in Chapter 4 for each of the key methods used: a literature review, semi-structured interviews, and an internet survey. Chapter 5 disseminates the findings of this study in a straightforward manner, structured by the respondents' organisational affiliations with the intent that these be easily accessible to key stakeholders and management agencies who may find the results practically useful. Finally, Chapter 6 provides a more engaging and less linear interpretation of the results as they relate to the theoretical framework examined in Chapter 3, and provides some concluding thoughts on the practical implications of the research.

CHAPTER 2: LAYING THE FOUNDATIONS

In the following chapter, I review the legislative framework and management programmes currently influencing approaches to coarse fish management in New Zealand, before moving to discuss the importance of indigenous freshwater biodiversity and the impact that non-indigenous invasive species can have on this. Finally, the social influence on values and perceptions regarding non-indigenous invasive species are examined, and the importance of including social research when considering environmental matters is asserted.

2.1 Legislative and management context

2.1.1 International legislation

There are several global programmes and treatise that are important to this research, including the International Union for Conservation of Nature and Natural Resources (IUCN, commonly called the World Conservation Union), and the United Nations Environment Programme (UNEP). The most recent, hence most relevant, international treatise is the Convention on Biological Diversity (CBD), adopted in Rio de Janeiro in June 1992. With regards to invasive species, Article 8(h) of the CBD states that:

> Each Contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control or eradicate those non-indigenous species which threaten ecosystems, habitats or species.

The Convention also requires governments to develop National Biodiversity Strategies (see section 2.1.2).

The Global Invasive Species Programme (GISP) is also noteworthy. Formally established in 1997, GISP seeks to improve the scientific basis for decision making and develop early warning and response capabilities to enhance management ability, reduce the economic impacts of invasive species and control mechanisms, strengthen international agreements and examine relevant legal and institutional frameworks, develop public education and improve ecological understanding, and develop codes of conduct for species movement (McNeely,

2001). Importantly (and somewhat unusually) GISP recognises the dynamic nature of ecosystems, and GISP do not promote attempts to 'freeze' any ecosystem in an illusory pristine state. Instead, they promote the active management of the increasing human effects on ecosystems (McNeely, 2001).

2.1.2 National legislation and management

National Biodiversity Strategy

Currently, management of the freshwater environment is complex, characterised by overlapping managerial responsibilities informed by multiple laws (Department of Conservation and Ministry for the Environment, 2000). Freshwater ecosystems are particularly vulnerable to environmental degradation as their continuous nature causes them to be adversely affected by many land-use practices. There are a number of policy mechanisms currently being used to manage freshwater biodiversity issues; one of these is the New Zealand Biodiversity Strategy (NZBS), as required by the CBD.

The purpose of the NZBS is described as to establish a framework for action to allow the conservation and sustainable use of New Zealand's biodiversity (Department of Conservation and Ministry for the Environment, 2000). While the primary focus of the NZBS is on New Zealand's indigenous biodiversity, the conservation of resources relating to our important introduced species is also addressed due to the economic value they provide to New Zealand. This is interesting in that it shows that some non-indigenous species can be highly valued for economic reasons, regardless of their environmental impact (see section 2.2.3), despite the emphasis placed on native species in most parts of the Strategy.

The NZBS states the 'desired outcome' for freshwater biodiversity for the year 2020 as maintaining the extent and condition of existing freshwater ecosystems so that they support mostly indigenous biological communities. To achieve this, the further spread of organisms considered pests is to be prevented, and introduced fish are to be managed to minimise their threats to indigenous species (Department of Conservation and Ministry for the Environment, 2000: 45). This 'desired outcome' provides an important contextual framework to keep in the

background when interpreting the discussion of the findings of this research (Chapter 6).

National Biosecurity Strategy

Biosecurity involves managing potential risks presented by biological organisms to the environment, the economy, or people's health (McNeely, 2001). Effective biosecurity measures can help to protect and preserve indigenous biodiversity. There are several agencies involved in managing New Zealand's biosecurity, and these are outlined in the rest of this section (adapted from MAF Biosecurity New Zealand, 2008a).

Biosecurity New Zealand (BNZ) is the division of the Ministry of Agriculture and Forestry (MAF) that holds overall responsibility for biosecurity, but it is just one part of New Zealand's biosecurity system. Other agencies involved with biosecurity include the Department of Conservation (DOC), the Ministry of Health (MOH), the Ministry of Fisheries (MFish), and regional governments. MOH and MFish do not play an important role with regards to pest fish; MOH deals with health risks, while MFish mainly focuses on marine fisheries, providing advice on and contributing to the formulation of strategic goals for the marine biosecurity system.

The central government is responsible for border management, national-scale events, agency co-ordination, and the legislative framework, while BNZ lead and co-ordinate the Government's biosecurity programme. The main legislation used by BNZ is the Biosecurity Act 1993 and the 'new organism' provisions of the Hazardous Substances and New Organisms (HSNO) Act 1996. BNZ's role in pest management is to ensure that the management roles of other agencies are clear, that pests are being managed at the appropriate (national or regional) level, and the legislative tools being used are suitable.

DOC is responsible for the conservation of New Zealand's natural and historic heritage. As part of this, DOC manages 'pest' fish on public conservation lands and other areas where this supports the protection of conservation lands. Lastly, regional councils have roles as both regulators and deliverers of biosecurity

services. The Biosecurity Act 1993 allows regional councils to control pests by developing regional pest management strategies (RPMS). Councils can also consider biosecurity needs during the planning process under the Resource Management Act 1991 and the Local Government Act 2002.

Environment Waikato is the regional council responsible for the Waikato region, the central focus of this research. During 2002-2007 tench, rudd, and gambusia were managed as a 'potential pest', while brown bull-headed catfish and koi carp were to be 'contained' in the Waikato region (Table 2.1). In the Proposed RPMS 2007-2012 (Environment Waikato, 2007) brown bull-headed catfish, koi carp, gambusia, and wild goldfish (section 6.15 of the RPMS), and perch, tench and rudd (section 6.16) are all classed as an 'environmental threat'.

Table 2.1 The management of coarse fish in the Waikato region from 2002-2007 (adapted from MAF Biosecurity New Zealand, 2008b).

Species - Common Name	**Brown bull-headed catfish**	**Tench/ Rudd/ Gambusia**	**Koi carp**
Management Programme	Containment	Potential Pest	Containment
Programme Objective	Raise public awareness of the effects of catfish. Gather information and contribute to research on means of control.	Raise awareness of each potential pest animal and the possible risks they pose.	Contain and, where practicable, reduce populations in isolated freshwater systems. Raise public awareness of their effects. Gather information and contribute to research on means of control.

Brown bull-headed catfish have not yet been classed as a 'noxious fish' or an 'unwanted organism' (Table 2.2). However, MFish regulations require recreational fishers to kill catfish on capture (Environment Waikato, 2007). Koi carp are classified as a 'noxious fish' under the Freshwater Fisheries Regulations 1983 and an 'unwanted organism' under the Biosecurity Act 1993 (Environment Waikato, 2007; Table 2.2). Gambusia are also classed as an 'unwanted organism', and it is suspected that wild goldfish negatively impact native species.

Perch, tench, and rudd (in the Auckland/Waikato region) are 'sports fish' under the Freshwater Fisheries Regulations 1983 (Table 2.2), and are managed by Fish and Game New Zealand. Their further spread is considered undesirable and there is provision in the RPMS for their eradication should they ever appear in water bodies where they have not been legally authorised (Environment Waikato, 2007).

Table 2.2 The legal status, and associated penalties, of introduced fish in New Zealand (adapted from Department of Conservation, 2006: 10; Department of Conservation and Fish and Game New Zealand).

Freshwater Fisheries Regulations 1983		**Biosecurity Act 1993**	**Conservation Act 1987**	**HSNO 1997**	**No Legal Status**
Sports Fish	***Noxious Fish***	***Unwanted Organisms***	***Restricted Fish***	***Prohibited Organisms***	***No Legal Status***
	$5,000 fine to possess, control, rear, raise, hatch, or consign any of these species	$100,000 fine or 5 years imprisonment to release, spread, sell, or breed any of these species	$5,000 fine for introducing any live aquatic life into an area where they don't already exist		
Trout (2 spp.)	Koi carp**	Koi carp**	Grass carp	Stickleback	Catfish**
Salmon (3 spp.)	Rudd (excl. A/W)**	Gambusia**	Silver carp	Pike family	Golden orfe**
Brook char	Piranha	Gudgeon		Any venomous fish	Naturalised aquarium fish*
Mackinaw	Pike	Marron			Aquarium fish in captivity
Tench	Walking catfish	Channel catfish			
Perch	Tilapia spp.				
Rudd (A/W only)					

Key
Naturalised
Only in captivity
Not in NZ at all
Possibly eradicated from NZ
Can only breed in captivity

* Goldfish, guppy, swordtail, sailfin molly, caudo.

** Species that can be (and are) considered pests.

A/W = Auckland/Waikato region

2.2 Ecological restoration and biodiversity conservation

2.2.1 The New Zealand context

Ecological restoration has become a key focus of conservation in Aotearoa/New Zealand as the importance of preserving biodiverse ecosystems that can withstand human and environmental pressures is increasingly recognised (Craig et al., 2000; Robbins, 2004a). The isolated biogeographical history of New Zealand allowed native flora and fauna to evolve with very distinct characteristics, often without any form of defence against invasive predators or ability to compete with introduced species for food (Jay and Morad, 2006). The subsequent decline of Aotearoa's indigenous biodiversity has occurred relatively rapidly, as New Zealand was only settled by humans within approximately the last 800 years (Department of Conservation and Ministry for the Environment, 2000). Although conservation practices have been occurring in Aotearoa during much of human settlement, these have changed dramatically in that time (e.g. see Young, 2004), and it is only recently that biodiversity has become a central focus of conservation.

Biodiversity conservation and restoration involve managing the environment in such a way that the fullest diversity of indigenous species possible is protected or enhanced. This concept is based on ecological principles that value the natural state of the environment above socially or economically important organisms or land-use practices (although the ideal of ecological purity is also a social value). The contribution to biodiversity provided by New Zealand's endemic species is important globally, as well as locally (Parliamentary Commissioner for the Environment, 2000). Biodiversity is also important as biodiversity that is well maintained is an effective indicator of the sustainable management or use of freshwater ecosystems (Dudgeon et al., 2006).

The Māori world view and approach to the environment is important to consider when approaching any issue in Aotearoa/New Zealand. Māori cosmology links all living and non-living things through the union of Papatūānuku (the earth mother) and Ranginui (the sky father), and their offspring, the atua kaitiaki, or spiritual guardians (Department of Conservation and Ministry for the Environment, 2000).

This provides a holistic view of the environment and biodiversity, manifested as the concept of kaitiakitanga (guardianship).

It is increasingly being realised that sustaining biodiversity over generations will require us to think in a similarly holistic manner, beyond protecting remnant, indigenous places, to managing processes that maintain the integrity of the entire landscape of the ecosystem in an effective and bicultural manner (Park, 2000). This is particularly important for freshwater environments, as river systems often extend over large areas of land, increasing the likelihood that detrimental environmental impacts in terrestrial systems will impact freshwater ecosystems.

2.2.2 The freshwater environment

Fresh water makes up about 0.01% of the world's water and 0.8% of the Earth's surface but supports at least 100,000 species, around 5.5% of the total. Protection of freshwater biodiversity has been termed the ultimate conservation challenge, due to the complex and continuous form of freshwater areas (Dudgeon et al., 2006). In New Zealand, freshwater ecosystems support a wide range of indigenous aquatic species, provide beneficial ecosystem services, and are of great spiritual and cultural significance to Māori (Department of Conservation, 2003). While historically New Zealand's freshwater management has focused on aspects such as site protection, riparian management, restoration of fish passage, dealing with point source pollution, maintenance of minimum flows, and harvest management, it is increasingly being recognised that habitat protection alone will not ensure the maintenance of indigenous freshwater biodiversity, and that the impacts of invasive species need to be addressed (Chadderton, 2003).

2.2.3 Aquatic non-indigenous invasive species

Freshwater ecosystems have been identified as particularly vulnerable to the impacts of invasive species (Cambray, 2003; Koehn, 2004). Forty freshwater fish species have been introduced to New Zealand, of which 19 have become established and nine (22.5% of those introduced) are considered pests. In terms of vertebrate introductions, the percentage of introduced fish that have become pests is second only to terrestrial mammals (50.9%), of which there were only originally three species native to New Zealand (one of which is now extinct;

Table 2.3). The impact of the establishment of non-indigenous fish is increased by the fact that exotic species are more likely to successfully invade fresh waters already modified or degraded by humans, especially if they are adapted to such modification. This often occurs - whether through extraction, diversion, containment, or contamination – in ways that compromise its habitat value for organisms (Dudgeon et al., 2006).

Table 2.3 Numbers of vertebrate species introduced to New Zealand and their present status (adapted from Clout, 2002: 186; Department of Conservation, 2009; NZ Birds, 2009).

Group	Number of native species*	Number introduced	Number established	Number of pests
Birds	142	137	36	6
Terrestrial mammals	2	55	32	28
Freshwater fish	~40	40	19	9
Frogs and reptiles	50	6	4	-

* Approximate number of extant species.

The State of New Zealand's Environment 1997 report labelled indigenous biodiversity decline our "most pervasive environmental issue" (Department of Conservation and Ministry for the Environment, 2000: n.p.; see also Clout, 2002; Koehn, 2004). Internationally, the impacts of invasive species on biodiversity loss are considered second only to land-use change. This importance was reflected in a recent New Zealand report, which stated that: "introduced invasive species pose the single largest threat to the survival of many of New Zealand's threatened species and ecosystems" (Parliamentary Commissioner for the Environment, 2000: 19; although I would argue that human activity poses the largest threat). Indeed, military analogies are often invoked when invasive species are discussed:

> New Zealand is *under siege*. Potential animal and plant pests are *battering* our *defence systems* in ever increasing numbers as volumes of goods and passengers passing through our borders soar (Parliamentary Commissioner for the Environment, 2000: 2; emphasis added).

Fortunately, as New Zealand is a geographically isolated island nation, it has not been invaded by non-indigenous species to the same extent that most land-locked

countries have been. This provides economic advantages in the form of pest-free exports and unique tourist experiences (Parliamentary Commissioner for the Environment, 2000). However, it is important to note that New Zealand's biosecurity system evolved with the primary aim of protecting land-based industries such as agriculture, horticulture, and forestry. These industries are heavily reliant on introduced species themselves, reflecting a preference for and focus on non-indigenous species of economic import at the expense of the natural environment. To date, most focus has been on this economic flora and fauna rather than indigenous flora and fauna, and it has been recognised that this policy needs to change its focus if it is to effectively address the unique biosecurity needs of New Zealand (Parliamentary Commissioner for the Environment, 2000).

Exotic fish were introduced to New Zealand by Acclimatisation Societies mainly to satisfy a nostalgic desire to be reminded of Britain, as well as to provide more species for sport (Veitch and Clout, 2001). The fish most commonly introduced were those stocked for sport, such as salmonids and coarse fish, which also tend to be among the most damaging of the invasive fish species (de Winton et al., 2003; Fuller, 2003). The fact that these fish are so valued by anglers poses a major conservation and management dilemma that is difficult to resolve (McDowall, 2000). Salmonid sports fish such as trout pose an especially unusual challenge for management; while they provide huge economic benefits to New Zealand, they also cause changes in ecosystem function and are considered responsible for the localised extinctions of some non-migratory galaxiids (Townsend and Simon, 2006). However, salmonid fish are not a central focus of this study because they are considered favourably in central government policies due to their value to a large number of game anglers as sports fish. There are fewer coarse anglers than trout anglers in New Zealand.

Extensive prioritisation exercises have been carried out to determine which non-indigenous fish are considered the most problematic and therefore require the most control (Appendix III). The six most problematic fish appear to be koi carp, perch, catfish, gambusia, brown trout, and rudd. Rudd and koi carp have been designated 'noxious fish' under the Freshwater Fisheries Regulations 1983. One of the major reasons for this is based on the concern of game anglers, who worry

that their valued trout-fishing waters will be invaded by these less-valued 'coarse' fish (Veitch and Clout, 2001: 70). Management recommendations often reflect these concerns, and impacts on trout fishing are commonly emphasised (e.g. Table 2.4). The ability of select special-interest groups to influence official policy has also been recognised by Veitch and Clout (2001: 70), who state:

> The different official attitudes to species of fish that are valued by different groups in the angling community illustrates that official responses to invasive species can sometimes reflect the influence of special-interest groups, rather than objective assessments of risks to native biodiversity.

Table 2.4 Recommendations for management of coarse fish in New Zealand (adapted from Dean, 2003: 3).

Fish species	Distribution	Concern	Dean's Recommendation
Goldfish	Widespread	Minimal	–
Perch	Widespread in parts of NZ	Impact on trout stocks	Management as acclimatised fish
Tench	Widespread	Minimal	Management as acclimatised fish
Catfish	Lake Taupo, Waikato River, isolated sites	Nuisance species	Management as acclimatised fish
Rudd	Widespread north of Waikato	Interfere with trout angling	Avoid spread beyond existing range
Koi carp	Waikato region	Impacts on water quality and aquatic habitats	Prevent further spread and eradicate existing populations where practicable

2.3 Alternative values and perceptions

However, this dominant 'environmental imaginary' – that native species (and salmonids) are good/wanted/desirable and non-indigenous invasive species (like coarse fish) are bad/pest/undesirable – is not held by everyone. It is important to recognise several alternative values and perceptions relating to non-indigenous invasive fish.

Firstly, there are multiple factors that are potentially involved in the decline of native species, and it should not be automatically assumed that introduced fish are the only, or even the primary, reason for their decline as this may mask the effect

of other, potentially more important, factors. This provides some justification for the diverse perspectives on which non-indigenous invasive species, if any, should be targeted for control (Lee et al., 2006). Five major and interacting threats to freshwater environments have been identified (Dudgeon et al., 2006), indicating that while invasive species are a problem, they are only part of the problem (Figure 2.1).

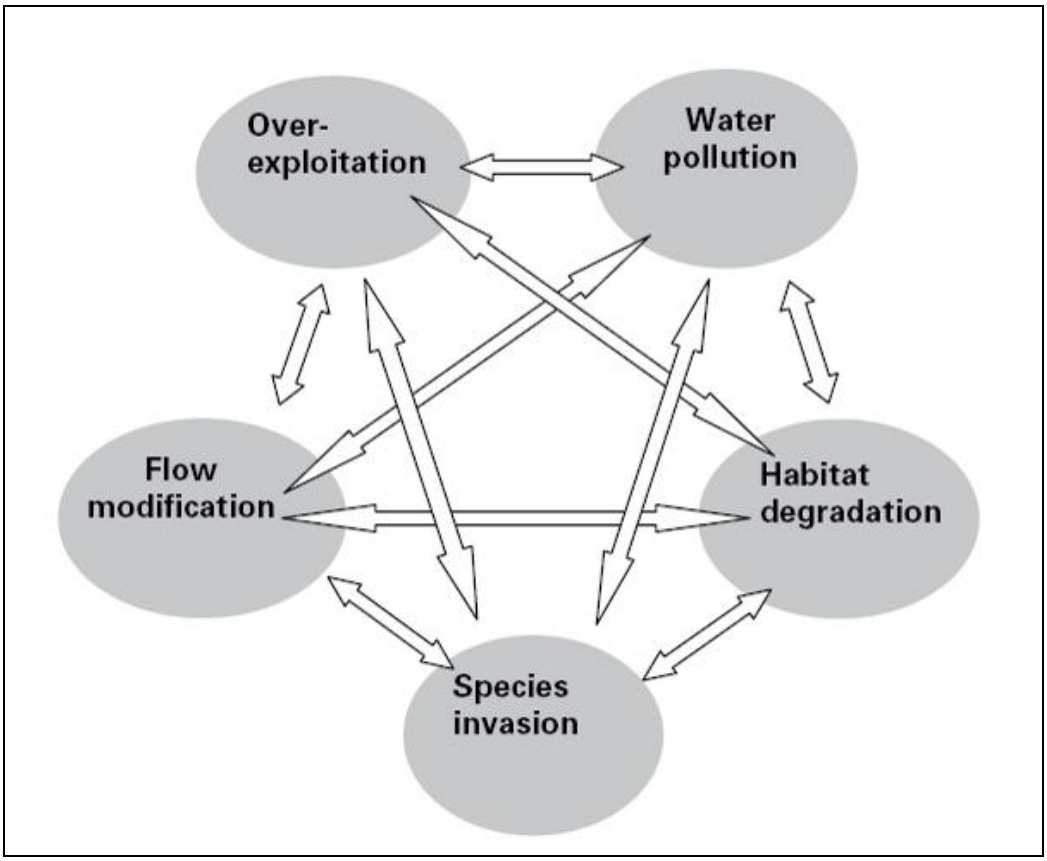

Figure 2.1 The five major threat categories and their interactive impacts on freshwater biodiversity (from Dudgeon et al., 2006: 165).[3]

Secondly, it is important to recognise the social impacts that can result from the methods employed to manage some invasive species, such as conflicts over the need to control and definitions of what constitutes a pest, or over the best way of conducting control (Clout, 2002). For example, Māori affected by the presence of an invasive fish species in a local lake may consider the removal of this species desirable, but the use of rotenone (the chemical eradication agent preferred by DOC) to achieve that purpose undesirable. Introducing chemicals to areas used to harvest food (kai) and for cleaning may be considered more objectionable than the presence of the invasive fish.

[3] Reproduced with permission from Wiley-Blackwell

Thirdly, it is important to note that, even if the problems in classifying invasive species were overcome, not everybody agrees with eradication. Many people hold complex values relating to invasive species, such as their habitat, aesthetic, recreational, and microclimatic features, and many others object to removing, harming, or killing animal species (Foster and Sandberg, 2004). Furthermore, some species, such as trout, may act in an invasive manner and be detrimental to the environment, but remain relatively free from control as they are valued socially and economically. This reflects a human perception that the economy is more important than the environment, if not a preference for the species in question itself.

Trout have been ranked among the top six most problematic freshwater fish in New Zealand (Appendix III) and are recognised internationally as being invasive species in many environments where they have been introduced. In New Zealand, trout have been found to reduce the populations of native benthic invertebrates (Cambray, 2003) and have caused the decline and local extinctions of some endemic galaxiid fish (Veitch and Clout, 2001; see also Townsend, 1996; Townsend and Simon, 2006). However, the effects of trout on indigenous ecosystems have caused very little official concern in New Zealand. In fact, despite the increasing understanding of the negative effects of trout, many New Zealanders take trout as an honorary native species. Tourism New Zealand has gone as far as promoting trout in an advertisement that is meant to reflect '100% pure' New Zealand. Cambray (2003) notes that a New Zealand grayling (*Prototroctes oxyrhynchus*) would have been a more appropriate focus of the advertisement, but this species is now designated extinct, and the introduction of trout is thought to be one of the probable causes of this.

2.3.1 Environmental conservation

Environmental conservation and ecological restoration are often employed to help return an environment to a more 'natural' state. What is not usually recognised is that these are human values, often framed in moral terms. The conservation decisions made, and the impact these decisions have on the environment, are determined by where individuals place the value of environmental conservation amongst their vast hierarchy of values (Reaser, 2001). The level at which

environmental conservation is valued by humans is determined in a large part by the way we perceive the world beyond ourselves and our relationship to that world. Thus, invasive species are always derived from our values, choices, and behaviours (Reaser, 2001). Similarly, the motivations and aims of ecological restoration are derived from the values, choices, and behaviours of environmental managers.

The subjective and unstable nature of human environmental values is evident in the changing nature of (Pākehā) New Zealanders attitudes to the environment. Originally, European settlers to New Zealand placed a high value on introduced species and considered the native biota to be lacking in diversity (Young, 2004). Indeed, the Pākehā environmental ethic of most of the 19th century centred on the destruction of indigenous biota for human settlement and farming and the acclimatisation of introduced species (Young, 2004).

Now, as New Zealand becomes more postcolonial, New Zealanders increasingly (and proudly) perceive their native flora and fauna as symbols of identity (Jay and Morad, 2006). This is somewhat ironic, given the huge emphasis that remains on maintaining and protecting industries based on non-indigenous species such as farming, forestry, and horticulture, and the important contribution these industries make to New Zealand's economy. However, it also suggests New Zealanders are starting to focus on and appreciate indigenous species, rather than valuing those of traditional importance to Britain. While Māori identities have long been connected with the natural environment, the majority of Pākehā New Zealanders are still in the process of creating a sense of belonging to the land, involving looking both backwards and forwards (Head, 2000).

This change in perspective has had implications for environmental management in New Zealand. Historically, management was centred on the need to protect economic industries (based on introduced species) from incursions of pests, although the conservation and preservation of particular natural areas has also been a focus in New Zealand. Interestingly, the very concept of 'conservation' originates from traditions of hunting and agriculture and the protection of species valued by elite hunters or for food (Young, 2004). Environmental management is

beginning to shift its focus to valuing native species through the implementation of the Resource Management Act 1991 and other biodiversity and biosecurity measures, although most biosecurity resources are still focused on introduced species of economic importance.

To review, this chapter has outlined several legal, ecological, and social reasons for understanding the ways in which humans ascribe values to invasive species in general, and coarse fish in particular. Human perceptions of non-indigenous species will ultimately drive public policy, and those perceptions need to be well understood given the large role invasive species play in New Zealand's conservation strategies (Donlan and Martin, 2004).

Cultural geographers are well equipped to examine these perceptions and value judgements through conceptualising the natural environment as the physical manifestation of dominant social and political ideologies (Head, 2000). Social research tends to reveal hidden costs and the differential distribution of power that produces environmental, as well as social, outcomes (Robbins, 2004a). This relationship between environmental perceptions, value judgements, and power are examined further in Chapter 3, and it is hoped that this research will be able to contribute to effective and just management outcomes.

CHAPTER 3: THEORETICAL FRAMEWORK

This study offers a relatively novel (although increasingly more common) approach to ecological restoration research as it is largely grounded in environmental and social geographical theory, rather than scientific theory. Although it is necessary to utilise the understandings offered by science, in this chapter I intend to demonstrate the importance of combining this knowledge with the different interpretations provided by social science to produce a more comprehensive understanding of coarse fish management. Although my intention is to discuss social and scientific theories as mutually constitutive and necessary allies, the strong boundaries and binaries that exist between the two disciplines make it difficult to put forward an argument without reinforcing these distinctions.

What follows is an introduction to literature that casts light on the complexities inherent in the management of non-indigenous invasive fish. In particular, I will discuss the contribution that social construction, and especially environmental perception, makes to this research. I then outline the importance of understanding political ecology and power relations when dealing with 'pest' species and the environment. Finally, I examine the current understandings of environmental adult education, and discuss some of the problematic aspects of environmental education. The ideas introduced in this chapter provide a basis for the interpretation discussed in Chapter 6.

3.1 Social construction

> *An[y] evidently natural object, idea, or process is, at bottom, an expression of the human imagination, suffused with political and cultural influence (Robbins, 2004a: 108).*

Social construction, which falls under the theoretical umbrella of post-structuralism, provides a uniquely social geography perspective on the freshwater restoration debate, particularly with relation to the ways different species are valued and to the differing 'environmental imaginaries' that are produced by this (section 3.2). The socially constructed nature of invasive species has been examined by many authors (e.g. see Robbins, 2004b), on the basis that

the socio-political aspects of the environment are interconnected with, and as important as, the physical (see Robbins, 2004a, quoted above).

When dealing with value-laden phenomena there is an inherent conflict between the objective, 'truth' seeking focus of the physical sciences, and the pursuit of subjective and situated knowledges from within the social sciences (Baronov, 2004). There is a need to account for the social meaning of value-laden objects, as well as the 'facts', because these social meanings are subjected to political processes of decision making, which endorse and sustain the values and perceptions of certain social and cultural groups and ignore or marginalise the views of others. The morphology of the human-influenced landscape is thus socially 'constructed', shaped largely (although not entirely) by the political interplay of different social groups. Consequently, cultural geographers view landscapes (and the natural phenomena contained therein) as socio-political ideologies transformed into a physical form, that are then 'read' in different ways by different individuals and communities (Head, 2000).

An example of this is reflected in the many different 'readings' of invasive species that exist. Invasive species are usually constructed as unwanted in their new habitats, but ideologies underlying this perception are rarely explicitly acknowledged:

> There is a tendency to perceive invasive species as unnatural or inauthentic occupants of particular habitats. But the notion that any particular species is not a natural resident of a specific space may never be a matter of empirical fact. Rather, such a contention is entirely interpretive, largely a function of ideological convictions about what is (or even might be) natural (Foster and Sandberg, 2004: 181).

Interestingly, the promotion of a 'natural' place within ecologically stable community boundaries appears to contradict and deny the recognition by the ecological sciences that environmental systems are in fact dynamic and in a constant state of change (O'Brien, 2006). It is important to remember that, when taking the long view, all of evolutionary history has involved invasions, competition, and replacement, and invasions have in fact been one of the key forces driving evolution (Warren, 2007).

Further, Brendon Larson (2008) argues that in order to justify the human need to control nature we have made an enemy of invasive species, reducing them to an 'other' rather than considering them an aspect of biodiversity that we care about.[4] Although he considers himself a conservationist, Larson (2008) wonders if we have gone too far in the case of invasive species, creating enmity towards the natural world and protecting nature to the point of contriving it. This is, I feel, an important point, which will be examined further in Chapter 6. At a time when environmental issues are high on the political agenda, I am not sure we want to be encouraging people to despise aspects of the natural world.

Clearly, the story of each invasive species is ecologically and socio-culturally complex, and varies temporally, spatially, and experientially (Foster and Sandberg, 2004). Restoration ecology is "emerging as yet another domain where expert knowledge sets agendas" (O'Brien, 2006). 'Invasive species' is a contested term and, from a social justice perspective, it is critical that the dominant ideologies of environmental management are not just automatically assumed to be 'right', and that other, marginalised or ignored discourses are identified and examined (see section 3.2.3). That is, it is important to be explicit about the value judgements being made and identify the people that are making them (Head, 2000; Smith and Deemer, 2003).

However, it can be difficult to apply the idea that the natural phenomena of landscapes are products of complex interactions between social process and materiality (Head, 2000) to practical and appropriate management activities (Foster and Sandberg, 2004; Robbins, 2004b). This difficulty is often overlooked by authors writing on social construction. In this study, I attempt to link these insights to practical applications in an attempt to comprehend more fully the management of freshwater environments. It is not my intention to deny the very real biophysical impacts of invasive species. Rather, I intend to underscore the ironies of assuming one way of valuing nature and natural resources is superior to another, and to highlight the power plays that result from this assumption. For this reason, the most important contribution social construction can make to the

[4] It should be noted that the clear-cut distinction between native, economically valued introduced, and invasive species is largely one made by Pākehā New Zealanders; for Māori 'useful' species like wild pigs are accepted if their benefits are seen to outweigh their negative effects (Head 2000).

effective management of invasive fish is through understanding the environmental perceptions of the different groups involved. In the following section, I explore the possibilities social construction offers as a means to better understand the complex ways in which people develop perceptions of the freshwater environment.

3.2 Environmental perception: a contest of world views

> *Value conflicts are like conflicts between different mathematical systems with different assumptions and definitions wherein the argument is really over which system (or view of the world, including values) should be adopted (Kassiola, 2003: 179).*

Environmental perception is an example of the practical consequences of social construction. Defined in *The Dictionary of Human Geography* as "the process whereby individuals and groups base their actions upon how they perceive their environment" (Johnston et al., 2000: 222), the theory of environmental perception forms the backbone of my research. This perspective is useful as the different stakeholder groups all hold different perceptions of the freshwater environment and their actions in the 'real world' are based on that perception, not on the environment as it 'is'. Therefore, many environmental problems are ultimately human problems, appropriate solutions to which we can only find by understanding where people's perceptions, values and behaviours are situated (Tuan, 1974).

Coarse fish are value-laden phenomena. As indicated in section 3.1, while biological science can deal with the 'facts' of coarse fish, the diverse and contrasting values attached to them by a multitude of stakeholder groups remain the domain of social science. There is no 'right' or straightforward way to conceptualise invasive species; each can be examined from different ecological and social perspectives (Foster and Sandberg, 2004). Issues that are important to one individual regarding invasive species are often incompatible with the needs and preferences of another (Nemec, 1997), and resolving conflicts between groups of people with differing ideologies is often extremely difficult (Campbell, 1999).

This is evident when attempting to manage coarse fish and freshwater areas in New Zealand, as the ideologies and world views of management agencies,

restoration scientists, coarse anglers, and local Māori may vary significantly. In order to make a noteworthy contribution to improving the management of freshwater ecosystems in New Zealand, the environmental ideologies of all of these groups need to be understood and treated as valid. The following subsections outline several different facets of the general foundation of many environmental perceptions.

3.2.1 'The truth is out there'

Since Descartes teachings of the 17th century, the natural sciences have been considered the authority on environmental issues and ecosystem management. Cartesian philosophy has separated the human from the natural environment, stripped nature of any intrinsic value, and divorced the mind from the body (Orr, 1999). 'Truth' was defined as that which could be empirically observed and recorded, and that which could not was simply not counted. The premise of science that the world can be known through hard fact results in models such as that shown Figure 3.1, and the assumption that 'the truth is out there' to be discovered by humankind still permeates Western knowledge today. Within such a framework an invasive species is usually considered a pest and there is generally little recognition of the subjective nature of such a classification. However, this ignores the multiplicity of 'truths' that are created through human classifications of what counts as an invasive species and decisions about what is important to study in the first place.

This perspective further ignores the practical effect that the values and perceptions inherent in this process have on management activities. This is not to say that the 'facts' of science are not important, rather that subjective social relationships to the environment and perceptions of invasive species are equally as important and need to be acknowledged (Warren, 2007). Most environmental managers in the Western world, like the organisations examined in this study, currently subscribe to the scientific paradigm and its search for truth. However, an academic grounding in 'truth' and 'facts' is not sufficient when dealing with landscapes that have multiple meanings for different stakeholders (Biersack and Greenberg, 2006; Collier, 1994; Cortner and Moote, 1999).

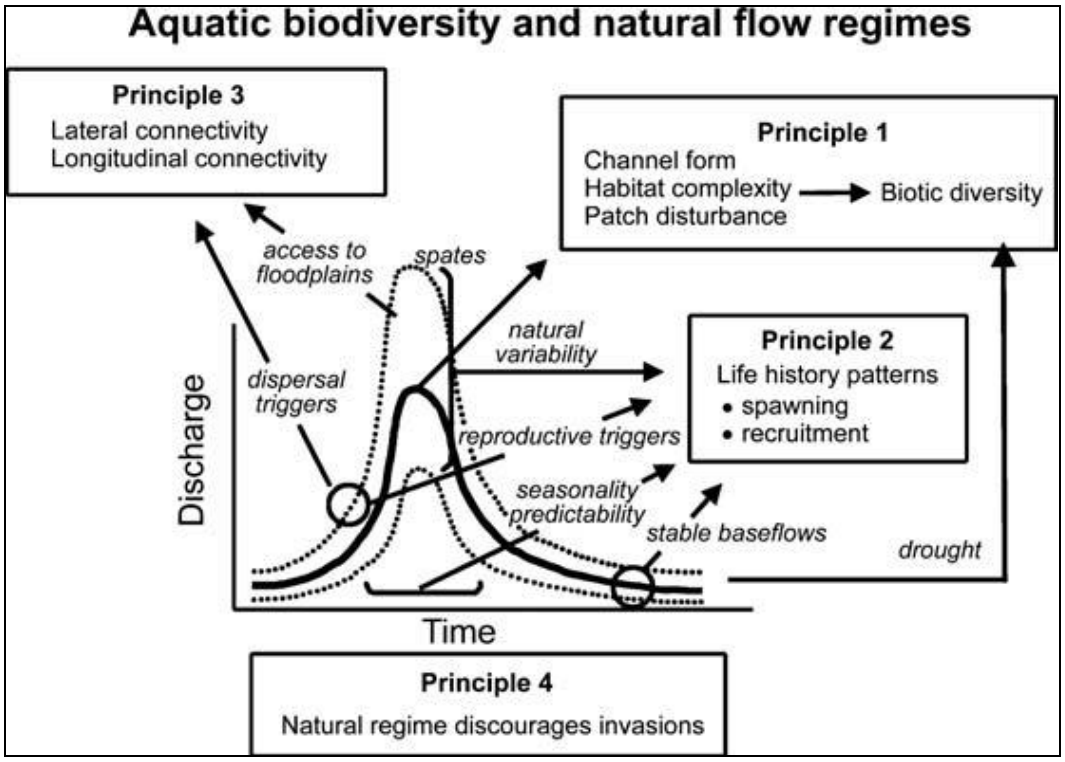

Figure 3.1 Representation of the natural flow regime of a river showing how it influences aquatic biodiversity through several inter-related mechanisms (Principles 1-4, note in particular Principle 4) that operate over different spatial and temporal scales (from Dudgeon et al., 2006: 172).[5]

Consequently, in some instances environmental, scientists and conservation managers are undertaking interdisciplinary training (Head, 2000). This has important practical implications for environmental management:

> A decision-maker who understands long term changes in the landscape will not waste energy trying to reconstruct a single 'authentic' past, but will be aware that the process of valuation cultural, or natural, heritage must be an explicit one (Head, 2000: 153).

There now appears to be a general agreement within the literature dealing with invasive species that management issues are complex and require the integration of science, policy, and land-use practices. However, there has been much less attention devoted to the socio-cultural context within which we comprehend and respond to invasive species (Foster and Sandberg, 2004).

[5] Reproduced with permission from Wiley-Blackwell

3.2.2 'There is no truth'

In stark contrast to the scientific belief in objective truth, many social scientists recognise that the world can never be objectively known, believing that Descartes and those following him had it wrong. Instead, it is acknowledged that many taken for granted distinctions, such as those between object and subject, feeling and knowledge, mind and body, and human and nature, are socially constructed rather than 'real' (Orr, 1999). Davies and Dwyer recognise the fluid nature of environmental understanding that is gained by social scientists, stating that:

> In place of the pursuit of certainty in generating representations of the world, there is recognition that the world is so textured as to exceed our capacity to understand it, and thus to accede that social science methodologies and forms of knowing will be characterized as much by openness, reflexivity and recursivity as by categorization, conclusion and closure (Davies and Dwyer, 2007: 258).

An important perspective to consider here is that of relativism. Relativism recognises that humans are practical and moral beings and that, as a result of this, knowledge will always be embedded within social frameworks reflecting our historical, cultural, and engendered ways of being (Smith and Deemer, 2003). That is, knowledge is never objective, as it can never be separated from the environment and emotional contexts in which it is generated (Orr, 1999). There are many critics of relativism, such as those who view the concept that everything is relative and nothing can be defined as right or wrong as "akin to intellectual nihilism and moral irresponsibility" (Johnston et al., 2000: 693). However, I believe it is essential that the essence of relativism – that all knowledge is created and embedded in spatially and temporally dependent social frameworks – is recognised, while ensuring that the political possibilities that arise from this are not "rendered moot" (Smith and Deemer, 2003: 454).

Such reflexive and subjective notions tend to erode the dominant Western boundaries between human and nature, tame and wild, civilised and savage, native and introduced. As such, many of the previously taken for granted conceptual and physical boundaries in environmental management become problematic (Head, 2000). This is important as it reflects the subjective nature of the different social

approaches to invasive fish management. However, unless there is political impetus to make connections, it can become very difficult to reconcile such multiple moral meanings and options with practical management decisions regarding the biophysical environment (Head, 2000). One way in which this can be achieved is through seeking critical, mutual, engagement.

3.2.3 Social justice and mutual engagement

Two key approaches form a middle ground with the potential to negotiate the key points of relativism and the practicalities of dealing with physical landscapes. These are critical mutual engagement, through the concept of 'situated knowledge' (Haraway, 1991), and contemporary social justice theory (Harvey, 1996). Situated knowledge replaces the (mis)conception of objectivity by emphasising "embodied physicality, social construction, and cultural politics" (Johnston et al., 2000: 742). The concept of situated knowledge also provides an agenda for political action, which is often lost in the theory of relativism. Haraway (1991) argues that through the idea of situated knowledge the traditional notion of objectivity can be recast as an incomplete process rather than a final outcome. As Smith and Deemer (2003: 445) note, "to not make judgements is to lose site [sic] of one's orientation in moral space, which is to lose one's grounding as a human being". Situated knowledge opens the way for the development of mutually agreed constructions.

Similarly, contemporary social justice theory is concerned with the possibility of reconciling alternative perspectives to produce meaningful and equitable solutions for the 'real world'. David Harvey (1996) identifies that the production of differences in ecological, cultural, economic, political, and social conditions need to be critically analysed, alongside the justice or injustice inherent in these differences.

My assertion is that it is not *wrong* to make moral judgements based on individual environmental values and perceptions, but it is essential that these judgements are negotiated and their underlying assumptions made explicit. It is only through negotiating transparent moral judgements with multiple stakeholders that it becomes possible for critical engagement grounded in social justice to take place,

undertaken on the basis of assessments of the value differences and the losses and gains brought about by different policy decisions. This suggests a collective process of environmental ethical reasoning, allowing biodiversity conservation to be undertaken in a political, socially just manner (e.g. Brechin et al., 2002; Table 3.1).

One way in which these moral judgements can be guided is by turning to relevant legislation. In this case, the key piece of legislation surrounding invasive species in New Zealand is the Convention on Biological Diversity (section 2.1.1). As a signatory to the treaty, New Zealand has an international obligation to manage invasive species in the manner described in Article 8(h) of the Convention. While this provides some guidance regarding the appropriate course of action for biodiversity management in New Zealand, it should be explicitly recognised that the Convention is socially created from a particular paradigm of Western science and a political ecology of decision making that prioritises 'indigenous' over 'introduced' (unless the introduced species is considered economically important).

Table 3.1 The six key elements of social and political process (from Brechin et al., 2002: 43).

Element	Questions	Issues in biodiversity conservation
Human dignity	Who benefits? Should biodiversity be granted moral superiority to human welfare? On what grounds?	Establishment of explicit moral parameters for social process associated with conservation intervention. Accounting for principles of social justice: (1) full participation; (2) self-representation/autonomy; (3) self-determination.
Legitimacy	Is the process considered appropriate and just by those most affected?	Social control built on strong agreements, fair enforcement, strong organisational and institutional arrangements, and constructive dialogue.
Governance	Who decides? Based on what authority? Who participates and how? How will decision making take place? What are the parameters for accountability and enforcement?	Establishment of "rules" or "norms" and responsibilities for decision making, accountability, enforcement, and participation.
Accountability	To what extent is each party holding up its end of the bargain? How effectively are participants pursuing their goals?	Responsibility: • Rights imply responsibilities • Upholding commitments Performance: • Appraisal focused on social and political process in addition to other indicators • Problems of implementation as opposed to conceptual inadequacy
Adaptation and learning	How can we systematically adapt and learn from experience?	Constant reflection and experimentation. Organisational and social learning.
Non-local forces	To what extent does environmental change result from large-scale commercial enterprises? How are local practices driven by wider political economic process?	Scales of intervention. Focus of conservation objectives. Strategic political alliances.

3.3 Political ecology and power

One way of gaining power over land is to have one's own definition – of culture, nature, landscape, or all three – appear as the common sense one, the natural one (Head, 2000: 56).

Political ecology links environmental perceptions to social constructions of the landscape through examining which particular environmental perspectives and values are valorised and upheld by the political system and which are marginalised, ignored, or actively opposed. The interactions between power, individual values, and the biophysical environment create the space where the dominant understandings – and social constructions – of a given society are created and maintained (Figure 3.2). Politics and environmental management are almost impossible to separate; politics reflects the interactions between people, the environment, and governmental institutions (Cortner and Moote, 1999). There are many different definitions of political ecology, and it appears to identify a general *way* of approaching research rather than a coherent theory (Johnston et al., 2000). Essentially, political ecology explores the ways in which power relations are integral to the condition and change of social and environmental systems, while concurrently seeking better and more sustainable ways of doing things (Robbins, 2004a). This is also one of the aims of this research.

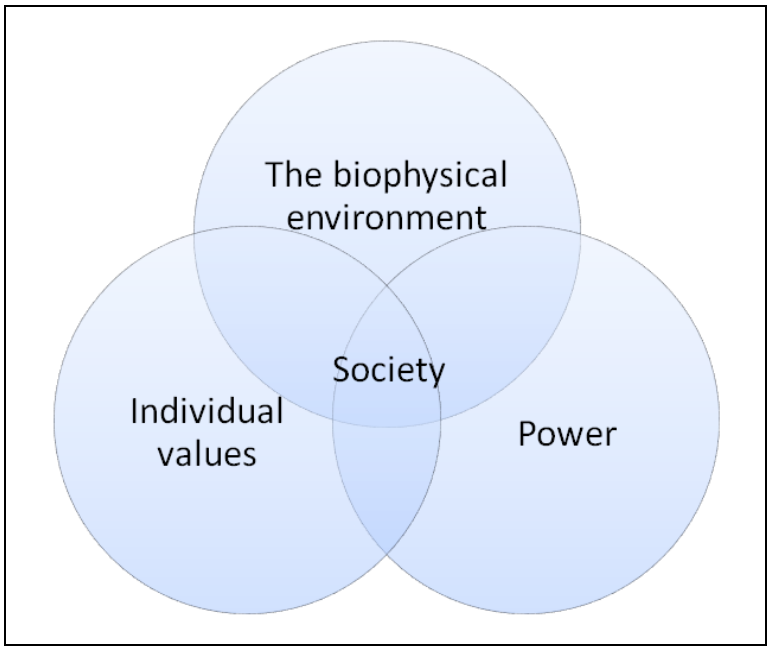

Figure 3.2 The interrelationships between power, the environment, individual values, and society (adapted from Kearns, 2007: 209).

Power and politics are integral to understanding the current management of, and behaviours relating to, coarse fish and freshwater ecosystems. It is critically important that we recognise who is vested with the authority to make judgements, and that these judgements are transparent and based upon solid reasoning (Smith and Deemer, 2003). This is because the value perceptions of the political establishment or the mainstream public often define the moral truth while those of others, like coarse anglers, are marginalised or ignored. Warren (2007: 441) discusses the ideological loadings inherent in the native/invasive framework, recognising that "the drawing of lines always raises issues of power, identity and control". The political influences on the way introduced fish are classified and managed will be discussed further in Chapter 6.

3.3.1 The importance of language

One of the ways in which dominant social groups influence political outcomes is through the use of language and the associations that language creates. Language is not neutral and, when combined with forms of social practice, is one of the less visible ways in which power can be wielded or resisted. The ways in which language weaves its way through many forms of social practice is something that was examined in great detail by Michel Foucault (e.g. Foucault, 1984). Norman Fairclough (1989) explored further the implications of the power relations inherent in language and how these relationships are manifested within texts, processes, and social conditions, including institutional and social structures such as government agencies. Fairclough discusses the ways in which dominant ideologies come to be seen as 'common sense', observing that:

> If a discourse type so dominates an institution that dominated types are more or less entirely suppressed or contained, then it will cease to be seen as arbitrary (in the sense of being one among several possible ways of 'seeing' things) and will come to be seen as *natural*, and legitimate because it is simply *the* way of conducting oneself (Fairclough, 1989: 91; emphasis in original).

In a similar vein, the role of metaphors in ecological communication has been extensively examined by Brendon Larson (2006; Larson et al., 2005). He argues that the social meanings of biological metaphors, such as progress and

competition, cannot be isolated from their social context, because they are drawn from everyday language (Larson, 2006). While the social meanings of these metaphors may become 'dead' to biologists, the same does not occur for the general public. Particular metaphors may then reinforce existing social values by grounding them in the 'natural' world (Larson, 2006). An example of this can be seen in the worrying xenophobic parallels that exist between 'nativist' discourses regarding both human and non-human foreigners, which likens immigrants to "sexually prolific intruders who often first settle in squalid conditions, and then proceed to encroach upon and degrade once stable native communities", if not immediately, then certainly in the near future (O'Brien, 2006: 69).

Some authors, such as David Simberloff (e.g. Simberloff, 2003), regard the persistent debate over language as an unimportant and distracting annoyance, and demand proof of overt xenophobic and racist intentions. However, this dismisses the very real ways in which language can carry such values, regardless of the original intentions of the author, reinforcing the association of particular values with discussions of invasive species (O'Brien, 2006). Arguments surrounding the use of language and terminology are often based on the premise that any attempt to draw a line along the continuum between native and alien species cannot be done objectively and unambiguously and unavoidably involves making arbitrary choices. This does not mean that utilising such criteria for differentiation is not useful in making practical decisions for environmental management, only that claims to scientific objectivity are not justified (Warren, 2008).

It should be noted that the nativist discourses surrounding ecological restoration can also be reframed in a positive light. Jordan argues that preference for native species should not be seen negatively, but should instead be seen as a desire to "protect the oppressed and threatened group from extinction" (Jordan III, 1994: 113). Regardless, the terminology used both reflects and reinforces the value-laden judgements of a society,[6] and it is important that this is explicitly recognised. Such a critical awareness of the language and compliance mechanisms

[6] Some examples of changes in language relating to conservation, based on changing values and power structures, are reflected in the use of the following terms: 'regenerating bush' in place of 'scrub'; 'native forest' instead of 'bush'; and the replacement of 'swamp' with 'wetland'. The positive appropriation of weta by Weta Workshops also reflects a change in social values.

inherent in the management of invasive species and freshwater ecosystems is essential if we are to progress to more effective and democratic future management based on communication, and it is here that the value of environmental education (and environmental communication) is evident.

3.4 Environmental adult education

> *The skills, aptitudes, and attitudes that were necessary to industrialise the Earth are not the same as those that are needed now to heal the Earth, or to build durable economies and good communities (Orr, 1999: 232).*

Utilising a framework of environmental adult education will be important in addressing the final aim of this research: to investigate appropriate and effective educational methods to help discourage the further spread of non-indigenous invasive fish, and to raise awareness of the freshwater ecosystem restoration programme in general. The importance of environmental adult education is recognised in the New Zealand context within the Ministry for the Environment's *Learning to Care for Our Environment* (1998) report. The report describes environmental education as a multi-disciplinary, life-time learning approach designed to develop tools that enable individuals to contribute to maintaining and improving the quality of the environment (Ministry for the Environment, 1998).

Environmental education is often focused at school children, but knowledge-based campaigns have also been a popular way of changing and promoting conservation behaviours in the more general public (Frick et al., 2004). Frick et al. (2004) identify three main forms of environmental knowledge – system knowledge, action-related knowledge, and effectiveness knowledge – and state that it is important for education to incorporate all these forms of knowledge. However, it is increasingly being recognised that increasing knowledge alone often does not usually lead to behaviour change.

Heimlich and Ardoin (2008) assert that, to change behaviours, the individual habits, tasks, and skills that contribute to the larger environmental behaviour being encouraged must be dissected and analysed, in order to change the routines that exist around that behaviour (see also Reaser, 2001). However, there are many

different arguments regarding the role of education. While some contend that environmental education specifically calls for behaviour change, and that its ultimate purpose is to affect individuals' behaviours, others argue that the principle responsibility of education is to enhance the intellectual capacity of individuals rather than to impose on individuals ideas of how they should live (Heimlich and Ardoin, 2008). The 'education for behaviour change' agenda has been extensively criticised, and it is this latter approach that will be used in this study.

One critique of the 'education for behaviour change' agenda is put forward by Darlene Clover (2002a), who considers it flawed and simplistic. She argues that the approach reinforces the idea that different knowledge can and should be attributed different status and that it camouflages the broader politics of socio-environmental problems. Clover uses the term 'concientización' to describe a more inclusive, collectively discovered form of knowledge, which recognises the environmental knowledges and perspectives that individuals already possess and utilises those knowledges as they move toward deeper environmental understandings and more effective environmental practices. She sees this as challenging people to make meaningful contributions to the political aspects of environmental problems, rather than perceiving the issues as the behavioural failing of certain individuals (Clover, 2002b).

David Harvey (1996) and Donna Haraway (1991) are two authors who feel similarly uncomfortable about the motives of those driving the 'education for behaviour change' agenda. Instead, they focus on the importance of critically reconciling alternative perspectives to construct mutually agreed value systems and an appropriate course of action (section 3.2.3). Harvey (1996) and Haraway (1991) both emphasise that any system that automatically privileges one sector of society's views above others is not socially just, no matter how morally right the privileged section may appear.

It became evident as I reviewed literature for this study that most researchers operated from the supposition that controlling the environment, and correspondingly controlling people's behaviour, was the 'right' thing to do

(e.g. Bardsley and Edwards-Jones, 2006; Bremner and Park, 2007; García-Llorente et al., 2008). There was little or no critical engagement with the underlying assumptions driving their research; it was supposed that the way the researchers interacted with the environment was 'right', and people who acted differently should be subject to behavioural modification. In contrast, I believe the most socially just way to significantly contribute to the development of educational methods that focus on raising awareness of the freshwater restoration programme in general, and non-indigenous introduced fish management in particular, is to engage with these assumptions explicitly. This involves open discussion with multiple stakeholders and the development of a mutually agreeable course of action, discussed further in Chapter 6.

In summary, the insights provided by the theories of social construction and environmental perception are essential to the effective management of invasive fish. Through understanding the diverse perspectives of the different groups involved, the ways in which power and politics are integral to this process become evident. The interactions between power and language with individual values, the biophysical environment, and society play a large role in constructing dominant perceptions and conceptions of the environment. Finally, a case was made for the importance of utilising environmental education as a tool to increase the understandings of individuals, enabling them to make their own, informed, decisions. In the following chapter, I discuss how these theories informed the methodological framework employed for this research, particularly with regards to the formation of the interview questions.

CHAPTER 4: METHODOLOGICAL APPROACH

This research employed three main methodologies. First, I conducted a literature review in order to situate my findings amongst the current wider literature on the subject within both science and social science. This provided a platform from which discourse analysis could be undertaken as well as aiding the formation and refinement of the research and interview questions (Healey, 2005). Second, I carried out semi-structured interviews with key informants from six different freshwater management agencies, as well as a freshwater scientist, Waikato-Tainui, the New Zealand Federation of Coarse Anglers (NZFOCA), and individual coarse anglers. Finally, I employed an internet survey which was distributed to coarse anglers through club contacts within NZFOCA, and was also posted on the New Zealand coarse fishing website (Coarse fishing, 2008). These three methods were integrated as an interconnected pathway to investigate the research questions and each is described in more detail below.

4.1 Defining the research topic

This research was defined in a large part by Milestone 11 of FRST contract UOWX0505 'Restoring Freshwater Ecosystems and Resurrecting Indigenous Lake Biodiversity' (see Appendix I). However, in order for me to take ownership of it and mould it to form a social geography thesis, I needed to develop the preliminary ideas further and the original research questions were reframed (section 1.1). This evolution initially took place through conversations with peers, supervisors, and other people with some knowledge of the issues being investigated. Following this, an extensive literature review was carried out to further define the research objectives (section 4.1.2).

4.1.1 Conversations

Discussing this research with people involved in both biological sciences and the social sciences allowed me to think through the topic from multiple perspectives, which was important as it allowed me to ensure the interdisciplinary aims of the research were maintained. However, these conversations also served to highlight the trials involved in attempting interdisciplinary research such as this. One of the

most challenging aspects of this research was reflected in the differences between the ideas and perspectives of my two supervisors: one situated in the Department of Geography, Tourism and Environmental Planning, and the other in the Department of Biological Sciences. During my attempts to reconcile both points of view I realised how far removed the two disciplines, and the majority of the people operating within each, really are from each other. Although this was often disheartening, it also strengthened my belief that both fields have a lot to offer each other.

My own position as a Master's student situated between two disciplines presented further challenges. I seemed to be constantly realigning myself with the dominant ideas of either the biological sciences or the social sciences, and found it hard to find a place that spanned them both. I was never sure of my position in relation to this research. I certainly support the intentions of agencies that are attempting to manage and look after the freshwater environment, and yet I sympathise with coarse anglers' love of experiencing and utilising a different version of this environment. Tolich and Davidson (1999) also recognise the importance of reflexive communication, stating that:

> By being up-front about our own theoretical and ideological bias we can reflect self-consciously on the way this tempers our view of the social world. We can also use supervisors, fellow students, colleagues, and friends to help bring those assumptions and values into perspective.

This thesis does not reflect the diversity of each subject that I had hoped it would, nor do I feel it has provided a truly interdisciplinary approach to the research questions, but it still provides an important contribution to interdisciplinary environmental research. I found it difficult to reconcile the rigid answers demanded by the FRST contract and the various stakeholder groups with the more thoughtful and reflexive nature of social geographic research. However, combining these reflexive conversations with the literature review discussed below allowed this research to be approached in an integrated and comprehensive manner.

4.1.2 Literature review

To ensure the current understandings of both biology and social science were integrated into this research an extensive literature review was carried out. Following Healey (2005), key terms and search phrases were identified, including: non-indigenous, non-native, invasive, pest, exotic, alien, indigenous, native, New Zealand, freshwater, fish, freshwater fish, coarse fish, social, human, cultural, fisher, angler, and coarse angler. The University of Waikato library catalogue and the Academic Search Premier Database was repeatedly searched during the course of the study using the key words outlined above. Articles were filtered by their relevance to the research questions, and further references were found by utilising the bibliography of particularly pertinent articles. The information gained from these searches has mostly been incorporated in to Chapter's 2, 3, and 6, and has also provided a level of background knowledge which aided the design of the interview and internet survey questions.

4.2 Semi-structured interviews

4.2.1 Rationale

"Fieldwork begins with the assumption of multiple, socially constructed realities" (Tolich and Davidson, 1999: 58), and it is the task of the researcher to elucidate how the various actors construct their realities. Semi-structured interviews are perhaps the most common qualitative method used in human geography to achieve such interpretations (Longhurst, 2005). Conversational and informal in tone, they involve a self-reflexive and ordered listening on the part of the researcher, which allows the topic of interest to be addressed in the informant's own words while they remain relaxed and at ease. This is important as it allows the conversation to extend beyond the researcher's own knowledge, which can otherwise act as a limitation to the research (Longhurst, 2005). Semi-structured interviews can often be time consuming, but the depth of information obtained through this technique justified the time spent gathering it.

4.2.2 Implementation

Guiding themes and questions were prepared prior to the interviews (Appendix IV.4), although it was not intended that the interview be constrained by

or limited to these pre-prepared questions. On reflection, interviews with the management agencies tended to follow the prepared questions much more closely than those with the coarse anglers, which were more inclined to be relaxed and informal in tone. The interviews were designed to enable the individuals to feel comfortable and safe to express their opinions and beliefs, allowing their own environmental perceptions to emerge. The interview questions were derived by integrating the theoretical framework (Chapter 3) with the objectives of this research (section 1.1). Following conventional methodological practice (e.g. McLafferty, 2005), the introductory questions for each interview were designed to be open ended and situated within the informant's experiences to promote conversation (for example, "tell me about your angling"). The more formal and potentially controversial questions were asked later in the interview (for example, asking about potentially illegal fishing practices).

Informants were recruited for the interviews through a range of methods. Interviewees from freshwater management agencies were initially identified through the contacts of my supervisors or by contacting the agency directly and being pointed to the appropriate person. As the interviews progressed, it became more common for informants to refer me on to contacts in other agencies (known as snowballing), allowing me to identify other key individuals by utilising the knowledge and experience of the freshwater managers interviewed. Coarse anglers were recruited via a post on a forum on the coarse fishing website (Appendix IV.3). Informants were selected based on their level of involvement with coarse fish management or practical experience related to coarse fish.

Two interviews were carried out with employees of the Department of Conservation (DOC), and one interview with individuals of each of the following: Fish and Game Auckland/Waikato (A/W) Region, Fish and Game Eastern Regions (ER), Environment Waikato (EW), Auckland Regional Council (ARC), Ministry of Fisheries (MFish), a freshwater science from the National Institute of Water and Atmospheric Research (NIWA), and Waikato-Tainui. Five coarse anglers were interviewed, one of whom was a representative from NZFOCA.

The interviews were usually held at participants' place of work, although several of the interviews with coarse anglers took place in their home. Two interviews – with ARC and MFish – were conducted by telephone. All interviews were recorded by dictaphone (apart from one with a coarse angler who did not want the interview taped; quotes from this informant are indicated with *) and I transcribed each as soon as possible. In cases where it was difficult to understand the respondent on play back, my best guess is indicated in bracketed italics. At the start of each interview I asked participants if they would like to review a copy of their interview transcript, and those who did were emailed their transcript as soon as it was completed. None requested any changes be made. Transcribing and coding the interviews as soon as possible enabled the transcriptions to capture the most detailed information available in my memory at the time, which aided later data analysis.

Following Tolich and Davidson (1999), I utilised the techniques of positive and negative coding, identifying themes that were then cut and paste into thematic files using Microsoft Word. Coding involves assigning interpretive tags to the transcript text based on relevant themes or categories (Cope, 2005). Positive coding entails identifying existing and new areas of theoretical and empirical interest in the transcript. In practice, I made comments in the right margin of each transcript identifying areas of similarity and/or difference between interviews, comments that support conventional wisdom regarding invasive fish and freshwater management, and new points of interest. Negative coding identifies areas of weakness and points to ways to refine the research questions, although this proved to be ineffective as I did not attempt to refine the research questions early enough in the data collection process. I felt significant changes to later interview questions would result in a loss of integrity of the results.

The data obtained from the interviews was analysed by re-reading the transcripts and adding to the codes and identified themes with the comprehensive understanding obtained by the end of the research process. To aid analysis, two types of files were compiled. The first, based on organisational affiliations, allowed me to summarise the key points of participants from each organisation as they addressed the research questions. I have also used this structure to organise

the findings displayed in Chapter 5. The second, based on key themes, allowed me to analyse each theme in detail, from the diverse perspectives of all the participants. These organisational and thematic files were manually analysed and the extracts tied together to allow thorough understanding.

4.2.3 Critique

Two of the major critiques of this interview technique relate to the subjective nature of the information obtained and the power relations involved in conducting interviews. The production of individualistic information is a common criticism of qualitative research in general, usually directed by researchers steeped in positivist methodologies, although people's subjective positions are a central component of social research. It is widely recognised that interviews are not neutral tools of data gathering but instead involve active interactions between two people that lead to contextually negotiated results (Fontana and Frey, 2003). Interviews "do not offer researchers a route to 'the truth' but they do offer a route to partial insights into what people do and think" (Longhurst, 2005: 128). As such, this research needs to be recognised as subjective and partial; nevertheless the interviews provided rich and detailed commentaries regarding the research questions.

With regards to power, Fontana and Frey (2003: 82) discuss how the typical interview involves a hierarchical relationship, with the researcher in the dominant position. They argue that the friendly demeanour of the interviewer is merely a ruse to "gain the trust and confidence of the respondent without reciprocating those feelings in any way", and that this results in 'opportunistic' research. This exploitative possibility was in fact one of the aspects that most concerned me about carrying out this research. However, Fontana and Frey (2003) recognise that there has been a shift in the practice of interviewing, which allows a closer and less hierarchical relationship to form between the interviewer and the interviewee. They state that this shift allows interviewers to show their 'human side', answer questions, and express true emotions. To counter my above concern, I brought my 'human side' to each of the interviews, allowing the coarse anglers to feel comfortable expressing their values and describing their fishing practices to me. It should be noted that, in bringing this to the interviews with informants from government agencies, I felt I was taken less seriously than I would have been with

a more detached approach, but I do not think that this affected the results of the research significantly.

4.3 Internet survey

4.3.1 Rationale

Following the completion of the interviews an internet survey was employed to gain a more comprehensive understanding of the practices and beliefs of coarse anglers. The five semi-structured interviews carried out with coarse anglers allowed me to gain a lot of detailed information, but time constraints meant a limited number of interviews could be conducted. Utilising multiple methods in social research allows more advanced understandings of the complex nature of human beings and the ways they construct their lives (Fontana and Frey, 2003). Although the internet survey did not capture the same depth of information as the interviews, it had the advantage of being able to record information from a much larger group of people, and some of the respondents may have felt more comfortable stating their perceptions and behaviours in an anonymous fashion. An internet survey was selected in place of a more traditional postal questionnaire because of the swift and numerous distribution options available, particularly as the contact details of many coarse angling clubs and individuals are becoming increasingly difficult to find as they seek to avoid persecution from agencies like DOC.

It is important to consider who is likely to have access to email and the internet when carrying out an internet survey (McLafferty, 2005). I believed that most coarse anglers were likely to have this access for several reasons. On one hand, they tend to buy very expensive gear to support their angling and it is likely that there would not be a financial barrier to having a home computer and internet connection. Further, it is commonly thought that most New Zealand coarse anglers are British expatriates. As such they are likely to be in contact with friends and family in the United Kingdom, which probably utilises internet technologies such as email or skype. However, there will be some anglers who were not able to complete the survey, and this study does not claim to be representative of all coarse anglers in New Zealand (see section 4.3.4).

The internet survey was directed at anglers rather than the other stakeholder groups for several reasons. Not much is known about anglers' perceptions and practices, whereas the standpoint of management agencies is readily available. Anglers are a central component of understanding the 'human behavioural barriers to pest fish management' as they are often perceived to *be* the 'barrier'. Additionally, there are likely to be a much wider range of perceptions and behaviours inherent among the anglers than among the members of the management groups. Furthermore, informants from management agencies were asked to give an institutional standpoint as well as their personal view, thus their responses should be more demonstrative of the position of the organisation being represented.

4.3.2 Implementation

The survey (Appendix V.2) was designed to further elucidate the common practices and perceptions of coarse anglers. Unwin and Deans' (2003) and Unwin and Image's (2003) research was employed as a guide for wording some of the questions, such as the tick box options for what anglers value in their favourite sites. The Survey Monkey website, http://www.surveymonkey.com, was used to create and distribute the online survey. Survey Monkey provides a user-friendly online questionnaire building programme with multiple options for survey distribution and data collection. Due to time and licensing constraints, the potential of other surveying software was not investigated. Survey Monkey allowed a reasonable amount of freedom in the functional design of the survey, and allowed the results to be directly transferred to an Excel spreadsheet. I was also able to set up a second online survey allowing anglers to enter into a competition to win one of five $100 petrol vouchers (Appendix V.3); while this followed from the initial survey, it was not possible to link any identifying details provided by respondents to their original answers.

A pilot test was carried out with my supervisors, friends and family to ensure the wording and layout was easy to understand, the internet link generated by the Survey Monkey software worked effectively and the survey functioned as intended. Following this, a link inviting coarse anglers to complete the survey was

sent out to club members via the email lists of NZFOCA, and a link to the survey was also supplied on a post (Appendix V.1) on the coarse fishing website (Coarse fishing, 2008).

4.3.3 Response statistics

It is important to consider the demographics of the people who completed the survey in order to understand the section of the angling population that participated in the research. Fifty-six people started the internet survey, of which 53 people completed it. The five coarse anglers interviewed face-to-face had the opportunity to complete the survey and, given their interest in the project, it is likely that they did. Twenty-one respondents reported living in towns within the Auckland/Waikato region, 16 in the Wellington region, 13 in the South Island, and six people did not state their location.

Respondents varied from the age categories of 18-25 to more than 66 years old, although the greatest number of respondents were between 46 and 55 years old (29%). All of the respondents were male. Most of the coarse anglers have been fishing for more than 20 years (68%), and many (66%) were not born in New Zealand. Most of the New Zealand-born anglers had fished for less than five years, whereas the majority of the overseas-born anglers have been fishing for over 20 years (Figure 4.1). It is likely that these characterise many coarse anglers in New Zealand.

One trend in particular was found that is not likely to be representative of the majority of coarse anglers in New Zealand. Most (79%) of the coarse anglers that completed the internet survey belong to coarse angling clubs, and the greatest number of respondents were from the Hutt Valley Coarse Fishing Club in Wellington (Figure 4.2). However, it would be expected that the number of respondents belonging to clubs in the Auckland/Waikato region would be much higher than it was as this is the region where the highest concentration of coarse fish, as well as the highest concentration of people, are found. It is also likely that many people practice a less formal mode of coarse angling and are not associated with established fishing clubs; if this was a representative survey it

would be expected that a greater number of people would have indicated that they did not belong to a club.

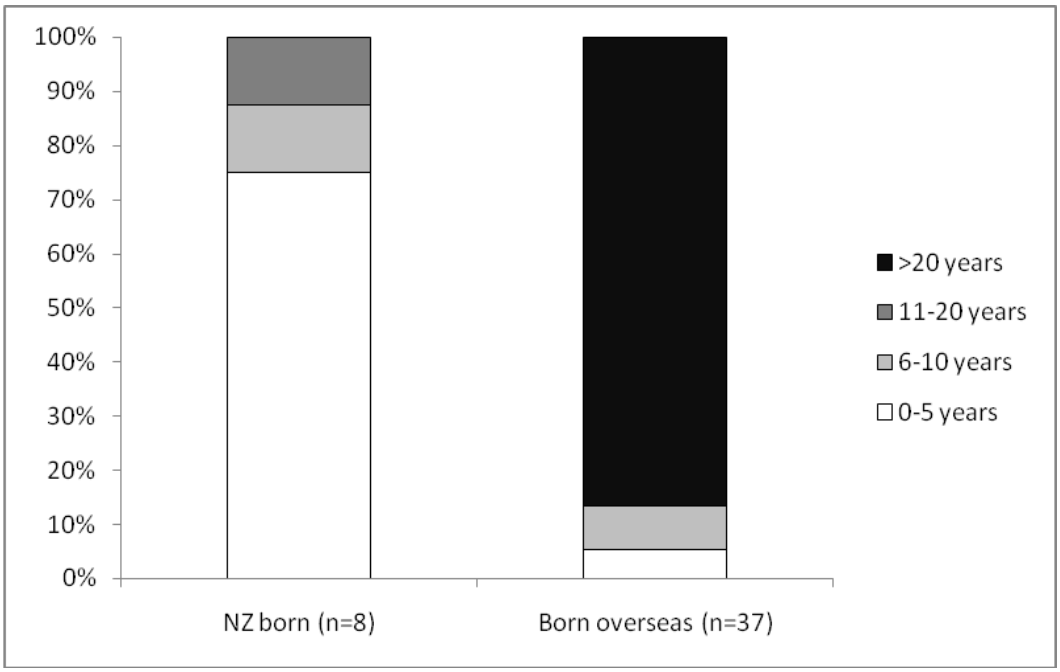

Figure 4.1 The length of time NZ-born anglers have coarse fished compared to overseas-born anglers.

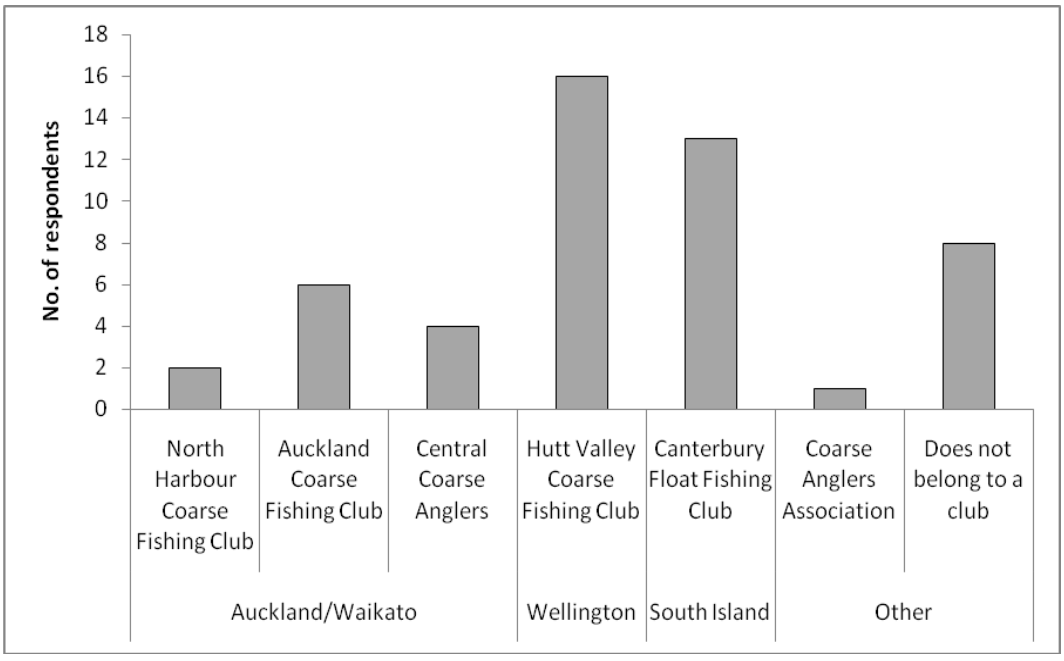

Figure 4.2 The clubs respondents belong to.

4.3.4 Critique

There have been many critiques of the use of questionnaire surveys, as well as the use of the internet as a medium for gathering information. Several factors can limit the effectiveness of questionnaire surveys, including poorly worded questions, non-response bias, and the highly subjective processes involved in interpreting ambiguous responses (McLafferty, 2005). The common criticism, usually directed by qualitative researchers, that surveys provide information of limited value, especially when compared with the deep level of information that can be obtained through detailed interviews (McLafferty, 2005), is negated in this study by the 'mixed method' approach.

Critical analyses of internet research often centre on their inability to obtain representative results (e.g. Denscombe, 2008; Hewson et al., 2003). However, I chose to utilise an internet survey instead of another option as I had limited time and funding available, and the internet provided an effective way to gain wide geographical coverage (Denscombe, 2008; Sue and Ritter, 2007; Table 4.1). Internet surveys are becoming increasingly effective as the use of the internet and home computers becomes more widespread (Hewson et al., 2003; Sue and Ritter, 2007), and I argue that many coarse anglers would have the necessary access to the internet. However, some anglers with the ability to complete the survey will not have done so for a variety of reasons, and as discussed below, this survey cannot be considered representative.

There are three main reasons why this survey is not representative. Firstly, 53 responses do not allow significant statistical analysis to be carried out on the information obtained. Secondly, as this internet survey was advertised on the coarse fishing website and through email, people who are not part of the coarse fishing forum, do not check their emails regularly, do not belong to a club, are not competent using or do not have easy access to the internet will have been excluded. Finally, the differences between those who received the invitation to participate in the survey and chose to participate and those who opted not to complete it may be significant, especially as some coarse anglers are particularly wary of anyone interested in their fishing activities, and their perspectives would have been omitted entirely. However, the intention of this survey was to provide

results that increase our understanding of coarse anglers in New Zealand and not to claim representativeness.

Table 4.1 Comparison of survey methods (adapted from Sue and Ritter, 2007: 7).

Survey Type	Advantages	Disadvantages
Mail	Low cost	Low response rate
	Wide geographic reach	Lengthy response period
	Anonymity allows sensitive questions	Contingency questions not effective
	No interviewer bias	Don't know who is responding to the survey
Telephone	Limited coverage bias	Confusion with sales calls
	Speedy responses	Intrusive
	Can ask complex questions	Call screening
	Wide geographic reach	No visual support
Face-to-face interview	Good response rates	Limited geographic reach
	Can ask complex questions	Time-consuming
	Long interviews tolerated	Expensive
		Interviewer bias
		Sensitive topics difficult to explore
Internet/online	Low cost	Coverage bias
	Fast and efficient	Reliance on software
	Contingency questions effective	Don't know who is responding to the survey
	Direct data entry	
	Wide geographic reach	

4.4 Ethical issues

Ethical approval was obtained on 14 April 2008 from the Faculty of Arts and Social Science Human Research Ethics Committee, prior to undertaking the interviews and internet survey. As well as providing legal protection to the university institution, the ability and privilege associated with research into an individual or group's perspective comes with an associated obligation to protect them and the information divulged (Tolich and Davidson, 1999). The five main ethical principles of doing no harm, ensuring voluntary participation and informed consent, avoiding deceit, and maintaining confidentiality or anonymity were taken into account when considering the ethical implications of, and conducting, this research.

Thus, all participants were required to read an information sheet and sign a consent form (Appendix IV.1-2) before participating in the research. Informants were advised that all cassette tape recordings, printed transcripts, and other identifying details would be stored in a locked cupboard for three years and that all typed transcripts and any other personal information obtained would be stored in a password protected profile and kept for three years. Further, participants had the following rights: to request any or all of the information they provided be omitted from the research report; to pull out of the project at any stage within one month of their involvement; and that they could ask to see a copy of the transcripts of their interviews within one month of their involvement. Confidentiality was assured to all interviewees and anonymity to all who completed the internet survey.

Ensuring confidentiality was critical because I was expecting that some of the informants would be carrying out illegal behaviours and would be wary to disclose this information; this proved especially important as members of the coarse fishing forum began to question my motives in carrying out this research. There is an obvious ethical concern relating to the potential use of the information obtained during this study to cause harm to the informants, and it needed to be clear that my intention in obtaining this information was to contribute to understanding the practices and beliefs of coarse anglers and to forward the implementation of freshwater management in New Zealand, rather than to carry out a covert information gathering exercise. Where it does not compromise the value of this research, specific details have been kept deliberately vague in Chapter 5 in order to ensure that I do not break the confidence of any of the participants. As such, informants have been referred to by their organisational or community affiliations and the date of the interview. The following chapter outlines the key research findings, while a more critical analysis is provided in Chapter 6.

CHAPTER 5: FINDINGS

The following chapter outlines the main findings of the research. The findings are reasonably descriptive; a more detailed and critical analysis is carried out in Chapter 6. While the primary source of information outlined in the sections below comes from the interviews and the internet survey, secondary sources such as websites and government reports were also used to supplement the data. The results are structured by the respondents' organisational affiliations in order to best reflect the values, perceptions, and practices of each group. The role of each group in relation to freshwater management or resource use is outlined in each of the sections below, as are the key findings as they apply to the research questions. A summary of the main findings is provided in section 5.8. As anonymity and confidentiality was promised to informants, I have identified them only through the organisation they are associated with.

5.1 The Department of Conservation

5.1.1 The role of the Department of Conservation

The Department of Conservation (DOC)'s legislative mandate falls under the Conservation Act 1987, as well as other statutes such as the National Parks Act 1980 and the Reserves Act 1977 (Department of Conservation, 2008). Under the Conservation Act, DOC's key functions are to:

- Manage land and other natural and historic resources;
- Preserve as far as practicable all indigenous freshwater fisheries, protect recreational fisheries and freshwater habitats;
- Advocate conservation of natural and historic resources;
- Promote the benefits of conservation (including in Antarctica and internationally);
- Provide conservation information; and
- Foster recreation and allow tourism, to the extent that such use is not inconsistent with the conservation of any natural or historic resource.

The Department's role in freshwater management is defined in section 6AB of the Conservation Act 1987 and has traditionally been important for protection of

indigenous freshwater fish and habitat as well as for biosecurity (DOC interview 28-05-08). Two people from DOC were interviewed for this research.

5.1.2 Perceptions of coarse fish(ing)

The DOC informants held a strong belief that coarse fish were detrimental to the quality of freshwater areas and the survival of native fish species, although there was also some recognition that there wasn't necessarily enough scientific evidence to support such claims for all coarse fish species. One informant likened the impacts of coarse fish to a chicken and egg scenario, musing: "do they cause the poor water quality, or are they the only species that tolerate it?" (DOC interview 28-05-08). DOC informants acknowledged that there are many factors impacting on the quality of indigenous freshwater ecosystems, but emphasise the importance and value obtained from seeing results that allow them to believe they are making a difference in restoring freshwater areas:

> Impacts of pest fish, for example, they're just one of many threats. You know, we've got all sorts of things. We've got urbanisation, we've got sedimentation…all those things are all threats…nitrogen loads…channelisation, drainage, all those things are huge threats. Pest fish, at this stage, because they're still relatively restricted, we can make a difference (DOC interview 28-05-08).

When asked about the practice of coarse angling, two main responses emerged. The first relates to the belief that most coarse anglers operate illegally:

> I do have problems with some of the way[s] that the sorts of people fishing for coarse species or pest fish species operate… One, there's clearly people releasing fish when it's against the law, and secondly there's people clearly taking fish away live from the banks of the river… I think there are some people doing it legally but there are very, very few. They're mostly doing it in an illegal sense (DOC interview 24-04-08).

This view is likely to be particularly strong in the Auckland/Waikato region, where the koi-containment area is located. Most coarse anglers re-release koi carp to the waterway where they caught them, breaking section 67B of the Freshwater Fisheries Regulations 1983, which states that European and Japanese koi carp must be killed on capture. There is a strongly held ethic amongst the coarse

angling community that fish should not be killed. Thus, many coarse anglers would argue that they do not follow the law because it is so far removed from their own moral standpoint. However, there are also other illegal behaviours occurring, for example, anglers' fish for rudd in areas other than the Auckland/Waikato region.

The second key perception is that coarse angling is not a legitimate sport. Informants commonly compared coarse fishing with trout angling with unfavourable results, reflecting the dominant opinion of Fish and Game New Zealand. One DOC informant explained that coarse fishers were considered inferior to trout anglers, "because they basically sit there and wait... [laughs], it's not really a sport" (DOC interview 28-05-08). The main reasons coarse angling was considered an 'inferior' sport were the sedentary nature of the practice and the low water quality of the areas usually inhabited by coarse fish described below:

> They tend to live in scummy ponds with not good water quality…You know, no trout fishermen in his right mind would want to fish there. But for a coarse fisherman, he just thinks they're fantastic! He can sit on his little chair and put his little fishing rod out. So yeah, I guess in terms of what the fishermen value, it's going to be different for each of them (DOC interview 28-05-08).

In contrast, trout live in fairly pristine environments, with cold, deoxygenated bottom waters.

5.1.3 Perceptions of control targets and techniques

DOC employ several management techniques to control and minimise the impacts of coarse fish. Four key management principles are generally followed – prevention, containment, control, and eradication – with different procedures inherent in each approach. Prevention and containment are considered biosecurity measures and involve making sure no new incursions of species occur. Control and eradication are more aligned with restoration, and can be either pest-led or site-led, depending on how established and wide-spread a species is.

Ideally, DOC would like to see koi carp, catfish, rudd, and goldfish controlled. However, complete eradication is very difficult to achieve. The mechanisms most

preferred for undertaking control by one informant were biological agents such as species-specific pathogens, predator control mechanisms, or genetic manipulation, like daughterless carp (see Koehn, 2003 for a further discussion of these techniques). DOC considered these to be more long-term and wide-reaching than current mechanisms such as rotenone (cube root powder) and physical removal, and believed they could be marketed to the public as more 'natural' options (DOC interview 24-04-08). However, rotenone can also be considered 'natural' as it is created from the cube root plant, and was considered a good tool for eradication by the other informant as it is effective and breaks down easily (DOC interview 28-05-08). Both informants agreed that netting, drainage, and spear fishing – the techniques commonly preferred by local iwi – are not particularly effective control mechanisms, although it was recognised that they do still have a part to play. The impact of bow hunting was not discussed.

5.1.4 Important sites for conservation

The Department of Conservation were reluctant to allocate values to different freshwater sites, stating that all freshwater areas are considered important and valuable by DOC. This is particularly true given the continuum-like structure of freshwater areas and the need to consider the catchment-level implications of management and land use practices. The informants discussed how different areas require different management approaches; while the more pristine sites need to be managed to ensure they stay that way, the more degraded sites also provide important habitat for some species of fish and for fish passage connectivity:

> Restoration is important for…keeping water nice, for want of a better term, is important across all of those types of [different fish species] habitats. Whether it's a, what we'd call scummy pond actually still has some values… there's often still native fish there, there's often still eels there (DOC interview 28-05-08).

5.1.5 Potential for compromise

Despite the above assertion that all freshwater areas are important, DOC displayed a willingness to engage in discussion with coarse anglers. One interviewee, who recognised the current marginalisation of coarse anglers, suggested the possibility of communicating and forwarding management plans through a forum:

> I think it would be worthwhile having some sort of forum or meeting group where we could all sit together and come up with a plan for the Waikato as to how we're going to manage the fish, or at least what everyone's approach is going to be and we can all see where everyone's coming from… At the moment the coarse fishermen...have organised groups, but they're pretty marginalised. No one has ever bothered…they just ignore them as much as humanly possible. I suppose there's a reluctance, if you were to give them too much…credence, that you'd create a bigger problem for yourself in a sense (DOC interview 24-04-08).

Recognising that preventing the further spread of coarse fish is a high priority, and that already established populations will be practically impossible to eradicate, DOC found the idea of negotiating a compromise with coarse anglers agreeable:

> It would be useful because what you'd ideally want to do is draw a line in the sand and say these are where the coarse fish are, this is where you can fish for coarse fish, these places you can't fish for coarse fish and we'll be trying to get rid of them, and if they turn up in any new places we'll be trying to get rid of them (DOC interview 24-04-08).

However, it was also noted that attempts to reach such a compromise have been undertaken previously, without much success:

> I've worked really closely with the Federation of Coarse Anglers…and at the national level they're fine, they don't want to spread fish around and da-da-da. But they've got members who want to and do move fish around. And they are our biggest problem at the moment (DOC interview 28-05-08).

Coarse anglers dispute the allegation that they are responsible for the spread of coarse fish (section 5.7.5), but the experiences of this informant suggest otherwise:

> In Christchurch we've got a very active spreading…at the moment, and we've been unable to stop that, and there have been discussions about whether we try and…keep them restricted to ten ponds, but we keep finding them in new ponds, and so we're very hesitant about doing that (DOC interview 28-05-08).

5.1.6 Improving freshwater management and legislation

With regards to DOC's current management practices, both interviewees felt that, if the resources became available, they would like to have access to "more and better" control tools. Developing such techniques would require research into the

tools themselves and the life habits of the fish, which is also something that the NIWA scientist felt was of high priority. As well as this, the informants suggested that DOC should be recognised as the lead organisation for pest fish management in New Zealand (DOC interview 28-05-08).

DOC, like the majority of research participants, felt that the legislation surrounding pest fish management is good in intent but not in practice. The main complaint referred to the complexity and overlap inherent in the legislation, which complicated things for the general public, as well as the management agencies:

> I think the complexity of it is the big problem. There's a lot of overlap between different organisations and different organisations aren't even sure where their role starts and stops, and then you're trying to explain that to people that come along and ask a question, so it makes it hard for the public to understand as well (DOC interview 24-04-08).

Some examples of this overlap include: the inconsistent management of freshwater fisheries between organisations (DOC manage the whitebait fishery while MFish manage all other fisheries); the confusing application of legislation (the Fisheries Act can override the Conservation Act in some circumstances, but not others); and the conflicting interests that emerge when a fish considered a 'pest' by DOC is considered a 'sports' fish by Fish and Game.

In particular, DOC are dissatisfied with section 67B of the Freshwater Fisheries Regulations 1983, which states that koi carp must be killed on capture. While this rule was developed to prevent the spread of koi carp, in effect it poses a barrier to freshwater conservation:

> There's legislation around translocation of freshwater life, aquatic life, and that is, it was designed for one purpose which was to stop the spread of unwanted fish, or unwanted aquatic life. But now the process of meeting the legislative requirements is…a barrier to also translocating native wildlife for restoration [and research] purposes (DOC interview 24-04-08).

This rule also forms a barrier to effective communication with coarse anglers:

> When coarse fishermen are practicing catch and release of pest fish such as koi and catfish they are breaking the law. This means that when DOC staff make contact with these fishers at the bank side (e.g. during a competition) they are compelled to take action. At a minimum this means killing all the pest fish held in any keep net. In a worst case scenario this could result in prosecution action. Either way it immediately puts DOC staff and coarse fishers in conflict with each other (DOC, personal communication).

5.1.7 Educational methods and incentives

Effective public education was considered by most of those interviewed to be essential for the effective completion of freshwater restoration projects. Somewhat ironically, it is often anglers that fish for non-indigenous species like trout that provide the initial vocalisation and motivation to protect a resource like freshwater ecosystems:

> You have to give [the public] a reason to care about a resource. So that's why you have trout fishermen. Although they're into trout, they've actually probably been the most vocal and active people for freshwater protection and restoration. So I think that's the way, you've got to make people realise it's a resource that's important to them (DOC interview 24-04-08).

The kinds of educational methods usually employed by DOC include distributing posters, pamphlets, and key chains, having live fish at events like the Field Days and Boating and Fishing shows, and using competitions and stickers to get children involved. However, although they know the message they want to promote, they recognise that changing public attitudes and behaviours is much more difficult and is often a source of frustration. One interviewee emphasised that coarse anglers "know what they're doing", and that rather than raising awareness they need to be increasing compliance (DOC interview 28-05-08). In a study into the effectiveness of the 'check, clean, dry' Didymo response campaign, DOC found that although many people reported hearing of the campaign and knew the actions they should take to help prevent the spread of Didymo, a much smaller percentage of people were actually following through on the recommended actions:

> They'd heard about the check, clean, dry, but only so many people were changing their behaviour. And that's the hardest thing to do, is to change behaviour. I mean you look at multinational companies like Coke, or whoever, drink my product, buy my product. And they spend millions of dollars on advertising. Or even the social marketing campaigns like…stop smoking, you know, millions and millions of dollars. And do we get people to change their behaviour? No. I mean, yes, there is a change, but look at the investment to get that done (DOC interview 28-05-08).

5.2 Fish and Game New Zealand

5.2.1 The role of Fish and Game New Zealand

Fish and Game New Zealand consists of the national NZ Fish and Game Council and 12 regional Fish and Game Councils. These were established in 1990 to represent the interests of anglers and hunters and to manage, enhance, and maintain sports fish and game in NZ under Section 26B of the Conservation Act 1987 (Fish and Game New Zealand, 2008). Fish and Game administer the statutory management of sports fish and look after their recreational use by anglers throughout New Zealand, except in the Chatham Islands and the Lake Taupo catchment where it is overseen by DOC (Fish and Game New Zealand, 2008).

One representative from each of two Regional Fish and Game Councils (Auckland/Waikato (A/W) and Eastern Regions (ER)) were interviewed. These described the role of the Councils as to manage sports fish (rainbow trout, brown trout, perch, tench, and rudd in A/W), look after angler issues, manage licences, set regulations, co-ordinate research, create publicity, and undertake restoration work (in areas where it benefits trout, or other game species). Fish and Game (ER) also stated that they tend to pick up a lot of the habitat management in the Rotorua area, as DOC increasingly shifts their focus to wetlands and Crown protected areas.

5.2.2 Perceptions of coarse fish(ing)

Coarse fish have been considered a fairly minor part of Fish and Game's role in New Zealand, with much more emphasis put on trout fisheries. Coarse fishing

techniques are prohibited in the Eastern Region altogether, where it is clear that coarse fish are not considered a valued sports fish:

> We don't encourage [coarse fishing] at all. In fact we, by our regulations, we make it difficult. We don't outright prohibit it, because we have a national mandate to represent some what are called sports – well they are sports fish, but they're also coarse fish – so we have a mandate for all sports species. However, we have a high priority placed on trout (F&G ER interview 07-08-08).

Fish and Game have a mandate to promote coarse fishing in New Zealand. However, coarse fishing is marginalised by most Fish and Game Councils, and trout tend to be prioritised wherever there is a conflict with a coarse fish like perch:

> We've certainly lost a lot of trout fisheries because of perch… it competes for the same food as trout… It's more successful up here because it's slightly warmer and massive recruitment. And what else is an issue? Perch probably also prey on small trout. So it's a competitor for food and it's also, it's a direct competitor for food and also a predator (F&G A/W interview 05-05-08).

Although Fish and Game are concerned about the impacts of coarse fish on trout populations and water quality, they, like DOC, also recognise that there are many other factors, such as land-use change, that have a significant impact on freshwater environments:

> Coarse fish are a threat, but in the list of threats when you look at land-use changes, intensification of dairying…engineering options to clean up water quality like building big walls or pumping chemicals into lakes – when you put the list of threats there, coarse fish are not… So there's a whole raft of issues, habitat related issues, and us managing our own users as well; those would probably be more of a threat than coarse fish (F&G ER interview 07-08-08).

5.2.3 Perceptions of control targets and techniques

Fish and Game would like to see coarse fish that are not sports fish (i.e. catfish, koi carp, and rudd outside of the Auckland/Waikato region) controlled using a method that doesn't 'unduly effect valued sports fish' (i.e. trout). They recognise

that management is always a balancing act involving decisions about their location, their potential to cause environmental harm, and the impacts they have on native fish (F&G A/W interview 05-05-08). Despite citing the importance of balance, Fish and Game clearly value trout more highly in any decision that involves managing game fish and coarse fish.

5.2.4 Important sites for conservation and angling

Like DOC, Fish and Game were unwilling to name any site as particularly unsuitable for restoration or as especially suitable for coarse fishing, stating that they have some "fairly ambitious plans for restoring some pretty degraded places" (F&G A/W interview 05-05-08). However, they also noted that if an area did not contain trout they would not be interested in undertaking restoration work with it (F&G A/W interview 05-05-08). Fish and Game found it very difficult to prioritise water bodies:

> If you look at it from a…financial line obviously you'd have to say where you make the most money, which is the Rotorua Lakes. However, remote fisheries that don't get a lot of use can have a very high value as well (F&G ER interview 07-08-08).

5.2.5 Potential for compromise

There appeared to be some resentment remaining from historical attempts at finding a compromise with coarse anglers, and Fish and Game are wary of attempting such an agreement again. The original attempts occurred when what was the Acclimatisation Society became Fish and Game New Zealand:

> At that stage it was considered that we were after [coarse anglers] interests, to the extent of doing fish releases through the legal processes that were set up. *(The idea was that they would stop doing illegal releases, it would be better for the environment and we would stop the illegal releases)*[7]. And that basically failed because it was taking us four years to get permission from DOC, and then by that time the waters were stocked anyway, *(so the coarse anglers didn't keep their side of the bargain and I don't think DOC particularly kept their side of the bargain)*, and we were the meat in the sandwich (F&G A/W interview 05-05-08).

[7] In cases where it was difficult to understand the respondent when playing back the interview, my best guess is indicated in bracketed italics.

This informant repeatedly stated feeling "stuck in the middle" of groups with different agendas (namely DOC and coarse anglers), which possibly enhances these feelings of resentment.

Having said that, the other respondent viewed the possibility of taking part in a communicatory forum positively:

> Nationally it would probably be a good forum. The hardest group to get on board I would imagine would be the coarse anglers. And if you're getting coarse anglers involved you should include aquarists, or whatever they're called, and you may want to deal with it on a slightly wider than a coarse fish issue. So you perhaps need a national aquatic…something-or-other, you know, biodiversity group or whatever you want to call it, that tries to deal with a slightly bigger picture view. I would think that if you're going to just pick on the coarse fishery, well then they would quite rightly say well what about the, you know... You need to make sure if you do it then you keep it fair (F&G ER interview 07-08-08).

The differences between the attitudes of these two informants reflect the ways in which differences can be found between each Regional Fish and Game Council.

5.2.6 Improving freshwater management and legislation

The main factors cited by Fish and Game as limiting their ability to manage freshwater areas were a lack of resources and a lack of inter-agency communication. Fish and Game are funded solely by licence fees, resulting in a limited resource base, although this does allow them to experience a greater deal of political autonomy than most other management organisations (F&G A/W interview 05-05-08). Furthermore, Fish and Game believe they are undertaking habitat management at a disproportionate level to other agencies:

> We spend more resources on dealing with [habitat management] than we do with our species. And therefore that is something that we feel is something that really should be done by those agencies that have a statutory authority to that, which are regional councils and Department of Conservation (F&G ER interview 07-08-08).

With regards to communication, the Auckland/Waikato interviewee repeatedly reported feeling "left out of the loop"; reducing their ability to undertake

management effectively. Thus, Fish and Game believe that increasing clarity, collaboration, and capacity – in the legislation as well as in management practice – will enhance the management of freshwater areas. In the Eastern Regions there is an Aquatic Pest Technical Advisory Group (APTAG), which, in stark contrast to the Auckland/Waikato region, enables inter-agency communication and collaboration to occur. Informants have faith that a national network would have a similar positive effect:

> So all the regional council's, DOC, Fish and Game, around the country will end up with what's I think being called NAPTAG [National Aquatic Technical Advisory Group], they've got a national aquatic group. So there's a regional APTAG group and then there's a national one which encompasses (*all those groups*). So those groups will become able to deal with new incursions of any aquatic biodiversity threats (F&G ER interview 07-08-08).

This national group would also be able to provide a solid foundation from which public education could occur.

5.2.7 Educational methods and incentives

It can be difficult for people to engage with and learn about freshwater ecosystems, due to the unfamiliar nature of the freshwater medium. Fish and Game believe the most effective way to connect people with the freshwater environment is through direct experience:

> The best way to educate people about freshwater ecosystems is to put them in a diving mask and throw them in the water… A lot of what goes on in the water is misunderstood, because it's not seen, or it's a hard medium to get people interacting with (F&G ER interview 07-08-08).

They would like people to understand that it is important that organisms are not spread to new areas (F&G ER interview 07-08-08), and they also regularly promote the importance of looking after habitat:

> We have had articles in our publications we send to anglers, in our annual magazine, we do a fair bit of publicity about the value of habitat and…the potential impact of invasive species… [If we] look after the habitat, [we] look after the fish (F&G A/W interview 05-05-08).

Like DOC, Fish and Game recognise that education does not necessarily lead to behaviour change. They recommend installing tougher compliance enforcement penalties for people who do not check their boats are free of weed before entering another waterway, or who partake in illegal activity such as spreading fish (F&G ER interview 07-08-08), which reflects a sophisticated understanding of the role compliance mechanisms can play in reinforcing desired behaviours.

5.3 Regional Councils

5.3.1 The role of regional councils

Regional councils come under the legislative mandates of several acts, including the Resource Management Act 1991, the Local Government Act 2002, the Land Transport Act 1998, and the Biosecurity Act 1993, among others (Environment Waikato, 2008). The functions of regional councils, as outlined in the Local Government New Zealand constitution (2008), include:

- Resource management (e.g. water, soil, and coastal planning);
- Biosecurity control of regional plant and animal pests;
- River management, flood control and mitigation of erosion;
- Regional land transport planning and contracting of passenger services; and
- Civil defence (natural disasters, marine oil spill).

There were some important differences in the way the two regional councils involved in this research – Environment Waikato (EW) and Auckland Regional Council (ARC; interviewed by telephone) – saw their roles with respect to managing invasive freshwater species. While regional councils may have the same functions, the implementation of those functions can vary between regions. The EW interviewee considered that, until now, EW's main role had been one of information and redirection. However, it was hoped the 2007-2012 Regional Pest Management Strategy (RPMS) will serve to increase their capacity and political will to act on issues relating to invasive freshwater fish (EW interview 07-05-08). ARC, on the other hand, considered themselves as taking "a leading role in as far as freshwater research and restoration in the Auckland area is concerned" (ARC interview 25-07-08).

5.3.2 Perceptions of coarse fish(ing)

Many similarities emerged between the regional council's perceptions of coarse fish and coarse angling and those of DOC. Again, coarse fish were considered to be among the most problematic freshwater fish. This view was particularly evident in the Auckland region, and there is a coarse fish control programme underway involving gill netting at Lake Wainamu, near Bethells Beach. Studies have shown the water quality of Lake Wainamu has improved as the fish have been taken out (Rowe, 2007). The ARC informant reflected on the balance between maintaining the quality of the freshwater environment and allowing recreational activities:

> I guess the…introduction of species for coarse angling overall has had a pretty detrimental impact… obviously people's recreational pursuits are important to them, but in saying that it shouldn't really impinge on the effects on the environment (ARC interview 25-07-08).

The recognition that the practice of coarse angling is often marginalised by Fish and Game also emerged from interviews with regional councils:

> Coarse fishery management in New Zealand is non-existent, as far as I'm concerned. It's a fringe sport that I don't think Fish and Game have a great deal of, well, certainly in the Waikato, I don't think they have a great deal of interest in. But equally they're not taking a very proactive role in terms of managing it. So they're kind of a law unto themselves, the old coarse fishermen (EW interview 07-05-08).

Overlooking coarse anglers in this way hinders the effective management of freshwater areas – they will not simply go away if ignored.

5.3.3 Perceptions of control targets and techniques

In contrast to DOC, employees of regional councils tended to prefer gill netting to rotenone as a control technique. Rotenone requires resource consent to use, which can be difficult and time-consuming to obtain. It is interesting that the process of gaining resource consent is considered enough of a deterrent for regional council's not to utilise rotenone, and may suggest that its potential effectiveness is outweighed by this process.

With regards to controlling fish, regional council's were quick to point out that not all coarse fish cause problems in all environments. One informant noted that it is important to think about "where they are, the type of habitat they have been introduced to, and the impacts that they're likely to have in that" before any control programmes are instigated (EW interview 07-05-08). Despite this recognition, it was during the interviews with regional councils that the concept of the purist or nativist viewpoint, which renders any non-indigenous species an unwanted part of New Zealand's landscape, emerged:

> You could take a purists view and say if it's introduced – if it's introduced, if it's invasive – it should be removed… and I think for some species in new places that certainly should be the case. Just get rid of it. Don't even ask the question of whether it's going to have an impact or not, it shouldn't be there. Sort of a conservation approach I suppose (EW interview 07-05-08).

This approach is not likely to be practical for many of the coarse fish species in New Zealand, which are already well established (and highly socially valued) in certain areas, and are therefore difficult to eradicate completely.

5.3.4 Important sites for conservation

Several key trends emerged with regards to the freshwater areas that regional councils most value. Environment Waikato and Auckland Regional Council tend to place a particular focus on looking after wetland and peat lake habitats, as they are currently subject to the greatest pressures and were historically of ecological importance for these regions. Maintaining fish passage connectivity was cited as another significant focus for management efforts, although lowland water bodies tend to be focused on as they are currently subject to the greatest environmental pressures. The continual nature of freshwater ecosystems and the need to manage them as a holistic network was emphasised, reflecting the understandings of other management agencies that freshwater areas need to be managed at a catchment level.

Resources are also allocated to freshwater areas that already have a high ecological value. Informants discussed how the quality of each freshwater environment determines the type of management the site requires; a high quality site would be maintained where as a more degraded site would be subject to

restoration practices. High conservation value areas in Auckland (outlined in the appendices of ARC's RPMS), such as Lake Karaka, Lake Wainamu and Lake Ototoa, are protected from sports fishing altogether under rule 1.1.1.3 of the Auckland Regional Pest Management Strategy. Like DOC, the regional councils emphasised the importance of focusing on areas where managers can feel like they are making a difference. This suggests that it will be important for areas where such a difference can be made to be identified, to act as a source of encouragement for management agencies.

5.3.5 Potential for compromise

There appeared to be some reluctance within ARC to the suggestion of compromising with coarse anglers, even though the bulk of coarse anglers live in the Auckland region. This is likely to be due to the presence of several high value conservation areas in the region, as well as perception that ARC are taking a leading role in freshwater restoration. However, there did appear to be some willingness to consider setting aside some lakes for coarse fishing in the Waikato region:

> Rudd are here to stay, you're not going to eradicate them, they should be managed… we should put aside some waterways and say right-oh these are going to be those kind of coarse fisheries. As much as I say it shouldn't be here, it is (EW interview 07-05-08).

5.3.6 Improving freshwater management and legislation

Once again, respondents from regional councils highlighted the lack of clarity and collaboration regarding the responsibility for 'pest' fish management, as well as a lack of financial capacity, as the biggest barriers to the effective management of the freshwater environment. Informants reflected the concerns of most other organisations involved in freshwater management, discussing a lack of central organisation on invasive fish issues and noting that DOC's focus on the conservation estate may not be practical as it is often not where the problems are found.

Informants also discussed the problems that are caused by the complex nature of the legislation, using the management of long-finned eels as an example. With

long-finned eels MFish manage the fishery, regional councils manage the habitat, and DOC manage the species; subsequently long-finned eels are subject to multiple layers of legislation. ARC emphasised that they are committed to resolving some of these complicating issues:

> I think part of that has been addressed for the…RPMS, where there's been a…call for a liaison group to be instituted around that area, as far as…management of exotics. So that's already been recognised as…an area where we can…add benefit to proceedings I guess. So I think ARC is working towards that at the moment, in terms of…having better communication with other groups (ARC interview 25-07-08).

This liaison group would also have a role to play with regards to education.

5.3.7 Educational methods and incentives

Regional councils held a strong belief that public education is critically important to encourage people to engage with and care about freshwater areas. Like Fish and Game, informants felt that the most effective way to educate people about freshwater environments was to encourage their engagement with such areas:

> I heard this old Māori woman once say – which I thought was just fascinating – she said we've turned our backs on our rivers and streams. We've built fences next to them, turned our houses around to face the street instead of the rivers, and we've forgotten they're there. And I sort of thought, it's a nice kind of philosophical kind of thing, but practically it's also true, because we have! Urban people haven't got a clue (EW interview 07-05-08).

Interviewees discussed many ideas for educational opportunities, reflecting a more sophisticated understanding of environmental education than many other informants. This may be because their role tends to be broader than those of some of the other, more specialised interviewees. Some of the suggestions included utilising the Enviroschool programme, and educational displays at events such as Ambury Farm Day and BioBlitz, as well as those held at institutions like museums. They also emphasised the importance of creating and providing simple, useful resources, like informative posters. They discussed the need to energise people about freshwater areas, and suggested fostering care groups as one way to do this.

Informants believed one of the most important things education could provide to the general public was an understanding of the names, life habits and varieties of native fish. One informant discussed the challenge involved in getting people to recognise the value of New Zealand's indigenous fish fauna:

> You know, you're lucky if people actually know anything other than eels as far as native fish go, and if they actually recognise that trout aren't a native species… people do find it interesting I suppose once you actually, you know, show them what's in their local little backyard stream… they always seem to be quite sort of surprised and interested as to what actually exists in there... it's just about appealing to people in terms of educating themselves on the other sort of native species that perhaps aren't as well known or as well publicised as many of our native birds I guess… (ARC interview 25-07-08).

However, they also recognised the risk that people could "get overloaded with environmental information" to the point where they stop wanting to hear environmental messages (EW interview 07-05-08). Subsequently, they approve of DOC's attempts to target specific information to particular audiences:

> DOC have had a big focus on, for instance, the Asian community. And I think that's very sensible because there's some cultural issues there on, for example, the value of koi carp… In some of the Asian countries these things are native, or they're highly valued, and here they're not. So I think that's a very good idea, I think there's some issues around coarse fishermen that we need to start addressing… Targeting boaties, those are the people that are in amongst the water, and those are actually a pretty significant group. Commercial fishermen, eel fishermen, you know they've been targeted about cleaning their nets and the whole Didymo thing, but also about pest fish. And it's in their interests (EW interview 07-05-08).

5.4 Ministry of Fisheries

5.4.1 The role of the Ministry of Fisheries

The role of the Ministry of Fisheries (MFish), as outlined on their website (2008a), is to:

- Advise Government on the development of fisheries policies;
- Develop laws to manage fisheries;
- Administer the Quota Management System that regulates New Zealand commercial fishing activity;
- Promote fishers acting within fisheries laws; and
- Give effect to the principles of the Treaty of Waitangi as they relate to fisheries.

MFish consider themselves to be "guardian of the multitudes of Tangaroa", and this is expressed through their Māori name: Te Tautiaki i ngā tīni a Tangaroa (Ministry of Fisheries, 2008a). One interview was conducted, by telephone, with MFish. This informant further described their responsibilities to me under the Fisheries Act 1996 as, equally, to ensure the sustainable use of fishery resources and protect the aquatic environment, as well as to facilitate the appropriate use of fishery resources (MFish interview 18-07-08). This reflects the difference in the underlying ideologies of the Fisheries Act and the Conservation and Biosecurity Acts; the first is based on a philosophy of sustainable use, while the latter are founded upon ideas of protection and pest management.

5.4.2 Perceptions of coarse fish(ing)

In contrast to DOC and the regional councils interviewed, MFish tend to be of the opinion that there is not enough scientific evidence to demonstrate that coarse fish are detrimental to freshwater areas. Although the informant recognised that koi carp have potentially caused damaged in the Waikato region where they are in high concentration, they also acknowledged the subjective nature of people's perceptions of fish:

> People have a perception about [catfish] being an undesirable species, whereas trout is potentially more of an undesirable species. But because trout...is seen as a sports fishery which has got recreational fishing values, they don't want to necessarily…colour that perception with the view that trout may in fact be more of a problem to native fish than other introduced species (MFish interview 18-07-08).

Like the regional councils, MFish also recognise the management implications of Fish and Game's perception of coarse fish as inferior species (to trout):

> I mean they're pretty much self managed in the sense that…I think Fish and Game pretty much look after more trout, trout and salmon, and the level of effort they put into rudd, tench, and perch is probably very low, limited, if anything (MFish interview 18-07-08).

MFish consider Fish and Game to be an interest group with a vested interest in trout, but with statutory powers to effect management decisions that favour their interests. They do not think this promotes effective freshwater management.

5.4.3 Perceptions of control targets and techniques

The informant stated that MFish are happy with whatever control methods are deemed appropriate for a particular site or a particular species, as long as enough research has been carried out before control is undertaken. This reflects the advisory, facilitation role of MFish, who do not necessarily have the technical expertise to make these decisions themselves. MFish emphasise the important role research plays in both clearly demonstrating that certain species are having an effect and enabling control to be targeted effectively.

5.4.4 Important sites/potential for compromise

The role of MFish as facilitator rather than technical experts is also reflected in their statement that they, as an organisation, do not place value on different sites. Instead, they are directed by the preferences of tangata whenua in the first instance, and then those of other stakeholders, such as recreation fishers, environmental interests, and commercial fishers. MFish recognise that this often causes conflicts between the different stakeholder groups (MFish interview 18-07-08), but seem comfortable negotiating the tensions between social,

economic, and cultural values to arrive at the most effective solution. It may be that, through their abstract positioning, MFish are able to play a key part in facilitating a compromise between coarse anglers and management agencies.

5.4.5 Improving freshwater management and legislation

Many suggestions for improving the management of non-indigenous freshwater fish emerged from the interview with MFish. Again, their somewhat distant managerial role may have influenced the clarity of their ideas. Current freshwater management is based on the practices of the last 20 years, but MFish discussed how they do not believe that was very effective and think it should be totally revised. Starting with their own organisation, the informant suggested MFish could do with having a national freshwater team to increase their focus on freshwater issues (traditionally marine areas have been the main focus). They strongly emphasised their belief that an 'enabling' approach is much more effective than the traditionally prescriptive, risk averse approach of DOC, which again reflects the difference in the underlying philosophies of each agency's guiding legislation. While both approaches have the same desired outcome, MFish assert that the 'enabling' attitude is more efficient and socially just.

MFish also made several criticisms relating to current legislation. First, they consider the Freshwater Fisheries Regulations 1983 to be "archaic", and think that many of the regulations could be revoked or incorporated into the Fisheries Act 1996. MFish also suggested setting up a regulatory service with a specific focus on sports fish, discussing the confusion that is created by the current system:

> The experience to date has been that a person wishing to go and commercially fish for koi, or…recreationally fish for it, has had to go through quite a few hoops to actually get that to occur. And some of those hoops actually mean they actually have to get authority under both the Department of Conservation and also the Ministry of Fisheries when it comes to commercial fishing. And we think that that level of duplication is not really adding a lot of value, and we do not think that the level of risk involved with allowing people to commercially fish koi is a problem, provided that you...keep…you don't want to obviously see the fish range extended to other geographic areas (MFish interview 18-07-08).

In addition, MFish believe that the merits of the koi carp containment area should be revised, as they do not believe the system has been successful. In particular, they are concerned that there are so many laws surrounding the fishing of koi carp that it makes it difficult for them to be managed effectively:

> The concern I have, and other members of the Ministry of Fisheries have, is that koi is now…the most protected species in New Zealand, as opposed to the species that is actually a species that we would want to see somehow got rid of (MFish interview 18-07-08).

Finally, MFish strongly disagree with the duplication between the following pieces of legislation:

The Conservation Act and the Fisheries Act:

> We think that there is a lot of opportunity for the Department of Conservation to use its expertise [and the Conservation Act] to manage habitat and to advocate for habitat improvements, like, for example, fish passage, rather than getting involved with use management (MFish interview 18-07-08);

And Regional Pest Management Strategies and the Fisheries Act:

> Pest management strategies [are] fine in terms of prioritising where councils can do good work… in terms of the actual controls on how these species can be…managed, we can actually serve that purpose through the fisheries legislation (MFish interview 18-07-08).

5.4.6 Educational methods and incentives

MFish did not have many suggestions relating to education practices. However, they did note that diverse and often conflicting fishery interests (e.g. from the recreational, customary, commercial, or environmental sectors) operate most effectively when they approach councils as a unified force, through identifying common ground, "which is that their value is zero if the quality of the ecosystem is zero" (MFish interview 18-07-08). They suggest that the general public also need to be made aware of the value of healthy freshwater ecosystems to their daily lives.

5.5 NIWA freshwater scientist

5.5.1 The role of the National Institute of Water and Atmospheric Research

The National Institute of Water and Atmospheric Research (NIWA)'s mission is to "provide a scientific basis for the sustainable management and development of New Zealand's atmospheric, marine and freshwater systems and associated resources" (NIWA, 2008b). NIWA is one of nine Crown Research Institutes established in 1992, and is a standalone company with its own board of directors and shares held by the Crown. NIWA freshwater scientists are contracted by management agencies like DOC to conduct research into aspects of invasive fish such as their impacts and potential control techniques. An interview was carried out with one such freshwater scientist as part of this research.

5.5.2 Perceptions of coarse fish(ing)

NIWA have carried out extensive research into the impacts of coarse fish, and the interviewee believed that certain coarse fish species tend contribute to the decline of lakes through accelerating natural processes of lake eutrophication. Examples of the types of research carried out include studying the impacts of trout and gambusia on inanga, the effects of non-indigenous fish removal on water quality, and the ability of fish to have both top-down and bottom-up effects (e.g. Cambray, 2003; de Winton et al., 2003; Koehn, 2004; Rowe, 2007; Rowe et al., 2007; see also Hicks, 2003; Simon and Townsend, 2003; Townsend, 1996; Townsend, 2003; Townsend and Simon, 2006).

As discussed in section 2.2, ecological studies tend to take much less account of the social aspects of environmental restoration (although all research is conducted by people and thus has a social agenda). Subsequently, scientists tend to focus on the impacts coarse fish can have on native fish and ecosystems, which differs greatly from Fish and Game's focus on the effects on trout. This research has led to the belief that perch should be receiving more attention than some other introduced species that are more commonly perceived to be a problem:

> We think perch is…not receiving a large amount of attention at the moment, and perhaps it should be receiving a little bit more attention than koi carp and things that are more in the public eye but may be less of a problem… because of their potential effects on what we call biodiversity… At each size they are having an impact either on the environment or on native species (NIWA interview 18-09-08).

The NIWA scientist did not think that coarse fishing was a particularly popular sport in New Zealand and because of that did not view it as particularly problematic. He also voiced the common assumption that most of the people that do participate are British immigrants:

> I think there is a small role for coarse fish angling in New Zealand, relatively small. I suspect that it's primarily related to the fact that a lot of English immigrants…ah…basically want to do in New Zealand what they did in England, and that's probably eighty percent of the coarse fish anglers (NIWA interview 18-09-08).

While it does appear that the majority of coarse anglers are British expatriates, it is important to remember that this does not apply to them all. Catfish and koi carp, as well as some other species of coarse fish, are particularly valued by many people of Asian and Eastern European backgrounds, although these fishers often eat the fish rather than follow the practice of catch and release. Some New Zealanders also fish for coarse fish, and NZFOCA believe that this is becoming more common.

5.5.3 Perceptions of control targets and techniques

Rather than discussing control tools that already exist, NIWA considered the role of future research in developing control techniques and analysing the most effective ways to employ these methods (NIWA interview 18-09-08). One novel control method suggested involves the use of shags, which are currently causing problems for coarse fisheries in the United Kingdom:

> It's rather ironic that my colleagues in the UK are doing their best to eliminate or control shags, or what they call cormorants over there, because they are having an impact on perch fisheries. Whereas in New Zealand we are concerned about the proliferation of perch, and we would probably quite like to have more shags to control them (NIWA interview 18-09-08).

Further research into the fundamental life information such as life history, spawning habits, and the mortality of eggs and fry will also be required for control to be carried out effectively. The informant placed a lot of trust in the ability of scientific research to determine the most appropriate control techniques for different fish, and was less moved by emotive calls to target specific species.

5.5.4 Important sites/potential for compromise

NIWA believe that there is some scope for compromise with coarse anglers, although they caution that any areas specified for coarse fishing must not have a high ecological value in terms of freshwater connectivity or indigenous habitat:

> It's possible that [coarse fishing] is going to become more popular around the major cities as an urban recreational…pastime, for a very small group of people. And I think there is some scope to keep them satisfied using ponds…that have no outlet to rivers, quarry pits, in other words waters that are already perhaps degraded to some extent (NIWA interview 18-09-08).

The informant hinted that Fish and Game largely form a barrier to this occurring effectively:

> I suggested to Fish and Game about seven years ago now that we could go and do some survey work for them and identify such waters, and they didn't want to know about it (NIWA interview 18-09-08).

However, they believe that Fish and Game also hold the potential for a compromise to work effectively:

> If Fish and Game have some strong policies along the lines of public education – what is acceptable as a fishery and what isn't – then that's where that institutional barrier can disappear. Because I think their attitude to coarse fishing is a little bit ambivalent (NIWA interview 18-09-08).

5.5.5 Improving freshwater management and legislation

The biggest barrier to freshwater management identified by the NIWA scientist is the apparent lack of leadership in the field – no organisation wants to accept the cost of managing incursions of a species if they occurred from specifically dedicated coarse fishing lakes:

> I don't think [Fish and Game] want the extra responsibility of managing these fisheries. They're quite happy to accept the income from licence fees, but they don't want the additional burden of management (NIWA interview 18-09-08).

There is a need for one agency to step up and take ownership of directing freshwater management. NIWA believe that agency should be Fish and Game, although they recognise that their limited resource base hinders this.

NIWA have a much greater understanding of the concept of managing freshwater areas from a foundation of holistic restoration, rather than water quality restoration (the major focus of regional councils) or trout population restoration (the prime focus of Fish and Game New Zealand). This again reflects the value ecologists place on native ecosystems, rather than other social motivations. They cited the need to treat each water body holistically, at a catchment level if possible, and to recognise that each water body is unique and needs to be approached as such:

> Each lake will have its own characteristics for restoration and its own problems. And that means that for managers wanting to restore lakes they have to first of all accept that that lake is going to be different, and the restoration, what needs to be done, and the cost of it is going to be different to that lake. And also if they look at the literature, international literature, they will find that you can't just look at pest fish in isolation, or exotic plants as weeds, or water quality, you have to look at them all together, holistically. In other words it's lake restoration rather than water quality restoration (NIWA interview 18-09-08).

5.5.6 Educational methods and incentives

NIWA have a lot of faith in the benefits of putting resources into education; the informant stated: "I think that the biggest barrier at the moment is public education or lack of it" (NIWA interview 18-09-08). They asserted the need for people to understand that lakes are very fragile to introductions of aquatic life, even though the impacts may not be seen immediately. NIWA believe that education will be most effective if it is targeted at school children, because they have the ability to influence the beliefs and practices of the future generation:

> We are not going to convince these guys not to spread the fish…they're 'we'll do what we do and you can't tell us any other way'. Where the public relations campaign has to be targeted is the children in the schools. The primary school children. Because they're the ones that are going to, that's the future generation, and they're the ones that are going to be going into Dad's garage, 'what are you doing Dad?' 'I'm growing up some perch'. 'Why?' 'I want to put them in the –' 'you're not allowed to that!' Well it might not stop Dad but at least it's a little bit of a negative thing. And it's a bit like smoking, you know, (*stocking*) fish has got to become an act of ecological terrorism or vandalism (NIWA interview 18-09-08).

Although they cite the need for public education, NIWA also believe that the public are generally becoming more aware about the state of the environment, and are increasing the pressure on local management bodies to manage it effectively:

> I think the clean green message is starting to proliferate. And as people, particularly city folks, get out more and get out into the wild, you know, walk around the lake or walk down the riverside. There's some real, you know, this is not very nice, we want this to be improved. So there is general pressure coming on management agencies such as regional council's and others to improve their act when it comes to lakes (NIWA interview 18-09-08).

5.6 Waikato-Tainui

5.6.1 The importance and meaning of freshwater areas

> *The River belongs to us just as we belong to the River. The Waikato tribe and the River are inseparable. It is a gift left to us by our ancestors and we believe we have a duty to protect that gift for future generations (Sir Robert Te Kotahi Mahuta, 1975; cited in Waikato Raupatu Trustee Company Ltd, 2008: 4).*

As the above quote illustrates, freshwater areas are hugely important to Māori, and for a number of reasons. Freshwater fisheries are a traditional source of wealth for iwi and hapu, both culturally and commercially. Historically, it has always been important to be able to provide fish or shellfish to feed whānau (family) or guests, and sea food was also traded widely among tribal groups and later with European settlers (Ministry of Fisheries, 2008b). As well as the physical sustenance freshwater fisheries provide, freshwater areas are also a source of

spiritual sustenance, through historical, cultural and spiritual connections. A member of the Waikato-Tainui iwi was interviewed for this research. This respondent likened these connections to growing family food in a home garden:

> It is a bond, I guess that bond that you have with that area, kind of like…the bond that…Māori have with freshwater areas. But you imagine if that garden was passed down from generation to generation, it kind of amplifies the importance of it… So you imagine if your great grandparents gave you a house and a garden which they had grown food in and then consumed, and then they were using that food to…nourish themselves and their families, and so on. And it just follows on from generation to generation. Then you don't just see it as a patch of dirt (Tainui Māori interview 24-06-08).

5.6.2 The importance of freshwater areas and freshwater fish

In the interview with a member of the Waikato-Tainui iwi it emerged that, although some species of fish are utilised more often than others, all native fish are perceived to hold the same level of value:

> Obviously there [are some] we utilise more than others, you know what I mean? But they still have the same value, but in terms of utility of them, they will vary from…people to people. So obviously you have…eels and whitebait at the top, but then you have other fish that we don't, oh, that we do take, but not maybe as *(targeted)* as much. But, nonetheless, are still important (Tainui Māori interview 24-06-08).

Similarly, different freshwater areas were considered to be of equal value. However, areas with an important historical association, such as the Waikato River and the lower Waikato lakes, were considered particularly important.

5.6.3 Perceptions of control targets and techniques

Local iwi are generally happy with most control methods that are reasonably priced and effective. They stress that there needs to be a well established need for control, and that it is essential that they are consulted, before any control programme is instigated. In general, Māori would rather chemicals like rotenone were not used for control and other solutions were sought, but they stress their willingness to participate in discussions regarding the appropriateness of utilising chemicals or other control methods:

> Our opinion of any chemical…control is obviously we don't like, would rather find other solutions... So that's our fundamental position. But that doesn't mean we're not open to…considering any issues, any mechanisms of control I guess (Tainui Māori interview 24-06-08).

5.6.4 Improving freshwater management and legislation

NIWA's understanding of the integrated nature of the freshwater environment was reflected by this interviewee, who emphasised that management and fishing activities also need to be approached holistically:

> From my perspective there could be…more integration across the board between all agencies… And I guess working towards overarching purposes as well, in terms of restoring the health and wellbeing of the river and all those fish species and all that, so everyone's got a common goal (Tainui Māori interview 24-06-08).

The informant believes that a key mechanism for improving the management of the freshwater environment is now in place, through the settlement of the historical claims over the Waikato River between Waikato-Tainui and the Crown. This reflected the iwi's belief that, with the signing of the settlement, management would be moving in the right direction. The health and well-being of the Waikato River is at the heart of the Deed of Settlement, which aims to:

> Enhance the relationship between the Crown and Waikato-Tainui; to recognise and sustain the special relationship Waikato-Tainui have with the Waikato River; to enter a new era of co-management over the Waikato River across a range of agencies; and reflect a unity of commitment to respect and care for the Waikato River (Waikato Raupatu Trustee Company Ltd, 2008: 4).

5.6.5 Educational methods and incentives

The informant believes that the most effective way to educate the public about the importance of freshwater areas is to emphasise the indigenous nature of the systems, stating that we need to try and "pitch it from that native, not just a fish, but a native fish, that has the potential to, especially some species, to die off" (Tainui Māori interview 24-06-08). They also believed that most people are now

ignorant of the important role freshwater plays in our everyday lives, and do not realise where the water from the tap really comes from or their importance for recreational and cultural use.

> There's an underestimation of the value of it, because people say when you turn on the tap, 'where do you get your water from?' 'The tap', they don't know where it comes from… Mind you, you know over the summer and the water shortages? Obviously that made…a bit of an impact (Tainui Māori interview 24-06-08).

5.7 Coarse anglers

5.7.1 The New Zealand Federation of Coarse Anglers

The New Zealand Federation of Coarse Anglers (NZFOCA) formed in 1989 with the aim to protect the interests of New Zealand coarse anglers (Coarse fishing, 2008). NZFOCA manage seven clubs: the North Harbour Coarse Fishing Club, the Auckland Coarse Fishing Club, the West Auckland Coarse Fishing Club, Central Coarse Anglers, the Hutt Valley Coarse Fishing Club, the Canterbury Float Fishing Club, and Wagglers Coarse Fishing Club. The Federation also runs national coarse fishing competitions and allows members to compete in international contests. They hold an annual AGM, and have a coarse fishing constitution that they expect all club members to abide by (which includes the instruction that coarse fish are not to be released into any freshwater area other than where they were fished from; NZFOCA interview 21-05-08). The views of coarse anglers were obtained in this study through semi-structured interviews held with five coarse anglers, one of whom represented NZFOCA, and fifty-three complete responses to an internet survey (see Chapter 4).

5.7.2 Valued coarse fish

Coarse fish were valued in different ways by different anglers in different parts of New Zealand. In the Auckland/Waikato region, koi carp is generally the favoured fish; the main motivation of most anglers in this area is to catch the biggest koi they can find. Anglers from other regions typically enjoy fishing for tench, describing them as a beautiful shoaling fish, and also favour perch, due to their "fighting qualities" (NZFOCA interview 21-05-08). It is interesting to note that

many anglers outside of the Auckland/Waikato region mentioned fishing for rudd, although they are only classified as sports fish in the Auckland/Waikato region (thus, in other areas they are fished illegally). Generally, most anglers disliked catfish, although this reflects the non-representative nature of the survey (discussed in Chapter 4), as many Asian communities consider catfish a delicacy.

In the following section, 'traditional coarse fish' refer to perch, tench, and rudd, as these have been fished by coarse anglers for generations in Britain, and were, with the exception of rudd, introduced to New Zealand in the 1800s. Catfish and koi carp have been placed in the category of 'newer coarse fish', as they have only become popular in New Zealand relatively recently. 'Traditional game fish' (brown trout, rainbow trout, and salmon) and 'traditional native fish' (eels and whitebait) are also discussed to provided a more comprehensive basis for comparison.

The frequency anglers reported catching freshwater fish in the Auckland/Waikato region (Figure 5.1), the Wellington region (Figure 5.2), and in the South Island (Figure 5.3) were examined, and several important regional variations were identified. Koi carp are caught regularly/often in higher proportion in the Auckland/Waikato region than any other region, which makes sense as the koi carp containment area is in the Auckland/Waikato region. More Wellington anglers catch koi carp than South Island anglers; they are likely to find it easier to travel up to the Auckland/Waikato region to fish for koi carp than people living in the South Island. Most South Island anglers reported 'never' catching catfish. The 'traditional' species of coarse fish are fished for most often in the Wellington region, although they are also commonly fished in the Auckland/Waikato and South Island regions. Salmonid species (traditional game fish) were often fished for in the South Island, as well as the 'traditional' coarse fish species. Interestingly, very few anglers reported fishing for whitebait, considered a delicacy in New Zealand, although many sometimes/occasionally fish for eels. The bars of the graphs below have been adjusted to show the percentage of responses that reported fishing for the different species regularly/often, sometimes/occasionally, or never/not sure.

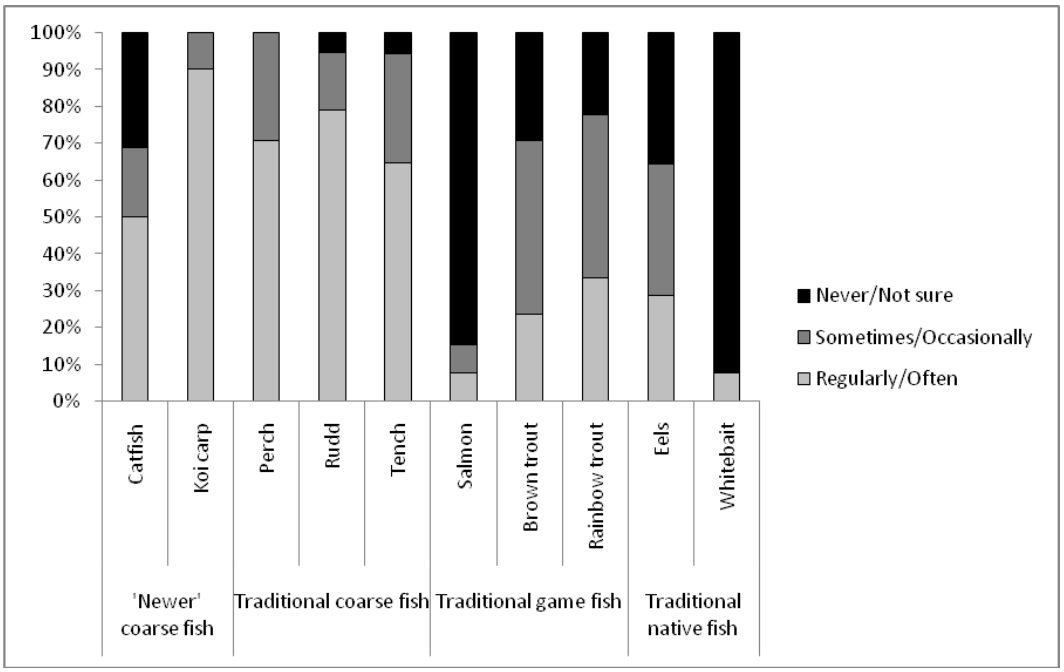

Figure 5.1 The frequency freshwater fish species are caught in the Auckland/Waikato region (n=21).

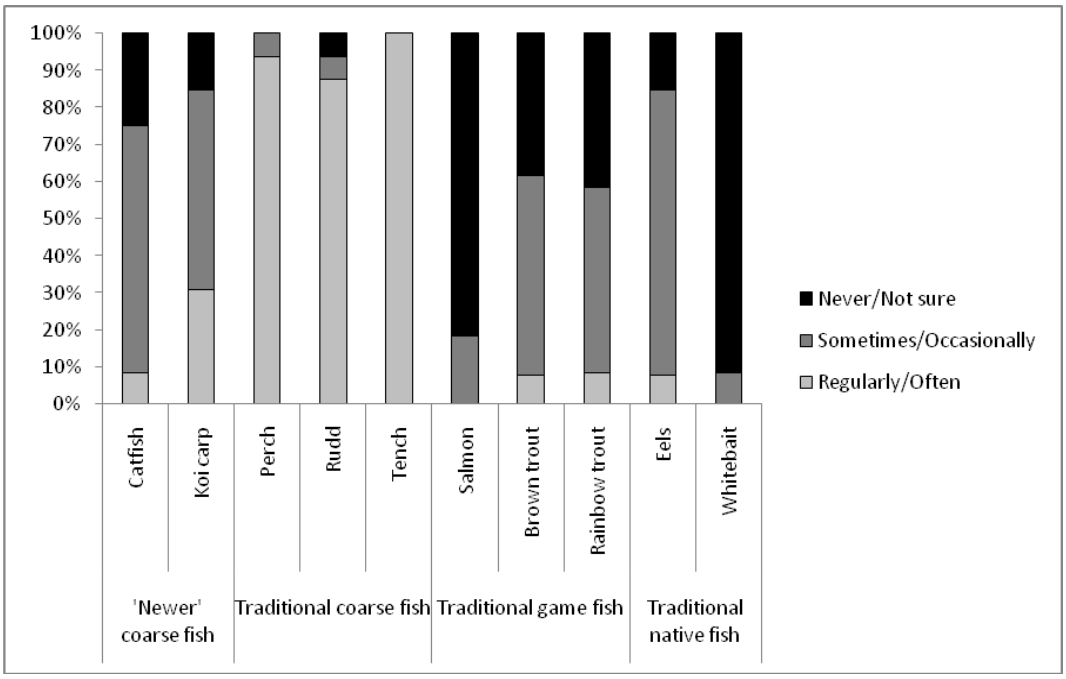

Figure 5.2 The frequency freshwater fish species are caught in the Wellington region (n=16).

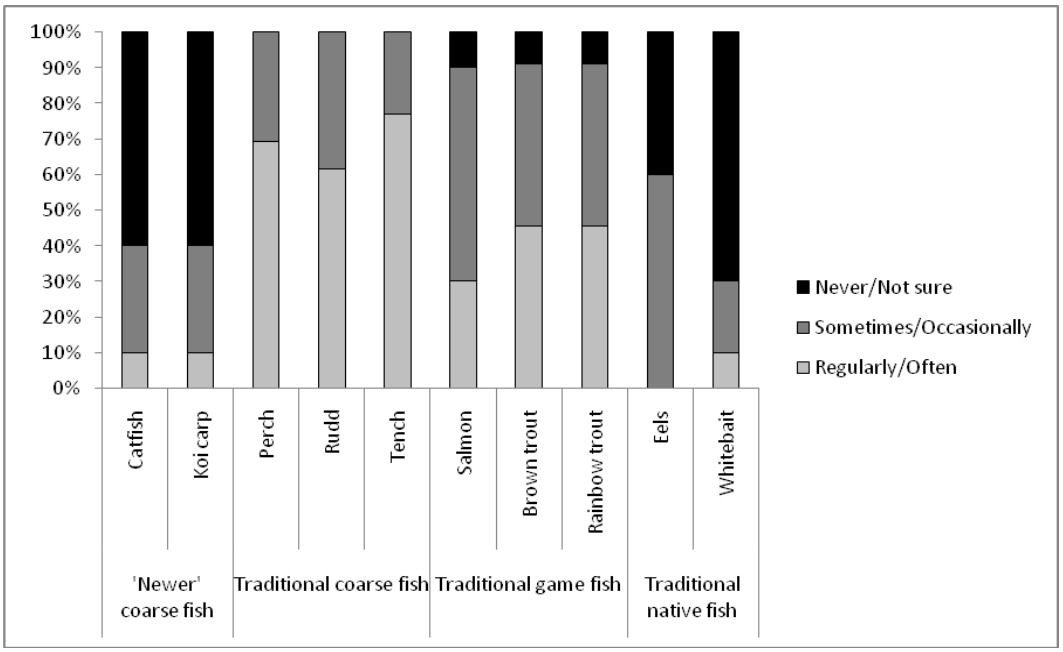

Figure 5.3 The frequency freshwater fish species are caught in the South Island (n=13).

There are also several important differences, as well as similarities, between anglers born in New Zealand (Figure 5.4) and those born overseas (Figure 5.5). It should be noted that while the sample size allows us to make inferences, it does not accurately reflect the preferences of all New Zealand-born coarse anglers (only eight respondents were born in New Zealand). 'Newer' coarse fish are fished in about the same frequency by New Zealand-born anglers and those born overseas. Overseas-born anglers are more likely to fish for traditional coarse fish species, whereas New Zealand-born anglers are more likely to fish for traditional game fish species, reflecting important historic and cultural differences. Interestingly, anglers born overseas reported fishing for eels – a native fish considered good to eat – sometimes/occasionally much more often than anglers born in New Zealand, although the latter were more likely to fish for whitebait.

The anglers recognise that coarse fish are not considered valuable by the majority of New Zealanders, and that this view is actively encouraged by freshwater management agencies:

> I just think that DOC don't want anyone seeing any value in them, because they're worried that if people…see some value in them, they'll want to spread them around" (Coarse angler interview 10-06-08).

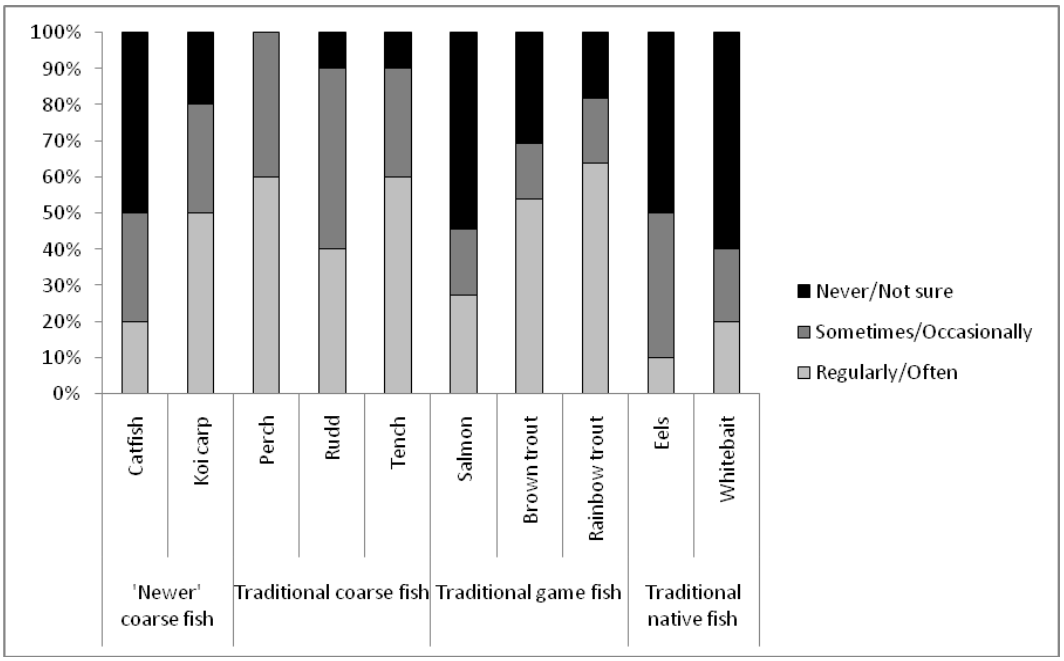

Figure 5.4 The frequency freshwater fish species are caught by NZ-born anglers (n=8).

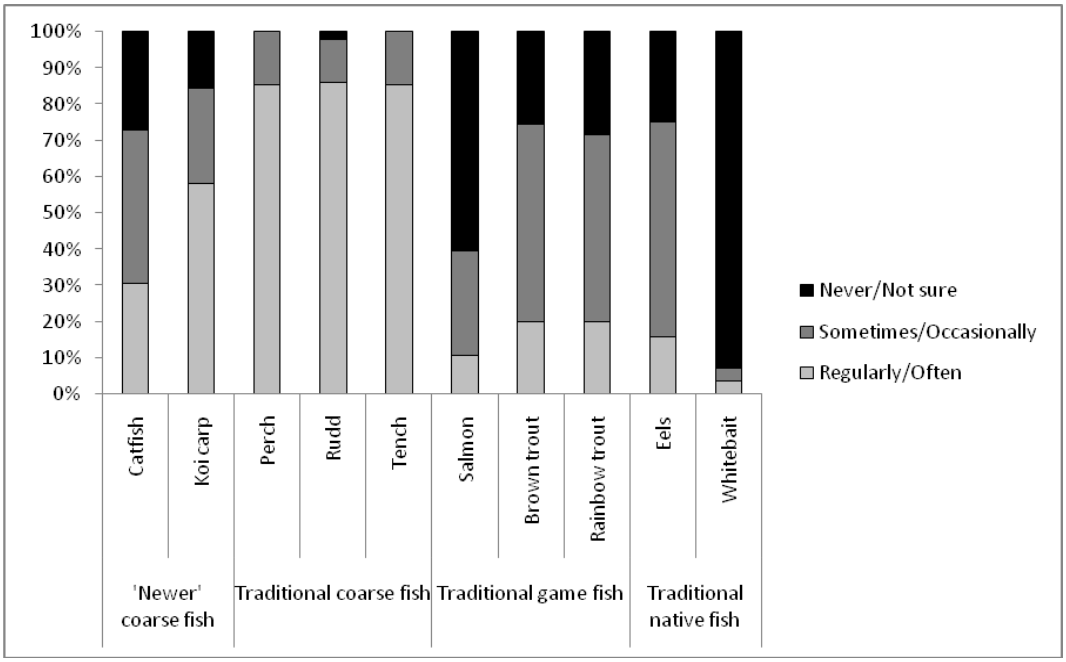

Figure 5.5 The frequency freshwater fish species are caught by anglers born overseas (n=49).

But they also dispute this (de)valuation, noting that "one person's vermin is another's treasure" (NZFOCA interview 21-05-08). They echo the enabling belief held by MFish, arguing that "the koi resource here would be worth millions of dollars if it was just farmed or utilised" (NZFOCA interview 21-05-08). Although utilising coarse fisheries economically in New Zealand may not be desirable or practical, it is important to take this argument seriously. The major foundation for

supporting trout despite their impact on native fish is the economic value they provide, and the reasons for this should be explicitly examined.

5.7.3 Values and perceptions relating to coarse fishing

It quickly became clear during interviews with coarse anglers that they considered coarse fishing to be more a lifestyle choice than a sport or a hobby. They discussed their experiences of angling with a sense of longing:

> I was brought up fishing as a child; I enjoy getting out into the countryside. I went fishing last Sunday, and caught nothing, didn't have a bite. Sat there for six hours in the glorious sunshine and it was just wonderful to be outside. Catching fish is a bonus. Plus, you go with a group of friends, and so it's social as well as...an activity (NZFOCA interview 21-05-08).

The importance of coarse fishing to the lives of anglers also emerged from the internet survey. The overwhelming majority (78%) of respondents indicated that they considered coarse angling to be 'very important', although it should be noted that the presence of this importance is likely to have influenced their initial willingness to take part in the survey. However, it is interesting to note that the categories of 'important' (7%), 'moderately important' (9%), and 'not that important' (6%) were also selected.

Coarse anglers tended to emphasise the family bonds that could be made through the practice of coarse angling. Several anglers referred to it as "a father-son thing" (e.g. Coarse angler interview 14-06-08), and one extended this generational bond to his grandchildren:

> I hope to take my grandchildren coarse fishing, you know? It's wonderful, gets kids off the street, gets them out in the environment for a whole day…you catch a fish, you look after it, and you put it back for somebody else to catch at a later date when it's bigger. A lot of people think we're mad, but millions and millions of people do it (NZFOCA interview 21-05-08).

Coarse anglers tend to have very different attitudes about fish and fishing to the general New Zealand population. As one coarse angler stated, "no disrespect to Kiwi's, but the mindset is you catch a fish you eat it, you don't catch a fish and put it back" (Coarse angler interview 17-07-08). It is interesting to hear the

dominant New Zealand culture of catching fish to eat reversed in such a manner, illustrating that the ways in which different practices are considered as acceptable or as deviant are socially constructed in different ways by different cultures.

Coarse anglers also recognise the contradictory ways in which some introduced species are constructed as valuable in New Zealand, while others are not. They tend to use trout as an example of this, despite evidence of similar environmental impacts:

> There's rudd and tench and carp been released right across New Zealand, as early as before the trout and salmon. But it sort of gets ignored. And it's like, they say 'oh they're not a native species', well nor is trout… But because that's what you've all grown up fishing for, you've taken [trout] as a native species" (Coarse angler interview 17-07-08).

> I would imagine, and most of our people believe, that trout would be the biggest hunter of native fish. And in fact, I've got a book here that was published in 1928, stating that most of the streams and rivers were devoid of life after the trout were put in them. But then the coarse fish gets the bad press, and it's only really perch that eat other fish (NZFOCA interview 21-05-08).

5.7.4 Perceptions of control targets and techniques

In general, coarse anglers do not think that it is possible to effectively control or eradicate fish once they are established in freshwater areas. They cite several reasons for this belief:

> I don't know how you can control fish, because, about ten years ago, there was a huge flood up here in the Waikato, at the Rangiriri, and the Waikato flooded, and they found koi miles away in fields and in ditches. You know…birds, you know, get spawn on their feet and things. Again, I suppose years gone by before human habitation, fish were spread by natural means anyway (NZFOCA interview 21-05-08).

However, there were a few species that coarse anglers would like to see managed if control was possible. Catfish were frequently cited as one of these, as well as koi carp areas where they are detrimentally affecting other, more valued, coarse fisheries.

As a general rule, coarse anglers state that they do not like the use of rotenone because "it just kills everything". Then again, they are not sure that there is a more effective alternative: "I don't think there's anything available that would control the koi in the quantities that are in the rivers" (Coarse angler interview 14-06-08).

5.7.5 Important sites

The internet survey asked anglers to name their five favourite coarse fishing sites ranked from 1 (most preferred site) to 5 (least preferred site; Table 5.1). If management agencies were to seriously consider allocating certain waterways as specific coarse fisheries, the significance of highly valued sites such as Lake Ngaroto, the Waikato River, the Otaki Lakes, the Whitby Lakes, and the Rotokohatu Lakes would need to be recognised. Anglers were also asked to identify what they valued in these sites (Figure 5.6). These characteristics may be just as important as the specific locations mentioned above. Factors such as plentiful fish stocks, good sized fish, peace and quiet, and convenient access are highlighted as very important:

> A lake or a river that's full of fish, easy to get to, pleasant surroundings…I suppose access would be the easiest, the most, because to drive with all your gear and then have to walk a long way is difficult (NZFOCA interview 21-05-08).

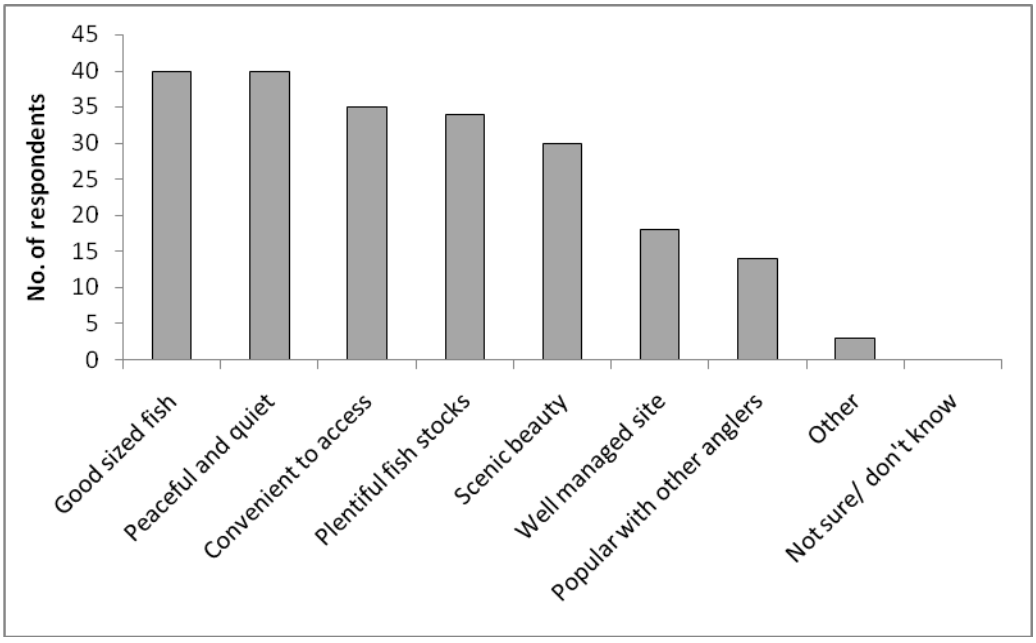

Figure 5.6 The aspects of fishing sites most valued by coarse anglers.

Table 5.1 Most preferred coarse fisheries (sites mentioned at least three times in the internet survey responses). Highly valued sites are indicated in bold.

Region	Site	No. times ranked as most preferred site	No. times ranked in top 5 sites
Auckland/Waikato	Auckland/Waikato area (general)	6	16
	Lake Ngaroto	**5**	**7**
	Waikato River	**3**	**11**
	Lake Pupuke	**2**	**5**
	Huntly Lakes (general)	**1**	**7**
	Mangawara River	1	4
	Rangiriri	0	6
	Bombay pond	0	4
	Lake Whangape	0	3
	Lake Hakanoa	0	3
Wellington	**Otaki Lakes**	**10**	**14**
	Whitby Lakes	**2**	**11**
	Lake Wairarapa	**2**	**6**
	Wellington (general)	1	4
	Ruamahanga River	0	7
South Island	**Rotokohatu Lakes**	**3**	**6**
	Canterbury (general)	3	3
	Kaiapoi Lakes	**2**	**8**
	Halswell River	1	4
	Southland (general)	0	3

An additional measure of the importance of coarse fishing was gained by asking anglers to state the distance that they usually travel to access coarse fisheries. There was no relationship between travel distance and the number of years spent coarse fishing (Figure 5.7), which was surprising as I thought anglers who were relatively new to the sport would be less likely to travel as far as more experienced anglers. However, there was some correlation between how important respondents considered coarse fishing to be in their lives and travel distance, with almost all of those willing to travel greater than 50 kilometres to access coarse fisheries considering angling ‘very important’ (Figure 5.8).

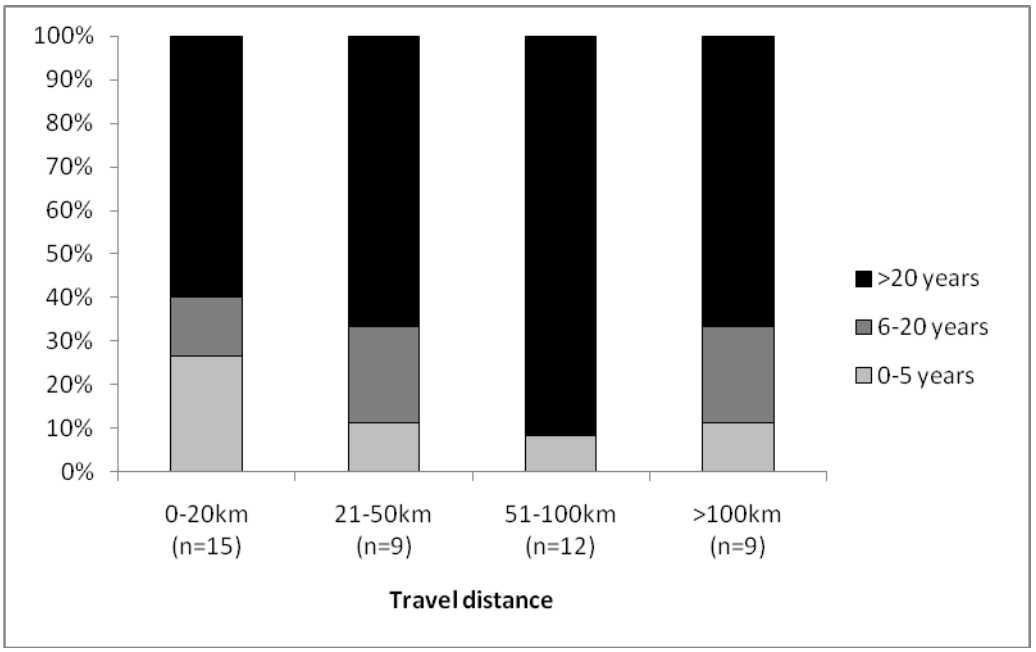

Figure 5.7 The distance anglers usually travel to access coarse fisheries compared with the number of years they have coarse fished.

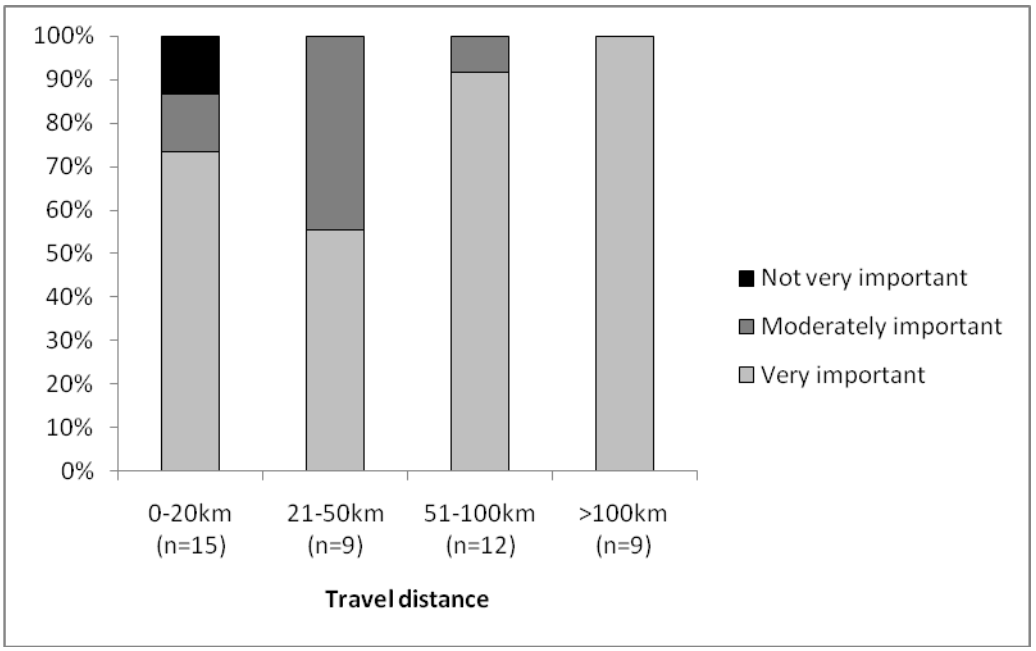

Figure 5.8 The distance anglers usually travel to access coarse fisheries compared with how important those anglers consider coarse fishing.

Another surprising finding was that anglers from the Auckland/Waikato region, which is considered the "hotspot" of coarse fish in New Zealand, were more likely to travel further to access coarse fishing sites than anglers from the South Island (Figure 5.9), where there are relatively few fisheries. Thus, it would be expected that South Island anglers would need to travel further. Wellington anglers reported

always travelling over 20 kilometres to access coarse fisheries (Figure 5.9), suggesting that, due to Wellington's geography, valued fisheries are located away from the city centre.

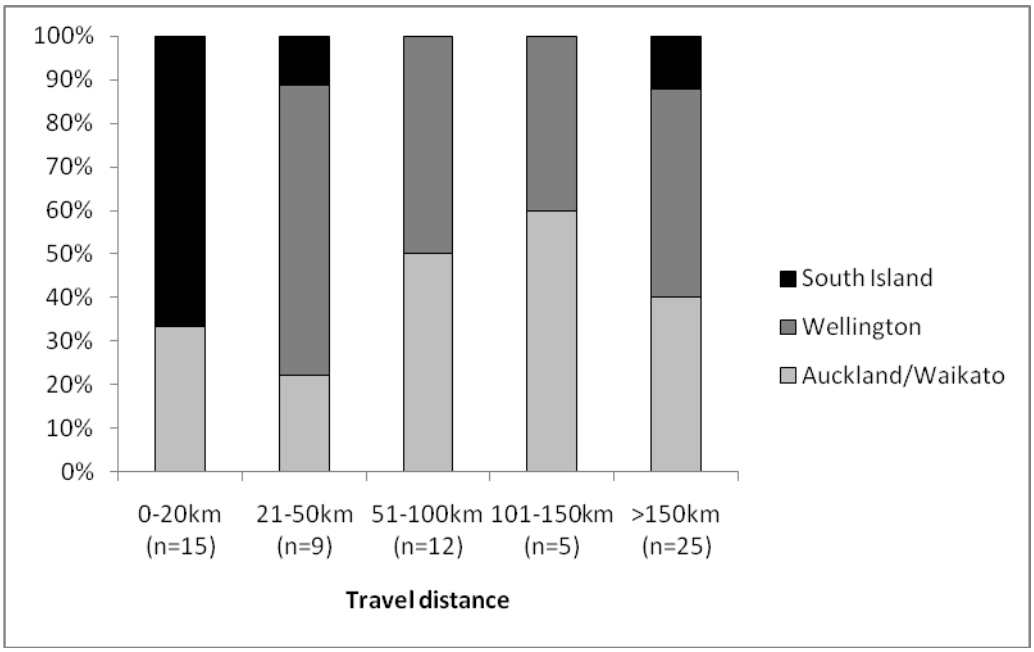

Figure 5.9 The distance anglers usually travel to access coarse fisheries in the Auckland/Waikato, Wellington, and South Island regions.

Many coarse anglers reported feeling "spoilt for choice" for fishing opportunities in New Zealand (e.g. Coarse angler interview 14-06-08). They argued that, because of this, they are not interested in spreading fish to create new fisheries. However, they would like to have some areas set aside for them to fish without fear of persecution:

> Most coarse anglers realise that we've got a fantastic environment here; we don't need any more coarse fisheries really. It's just that we'd like to keep what we've got, without persecution. It's in our, all our clubs' constitutions that nobody is to spread coarse fish (NZFOCA interview 21-05-08).

Indeed, interviewees tended to argue vehemently that they were not interested in, and did not agree with, spreading coarse fish:

> There were some people I think early on that did it, and they gave everyone else a bad name… I've heard of…two people that did. I mean there was one guy that just died [Stewart Smith], he was, like, 95, and I think he was responsible for most of the spreading around, of rudd anyway, I know. And there may be some people doing it now, I don't know if there is or not. But I mean, none of the guys that I know do anything like that (Coarse angler interview 10-06-08).

NZFOCA discourage the spread of coarse fish to new areas through their code of conduct and constitution, and are disappointed that the small numbers of anglers responsible for actively spreading coarse fish have given the rest a bad name:

> I think there was an article in the paper a few weeks ago that rudd had been found in the swamp lands. And it was blamed on us: coarse fishermen have spread fish to be able to fish in other locations. The reality of it is the swamp land is six inches deep and we couldn't fish there even if we wanted to… The fish are spread by birds. Ducks and things like that living in the lakes and rivers. Spawn on them, fly off into the next lake, oh there's fish in there (Coarse angler interview 17-07-08).

Again, it is important to note that the sample was a biased sample and it is unlikely that anyone involved with spreading fish would have participated in the research. As well as this, many (44%) of the respondents were from the Auckland/Waikato region, and anglers from other regions where coarse fish are not as common may feel more inclined to spread fish to create suitable fishing areas for themselves. This was reflected in the different regional perceptions regarding whether more areas should be set up for coarse fishing. A greater percentage of Auckland/Waikato respondents believed that there are enough opportunities for coarse fishing in New Zealand than anglers from other regions (Figure 5.10), indicating that if a specific coarse fishery was to be set up, it would have the greatest benefit if located it in the Wellington or Canterbury regions.

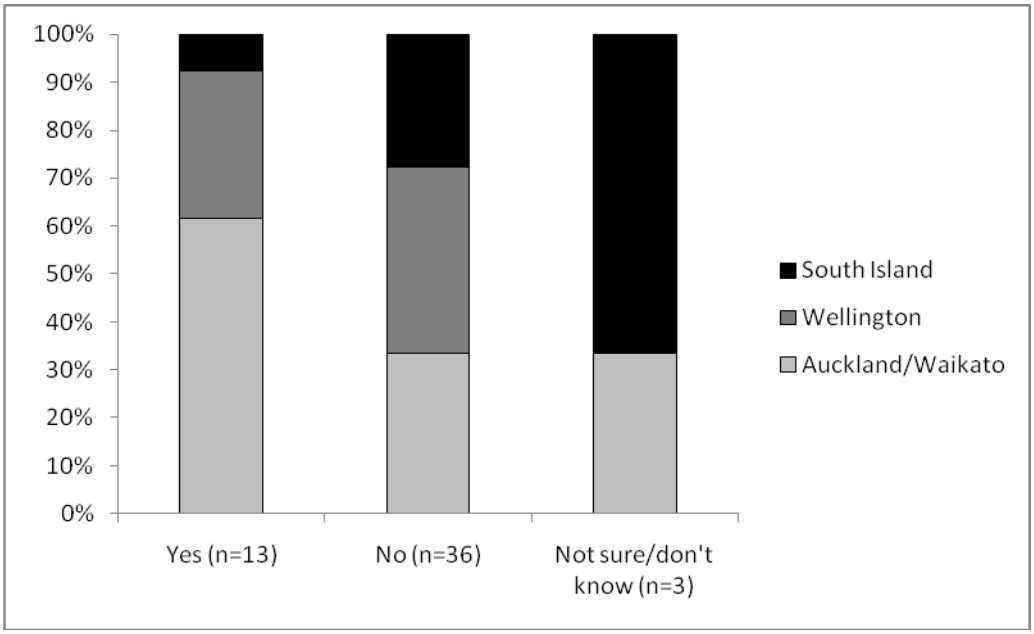

Figure 5.10 Regional beliefs about whether there are enough opportunities for coarse angling in New Zealand.

5.7.6 Potential for compromise

Coarse anglers are very interested in participating in conversations with management agencies. This was apparent in many of the interviews, as the following comments indicate:

> The Federation would [like to participate in a forum], definitely. Because we've always tried to make friends, and find out what we can and cannot do, and it always seems like what we can't do. So if there was a forum where things could change... All the original legislation I think was in the '60s and '70s, so it should maybe be updated (NZFOCA interview 21-05-08).

> I'd be interested to actually sit down and talk to them and see how they view us, and whether we're considered to be 'the enemy', or, or not. You know, we're, I suppose we're doing it purely recreationally. I think it would just be interesting to just sit down with them and just have a chat and…you know listen to what they do and they perhaps listen to what we get up to. But I think they do know. They're well aware of what we're up to (Coarse angler interview 14-06-08).

Anglers believe that they have much in common with freshwater management agencies:

> Talk to us and find out, you know, where there is some common ground. There must be somewhere… We have a vested interest in looking after the wildlife and the waterways, and I'd probably say most of the angling venues in the UK are well managed and well looked after (Coarse angler interview 14-06-08).

They emphasise that they are reasonable people with some concerns of their own:

> Well, legislation on not spreading fish we completely understand and completely agree… We find the legislation to establish another coarse fishery difficult, and the Department's reluctance… And the legislation on returning fish we completely disagree with, because of the ethics of killing fish (NZFOCA interview 21-05-08).

And would like to reassure management agencies that many coarse anglers disagree with the way in which some members express their views on the coarse fishing forum:

> That's not helping any of us. That's just making us look bad. And we agree with your opinion, we think we're being singled out and sort of stopped from doing what we want to do, but that's not how we should be doing it. It should be done in proper conversations with DOC, with Fish and Game, and talked through professionally. Not just start shouting at each other, that doesn't get us anywhere, well it just gets us into more trouble (Coarse angler interview 17-07-08).

5.7.7 Perceptions of management agencies

Coarse anglers tend to hold similar (low) opinions of most agencies involved in freshwater management. In particular, they disagree with the practices of DOC and Fish and Game NZ. This is largely because of these agencies unwillingness to engage in communication with them:

> I think the main thing would be that DOC, the water agencies, Fish and Game, need to come and see how we fish and what we do, and that we're not causing any damage… We go fishing, catch the fish, do what we can to look after them…and I think they need to understand what we do and how we do it (Coarse angler interview 17-07-08).

Anglers also hold fundamentally different values from DOC and Fish and Game with regards to what constitutes the ethical treatment of fish:

> I've seen pictures online and in the papers from DOC and Fish and Game where they've put nets into a waterway and pulled it out, and there's hundreds of rudd trapped in the net. That's not looking after fish. That's killing fish for no reason (Coarse angler interview 17-07-08).

Many coarse anglers reported feeling "beaten" (NZFOCA interview 21-05-08), and that they were constantly having to "battle" management agencies to make any progress. This was reflected in comments like "it just seems like some outlandish claims that [DOC] come up with. I mean, it's just ridiculous" (Coarse angler interview 10-06-08), and, "I think it is the worry that, if we talk to DOC, we lose everything" (Coarse angler interview 17-07-08). In particular, coarse anglers begrudge Fish and Game for accepting their licence fees but using that money to focus on trout fisheries rather than improving the status of coarse fishing in New Zealand:

> Fish and Game and all that, they don't really care about, you know, their main thing is trout. So, I mean, they list coarse fishing places and things on their site, but that's about it, you know? … To me, it seems like it's not really thought of, or considered, you know, worth talking to anyone about it or anything (Coarse angler interview 10-06-08).

> It seems that coarse fish are second rate compared to salmon and trout, especially trout. And… they've got the opinion the coarse fish destroy trout fisheries…which we don't agree with, because they're completely different…trout need fast flowing, highly oxygenated water, and coarse fisheries don't (NZFOCA interview 21-05-08).

Additionally, anglers resent being constantly painted as 'bad guys', hindering conservation efforts. Rather, most of them believe that they are actually looking after the environment:

> I know up in Wellington and Auckland a lot of the venues are looked after by the coarse anglers and the clubs, rather than the people who, I suppose, 'should' do it. None of that gets reported. It's sort of 'you're the bad guys'… And not well, hang on, you're helping DOC and different people, Fish and Game, and you're not charging us for it, you're doing it free, because you want the venue to be as good as it can be (Coarse angler interview 17-07-08).

5.7.8 Improving freshwater management and legislation

There are three main areas where coarse anglers believe coarse fishery management and legislation could and should be improved: (1) through allowing specific fisheries; (2) through abolishing regulation 67B of the Freshwater Fisheries Regulations 1983; and (3) by amending the current method of classifying fish. These three points are outlined further below.

First, coarse anglers stress that management agencies would benefit, as well as themselves, if a lake was specifically managed for coarse fishing:

> I think if a lake was created and specifically stocked, it wouldn't be a problem… It would be contained, it wouldn't be near a river… I've even looked into the extent that okay, if there was floods in the area, how high a bund would we need around the lake to stop it contaminating the river in terms of coarse fish… I mean people will go to any extent they have to to create that fishery (Coarse angler interview 17-07-08).

> It would be good over here to have a true fishery, commercial fishery, where it's stocked specifically for coarse fishing, but one that's got facilities on the ground. 'Cause the one's in the UK have got, um, small cafes, a fishing tackle shop, toilet facilities and things... I think it would be good for DOC and Fish and Game to see how a commercial fishery can be run and the money that can be generated from it (Coarse angler interview 17-07-08).

Second, perhaps the biggest issue that coarse anglers have with the current management of coarse fisheries is the law that they have to kill koi carp on capture (section 67B of the Freshwater Fisheries Regulations 1983). A strong ethic has emerged within the coarse angling fraternity that fish should not be killed if they are not needed as food, and anglers do not think that killing fish at a recreational level will have a positive impact on conservation efforts:

> I used to kill them... But then I just didn't want to do it anymore, I didn't want to just kill fish for the hell of it… to me it's a stupid, it's a dumb law... I think that…if you want to fish for them recreationally, and you're not moving them around to somewhere where they previously weren't, I don't think that you should be prosecuted for that. And I don't know if anyone ever has been (Coarse angler interview 10-06-08).

> Allowing us to catch them legally would be a better idea…none of us are going to transport fish, you know, we fully understand, that's the big no no. But if we're fishing a location where there are already thousands and thousands of fish, what difference does it make if I kill one fish? (Coarse angler interview 14-06-08).

> We completely agree that you cannot take a koi from one position, one river, and release it somewhere else. Completely. If you do that, you deserve everything you get it. But to catch koi in a lake, and you put it back where you caught it, there shouldn't be any punishment. It's not your fault you caught it…you never know what's going to be on the line (NZFOCA interview 21-05-08).

Coarse anglers have a sophisticated understanding of the purpose of the law, the extent of which is not recognised, I believe, by management agencies:

> I think it's really to, so that they can catch people that are moving them around. Because they've got to have some way of prosecuting someone if you took one and put it somewhere where it wasn't before (Coarse angler interview 10-06-08).

Third, coarse anglers argue that both the current classification of fish and regionally variable management is not effective. Several anglers suggested clarifying the classification of fish by using the categories 'sports fish' (or 'game fish'), 'coarse fish', and 'pest fish' (Coarse angler interviews 07-06-08 and 10-06-08), emphasising that the methods required to catch coarse fish are very different to those used to catch trout. They state that they will not consider 'coarse fish' to be 'pest fish' until they are presented with sufficient evidence regarding their impacts. Similarly coarse anglers believe that until the status of the fish is changed from that of 'pest', no management ideas will get very far (Coarse angler interview 07-06-08):

> It's fair enough you want to limit where they spread, but I mean they're never going to get rid of them. So how long are they going to class them as a pest fish? They could be here, you know, another hundred years or something like that. So I think they should maybe just set up, designate, some places as coarse fisheries and maybe manage them or something like that, you know (Coarse angler interview 10-06-08).

5.7.9 Potential for implementing educational methods and incentives

Coarse anglers show a definite interest in learning about the freshwater environment in general, as well as learning more about their sport:

> The more I learn, the better angler I become. And I go to a lot of trouble to understand the water in terms of using fish finders and depth gauges to work out what the depths of the waters are, to understand where the fish live, where they breed, to make you a better angler I suppose (Coarse angler interview 17-07-08).

> I'm definitely interested in learning more. We've done our own little experiments sometimes. In this part of Lake Whangape the water gets down to about 250 mm in September/October, and you can see all these orange tails sticking out, of koi carp sifting through the sediment for food. But when we got some of the sediment and sifted through it, we couldn't find anything in there! What do they eat? We've heard different things, but haven't been able to find any papers or any proof (Coarse angler interview 07-06-08[*]).

There is also some recognition that some coarse fish may have detrimental impacts on New Zealand's freshwater environment. However, coarse anglers are less inclined to take management suggestions seriously when more significant problems are not acknowledged:

> I mean everyone knows how they feed; they feed by digging into the bottom. And sure, they must have some impact, but…I don't think they're the reason why waters have declined in quality. You know, it's easy just to say yep, that's it, get rid of the carp and everything will be great again. But I think there's a whole raft of things, like…run-off from farms and all that stuff. You imagine all the fertiliser that's just running straight into lakes and things like that, you know, it's just, it's got to have some impact. And I think because they're not managed in any way they can just keep breeding and breeding and breeding until you get problem numbers of them. Whereas, you know…if you have them in small numbers then it's not a problem, it's just when they get to like a massive level… So yeah, I think yes, they have an effect, but only in huge numbers and closed waters (Coarse angler interview 10-06-08).

However, this view is not held by everyone. Thirty-eight anglers reported in the internet survey that they did not believe that coarse fish had any damaging impacts, compared to only eight who believe they do, and six who indicated that they were not sure. Coarse anglers are also unsure about what information to believe, and tend to rely on their own experience rather than what they term "misinformation":

> I also think there's a lot of misinformation about what carp do or don't do. And that's just coming from experience with, you know, fishing carp fisheries in the UK. Koi seem to get blamed for everything that's wrong in all the New Zealand waterways, but I don't necessarily think that's the case. I think there are a

[*] Quote taken from hand written notes rather than an accurate transcript. The interview was not taped.

> lot of other factors involved… well managed fisheries in the UK, the water's gin clear (Coarse angler interview 14-06-08).

With regards to the potential sources of education currently used by coarse anglers; the internet, contact with clubs and other anglers, and information from overseas are the most commonly utilised (Figure 5.11). This suggests that the internet and coarse angling clubs could be key areas for environmental education campaigns to be targeted, as well as for any formal communication to occur. I believe there is a great deal of potential for communication and education to make a difference to the practice and management of coarse fishing, as well as to the relationships between management agencies and coarse anglers.

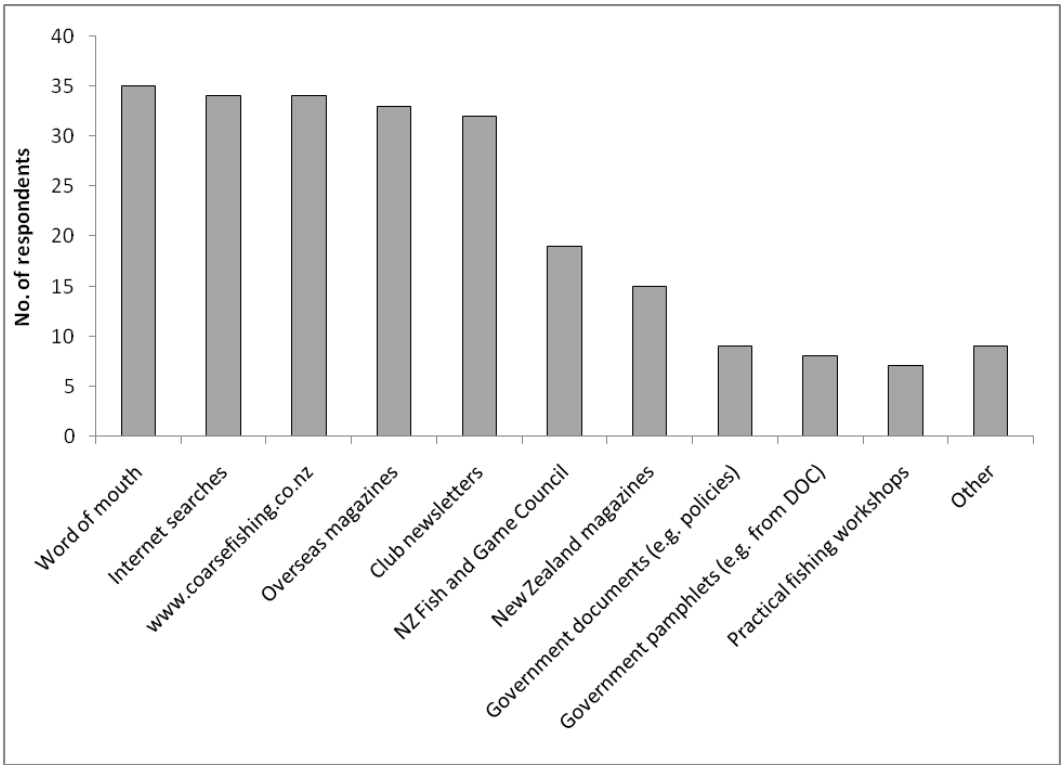

Figure 5.11 The common sources of information utilised by coarse anglers.

5.8 Summary of key findings

5.8.1 The importance of native freshwater areas

All respondents recognised the importance of freshwater areas for providing habitat to native aquatic organisms as well as fresh water for human needs. Most organisations tended to believe that freshwater areas should be preserved or conserved, although the Ministry of Fisheries, Māori, and coarse anglers had more

of a utilitarian approach. Coarse anglers believed that they were not harming the environment, and in some cases that they were actually improving it and contributing to management, which is in stark contrast to the perceptions of organisations like DOC. This deserves further consideration as it reflects vastly different viewpoints, which need to be recognised for effective communication to occur.

5.8.2 Perceptions of coarse fish(ing)

DOC, Fish and Game New Zealand, and regional councils all held similar opinions that coarse fish (and, correspondingly, coarse anglers) were not a welcome part of New Zealand's fauna, and that they cause significant environmental degradation. They also perceived the practice of coarse angling as inferior to trout angling. MFish, NIWA, and Māori did not perceive coarse fish in such black and white terms, preferring to make judgements on a case-by-case basis, examining each species in each of their locations. In contrast, coarse fish and coarse fishing are integral to the lives of coarse anglers and play a large role in how they define themselves.

5.8.3 Perceptions of control targets and techniques

In general, most respondents believed that control of coarse fish was necessary in some cases, and were happy with whatever techniques were appropriate for each situation. Amongst the organisations, the biggest difference in perceptions of control tools related to the difficulty of obtaining use consent (DOC were more likely to prefer rotenone, while regional councils were more likely to prefer gill netting) and how 'natural' or long lasting the effects were. Several organisations, MFish and NIWA in particular, stressed the importance of the impacts of the species and the need for control to be clear before management programmes were implemented. Interestingly, most coarse anglers also believed that control was necessary in some situations, but they did not want all coarse fish in all locations to be painted with the same brush. However, they did not think that any control mechanisms would have a long term effect in most environments and believed that many attempts to control fish, particularly in areas where they are well established, were futile.

An extensive review of public attitudes to pest control was carried out by DOC in 2006 (Fraser, 2006). This found that the level of public acceptance of control methods was related to the specificity, and humaneness of the technique, and the level of uncertainty or perceived risks related to the technique. Although the study focused on terrestrial invasive species, the three concerns mentioned above appeared to correspond to perceptions of control techniques in freshwater environments.

5.8.4 Potential for compromise

Most agencies mentioned being willing to engage in communication with coarse anglers, perhaps through a forum, and in some cases were even prepared to consider setting up specific coarse fishing areas. Somewhat surprisingly, Fish and Game was the organisation least likely to be willing to consider some form of compromise with coarse anglers, even though addressing the concerns of coarse anglers is part of their mandate. This may reflect the historical sense of resentment outlined in section 5.2.5. Fish and Game were considered a barrier to effective management by many of the people interviewed, suggesting it may be time for their function to be revised (although the Eastern Regions Fish and Game Council was identified as performing particularly well with regards to freshwater fish management).

If specific coarse fisheries are to be identified, it will be essential to recognise those sites that have a high conservation value or are ideal for restoration due to factors such as fish passage connectivity, as well as those sites already highly valued by coarse anglers. Some specific sites have been outlined in the above sections.

5.8.5 Improving freshwater management and legislation

Overwhelmingly, almost all respondents stated that the current legislation is confusing and complex, with overlapping jurisdictions and no clear direction. Part of this confusion is likely caused by the different philosophical aims of the Fisheries Act (sustainable use), the Conservation Act (preservation), and the Biosecurity Act (pest management). It is my opinion that this should be reviewed based on current research, and that the views and suggestions of all parties

included in this research are seriously taken into account to enable effective management. Some of the key suggestions include:

- Conducting further research into innovative control tools;
- Increasing inter-agency communication and collaboration;
- Establishing a lead agency to coordinate management;
- Revising the complex and overlapping aspects of the relevant legislation;
- Revoking Section 67B of the Freshwater Fisheries Regulations 1983 and revising other aspects of the Regulations;
- Establishing clearer fish classification, e.g. defining fish as 'game', 'coarse', or 'pest' fish; and
- Approaching freshwater management from a holistic perspective.

5.8.6 Educational methods and incentives

All organisations recognised the important role of environmental education and compliance incentives, but they also recognised the difficulty of converting awareness education into behaviour change. Coarse anglers enjoy learning about their sport and freshwater areas, but are wary of receiving 'propaganda' and information that does not meet their needs. There were several similarities amongst the way management agencies currently approach awareness education. These include:

- Providing simple and informative resources, such as posters, pamphlets, and stickers;
- Supplying educational displays at events like Boating and Fishing Shows, museum open days, and BioBlitz;
- Providing opportunities for direct experience with the unique qualities of the freshwater environment;
- Targeting school children, particularly through the Enviroschool programme; and
- Fostering urban and rural stream care groups.

It was also recognised, by DOC and Fish and Game in particular, that there is a need for compliance mechanisms and incentives to be instigated to facilitate the transformation of awareness into behaviour change.

Coarse anglers show a definite interest in learning more about the freshwater environment and coarse fish, although any education needs to be targeted at their level of interest. Currently, anglers utilise other anglers, internet searchers, the

coarse fishing website, overseas magazines, and club newsletters to find information that interests them. Sigband and Bell's (1994) book *Communication for Managers* provides some important guidelines for developing effective communication, among management agencies as well as between managers and coarse anglers. Successful communication revolves around the following elements of 'persuasive talk': arousing interest, describing and explaining, proving and visualising, and moving to action or approval (Sigband and Bell, 1994). This is discussed further in the following chapter.

CHAPTER 6: INTERPRETATION AND CONCLUSIONS

This chapter applies the theoretical framework outlined in Chapter 3 to some of the key findings summarised in Chapter 5, and to several broad themes that emerged during this research. In section 6.1, the implications of conflicting environmental perceptions on the interpretation and management of coarse fish in the freshwater environment is discussed. Section 6.2 extends these understandings to develop a potential, effective and socially just, approach to environmental management and ecological restoration, and the significance of communication and education to this process is examined in section 6.3. Following this, section 6.4 provides a more practical, 'where to from here' interpretation of the analyses discussed in the chapter, including suggestions for future research, and section 6.5 offers some concluding thoughts.

6.1 Environmental perception(s) and the biophysical landscape

As discussed in section 3.1, the 'natural' environment is also a 'social' environment, inscribed with the social and political ideologies of the people influencing and interacting with it (Head, 2000). This social construction of the biophysical environment, combined with the influence of language and power, serves to perpetuate dominant ideologies regarding the natural world, with important implications for management. A multitude of alternative environmental perceptions exist (section 3.2), all of which are valid to those that hold them.

6.1.1 Language, meanings, and metaphors

Language plays an important role in perpetuating certain ideas and marginalising others (see section 3.3.1). One of the ways the power of language is evident in environmental literature is through the use of ecological metaphors. The very phrase 'coarse' fish implies the fish are 'vulgar', 'crude', and 'common', suggesting they are not to be respected. While 'coarse' fish is intended to refer to the size of their scales (compared with the fine, small scales of salmonid species), the social connotations associated with the term remain. Metaphors are useful in facilitating understanding, particularly because they do so across the 'boundary' between science and society (Larson et al., 2005). However, the common

metaphors used in invasion biology, such as "aggressive" and "alien" (Table 6.1), serve to personify species in a manner which justifies militaristic responses to them and encourages the alignment of public opinion with those seeking their control or eradication.

Table 6.1 Examples of personifications of, and militaristic declarations against, invasive species in British newspapers (adapted from a study by Larson et al., 2005: 249-250).

General personification	Invasive species are foreign/other	Invasive species are killers	Militaristic policies
Aggressive	Alien*	Butchering	Ban
Attacking	Alien invasion	Choking (to death)	Biosecurity regime
Conquer	Colonise	Deadly	Contain/containment
Driving to extinction	Exotic	Killer/killing off	Control
Enemy	Foreign	Murderous	Counteroffensive
Evil	Invade/invader	Natural born killers	Defend
Fearsome/fearless	Wild	Slaughter	Hit list
Lurk		Smother	Vigilance
Pesky		Suffocate	

* The term used most commonly in reference to invasive species

At the same time, native species are highly valued as "cherished, precious, rare, or unique" (Larson et al., 2005: 251). This conception is more ideological than practical; few New Zealanders (other than professional conservationists) can name species of indigenous freshwater fish other than eels, whitebait, and perhaps bullies, and many think that trout are a native species (ARC interview 25-07-08). Further, while it is often contended that native communities are more 'stable' than those that include introduced species, they are also described as "'defenceless', 'delicate', 'fragile', 'susceptible', 'vulnerable', and 'weaker' than invaders" (Larson et al., 2005: 251). These descriptions deny native species any agency or resilience of their own while invasive species are constructed to operate at a highly conscious level of agency, further justifying the "need" for the human control of nature.

6.1.2 Implications for the management of coarse fish

This perception is prevalent in New Zealand; most freshwater management organisations allocate coarse fish similar levels of autonomy, and correspondingly construct indigenous species as in need of protection. In contrast, coarse anglers

are more inclined to see all fish species as having similar levels of agency, and, apart from the desire to have access to a highly managed coarse fishery, are disposed to leaving 'natured' to its own devices. While many indigenous New Zealand freshwater fish species are indeed endangered, there are two main contradictions in the approach generally taken by management agencies.

First, as has been mentioned elsewhere in this thesis, trout are not given the same level of agency, or personification, as most coarse fish species. This is problematic because it is inconsistent – while public agreement is sought to support the control of the "evil" invasive species, invasive species that are considered to be of social or economic importance, like trout, are framed as desirable, despite evidence of negative impacts on indigenous fish.

Second, allocating coarse fish enemy status also serves to marginalise coarse anglers' values and perceptions. It is often overlooked that coarse anglers care, and know, more about freshwater biodiversity than most of the general New Zealand public. In this capacity, the knowledge and experience of coarse anglers could be applied to help conservation or awareness raising programmes (section 6.3). Given the assertion that all environmental perceptions are valid, a process of negotiation, or mutually agreed construction (see Haraway, 1991; Harvey, 1996), needs to occur for management to be socially just and have a long-term positive effect on the environment.

6.1.3 Invasive species: a misguided focus?

Two key themes have emerged in this section that lead me to suggest the militaristic preoccupation with invasive species, while still important, may be misguided. Firstly, this focus on invasive species distracts attention from the problems of habitat loss and degradation, which have been identified as having more significant impacts on indigenous species and ecosystems than invasive species. Indeed, invasive species tend to be more able to invade areas that have already been modified in some way. Land-use change and the associated environmental degradation take place in the context of economic development, to which environmental concerns usually come second. Interestingly, it is this same framework of economic development and social values that legitimises trout, the

presence of which many freshwater management agencies accept. Although invasive species, by their very definition, have negative impacts, I suggest that the focus on these species reflects a human attempt to control nature without addressing the more important, human-caused, issues. This is also recognised by Larson (2008: 14), who states:

> [There is] a serious limitation in our usual perception of invasive species as a problem in themselves, rather than a symptom – a riffle within a torrent of global change brought about by our species.

Again, while I do not deny the very real biophysical impacts of invasive species, I do intend to illuminate the ways in which certain environmental values become constructed as superior to others, and to highlight the power plays that result from this assumption.

Secondly, at a time when environmental issues are high on the public radar and the implications of climate change are causing concern, I suspect that teaching people that certain parts of nature are 'bad', 'unwanted', or even 'evil', may not be in the environment's best interests. People are learning what is 'wrong' with nature, that 'proper' nature is neat, tidy, and controlled, rather than to delight in nature and its chaos (Larson, 2008). The following section probes the implications of this conceptualisation of the natural environment for management and restoration practice, and examines several alternative and innovative foundations for restoration.

6.2 Reconceptualising management and restoration

Ecological restoration involves actively managing aspects of the natural environment in an attempt to have that environment reflect an imagined 'pristine', ordered state. The assumption that such a state ever existed, let alone can be recreated through human activity, reflects the authoritarian and deterministic approach that usually informs conservation in New Zealand. It is not often recognised that, while ostensibly rooted in ecological knowledge and fidelity, in practice ecological restoration also takes into account the diverse perspectives of interested stakeholders (Higgs, 1997), involving conscious human choices to intervene with 'nature' and about what to restore to.

Protecting environmental diversity is often framed as a moral imperative (e.g. Cambray, 2003). This locates conservation firmly within a social context, but other underlying social factors are rarely explicitly acknowledged. Explicit engagement by the conservation community with the general public is important for long-lasting, socially just, and ecologically defined, restoration to occur, despite the difficulties and imperfections inherent in this process (Brechin et al., 2002).

Higgs (1997) reflects on the following aspects of ecological restoration: Is restoration, in the sense of returning to some prior state, really what we want, or would we be better off with a model of regeneration (see below)? What sort of relationship with nature does restoration signify and encourage? Who really stands to gain from restoration? And, what counts as proper representation of nature? It is important that the underlying reasons behind the human drive to manage the environment and control invasive species are acknowledged:

> A little rethinking of our managerial ethos towards invasive species might encourage some constructive conversations about the undertones of invasion biology: our grief, our sorrow, our anger, our regret and even our hopes. In the process, we could discuss our relation to change, to uncertainty, to a deepening sense that we truly do have global impacts (Larson, 2008: 17).

This is relevant to this research because it demonstrates that there are multiple ways in which coarse fish and conservation of the freshwater environment can be conceptualised and approached. Several innovative proposals have been constructed that engage with the above questions and others like them to develop suggestions for effective 'socio-political-ecological' restoration. The possibilities posed by 'conservation with social justice' and 'regeneration' are briefly discussed below (see also Cairns, 1995 for a discussion on 'ecosocietal' restoration).

Conservation with social justice

Conservation with social justice revolves around the argument that current, protectionist-based approaches are not effective over long periods of time, as they

do not take into account the social practices associated with conservation (Brechin et al., 2002). Instead, describe conservation with social justice poses a viable alternative to the current 'authoritarian protectionism' approach, while satisfying ecological, pragmatic, and moral criteria (Brechin et al., 2002; Table 6.2).

Table 6.2 Socially just biodiversity conservation (from Brechin et al., 2002: 52).

Element	Recommendation	Components
Conservation with social justice	Establish explicit parameters for social and political processes associated with biodiversity conservation.	A set of standards that can guide design, implementation, and appraisal of biodiversity programs. Organisations define commitment in a particular place, stabilise expectations of affected parties, and set boundaries of accountability.
Conservation in context	Apply knowledge in context and adopt a problem-oriented approach, recognising local uniqueness and issues of scale.	Detailed action strategies negotiated by participants in particular setting. Apply conservation "tools" most appropriate for given context.
Knowledge about conservation	Develop and synthesise systemic social scientific knowledge of conservation as a social and political process.	Social theory and the environment. Social causes of environmental change. Conservation management as a process of human organisation. Political dynamics of conservation. Social impact assessment. Organisations and natural resource management.
Conservation organisation	Increase capacity for organisational coordination and collaboration.	Organisations – structure, goals, commitment, capacity. Organisational networks and collaborations.
Conservation performance	Establish parameters for appraisal of social process.	Decision process appraisal. Organisational performance. Comparative case studies.
Dialogue on conservation	Establish an ongoing "workshop" on biodiversity conservation to find common ground and generate strategies.	Continuing series of meetings or roundtable discussions centred on problem solving and strategy building. Overlapping working groups for international, national, and local contexts.

Regeneration

In contrast to the above to proposal, Eric Higgs (1997) thinks the term 'restoration' should be replaced altogether. Instead, he favours the concept of 'regeneration'. This, Higgs (1997) argues, looks to the future instead of fixating on the past, and openly recognises the partial and tentative nature of human engagements with ecosystems. He maintains that the constructive connotations of regeneration reflect more accurately the conservation practices that actually occur, as in most cases an ecosystem can never be truly 'restored', and allows more freedom to explicitly engage with the ideologies underlying these practices.

The suggestions outlined above pose an interesting challenge; the effects of invasive species are complex, with many social, ethical, and legal aspects to consider as well as the biological and ecological dimensions. While a nativist approach may be considered ideal to many management personnel, it is simply not practical in most areas. This is recognised even by staunch conservationists like Cambray, who states that while areas with the potential to be rehabilitated need to be identified and prioritised, it may be practical for other areas to be "conceded" to the "aliens" (Cambray, 2003: 223). It will still be important to address the more serious impacts of invasive fish (Chadderton, 2003), and the most practical way to do this may be to prevent their further spread, particularly to the South Island. However, including coarse anglers in future decisions regarding the freshwater environment – which they also value highly, although they may express this in a different way to the majority of New Zealanders – will allow restoration to proceed in a socially just manner and resources to be focused where they are most appropriate.

6.3 Communication and education

Communication, and its corresponding importance for education, emerged as a fundamentally important but currently lacking aspect of successful environmental management. While effective communication is theoretically simple – involving the transmission of information from an encoder to a receiver, who subsequently decodes the message and initiates a feedback loop back to the transmitter (Sigband and Bell, 1994) – in practice many factors interfere with this process (Table 6.3). During this study it became clear that communication needs to

improve between freshwater management agencies, as well as between these organisations and coarse anglers. Below, section 6.3.1 examines the possibilities and implications of improved communication and collaboration between management agencies, while section 6.3.2 discusses the role that communication plays in interactions with, and education of, coarse anglers.

Table 6.3 Examples of barriers to effective communication (adapted from Sigband and Bell, 1994).

Barriers to communication	
Bias	Emotions
Competition for attention	Lack of knowledge
Cultural differences	Language
Differences in perceptions	Personality
Differences in values	Poor listening
Distractions	Prejudice

6.3.1 'Just' communication

The heading of this section is purposefully ambiguous – 'just' is intended to mean both simple and fair. As mentioned above communication is theoretically straightforward, but practically complicated (Table 6.3). In this study, the main barrier to communication between management agencies is distractions, with many informants citing a lack of time and resources as key reasons why networks were not formed between agencies. These distractions mean that many organisations perceive they cannot spare the time to instigate effective communication mechanisms, despite the huge benefits that these mechanisms would bring to the overall practice of freshwater management in New Zealand.

The report *New Zealand Under Siege*, by the Parliamentary Commissioner for the Environment (2000), recognises the importance of good cooperation and linkages between multiple biosecurity agencies, as well as Non-Government Organisations (NGOs), science providers, and Māori. This research reinforced the emphasis the (2000) report placed on the importance of taking into account all interests in biosecurity risk management, as well as utilising practices that make the best use of existing expertise and legislation, ensure the responsibilities and

accountabilities of the various agencies are clear, and facilitate the fast and efficient sharing of information.

Furthermore, the overwhelming response from respondents to this research was that the current legislation regarding aquatic biodiversity and 'pest' management is confusing and complex, with overlapping jurisdictions and no organisation taking leadership. The *New Zealand Under Siege* report notes that assigning an agency the responsibility of managing aquatic 'pests' would be a significant first step in improving the current situation. Similarly, Brechin et al. (2002) note that umbrella organisational structures are the most effective way to deal with the complexity of environmental protection activities, provided that these are supported by negotiated coordination strategies. Communication has a significant role to play in allowing this to occur. Several notable suggestions for improving inter-agency communication and management have been outlined in section 5.8.5.

With regards to the relationship between management agencies and coarse anglers, several key barriers to communication are evident. These include bias, emotions, and prejudice (from each side); differences in values and perceptions; and a lack of fundamental knowledge, meaning managers and coarse anglers are not communicating from the same level of understanding. Effective communication cannot occur when one 'side' believes their world view is the 'right' one, and all others need their 'misconceptions' righted (Gough, 1999). Instead, Reaser notes, "good communicators shape their language (messages) to match their audience's map of the world" (Reaser, 2001: 102). One way in which this can occur is through implementing educational strategies that promote awareness at a level that matches coarse anglers' understanding of the world, enabling them to make educated choices about the way they live their lives. The possibilities posed by this are discussed further in the following section.

6.3.2 Environmental education

Environmental education has been extensively discussed in Chapter 3, and it is the objective that this research has been least able to address. This is due in large part to my inability to resolve my own conflicting ideas regarding the purpose, and appropriateness, of environmental education, and it is important to reiterate my

discomfort with the implementation of programmes to promote behaviour change that have not been critically examined (see also Clover, 2002a; Haraway, 1991; Harvey, 1996). Instead, I believe educational methods based on the principles of social justice and mutual engagement (section 3.2.3), targeted at individual habits, beliefs, and skills, will provide the most significant and long lasting benefits for environmental management.

Explicit engagement with the motivations of individuals and organisations is particularly important with regards to 'educating' coarse anglers. Coarse anglers showed a sophisticated understanding of the underlying reasons freshwater management agencies promoted certain messages and supported particular laws (section 5.7.8), and it would be inappropriate and patronising not to take this into account when designing educational campaigns. The distance that exists between coarse anglers and management agencies is partly due to the anglers' distrust of what they term "propaganda", as well as their emotional response to feeling that their perspective is ignored and their personal experiences with the freshwater environment marginalised. Similar findings are reflected in other studies on environmental education. For example, Connell et al. (1999) found that Australian secondary students, like coarse anglers, were highly wary of receiving 'one sided' environmental messages, did not trust the media (although they recognised it as a major source of environmental information), and believed personal experience to be the most reliable source of environmental education.

One factor that management agencies appeared not to recognise was the high levels of motivation shown by coarse anglers to learn more about the freshwater environment. This is important given that people are more likely to be motivated to make decisions when they receive information that fits with their experiences of the world and meets their needs (Reaser, 2001). Coarse anglers already have a level of knowledge about the freshwater environment, largely obtained through personal experience. They are eager to receive further information that matches their interests, such as the food preferences and habits of koi carp (Coarse angler interview 07-06-08[*]), and have even offered their support to scientific research

[*] Quote taken from hand written notes rather than an accurate transcript. The interview was not taped.

programmes, such as koi carp tagging and monitoring experiments (Coarse angler interview 07-06-08*).

The possibility of integrating the practical knowledge already held by anglers with conservation management and/or scientific research has been investigated in other studies. For example, Granek et al. (2008) highlighted some of the ways in which anglers can be employed to help conservation efforts (Table 6.4; see also Clover, 2002a; 2002b). Several of the areas for engagement posed by Granek et al. (2008) were also suggested by coarse anglers in this research, in particular: monitoring, promoting conservation through a user fee, involvement in protected area design, and supporting conservation in terrestrial systems.

Table 6.4 Potential areas for angler engagement in freshwater management and conservation (adapted from Granek et al., 2008: 1132).

Type of participation	Activity by fishers
Monitoring	Collect standard suite of quantitative and qualitative data on fish caught: species, location, size, sex, condition.
Involvement in fisheries research	Direct support; train scientists in efficient catch methods; catch fish for scientists; indirect support; in-kind support (e.g. boat or equipment use); financial support (e.g. via angling associations).
Enforcement	Self and peer monitoring.
Promote conservation	Pay user fee; join conservation group(s); engage in conservation-based approach to resource use.
Involvement in protected area design	Give input into design process; identify prime fishing areas; assist with quota determination.
Advocacy across systems/education	Support conservation in other systems.

In New Zealand, the positive role trout anglers' play in drawing attention to the freshwater environment is recognised, particularly by DOC and Fish and Game. Trout prefer fairly pristine, cold, and highly oxygenated freshwater environments – environments environmental managers most want to maintain – which is likely to be one of the reasons trout anglers are viewed in this positive light. The marginalisation of coarse fishing as a sport is echoed in the way that it is assumed that coarse anglers only have the ability to have a negative effect on the freshwater environment. This reflects a fundamental difference in the world views

of management agencies and coarse anglers, as the anglers believe they are interacting with the environment in a positive manner (section 5.7.3). Despite this difference, encouraging comments were made during this research that suggest some managers may be willing to engage with some anglers in negotiations regarding the appropriate way to approach freshwater and coarse fish management in New Zealand.

6.4 Where to from here?

This chapter has largely focused on the theoretical foundations that underpin the current management of the freshwater environment in New Zealand. While this is important, it can be difficult to apply these understandings to the more practical aspects of management. Below, I provide some suggestions to help guide the practical implementation of these ideas in freshwater management programmes. Following this, I offer some ideas for further research regarding freshwater management, the practices and perspectives of coarse anglers, and the life habits of coarse fish.

6.4.1 Practical implementation

Freshwater restoration practice

This thesis has pointed to the importance of ensuring restoration is carried out in a transparent, holistic, and socially just manner. This can be ensured by providing clear, unambiguous information to all management agencies and stakeholder groups affected by the restoration process, as well as the general public. The motives behind and importance for the restoration should be explicitly discussed, and an appropriate plan of action negotiated between groups. If specific invasive species are to be targeted as part of the restoration programme, the reasons for this need to be clear and based on sound reasoning rather than a popular belief in the negative effects of a species, or an ideological and usually unrealistic attempt to restore an area to an (imagined) ‘pristine’, pre-human state.

Restructuring management

Several suggestions emerged during this research regarding the improvement of current management practices (section 5.8.5). Of these, the proposition that one agency become the lead organisation with regards to managing and coordinating invasive fish in the freshwater environment seems particularly worthwhile, particularly as this is supported by the findings of other studies (e.g. Brechin et al., 2002; Parliamentary Commissioner for the Environment, 2000).

With regards to legislation, I suggest a revision of the overlapping aspects of the various regulations is conducted as soon as possible, and that the relevant policies are incorporated into a less ambiguous and contradictory format. In particular, I recommend abolishing Section 67B of the Freshwater Fisheries Regulation 1983, which states that koi carp must be killed on capture. While it may be necessary to have a means to control the movement of koi carp, the rule itself should be revised, as it hinders conservation and research efforts as well as contradicting coarse anglers' strong fishing ethic. Furthermore, it may be appropriate to examine the underlying philosophies of the principal pieces of legislation – the Fisheries Act 1996 (sustainable use), the Conservation Act 1987 (preservation), and the Biosecurity Act 1993 (pest management) – to help develop a more comprehensive management strategy. It appears that these different driving philosophies contribute in some part to the confusion and complexity evident in the legislation.

Communication and education

It is important that, if the different freshwater management agencies are to continue to work together and manage different aspects of the freshwater environment, effective communication systems are set up. There a several forms which this could take, including forming a network group (possibly modelled on APTAG) that holds monthly meetings, or setting up a common database, accessible to all organisations, to facilitate the fast and efficient transfer of information.

Numerous suggestions for education have been discussed in this thesis (section 5.8.6 and 6.3.2). I advise that communication between management agencies and coarse anglers, perhaps in the form of a forum, is carried out before

any education strategies are implemented. This will enable management agencies to further understand coarse anglers' values and practices before resources are spent on management programmes, and a show of good will by these organisations is likely to be highly appreciated by anglers.

Potential for compromise

Finally, there does appear to be the potential for a compromise between management agencies and coarse anglers. There is a large amount of common ground between management agencies and coarse anglers, including a desire to communicate with one another and a similar appreciation of the freshwater environment. Further, it *may* be appropriate to set up a legitimate, managed coarse fishery, although the merits of this will need to be extensively discussed between conservation organisations.

If this was to occur, the fishery could be an existing freshwater area, such as quarry pits or a degraded lake already containing coarse fish, or a created fishery. If an existing site was to be used, it would be important to recognise the significance of particular sites to conservation efforts, such as those identified as high value conservation areas in the Auckland region, to ensure conservation efforts are not hindered by the creation of a coarse fishery. Similarly, areas like Lake Ngaroto, the Otaki Lakes, and the Rotokohatu Lakes (Table 5.1), should be recognised for their importance to coarse anglers. As well as specific sites, a number of features were identified as important to coarse anglers (Figure 5.6). These include good sized and plentiful fish stocks and convenience of access, and should be considered if a new fishery was to be created.

6.4.2 Future research

This study provides only a partial insight into the perceptions and practices of coarse anglers and the current management of the freshwater environment. Consequently, several areas for future research emerged. These revolve around the following themes: the values and beliefs of the types of coarse anglers not included in this study, and the potential of the practical experience of coarse anglers to be utilised in conservation measures through the principle of 'concientización' (section 3.4); refining management practices and legislation;

and increasing understandings of the life habits of coarse fish and, correspondingly, potential control mechanisms. These are discussed further below.

Most coarse anglers involved in this research were of British backgrounds; Asian, Eastern European, and New Zealand coarse anglers were largely omitted from this study. It is likely that the practices and perceptions of each of these groups will differ significantly, and it would be useful to incorporate these into future research. Further, it would be worthwhile to examine how direct experience with scientific evidence of negative impacts influences coarse anglers' understandings of coarse fish in freshwater areas. There is also significant potential for coarse anglers to assist with conservation management and scientific research (Table 6.4), for example, through participating in monitoring experiments, and it may be appropriate for a case study of the effectiveness of this to be conducted. Similarly, a trial coarse fishery could be investigated through a case study.

This research only touched on the underlying philosophies and guiding principles of freshwater management and legislation. It would be interesting to investigate further the ways in which the underlying philosophies of legislation lead to conflicting and sometimes contradictory management approaches. Further, the impact guiding principles and philosophies have on actual management practices could be investigated, with the intention of determining the most effective level of specificity for successful management to occur.

Finally, the following three aspects of the life habits of coarse fish and control mechanisms warrant further research. (1) The legitimacy of coarse anglers' ideas about how coarse fish are spread (e.g. through flooding or being transferred as spawn on ducks feet) should be investigated. (2) The extent to which coarse fish cause environmental degradation as opposed to merely existing in degraded conditions should be determined. (3) Research into novel, humane, and species-specific control mechanisms that correspond with the life habits of different fish species would be beneficial.

6.5 Concluding thoughts

By examining the ways in which coarse fish are valued by different people in different times and different places and how these values inform approaches to coarse fish management in New Zealand, I have argued there is a need for a more nuanced understanding of coarse fish in Aotearoa. I have also identified a space for communication and compromise, among environmental agencies and between these organisations and coarse anglers, with the intention that this will contribute to effective and socially just management practices. Finally, I investigated appropriate educational methods, to help raise awareness of coarse fish and the freshwater environment in general. This thesis is interdisciplinary in nature, and provides an important contribution to understanding and demonstrating the ways in which social science complements scientific approaches to environmental management.

The question posed by the title of this thesis – 'Pest or pastime? Coarse fish in Aotearoa/New Zealand' – has also been addressed. I suggest that the categories of 'pest' and 'pastime' are not sufficient to allow for the range of environmental perception ascribed to coarse fish. Recognising the legitimacy of a multiplicity of perspectives, they are both a pest and a pastime, and probably many things in between. This indicates that the current classifications employed by environmental managers are simplistic and reinforce dominant ideas and binaries that have not been explicitly examined or negotiated. It may be time to reconceptualise such categories.

GLOSSARY OF TERMS

Agency: the ability or the capacity to act. Agency often refers to the ability for conscious choices to be made in an autonomous fashion (Valentine, 2001).

Biodiversity (biological diversity): the term given to the variety of life on Earth in all its forms, including genetic differences within each species, and its geographical distribution. Biodiversity can also refer to the variety of ecosystems on Earth and the unique communities of organisms that inhabit them (Secretariat of the Convention on Biological Diversity, 2000).

Biosecurity (biological security): the management of the potential risks non-indigenous organisms may pose to the environment, the economy, or people's health. Biosecurity involves utilising techniques such as exclusion, mitigation, control, and eradication (McNeely, 2001).

Catchment (synonyms: river system, drainage basin, watershed): the total area (bounded by ridges) that drains rain, ground water, sediment, and nutrients to a main river channel and all its tributary streams (Hamblin and Christiansen, 2001).

Endemic species: a species that is exclusively native to New Zealand (i.e. it is found nowhere else in the world), or is restricted to specialised habitats within New Zealand (Smith and Smith, 2001).

Eradication: the annihilation of an entire population of a species in a managed area, resulting in the complete elimination of the species from that location (McNeely, 2001).

Establishment (synonym: naturalisation): the process of a species in a new habitat reproducing to the extent that the survival of that species is ensured without the need for the introduction of species from a different population (McNeely, 2001). Established species do not necessarily invade other ecosystems.

Eutrophication: the nutrient enrichment of a water body. Eutrophication occurs naturally over time, but is often accelerated by human activity and land-use change (Smith and Smith, 2001).

Extant: still in existence, not extinct (Soanes, 2000).

Fish passage connectivity: the connection and maintenance of the health of rivers and streams from their origin to the sea. This is important as many of New Zealand's fish are diadromous, requiring access to both fresh and salt water during their life cycle, which can be hindered by the draining of freshwater areas and structures such as dams.

Incursion: the introduction of an organism not previously known to be established in New Zealand (Green, 2000).

Indigenous species (synonym: native species): a species living within its natural geographical range. This includes any areas the species can reach and occupy using its legs or wings, or natural dispersal mechanisms such as being wind-borne, even if it is seldom found in that area (McNeely, 2001).

Introduction: the human-induced movement, whether intentional or accidental, of a species, or any part of a species that might survive and subsequently reproduce (such as gametes, seeds, eggs, or propagules), outside its past or present geographical distribution. This may occur within or between countries (McNeely, 2001).

Invasive species: a non-indigenous species "whose establishment and spread threaten ecosystems, habitats or species with economic or environmental harm", as discussed in Article 8(h) of the Convention on Biological Diversity (McNeely, 2001: 3).

Non-indigenous species (synonyms: non-native, foreign, exotic, alien): a species (including any part of that species that might survive and subsequently reproduce) introduced to an area outside its normal past or present geographical distribution (McNeely, 2001).

Pest: any species or biotype of plant, animal, or pathogenic agent that is perceived to be harmful to native, or socially or economically valued, organisms or ecosystems (adapted from McNeely, 2001).

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APPENDIX I: MILESTONE 11

I.1 FRST contract UOWX0505: Restoring freshwater ecosystems and resurrecting indigenous lake biodiversity

Table I.1 Intermediate Outcome 2

Short Title	Pest fish management for lake biodiversity restoration
IO Statement	This research will provide action to reduce the decline of lake biodiversity from pest fish invasions. We aim to understand critical aspects of the ecology of existing pest fish species in New Zealand, and use this knowledge to develop new tools and technologies to eradicate these pests. With the support of our end-user groups, particularly DOC and Fish & Game NZ, we will educate the public about the problem of pest fish and then reduce pest fish abundance in key habitats (at least 5 water bodies of over 5 ha) to the point where they no longer threaten native species.
Start date	01/07/2005
End date	30/06/2015
Portfolio	Resilient, Functioning and Restored Natural Ecosystems
Output	14.1

Milestone 11	Overcoming human behavioural barriers to successful pest fish management
Description	Social research has been undertaken to identify the most effective methods to prevent further accidental releases of pest fish species, to understand reasons for, and to develop incentives to successfully discourage deliberate spread of these pest fish species. Public perceptions and concerns over the use of pest fish control techniques have been identified. Iwi groups and ngā whenua rāhui representatives have been included in the discussion about pest fish. An outreach programme is produced to develop community support for pest fish control, deliberate introduction of pest species is deemed socially unacceptable, and inform public debate on control options.
Start date	01/07/2009
End date	30/06/2012
Achievement Measure	Social research has been undertaken to identify broad public perceptions of pest fish species and management techniques, and motivations behind deliberate introductions of these species. The findings have been documented and peer reviewed. Effective learning methods and incentives to modify undesirable behaviours have been identified and introduced by relevant management agencies. DOC, regional councils, and other authorities have undertaken public education and outreach programmes to modify behaviour to prevent deliberate or accidental introductions of pest fish species. The OBI Technical Group has indicated they are satisfied that society is now well informed about the impacts of pest fish species and efficacy and public safety of control options.

Milestone dependant on	Milestone 1
Milestone Contributes to	Milestone 15 Milestone 16 Milestone 17 Milestone 18

Milestone 17	Regional freshwater biodiversity improved
Description	Monitoring (and annual reporting) by central and local government agencies indicate successful biodiversity restoration is being achieved through pest fish management in targeted freshwater ecosystems.
Start date	01/06/2010
End date	30/06/2015
Achievement Measure	Annual reporting by central and local government agencies document the halt in spread of pest fish species, and a general improvement in biodiversity condition as a result of improved integrated pest fish management approach. Results of management efforts using these new tools have been published in scientific journals, and annual reports by local, regional and central government and non government (Fish and Game New Zealand) agencies.
Milestone dependant on	Milestone 1 Milestone 2 Milestone 3 Milestone 4 Milestone 5 Milestone 6 Milestone 8 Milestone 7 Milestone 10 Milestone 9 Milestone 11
Milestone Contributes to	Milestone 18

Milestone 18	Closeout
Description	A review has been conducted of the Intermediate Outcome and of the lessons learned.
Start date	01/03/2015
End date	30/06/2015
Achievement Measure	The final report of the Intermediate Outcome is accepted by the Governance Board and provided to the Foundation.
Milestone dependant on	Milestone 1 Milestone 2 Milestone 3 Milestone 4 Milestone 5 Milestone 6 Milestone 8 Milestone 7 Milestone 10 Milestone 9 Milestone 11 Milestone 12 Milestone 13 Milestone 14 Milestone 15 Milestone 16 Milestone 17 Milestone 18

APPENDIX II: GLOSSARY OF FISHES

II.1 Coarse fish

Catfish (*Ameiurus nebulosus*)

Catfish (Figure II.1), of the Ictaluridae family, are native to North America. They are characterised by the presence of distinctive, whisker-like barbells around their mouths, hence the common name catfish (McDowall, 1990). Brown bull-headed catfish are a dark brown to olive green colour with paler sides and bellies. This species of catfish were introduced to New Zealand in the late 1800s, and are the only member of the Ictaluridae family found in New Zealand (McDowall, 1990). Currently, catfish are present in all the hydroelectric reservoirs of the Waikato River and throughout the lower river. They have also been recorded in the Kaituna Lagoon and in a stream in Hokianga Harbour (NIWA, 2008a).

Gambusia (*Gambusia affinis*)

Gambusia (Figure II.2) are native to the Gulf of Mexico, where they are renowned for eating large numbers of mosquito larvae (hence the common name mosquitofish). Gambusia are small species with green-brown backs, blue-grey sides, and silvery white bellies (McDowall, 1990). They were probably introduced to New Zealand in the 1930s, and are now widespread in the North Island. They have recently been discovered in the Nelson/Marlborough area, along with new incursions of other coarse fish species (NIWA, 2008a). Gambusia are classified as an unwanted organism under the Biosecurity Act 1993.

Goldfish (*Carassius auratus*)

Feral goldfish (Figure II.3) are the same species of the family Cyprinidae as those found in aquariums, despite their dark bronze colouring in place of bright colours, bulging eyes and feathery fins (NIWA, 2008a). Native to eastern Asia, goldfish were first brought to New Zealand in the late 1860s (McDowall, 1990). Goldfish have subsequently established throughout the North Island, although their South Island distribution is more restricted. In the early 1900s, feral goldfish populations were important to the Māori as a food fish, and fish from Lake Taupo are still eaten by the people of Tūwharetoa today (NIWA, 2008a).

Koi carp *(Cyprinus carpio)*

Koi carp (Figure II.4) are an ornamental strain of the common or European carp and are often orange with black spots. Although it is possible that koi carp were brought to New Zealand in the 1860s, there was no evidence of established populations in the wild before the 1960s (McDowall, 1990). Native to Western Europe, the Mediterranean and Western Asia, koi carp are now found in every continent except Antarctica (Environment Waikato, 2002). They are classified as a noxious fish under the Freshwater Fisheries Regulations 1983 and as an unwanted organism under the Biosecurity Act.

Perch *(Perca fluviatilis)*

Perch (Figure II.5) are native to Europe and were introduced to New Zealand in the late 1860s (McDowall, 1990). They are a fine table fish with firm white flesh and have six or more dark bands along their sides (NIWA, 2008a). Perch have become well established in Otago and Southland, but also occur in many other parts of New Zealand. They are piscivorous, and have been shown to reduce the abundance of common bullies in lakes (NIWA, 2008a).

Rudd *(Scardinius erythrophthalmus)*

Originally from Europe and Asia, rudd (Figure II.6) were illegally imported to New Zealand in 1967 and subsequently widely released (McDowall, 1990). Rudd are now well established in many North Island waterways, particularly in the Waikato River catchment, and have been implicated in the decline of trout fisheries (NIWA, 2008a). They are darker on their backs than on their bellies and their fins are usually bright reddish orange.

Tench *(Tinca tinca)*

Tench (Figure II.7) are native to Europe and were first introduced to New Zealand in 1867 as a sports fish. Most fishing for tench occurs in the Auckland area, but tench are also present in isolated areas in Northland, Tauranga, Wellington, Oamaru, Nelson, Marlborough and Canterbury (NIWA, 2008a). Tench have distinctive orange eyes and are olive green in colour.

Figure II.1 Catfish (NIWA, 2008a; photograph by R.M. McDowall).

Figure II.2 Gambusia (mosquitofish) (NIWA, 2008a; photograph by R.M. McDowall).

Figure II.3 Goldfish (NIWA, 2008a; photograph by S.C. Moore).

Figure II.4 Koi carp (NIWA, 2008a; photograph by D.K. Rowe).

Figure II.5 Perch (NIWA, 2008a; photograph by S.C. Moore).

Figure II.6 Rudd (NIWA, 2008a; photograph by D.K. Rowe).

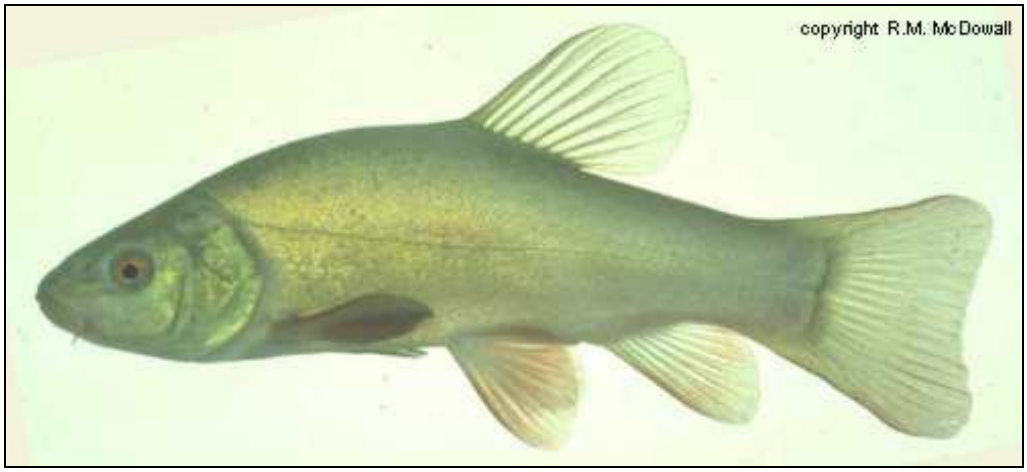

Figure II.7 Tench (NIWA, 2008a; photograph by R.M. McDowall).

II.2 Salmonids

Brown trout (*Salmo trutta*)

Brown trout (Figure II.8) are native to Europe and were first introduced into New Zealand in the late 1860s. Many subsequent introductions have occurred, and brown trout are now the most widespread and common introduced freshwater fish in New Zealand, although they are not yet established on Chatham or Stewart Islands (NIWA, 2008a). Indeed, New Zealanders are often surprised to find that brown trout are not a native species (McDowall, 1990) The colour pattern of brown trout varies with their habitat; sea-run and lake fish tend to be silvery with brown and olive spots of varying intensity, whereas river-dwelling fish are darker with dark brown and red spots (NIWA, 2008a).

Chinook salmon (*Oncorhynchus tshawytscha*)

Chinook salmon (Figure II.9) are the most common of three Pacific species from the genus *Oncorhynchus* that have become established in New Zealand (Chinook salmon, Atlantic salmon, and Sock-eye salmon). Native to the northwest coast of North America and northeast Asia, their species name (tshawytscha) is thought to refer to their distinctive black gums (NIWA, 2008a). Chinook salmon occur mainly on the east coast of the South Island from the Waiau River in the north to the Clutha River in the south. They are silver in colour, with olive green backs containing small black spots. Adults grow to maturity in the sea and migrate upstream to spawn, usually when they are three years old (NIWA, 2008a).

Rainbow trout (*Oncorhynchus mykiss*)

Rainbow trout (Figure II.10) are native to the west of North America and the Kamchatka Peninsula, and were probably introduced into New Zealand in 1883. They did not establish as readily as brown trout, but self-sustaining populations of rainbow trout are now widespread in New Zealand (NIWA, 2008a). Lake dwelling rainbow trout are generally silver with small, darker spots along the back, while the backs of river dwelling fish are often more olive-green, and the red band, or rainbow, along the lateral line more prominent. Most rainbow trout migrate to their spawning grounds, with both lake and river dwelling fish moving upstream to suitable locations, often in small tributaries (NIWA, 2008a).

Figure II.8 Brown trout (NIWA, 2008a; photograph by J.D. Hall).

Figure II.9 Chinook salmon (NIWA, 2008a; photograph by R.M. McDowall).

Figure II.10 Rainbow trout (NIWA, 2008a; photography by R.M. McDowall).

II.3 Native fish

Eels (*Anguilla* spp.)

There are about 16 species of freshwater eels which are found in Europe, on the east coast of North America, and throughout the eastern Pacific and Indian Oceans. There are two distinct Anguillidae species native to New Zealand, the long-finned eel (*Anguilla dieffenbachii,* Figure II.11) and the short-finned eel (*Anguilla australis,* Figure II.12). Their names are derived from the length of the dorsal fin, which is used to distinguish the species. A third eel species, the Australian long-finned eel (*Anguilla reinhardtii*), has recently been discovered in the Waikato River, and may have colonised other river systems in New Zealand (NIWA, 2008a).

Eels breed hundreds of kilometres away from New Zealand, probably in deep ocean trenches near Tonga. The larvae reach New Zealand by drifting on ocean currents. Eels take many years to grow and it is often decades before an individual is ready to migrate back to the tropics, where the adults die after spawning (NIWA, 2008a).

Galaxiidae family

The Galaxiidae family occurs throughout the southern hemisphere and is the largest family of freshwater fishes in New Zealand. Approximately 26 species are native to New Zealand which have been divided into two genera; the galaxiids (*Galaxias* spp.) and the mudfish (*Neochanna* spp.). One common feature of all these species is that they do not have scales, although they do not produce copious amounts of slime like eels (NIWA, 2008a).

Inanga (*Galaxias maculatus*)

Inanga (Figure II.13) are one of five separate galaxiid species that make up the whitebait catch (inanga, banded kokopu, koaro, shortjaw kokopu, and giant kokopu), which is currently in decline. Inanga usually make up the majority of the whitebait catch, and thus this fish is probably encountered more often than other members of the Galaxiidae family. Inanga have a silvery belly and slightly forked tail (NIWA, 2008a).

Figure II.11 Long-finned eel (NIWA, 2008a; photography by R.M. McDowall).

Figure II.12 Short-finned eel (NIWA, 2008a; photography by R.M. McDowall).

Figure II.13 Inanga (NIWA, 2008a; photography by S.C. Moore).

APPENDIX III: PRIORITISING FISH

Several attempts have been made to identify problematic freshwater fish in New Zealand. Two of the most recent prioritisation exercises are discussed below. At a DOC workshop held in 2001, participants from a variety of freshwater management agencies and stakeholder groups ranked different species of fish based on their potential impact on indigenous fish and freshwater ecosystems (Department of Conservation, 2003; Table III.1). This comparison included native predators, like eels, and named koi carp, catfish, rudd, perch, brown trout, and gambusia as the six most problematic fish in New Zealand. In contrast, Wilding and Rowe (2008) evaluated the potential risks associated with non-indigenous fish only. Their Fish Risk Assessment Model (FRAM) judged fish species by their establishment risk, as well as their potential ecological impact. Combining these scores determined each species overall ecological risk, and the six most problematic freshwater fish identified by this method were perch, koi carp, catfish, gambusia, brown trout, and rainbow trout (Table III.2). When these methods are combined, perch, koi carp, catfish, gambusia, rudd, and brown trout appear to be the most problematic freshwater fish in New Zealand (Figure III.1).

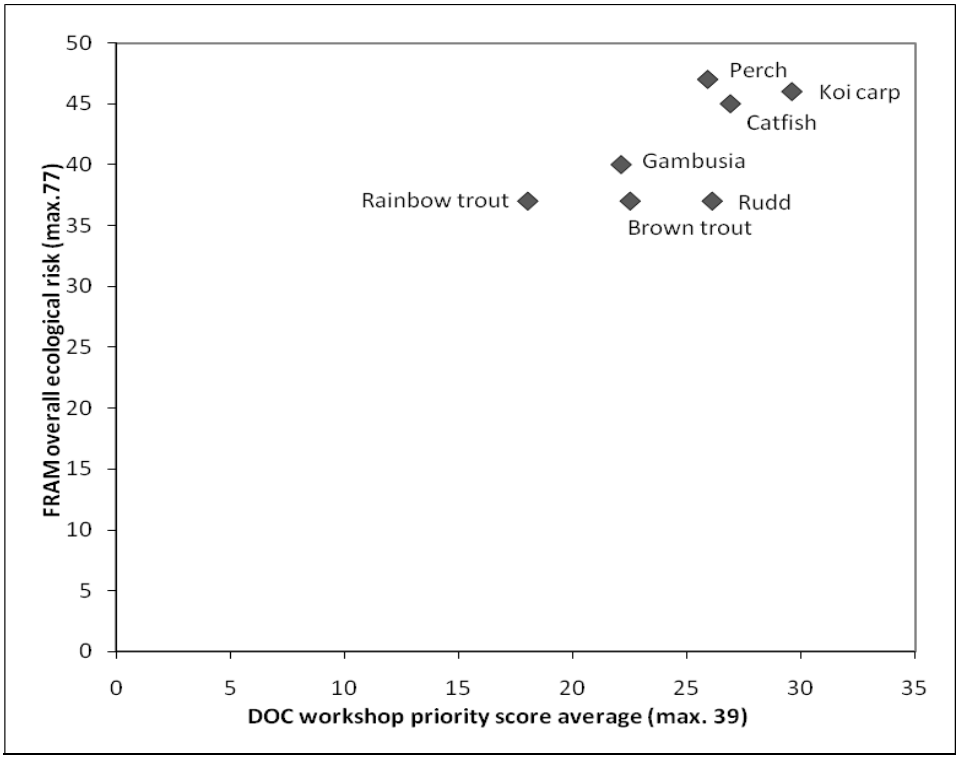

Figure III.14 New Zealand's highest priority freshwater fish.

Table III.1 Prioritisation rankings for the control of invasive freshwater fish (adapted from Department of Conservation, 2003: 171, 173).

Priority order	Priority order based on average score all groups	Score (range – max. 39)	Distribution (range status)
1	**Koi carp**	**29.6 (26-35)**	North I., widespread in north of North I. (expanding)
2	**Catfish**	**26.9 (23-29)**	North and South I., widespread in north of North I. (expanding)
3	**Rudd**	**26.1 (23-29)**	Becoming widespread North and South I. (expanding)
4	**Perch**	**25.9 (22-33)**	Widespread North and South I. (expanding)
5	**Brown trout**	**22.5 (18-27)**	Widespread North and South I. (stable)
6	**Gambusia**	**22.1 (23-31)**	North and South I., widespread in north of North I. (expanding)
7	New Zealand long-finned eel	19.0 (16-22)	(Potentially spreading into areas that were naturally free of eels)
8	New Zealand short-finned eel	19.0 (16-22)	(Potentially spreading into areas that were naturally free of eels)
9	**Rainbow trout**	**18.0 (14-24.5)**	Widespread North and South I. (stable)
10	Australian long-finned eel	17.0 (13-22)	(Potentially spreading into areas that were naturally free of eels)

NB *species and scores in bold are those ranked by both the DOC workshop participants and the FRAM criteria.*

Table III.2 Fish Risk Assessment Model (FRAM) scores for the overall ecological risk associated with invasive fish species present in the wild in New Zealand (adapted from Department of Conservation, 2003: 171; Wilding and Rowe, 2008).

Species	Overall ecological risk (max. 77)	Distribution (range status)	Comment on species groups
Perch	**47**	Widespread North and South I. (expanding)	Species that have caused environmental impacts in NZ
Koi carp	**46**	North I., widespread only in north (expanding)	
Brown bull-headed catfish	**45**	North and South I., widespread in north of North I. (expanding)	
Gambusia	**40**	North and South I., widespread in north of North I. (expanding)	
Brown trout	**39**	Widespread North and South I. (stable)	
Orfe*	38	Localised, Auckland region (unknown)	
Rainbow trout	**37**	Widespread North and South I. (stable)	
Rudd	**37**	Becoming widespread, North and South I. (expanding)	
Tench	**32**	Localised, North and South I. (expanding)	No impacts reported, but wide potential distribution
Goldfish	30	Widespread North I., localised South I. (unknown)	
Sockeye salmon	30	Localised, South I. (declining)	
Brook char	29	Widespread South I., localised North I. (stable)	
Chinook salmon	29	Eastern South I., limited numbers in western South I., rare North I. (expanding)	No impacts known as distribution restricted
Grass carp	28	Localised, non-breeding, North and South I. (expanding)	
Atlantic salmon	28	Localised, South I. (declining)	
Mackinaw	26	Localised, South I. (stable)	
Caudo	22	Localised northern North I. (stable)	No impacts known and very restricted distribution
Silver carp	20	Localised, non-breeding, North I. (expanding)	
Swordtail	15	Localised central North I. (stable)	
Sailfin molly	15	Localised central North I. (stable)	
Guppy	14	Localised central North I. (stable)	

*Orfe are not known to cause impacts in NZ but they are recorded from only one location which has not been studied.

NB *species and scores in bold are those ranked by both the DOC workshop participants and the FRAM criteria.*

APPENDIX IV: THE INTERVIEWS

IV.1 Information sheet

The research

This research project aims to contribute to the successful management and restoration of freshwater ecosystems by examining the human aspects of non-indigenous invasive freshwater fish management. This research is being conducted to fulfil the requirements of a Master of Social Science at the University of Waikato and is being conducted by Kathryn Carter under the supervision of Dr Mairi Jay and Associate Professor Brendan Hicks (contact details below).

Participant interviews

A major part of this research involves talking to key informants who are involved in some way or have an interest in freshwater restoration and/or freshwater fishing. The intention is to allow all affected parties to be heard and understood when trying to develop methods for the most effective and most inclusive management of freshwater ecosystems. Most participants will be asked to undertake a semi-structured interview that should take no more than one hour that will be recorded and transcribed by Kathryn, although some participants may be asked to be part of a focus group or complete a questionnaire that should take approximately 30 minutes.

Confidentiality

The interviews will be transcribed by Kathryn and stored on a password protected computer, and any hard copies will be stored in a locked cupboard along with the details of the participants for three years. Interview transcripts will be coded for confidentiality and no individual's response will be able to be identified by anyone but Kathryn. Once this research is completed the results will be used to write a dissertation for Kathryn's Masters thesis, due in February 2009, and a paper will also be submitted to a peer-reviewed journal following this. Your confidentiality will be assured throughout and your honesty is appreciated. Kathryn is the only researcher who will have access to any identifying

information; the two supervisors mentioned above will only see transcripts that are codified for confidentiality.

This research project has been approved by the Human Research Ethics Committee of the Faculty of Arts and Social Sciences. Any questions about the ethical conduct of this research may be sent to the Secretary of the Committee, email fass-ethics@waikato.ac.nz, or post to the Faculty of Arts and Social Sciences, Te Kura Kete Aronui, University of Waikato, Te Whare Wānanga o Waikato, Private Bag 3105, Hamilton 3240.

You have the right to:

- Refuse to answer any particular question, and to withdraw from the project within one month of acting as a research participant.
- Ask any further questions about the research and request a summary of the results and conclusions of the research at any time during the course of the research.
- Examine the information you have provided and amend any part you wish, and to ask that any or all information not be used, within one month of acting as a research participant.

Thank you for taking the time to read this information sheet and for considering participating in the research.

Kathryn Carter

Kathryn Carter
Department of Geography, Tourism and Environmental Planning
The University of Waikato, Private Bag 3105, Hamilton
Phone: 0276109257
Email: ksc6@waikato.ac.nz

Dr Mairi Jay (primary supervisor)
Department of Geography, Tourism & Environmental Planning
The University of Waikato
Private Bag 3105, Hamilton
Phone: 07 838 4466 ex 8834
Email: mairij@waikato.ac.nz

Associate Professor Brendan Hicks (secondary supervisor)
Department of Biological Sciences
The University of Waikato
Private Bag 3105, Hamilton
Phone: 07 838 4466 ext. 4661
Email: hicksbj@waikato.ac.nz

IV.2 Consent form

I consent to completing a semi-structured interview for the project examining the human aspects of non-indigenous invasive freshwater fish management, conducted by Kathryn Carter and supervised by Dr Mairi Jay and Associate Professor Brendan Hicks from the University of Waikato.

- I am aware that I have the right to refuse to answer any questions.
- I understand that the transcripts of the interviews will be collated and analysed by computer and that my specific answers will remain confidential to Kathryn Carter.
- I understand that I am able to access my information within one month of completing the interview and request that all or part of this information be deleted, and that I am free to withdraw from the project within the same timeframe.
- I understand that the report written from my data, but not the data themselves, will be submitted as required for the fulfilment of a Master's in Social Science at the University of Waikato

You have the right to request to view a copy of the transcript of your interview, which will be provided to you as soon as possible. You can also indicate this now by circling the appropriate answer below:

I would like to view the transcript of the interview Yes No

Date: _____

Signature of Participant:_____

Print Name: _____

Thank you for your time and participation in this research. If you have any queries or concerns about this research or the way it was carried out please feel free to contact myself or my supervisors.

IV.3 Coarse fishing forum post

kat Junior Member		Join Date: May 2008 Posts: 1

Masters Research

My name is Kathryn Carter and I am a Masters student at the University of Waikato. My research involves examining the human aspects of invasive freshwater fish management in the Auckland/Waikato region.

A major part of my research involves understanding the values and perceptions of coarse anglers, as I really want to be able to put forward suggestions for management that suit as many people as possible (i.e. find some sort of functional compromise between freshwater restoration scientists and fishers). Basically, I don't want you guys to be ignored in the management discussion process.

If anyone would be interested in participating in my research it would be much appreciated! You would be involved in a semi-structured interview with me, which would take about 30 minutes, and all your answers and identifying details would remain confidential to me. If you have any further questions or are interested in being involved in my research, please feel free to email me at ksc6@waikato.ac.nz.

Thank you very much for considering this,

Kathryn

IV.4 The interview questions

IV.4.1 Department of Conservation, Fish and Game Council of NZ, Regional Councils, & Ministry of Fisheries

Explain your role in relation to freshwater fisheries and/or restoration to me.

How do important do you consider your (organisation's) role to be? Why?

Which freshwater fish species are most valued/preferred by your organisation? Why?

What are the freshwater fish species that are most problematic in your area? Why?

What areas/locations does your organisation most value/prefer for freshwater restoration? Why?

What areas/locations are considered least desirable for freshwater restoration? Why?

Are there any differences between your organisation's official stance and your personal opinion to the above questions? Does this effect the way you do your job at all?

What do you think of the way the freshwater fisheries you are involved with are currently managed? Why?

What do you think of the way the freshwater areas you are involved with are currently fished? Why?

What is your understanding of the current legislation governing freshwater areas and invasive fish species? Do you agree with the current legislation? Why?

Do you think non-indigenous invasive fish should be controlled (and which species in particular)? If so, what is your most preferred control method? Why?

Do you think your organisation is well organised and dealing effectively with regards to invasive freshwater fish management? Do you have any ideas/opinions as to how this could be improved?

Can you identify any institutional barriers that impede effective management of invasive fish?

E.g. do you have sufficient resources to manage invasive fish effectively?

Do you have any ideas/opinions as to how the different stakeholder groups (e.g. EW, DOC, Fish and Game, organised angling groups, Tainui, members of the public) could better communicate/understand each other/work together with regards to these freshwater fisheries?

What do you feel are the most effective methods to educate people about the value of indigenous freshwater ecosystems and invasive fish management? What are the most important messages you would like to get across, and who do you feel the most important target audience is? Why?

I would like to get in touch with coarse anglers and interested members of the public as part of this research – do you have any suggestions as to how I could go about this?

Can you think of anyone else from your organisation that would be beneficial for me to interview as part of this research?

Thank you very much for your time ☺

IV.4.2 Coarse Anglers

Tell me about your angling.

How do important do you consider fishing to be to you? Why?

Describe your ideal freshwater fishery. Why would this be ideal?

Which freshwater fish species do you most value/prefer? Why? Rank in preferred order if possible.

Which freshwater fish species do you least value/prefer? Why?

Which freshwater fish species do you fish for?

What freshwater areas/locations do you most value/prefer for fishing? Why? Rank in preferred order if possible.

What freshwater areas/locations do you least value/prefer for fishing? Why?

Would you like to have more opportunities to fish for certain species or at certain locations? If so, please elaborate.

How far are you prepared to travel to access your fisheries?

What do you think of the way freshwater fisheries are currently managed? Do you have any ideas/opinions as to how this could be improved?

What do you think of the way freshwater fisheries are currently fished by other fishers, recreational, customary, or commercial?

What do you do with the fish after you have caught them?

What is your understanding of the current legislation governing freshwater areas and invasive species? Do you agree with the current legislation? Why?

Do you consider the freshwater fish species that you fish for to have any damaging impacts on native fish species or native freshwater areas? Do you think this is important?

> *If yes, do you think non-indigenous fish that threaten native species should be controlled (and which species in particular)? If so, what is your most preferred control method? Why?*

How well organised do you feel freshwater fishing organisations are, and how important are they to your fishing? Do you have any ideas/opinions as to how this could be improved?

Do you have any ideas/opinions as to how the different stakeholder groups (e.g. EW, DOC, Fish and Game, organised angling groups, members of the public) could better communicate/understand each other/work together with regards to these freshwater fisheries?

Would you like to learn more about freshwater fisheries and fishing?

> *If yes, how do you like receiving such information? Where do you get most of your information from?*

Do you know of any other anglers that may be interested in participating in this research?

Thank you very much for your time ☺

IV.4.3 Waikato-Tainui

Tell me about what freshwater areas/fish mean to you, and of any involvement you may have with them.

> *Do you currently fish for any freshwater fish species?*
>
> *Do you currently actively try and restore any freshwater areas?*

How do important do you consider freshwater areas/fish to be? Why?

Describe your ideal freshwater fishery. Why would this be ideal?

Which freshwater fish species do you most value/prefer? Why?

Which freshwater fish species do you least value/prefer? Why?

What freshwater areas/locations do you most value/prefer? Why?

What freshwater areas/locations do you least value/prefer? Why?

What do you think of the way freshwater fisheries are currently managed?

What do you think of the way the fisheries are currently fished?

What is your understanding of the current legislation governing freshwater areas and invasive species? Do you agree with the current legislation? Why?

Do you think some non-indigenous freshwater fish are having a negative impact on some native fish and/or freshwater areas?

> *If yes, do you think non-indigenous fish that threaten native species should be controlled (and which species in particular)? If so, what is your most preferred control method? Why?*

Do you feel your values and your beliefs are reflected in the way these areas are currently being used and/or managed?

Do you have any ideas/opinions as to how the different stakeholder groups (e.g. EW, DOC, Fish and Game, organised angling groups, members of the public) could better communicate/understand each other/work together with regards to these freshwater fisheries?

What do you feel are the most effective methods to educate people about the value of indigenous freshwater ecosystems and invasive fish management? What are the most important messages you would like to get across, and who do you feel the most important target audience is? Why?

Thank you very much for your time ☺

APPENDIX V: THE INTERNET SURVEY

V.1 Coarse fishing forum post

kat
Junior Member

Join Date: May 2008
Posts: 2

Internet survey

To all interested coarse anglers

I am asking for your help once again!

Would you like to go in the draw to win one of five $100 petrol vouchers?

My name is Kathryn Carter, and I am a Master student at the University of Waikato. As noted in my original post, a major part of my research involves understanding the values and perceptions of coarse anglers (as well as other relevant parties). I want to be able to put forward suggestions for management that suit as many people as possible and find some sort of fair and functional compromise between freshwater restoration scientists and fishers. Basically, I don't want coarse anglers to be ignored in this process.

What would I like from you?
If you are happy to have your views included as part of my research, please visit the link below and complete the survey by Monday, 29 September. Your views and opinions will remain entirely anonymous. You will be able to find out more about the survey when you click on the link below, and can choose not to complete the survey if you do not wish to.

http://www.surveymonkey.com/s.aspx?s...fWkM4gXA_3d_3d

You may also receive this message in an email, if that is the case please bear with me, and only complete the survey once. For those of you who have already generously given up your time to be interviewed by me, you may also complete the survey if you would like to.

Thank you very much for taking the time to read this post and for considering participating in and contributing to my research. If you have any questions please do not hesitate to contact me on the email address below. I really appreciate your support.

Kathryn Carter

Master Student
Department of Geography, Tourism and Environmental Planning
The University of Waikato, Private Bag 3105, Hamilton
Phone: 0276109257
Email: ksc6@waikato.ac.nz

V.2 The survey

Coarse Angler Internet Survey

Survey Information

WHAT IS THIS RESEARCH ABOUT?

My name is Kathryn Carter, and I am a Master student at the University of Waikato. I am researching the human aspects of non-indigenous freshwater fish management. A major part of my research involves understanding the values and perceptions of coarse anglers (as well as other relevant parties) to help guide the management of freshwater fisheries in New Zealand in a fair and functional way. Basically, I don't want coarse anglers to be ignored in this process.

WHAT WOULD I LIKE FROM YOU?

If you are happy to have your views included as part of my research, please complete this survey as soon as possible. Your views and opinions will remain entirely anonymous. The survey should take no more than 15 minutes to complete.

WHAT'S IN IT FOR YOU?

Everyone who completes the survey by Monday, 29 September 2008 can go in the draw to win one of five $100 petrol vouchers. As well as this, you will be able to contribute to enhancing the understanding of coarse angling in New Zealand.

WHAT ARE YOUR RIGHTS?

You have the right not to complete the questionnaire at all. If you do complete it, you can choose not to answer any question you do not wish to answer.

You have the right to contact me and ask any questions about the research at any time before 30 April 2009. My contact details are included below.

Your identity will remain completely anonymous and confidential, and your entry into the competition will not be able to be linked with your questionnaire response.

If you have any questions about the ethical conduct of this research you may contact the secretary of the Human Research Ethics Committee of the Faculty of Arts and Social Sciences, email fass-ethics@waikato.ac.nz.

You can begin the survey by clicking on the 'next' button below. If you do not wish to complete the survey, click on the 'exit survey' link at the top right of the page.

Thank you very much for considering participating in my research.

Kathryn Carter
Department of Geography, Tourism and Environmental Planning
The University of Waikato, Private Bag 3105, Hamilton
Phone: 0276109257
Email: ksc6@waikato.ac.nz

This research is supervised by:

Dr Mairi Jay (primary supervisor)
Department of Geography, Tourism and Environmental Planning
The University of Waikato, Private Bag 3105, Hamilton
Phone: 07 838 4466 ex 8834
Email : mairij@waikato.ac.nz

Associate Professor Brendan Hicks (secondary supervisor)
Department of Biological Sciences
The University of Waikato, Private Bag 3105, Hamilton
Phone: 07 838 4466 ext. 4661
Email: hicksbj@waikato.ac.nz

Coarse Angler Internet Survey

Finding out about fishing

Please answer the following questions by ticking the appropriate box, or typing an answer where the space is provided. All your answers will remain completely anonymous and confidential. Thank you very much for your time.

1. How long have you fished for coarse fish?

- ◯ 0-5 years
- ◯ 6-10 years
- ◯ 11-20 years
- ◯ More than 20 years
- ◯ Not sure/don't know

2. How important is coarse fishing to you?

- ◯ Very important
- ◯ Important
- ◯ Moderately important
- ◯ Not that important
- ◯ Very unimportant
- ◯ Not sure/don't know

Why did you select that level of importance?

3. How often do you fish for the following freshwater species in New Zealand? Please tick the appropriate box for each species of fish listed below.

	Regularly	Often	Sometimes	Occasionally	Never/Not sure
Brown trout	◯	◯	◯	◯	◯
Catfish	◯	◯	◯	◯	◯
Eels	◯	◯	◯	◯	◯
Koi carp	◯	◯	◯	◯	◯
Other carp species	◯	◯	◯	◯	◯
Perch	◯	◯	◯	◯	◯
Rainbow trout	◯	◯	◯	◯	◯
Rudd	◯	◯	◯	◯	◯
Salmon	◯	◯	◯	◯	◯
Tench	◯	◯	◯	◯	◯
Whitebait	◯	◯	◯	◯	◯

Other (please specify the type of freshwater fish and how often you fish for it)

Coarse Angler Internet Survey

4. Of the species that you fish for often or regularly, why do you fish for them? Tick all boxes that apply.

- ☐ Not sure/don't know
- ☐ They are enjoyable to fish for
- ☐ I grew up fishing for them
- ☐ They are found locally
- ☐ For competition
- ☐ To provide food
- ☐ Other (please specify)

5. Of the species that you fish for often or regularly, what do you usually do with the fish after you have caught them? You may tick up to two boxes. Remember, your responses will remain completely anonymous.

- ☐ Keep them alive and take them home
- ☐ Kill them and take them home
- ☐ Keep them alive and re-release them into the same waterway
- ☐ Kill them and leave them on the bank
- ☐ Other (please specify)

Location, location, location

1. What are you favourite areas for coarse fishing? Rank up to five of your most preferred locations from 1-5 (where 1 is the most preferred).

1.
2.
3.
4.
5.

2. For the site you ranked as number 1 above, why do you prefer it? Tick all boxes that apply.

- ☐ Scenic beauty
- ☐ Peaceful and quiet
- ☐ Popular with other anglers
- ☐ Not sure/don't know
- ☐ Well managed site
- ☐ Convenient to access
- ☐ Good sized fish
- ☐ Plentiful fish stocks
- ☐ Other (please specify)

3. Do you currently belong to a coarse angling club?

- ◯ Yes
- ◯ Not sure/don't know
- ◯ No

If yes, what is the name of that club?

Coarse Angler Internet Survey

4. Which New Zealand city or town do you currently live in?

5. Approximately how far do you usually travel by car to access coarse fisheries?

- ◯ 0-5km
- ◯ 6-10km
- ◯ 11-20km
- ◯ 21-50km
- ◯ 51-100km
- ◯ 101-150km
- ◯ More than 150km
- ◯ Not sure/don't know
- ◯ None of those options describe my answer accurately (please explain)

Fishing in New Zealand

1. Do you think there are enough opportunities for coarse fishing in New Zealand?

- ◯ Yes
- ◯ Not sure/don't know
- ◯ No

2. Do you think the freshwater fish you fish for have any negative impacts on native fish species or freshwater areas?

- ◯ Yes
- ◯ Not sure/don't know
- ◯ No

3. Do you have an opinion about the current legislation governing coarse fish in New Zealand?

- ◯ Yes
- ◯ Not sure/don't know
- ◯ No

Fishing in New Zealand

1. What do you think of the current legislation governing coarse fish in New Zealand?

2. Do you have any ideas as to how the current legislation governing coarse fish in New Zealand could be improved?

Learning about fishing

Coarse Angler Internet Survey

1. Do you like to keep learning about freshwater fisheries and fishing?

- ◯ Yes
- ◯ Not sure/don't know
- ◯ No

Learning about fishing

1. How do you like learning about freshwater fisheries and fishing? (Where do you currently get most of your information from?) Tick all boxes that apply.

- ☐ Club newsletters
- ☐ Internet searches
- ☐ Government pamphlets (e.g. from DOC)
- ☐ New Zealand magazines
- ☐ www.coarsefishing.co.nz
- ☐ Other (please specify)
- ☐ Government documents (e.g. policies)
- ☐ NZ Fish and Game Council
- ☐ Practical fishing workshops
- ☐ Overseas magazines
- ☐ Word of mouth

Personal information

I'd now like to gather some personal information about you to help with my analysis. Remember, all of your answers will remain anonymous and confidential.

1. Which age group do you fit into?

- ◯ Under 18 years
- ◯ 18-25 years
- ◯ 26-35 years
- ◯ 36-45 years
- ◯ 46-55 years
- ◯ 56-65 years
- ◯ 66+ years
- ◯ I would rather not answer this question

2. Are you male or female?

- ◯ Male
- ◯ Female

3. Were you born in New Zealand?

- ◯ Yes
- ◯ Not sure/don't know
- ◯ No

If you were not born in New Zealand, approximately how many years have you lived in New Zealand?

V.3 The competition entry form