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PERCEPTIONS OF COARSE ANGLERS AND FRESHWATER MANAGERS, AND THE IMPACT OF THESE PERCEPTIONS ON MANAGEMENT OF NON-INDIGENOUS INVASIVE FISH

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A report to stakeholders and end users

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Executive summary

This report examines coarse angler attitudes and behaviours to determine the reasons for, and develop incentives to successfully discourage, deliberate spread of coarse fish species. The perceptions of freshwater managers, and the ways in which these human perceptions influence management of non-indigenous invasive fish, are also explored. To achieve this two main methodological strategies were employed: (1) semi-structured interviews with representatives from management agencies, research providers, iwi, the New Zealand Federation of Coarse Anglers, and individual coarse anglers; and (2) an internet survey with individual coarse anglers. In contrast to many New Zealanders, coarse fish species are highly valued by coarse anglers and the practice of coarse fishing is an important part of their lives. While a large portion of coarse anglers state they would like more fishing opportunities (especially outside of the Auckland/Waikato region), they argue that they do not practice or support the illegal spread of coarse fish. Indeed, coarse anglers typically consider they are looking after the environment, and have developed a very strong ethic against killing fish unnecessarily. With regards to freshwater management agencies, anglers consider exclusively native restoration to be unrealistic and think the effects of coarse fish are exaggerated to generate public support for their control. In particular, they begrudge the Fish and Game councils for accepting their licence fees but using that revenue to focus on trout instead of coarse fish species, and they resent the way in which trout is perceived as a valued introduced species despite evidence of negative environmental impacts. Freshwater managers recognise a range factors impacting the freshwater environment, but feel 'pest' fish management is an area where they may be able to make a difference. The general consensus was that Fish and Game councils should be doing more to manage coarse anglers as a group. Mutual mistrust exists between coarse anglers and freshwater managers, but this is not inherent to the angler-manager relationship. Appropriately targeted educational materials that recognise the perceptions and knowledge already held by anglers could help increase understanding. However, genuine engagement is likely to be necessary to effect change at the level of attitudes and behaviour; all participants expressed interest in engaging in a process of communication and negotiation. Two key areas for future work have emerged from this study: investigating the risk posed by 'Asian/Eastern European' coarse anglers, and working closely with iwi and Nga Whenua Rahui to develop a culturally appropriate framework for non-indigenous invasive fish management.

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Introduction

Restoring indigenous ecosystems and biodiversity is a key focus in New Zealand conservation, including freshwater ecosystems. A project that has emerged as a result of this need, funded by the Ministry of Business, Innovation, and Employment (MBIE), is entitled 'Restoring Freshwater Ecosystems and Resurrecting Indigenous Lake Biodiversity' (MBIE contract UOWX0505). The research covered in this report sits under Milestone 11: Overcoming human behavioural barriers to successful 'pest' fish management. This report is based on research conducted for a Masters research thesis (Carter, 2009), which was interdisciplinary in nature and grounded in geography as a social science.

Most non-native freshwater fish species in New Zealand have been stocked for sports fishing, and are among the most damaging of the introduced fish species on native ecosystems (de Winton et al., 2003; McDowall, 1990). A subset of the sport fish, known as coarse fish for their larger (i.e., more coarse) scales than salmonid species, are often considered invasive; coarse fish can reach high population numbers, severely reduce native fish populations through competition for food and the predation of their young, reduce water quality by stirring up sediment as they feed, and greatly affect native plant populations (de Winton et al. 2003; McDowall, 2000; Rowe, 2004).

In New Zealand, coarse fishing usually means angling for perch (*Perca fluviatilis*), tench (*Tinca tinca*), rudd (*Scardinius erythrophthalmus*) and koi carp (*Cyprinus carpio*). Perch and tench are defined as sports fish under the Freshwater Fisheries Regulations 1983. Rudd is designated a sports fish in the Auckland/Waikato region and is classed as a 'noxious fish' (Freshwater Fisheries Regulations 1983) outside of this area. Koi carp (*Cyprinus carpio*) is an 'unwanted organism' (Biosecurity Act 1993) and also a 'noxious fish'. Other coarse fish species include brown bullhead catfish (*Ameiurus nebulosus*, commonly referred to as catfish) and wild goldfish (*Carassius auratus*), although these are not usually popular with coarse anglers.

Anglers require a license from Fish and Game New Zealand to capture coarse sports fish species (Freshwater Fisheries Regulations 1983; Conservation Act 1987); koi carp must be killed on capture (Section 67B, Freshwater Fisheries Regulations 1983), and the movement of fish between freshwater areas is highly regulated (Freshwater Fisheries Regulations 1983; Conservation Act 1987). Notwithstanding their status as sports fish, perch, rudd

(Auckland/Waikato region only) and tench are all classed as potential environmental threats, alongside brown bullhead catfish, koi carp and wild goldfish, in several regional pest management plans, such as the Waikato Regional Council Pest Management Plan 2014-2024 (Waikato Regional Council, 2014). Despite this, coarse fish have been liberated throughout New Zealand waterways, both accidentally and deliberately, and for this reason coarse fish are the major focus of this study.

In this report, the primary aim is to gain an understanding of coarse angler attitudes and behaviour to determine the reasons for, and develop incentives to successfully discourage, deliberate spread of these 'pest' fish species. A secondary aim is to gain an understanding of the perceptions of freshwater managers and the ways in which these human perceptions influence management of non-indigenous invasive fish. This report presents the results of the research and provides some localised interpretation. As coarse fish are the group of 'pest' fish species most often deliberately spread to new areas, they form the particular focus of the research.

To meet the primary aim, the following research questions were examined:

1. How are coarse fish valued and fishing opportunities perceived by coarse anglers?
2. How are freshwater management agencies and scientists perceived by coarse anglers, and how are coarse anglers perceived by management agencies (and scientists)?
3. How do the perceptions of managers influence current approaches to coarse fish management in NZ?
4. What is required to discourage the deliberate spread of coarse fish species (including educational methods and incentives)?

Methodology

Two main methodological strategies were employed: (1) semi-structured interviews with representatives from freshwater management agencies, research providers, iwi, the New Zealand Federation of Coarse Anglers (NZFOCA), and individual coarse anglers; and (2) an internet survey with individual coarse anglers. Specifically, semi-structured interviews were carried out with five coarse anglers, two key informants from the Department of Conservation (DOC), and one from each of the following: Waikato Regional Council (WRC, then Environment Waikato), Auckland Council (AC, then Auckland Regional Council), the Ministry of Primary Industries (MPI, then Ministry of Fisheries), Auckland/Waikato Fish

and Game Council, Eastern Regions Fish and Game Council, a Waikato-Tainui representative, a fisheries scientist from NIWA, and NZFOCA. The internet survey was distributed to coarse anglers through club contacts with NZFOCA and was also posted on the New Zealand coarse fishing website (http://www.coarsefishing.co.nz). The research focused on 'traditional' coarse anglers (those who typically follow the British model of coarse fishing), as they have engaged with management agencies in the past and can be accessed through their organised groups and online communities.

University of Waikato ethical approval was obtained prior to undertaking the interviews and internet survey. All respondents were given an information sheet and required to sign a consent form. Ensuring confidentiality was important because some informants might be carrying out illegal behaviours and would be wary of disclosing this information; confidentiality proved especially important as members of the online coarse fishing forum began to question the motives in carrying out this research. It needed to be clear that the intention in obtaining this information was to gain an understanding of the practices and beliefs of coarse anglers and to use this understanding to enhance 'pest' fish management in New Zealand, rather than to carry out a covert information gathering exercise.

Semi-structured interviews

Semi-structured interviews are a common research method in the social sciences. Questions and themes are prepared in order to guide the interviews, but rather than following a rigid structure they are conversational and informal in tone, involving a self-reflexive and ordered listening on the part of the researcher. This allows the topic of interest to be addressed in the informant's own words, drawing out personal insights and allowing the conversation to extend beyond the researcher's own knowledge, which can otherwise act as a limitation to the research (Longhurst, 2005). In practice, interviews with informants from management agencies and stakeholders followed a more structured, data-gathering interview process.

Informants were recruited for the interviews using a range of methods. Interviewees from management agencies were initially identified through the knowledge and contacts of University of Waikato staff or by contacting the agency directly. Informants were selected based on their level of involvement with coarse fish management or practical experience related to coarse fish. As the interviews progressed, it became more common for informants to refer the researcher to contacts in other agencies that they thought would be appropriate

for this research (known as 'snowballing'). This allowed the identification of other key agencies and individuals by utilising the knowledge and experience of the freshwater managers interviewed. The five coarse anglers interviewed were recruited via a post requesting interest on a forum on the coarse fishing website.

Interviews were typically held at participants' workplaces, although several interviews with coarse anglers took place in their places of residence. The aim was to allow the coarse anglers to feel comfortable expressing their values and describing their fishing practices to the researcher. All interviews were recorded by dictaphone (apart from one with a coarse angler who did not want their interview recorded), and transcribed as soon as possible after each interview. All participants were asked if they would like to review a copy of the transcript at the start of the interview, and those who did were emailed their transcript as soon as it was completed. None requested any changes be made. Following Tolich and Davidson (1999) methodology the techniques of positive and negative coding was utilised, identifying themes and categories that were cut and pasted into thematic files. Data analysis took place after all interviews were completed.

Internet survey

An internet survey targeted at coarse anglers was employed to complement the semi-structured interviews in order to gain a fuller understanding of the practices and beliefs of coarse anglers. A survey does not capture the same depth of information as interviews, but has the advantage of being able to record a large breadth of information from a much larger, geographically dispersed group of people, and some of the respondents may have felt more comfortable stating their perceptions and behaviours in a completely anonymous fashion.

The internet survey was designed to address aspects relevant to the overall research questions, using Unwin and Deans' (2003) and Unwin and Image's (2003) research into angler usage as a guide for wording some of the questions. The Survey Monkey website (http://www.surveymonkey.com) was used to create and distribute the online survey employed in this study. A completion incentive was offered where anglers entered into a competition to win one of five $100 petrol vouchers. Two distribution pathways were utilised to invite coarse anglers to complete the survey. A link to 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 on the coarse fishing website (http://www.coarsefishing.co.nz).

Critiques of utilising the internet often centre on their inability to obtain representative results (e.g. McLafferty, 2005). However, the internet provides an effective method to gain a wide geographical coverage with limited time and funding (Denscombe, 2008; Sue and Ritter, 2007). 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). However, anglers who are not part of an organised club or the coarse fishing forum, who do not check their emails regularly, or who are not competent using or do not have easy access to the internet, will have been excluded. In addition, some anglers with the ability to complete the survey will not have done so for a variety of reasons (non-response bias).

The internet survey provided results that increase our understanding of 'traditional' coarse anglers in New Zealand. However, another significant group, broadly defined as 'Asian/Eastern European' coarse anglers, are a very different community of people who have not been captured by this research. They are relatively difficult group to engage with as they operate in a less organised manner than traditional coarse anglers and language and cultural differences pose significant barriers to communication. Therefore, understanding the practices and risk posed by this group of fishers is an important area for future research.

Results

Background to results: angler demographics

Fifty-six people started the internet survey, and 53 people completed it. The five coarse anglers interviewed face-to-face had the opportunity to participate in the internet survey if they wished to. Twenty-one respondents reported being from the Auckland/Waikato region, 16 from the Wellington region, 13 from the South Island, and six who did not state their location. Respondents ranged from 18 to more than 66 years old, with the majority between 46 and 55 years old.

Many (72%) of the coarse anglers had been fishing for more than 20 years, and most (85%) were not born in New Zealand. Most (75%) of the New Zealand-born anglers had fished for less than five years, whereas the majority (86%) of the overseas-born anglers had been fishing for greater than 20 years. The majority (83%) of coarse anglers that completed the internet survey belonged to coarse angling clubs (Table 1).

Table 1. Coarse fishing club membership by respondents of the internet survey.

Region	Club	n
Auckland/Waikato	North Harbour Coarse Fishing Club	2
	Auckland Coarse Fishing Club	6
	Central Coarse Anglers	5
Wellington	Hutt Valley Coarse Fishing Club	16
South Island	Canterbury Float Fishing Club	13
Did not specify		2

Coarse anglers perceptions

Although commonly considered 'pests' by freshwater managers, to coarse anglers coarse 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. Many coarse anglers consider their fishing a fundamental part of their way of life and many actually consider that they are looking after the environment rather than harming it. Additionally, they hold a strong ethic against killing fish; this is a key factor influencing their relationship with freshwater managers.

Coarse anglers tend to have very different attitudes to the general New Zealand population, both towards coarse fish and coarse fishing. The anglers recognise that coarse fish are not considered valuable by most New Zealanders, but they also dispute this (de)valuation, recognising the diversity of values that exist. As the NZFOCA informant stated–"one person's vermin is another's treasure". Some anglers argue that the perception that coarse fish are a low value species is fostered by freshwater managers, stating, for example:

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

In terms of fishing, coarse anglers recognise that their ethic of returning fish to the water unharmed is unusual in New Zealand. As one informant stated, "no disrespect to Kiwi's, but the mind-set is you catch a fish you eat it, you don't catch a fish and put it back" (Coarse angler interview 17-07-08).

There are some regional differences in the way specific coarse fish species are valued by coarse anglers, reflecting the regional variation in distribution. In the Auckland/Waikato region, koi carp is generally the favoured fish; the main motivation of most anglers 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. Generally, most anglers disliked catfish, although this again reflects the non-representative nature of the survey, as many Asian communities consider catfish a delicacy.

The importance of coarse fishing to anglers' lives emerged from the internet survey, where the overwhelming majority (75%) of respondents indicated that they considered coarse angling to be 'very important'. Anglers are willing to travel large distances to engage in coarse fishing. When asked approximately how far they usually travelled by car to access coarse fisheries, 30% reported travelling less than 20 km and 40% indicated they usually travel over 50 km, including 16% who regularly travelled further than 100 km (Table 2).

Table 2. Distance usually travelled to access coarse fisheries, as indicated by internet survey respondents.

Distance	n
0-20 km	16
21-50 km	12
51-100 km	13
>100 km	9
No response	3

During the interviews, it became clear that coarse anglers considered fishing to be more a lifestyle choice than a sport or a hobby. The NZFOCA informant explained:

> 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.

Anglers tend to emphasise the family bonds that are formed through the practice of coarse angling, calling it, for example, "a father-son thing" (Coarse angler interview 14-06-08). Many consider it a productive pursuit for children and a pathway to encourage respect for the environment. This sentiment was also expressed during the NZFOCA interview:

> I hope to take my grandchildren coarse fishing, you know? It's a wonderful [sic], 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… If you can do something that doesn't hurt the environment I think it's wonderful.

This notion that they are not hurting the environment, and are even working to improve it, was reflected by many anglers in both interview and internet survey responses. For example:

> 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).

Coarse anglers appear to have developed a strong ethic against killing fish. While this probably emerged out of necessity in the United Kingdom where the popularity of coarse fishing and large population size meant that not re-releasing fish would have led to decreasing fish stocks, it appears to have evolved into an important part of the values of coarse fishing.

One New Zealand-born angler explained (referring to Section 67B, Freshwater Fisheries Regulations 1983):

> 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 (Coarse angler interview 10-06-08).

In another interview, an angler expressed his distress at seeing photos in newspaper stories about 'pest' fish removal:

> 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).

Asked in the internet survey what they usually do with the fish after they have caught them, the overwhelming majority (91%) reported that they 'keep them alive and re-release them into the same waterway' (Table 3). Only three respondents declared that they only 'kill them and take them home' (the other six respondents indicated that they also re-release fish). Worryingly, one person replied that they 'keep them alive and transport them to a waterway they aren't already in'. It is likely that this was a sarcastic response from a member of the coarse fishing forum who is known for expressing similarly provocative views to the chagrin of other forum members, but the response highlights the fact that some risk may remain.

Table 3. Treatment of coarse fish following capture by coarse anglers, as reported in the internet survey. Respondents could select multiple options.

What is usually done with fish after capture	n
Kill them and take them home	9
Kill them and leave them on the bank	0
Keep them alive and take them home	1
Keep them alive and re-release them into the same waterway	48
Other	1
No response	2

In terms of opportunities for coarse fishing, interviewed coarse anglers reported feeling "spoilt for choice" in New Zealand. However, about two thirds of survey respondents indicated they felt that there are not enough opportunities for coarse angling in New Zealand (Table 4).

Table 4. Response to the survey question: 'Are there enough opportunities for coarse angling in NZ?'

Response	n
Yes	13
No	36
Not sure/don't know	3
No response	1

Angler dissatisfaction with fishing opportunities is one of the reasons coarse fishers are considered a risk factor in the spread of fish, and there is some evidence that spread is continuing, with koi carp, perch, tench and rudd appearing in various South Island localities over the last few years. Anglers tended to argue strongly that they are not interested in, and

do not agree with, the illegal spread of fish to create new fisheries, although it is likely that anyone partaking in such activities would not have felt comfortable disclosing this in the survey.

Interview comments included:

> There were some people I think early on that did it, and they gave everyone else a bad name by, you know… I've heard of…two people that did. I mean there was one guy that just died, 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).

> 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).

Coarse angler and management agencies perceptions of each other, and the impact this has on management

There appears to be a mutual distrust between coarse anglers and management agencies. This appears to be based on historic grievances, such as the deliberate release of coarse fish documented by Winters (2012), and the reduced attention coarse fishing received after the acclimatisation societies changed to Fish and Game councils (F&G A/W interview 05-05-08). However, the focus on these past events is not helpful in terms of facilitating productive communication between the two groups and may contribute to the secretive behaviour of coarse anglers.

Although freshwater management decisions are guided by bio-physical science, human values and perceptions (of both the public and within the management agencies themselves) also influence the approach to management. This is evident in the way trout are a valued part of New Zealand's cultural landscape where coarse fish typically are not. An exception to this is the value Te Arawa place on morihana (wild goldfish) in the Rotorua Lakes area. Similarly, the Waikato-Tainui informant described the value ascribed to fish in their interview (24-06-08), noting that coarse fish species are not automatically considered problematic at all times and in all locations. The high value Waikato-Tainui place on all

native freshwater species emerged from this interview, though some species (such as tuna/eels and whitebait) are considered more "useful" than others.

In general, coarse anglers consider DOC and Regional Councils to be unrealistic in their focus on recreating native ecosystems and believe that the effects of coarse fish are exaggerated. This belief was also reflected in the internet survey, where thirty-eight anglers reported that they did not believe that coarse fish had any impacts, compared to only eight who believe they do.

One angler explained:

> 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, it is with the Fish and Game councils that coarse anglers hold the deepest grudge. Anglers resent paying license fees to an organisation that they consider typically does not value coarse sports fish and instead uses that money to focus on trout fisheries:

> 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).

Coarse anglers find the high economic value placed on trout deeply ironic, and many posts can be found on the coarse fishing forum debating theories about how coarse fish could

contribute to New Zealand's economy. Anglers often use trout as an example of the subjective nature of freshwater restoration, noting how one introduced and arguably invasive species can become highly valued while another does not, 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).

Freshwater managers identified a range of threats to the freshwater environment, including coarse fish and other non-indigenous invasive fish, although the degree to which each was a threat varied between organisations. Fish and Game were primarily concerned with the impact of pest fish on trout, and considered habitat issues and management of their users to be higher priority than fish management. To DOC and the regional councils, invasive fish management was considered a high priority as it was an area where they felt they had the potential to make a difference:

> 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).

Despite the focus on pest fish, informants recognised that there is not enough scientific evidence to support all claims for all species:

> "Coarse fish…well it's the whole chicken egg thing. Do they cause the poor water quality, or are they the only species that tolerate it?" (DOC interview 28-05-08).

MPI, in particular, did not think there was enough scientific evidence to support the claims that coarse fish had a detrimental effect on freshwater areas, and highlighted the role that subjective perceptions can play in management decisions:

> People have a perception about [catfish] being an undesirable species, whereas trout is potentially more of an undesirable species. But because trout, like rainbow and brown 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 (MPI interview 18-07-08).

Similarly, while the freshwater scientist was comfortable that there is sufficient evidence to state that certain coarse fish species tend to accelerate natural processes of lake eutrophication and increase the rate of water quality decline, they also recognised the role of perceptions in management decisions. In this case, they believed 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 that 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, which is native fish and crayfish, but also juvenile perch probably do have an effect on water quality as well… At each size they are having an impact either on the environment or on native species (Scientist interview 18-09-08).

From the perspective of freshwater managers, coarse anglers are typically considered almost as problematic as the fish themselves. Coarse anglers are seen as deliberate law breakers, in terms of their tendency to re-release live koi carp (against Section 67B, Freshwater Fisheries Regulations 1983), for their known role in introducing and spreading coarse fish in the Auckland/Waikato region, and for their possible role in introducing coarse fish to ponds in several South Island locations in recent years. One DOC informant noted in personal correspondence following the interview the conflict that inherently occurs between the agency and anglers as DOC find themselves in the position of having to respond to illegal behaviours when they come across them. Another respondent emphasised that environmental integrity should be prioritised above the recreational interests of coarse anglers:

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

The Department of Conservation, regional councils and the scientist all referred to coarse angling as an "inferior" or "fringe" sport relative to trout angling, not worth taking seriously, an opinion also reflected in a Fish and Game council interview. The main reasons coarse angling was considered an 'inferior' sport were the sedentary nature of the practice of coarse angling and the low water quality usually inhabited by coarse fish:

> 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 fishermen, 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).

Coarse fishing is restricted in the Eastern Region by Fish and Game regulations relating to fishing techniques. It is clear that coarse fish are not considered valued sports fish in this area due to their conflict with trout (F&G ER interview 07-08-08).

It was recognised in interviews with DOC, regional councils, MPI and the freshwater scientist that responsibility for coarse anglers falls under the mandate of Fish and Game councils under the Conservation Act 1987. However, informants suggested that the local Fish and Game councils are not interested in this user group and instead attempt to ignore them. Further, the MPI informant took the position that Fish and Game have a vested interested in trout with statutory powers to influence management decisions in favour of this interest, and do not believe that this promotes effective management. However, the freshwater scientist felt that coarse fishing could be managed well by Fish and Game councils if they developed some clear policies and guidelines:

> 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 (Scientist interview 18-09-08).

The perception by freshwater managers that coarse fishing is not a valuable pursuit has the effect that, in addition to the belief that coarse fisheries are not adequately managed, coarse anglers feel marginalised by management agencies. This has the impact of continuing a culture of mistrust and secrecy among coarse anglers. From this research it could be argued that as long as some coarse fish remain legal licensed sports fish, it is not productive to

marginalise the group of people that value them so such. Indeed, the language of battle was invoked in many coarse angler interviews, for example (emphasis added):

> I think, the same as the Federation, we feel like we're always being *beaten* by Fish and Game and DOC… (NZFOCA interview 21-05-08).

> Coarse fisheries are not managed… It's Fish and Game's job to manage them, and we're always *battling* with Fish and Game (NZFOCA interview 21-05-08).

> It just seems like some outlandish claims that [DOC] come up with. I mean, it's just ridiculous (Coarse angler interview 10-06-08).

> I think it is the worry that, if we talk to DOC, we *lose everything* (Coarse angler interview 17-07-08).

However, conflict between coarse anglers and freshwater managers is not inherent. Both DOC and the North Canterbury Fish and Game Council are working well with coarse anglers in Christchurch (DOC, personal communication; Winters, 2012). In this case, coarse anglers have voluntarily implemented local regulations, for example, not allowing coarse fish that are also pest fish to count towards competition points. There are many areas where coarse anglers and freshwater managers could find common ground in the Auckland/Waikato context.

Discouraging spread of coarse fish

Several possibilities for discouraging the spread of coarse fish species emerged from this research. These include: angler education; a review of the current legislation; improved communication between anglers and management agencies (and among the agencies themselves); and investigating the possibility of creating specific, designated coarse fisheries. However, this research has indicated that, particularly in the Auckland/Waikato region, the typical coarse angler does not appear to be interested in spreading fish and therefore need little discouragement. Instead, opportunity may exist to negotiate agreements considered legitimate and feasible by coarse anglers and freshwater managers alike (Brechin et al., 2002), and to utilise the interests of coarse anglers in favour of biodiversity protection.

Angler education

In the interview, the freshwater scientist asserted that "the biggest barrier is public education or lack of it". Management agencies all viewed education as an important tool for freshwater restoration, and already employ a wide range of educational methods to increase knowledge.

Managers highlighted the importance of making education meaningful for people, recognising the need to find a way for the public to decide they care about the freshwater environment. The importance of targeting information at the appropriate level to specific audiences was also recognised:

> 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 (WRC interview 07-05-08).

To help freshwater managers design their educational approach, coarse anglers were asked about their interest in learning more about the freshwater environment and coarse angling. They were also asked to specify the tools they currently use to obtain information. An impressive 96% of survey respondents indicated interest in learning about the freshwater environment in general, as well as learning more about their sport. This interest also emerged in coarse angler interviews:

> 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).

> 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).

The internet, contact with clubs and other anglers, and information from overseas are the most common sources of information used by coarse anglers (Figure 1). 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.

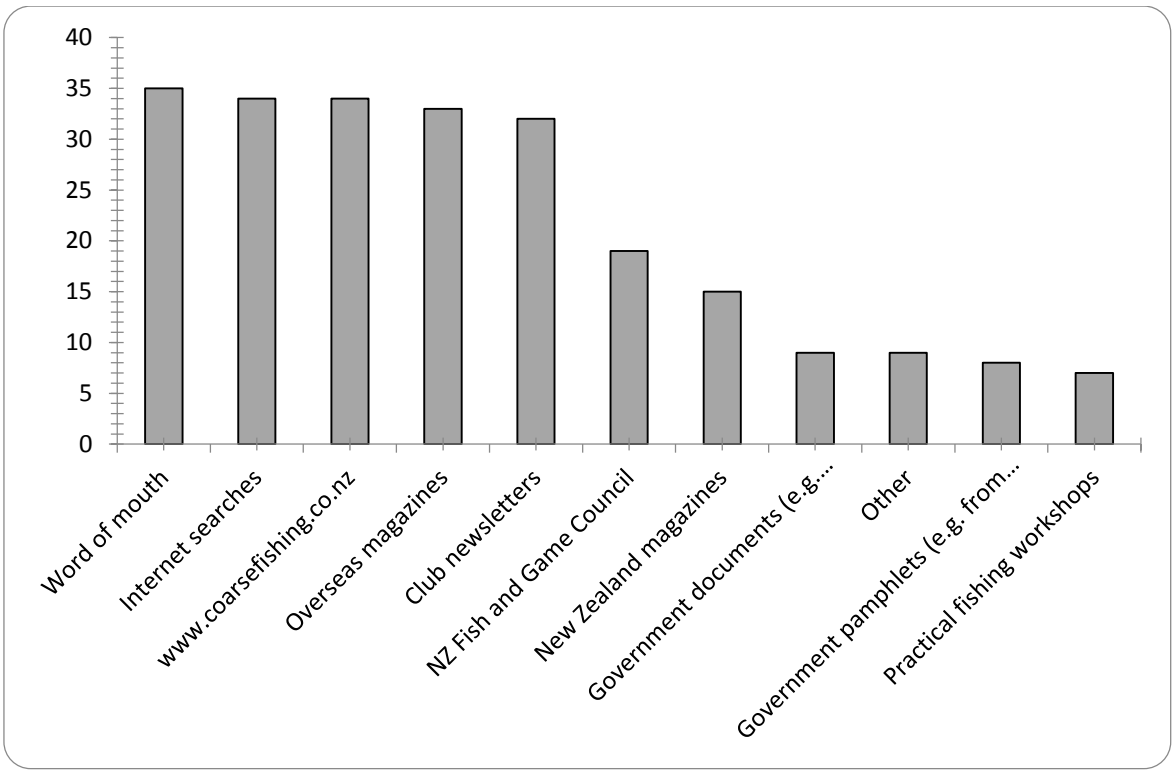

Figure 1. The common sources of information utilised by coarse anglers.

However, freshwater managers expressed frustration that, despite their best efforts, education often does not lead to behaviour change. DOC and Fish and Game both felt that anglers "know what they're doing" (DOC interview 28-05-08) and that education needs to be teamed with tougher compliance enforcement penalties in order to be effective at changing attitudes within coarse fishing culture: "It's a bit like smoking…stocking fish has got to become an act of ecological terrorism or vandalism" (Scientist interview 18-09-08). For their part, coarse anglers also stated that they are wary of receiving what they term "misinformation" or "propaganda" from government agencies:

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

Jamie Reaser (2001) outlines a framework of neurological levels to explain why simply addressing knowledge alone often doesn't lead to behaviour change. Reaser explains that, in order for behaviour change to occur, it is beliefs that need to be changed. Reaser notes that the more resources (capabilities, strategies, etc.) given to a person during the process of

changing beliefs, the quicker and more long lasting the behavioural change will be, and it is these resources that need to be provided in campaigns to change behaviour.

It is often overlooked that coarse anglers care and know more about freshwater biodiversity than most of the general New Zealand public. In addition, coarse anglers showed a sophisticated understanding of the underlying reasons freshwater management agencies promoted certain messages. The distance that exists between coarse anglers and management agencies is partly due to the anglers' distrust of "misinformation" and 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, such as that conducted by Connell et al. (1999) into the environmental education of secondary school students in Australia, which found that secondary students, like coarse anglers, were highly wary of receiving 'one sided' 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 information.

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. 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 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 (through the principle of 'concientización'; see Clover, 2002a; 2002b) 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 5). Several of the areas for engagement posed by Granek et al. (2008) were also suggested by coarse anglers in this research, in particular: monitoring (data collection), enforcement (self and peer monitoring), promoting conservation through a user fee, involvement in protected area design, and supporting conservation in terrestrial systems.

Table 5. 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.

Legislation

Most coarse anglers and freshwater managers interviewed expressed frustration with both the level of complexity and overlap between the different pieces of legislation governing non-indigenous invasive fish and, for different reasons, Section 67B, Freshwater Fisheries Regulations 1983. Examples of legislation overlap discussed in interviews included: DOC management of whitebait fishery is inconsistent with the management of other fisheries by MPI; the Fisheries Act can override the Conservation Act in some circumstances; and the conflict that arises between DOC and Fish and Game councils when a species considered a pest is classified as a sports fish. This creates confusion regarding the role of the different management agencies among the agencies themselves as well as the public.

Coarse anglers believed that the legislation surrounding 'pest' fish management is good in intent, but not in practice. Angler feeling was summarised in the NZFOCA interview:

> Well, legislation on not spreading fish [Section 26ZM, Conservation Act 1987] 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 [Section 67B, Freshwater Fisheries Regulations 1983] we completely disagree with, because of the ethics of killing fish.

Many freshwater managers also find aspects of the legislation frustrating. As a DOC interviewee explained:

> There's legislation around translocation of freshwater life, aquatic life [Section 26ZM, Conservation Act 1987], 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 purposes (DOC interview 24-04-08).

The Department of Conservation also recognise the barrier posed by Section 67B, Freshwater Fisheries Regulations 1983. As well as making it difficult to capture live koi carp for research and educational purposes, it can also hinder effective communication with, and management of 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. The only way round this is either to change the laws regarding the status of pest fish (highly unlikely), provide coarse fishers with an exemption to release unwanted organisms (again, highly unlikely), or coarse fishers must kill all unwanted organisms they catch (not likely to be popular with them) (DOC, pers. comm.).

This research would suggest the need to revise the overlapping aspects of the various regulations as soon as possible, and that the relevant policies are incorporated into a less ambiguous and contradictory format. In particular, Section 67B, Freshwater Fisheries Regulation 1983, which states that koi carp must be killed on capture could be considered for review. While it may be necessary to have a means to control the movement of koi carp, the rule itself hinders conservation and research efforts as well as offending coarse anglers' fishing ethic. Furthermore, it may be appropriate to examine the underlying philosophies of the principal pieces of legislation to help develop a more comprehensive management strategy. The Fisheries Act 1996 is guided by the principle of sustainable use, while the Conservation Act 1987 reflects an attitude of preservation, and the Biosecurity Act 1993 is based on pest management. It appears that these different driving philosophies contribute in some part to the confusion and complexity evident in the legislation.

Communication

There appears to be genuine interest from both coarse anglers and freshwater management agencies in engaging in productive communication and working to negotiate mutually legitimate agreements. There is certainly a large amount of common ground between management agencies and coarse anglers, including a similar appreciation of the value of the freshwater environment. Coarse anglers expressed their interest in both interviews and the internet survey, stating, for example:

> 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... (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).

> 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).

Most freshwater managers indicated a willingness to engage in communication with coarse anglers, and in some cases to even consider setting up specific coarse fishing areas. Managers recognise that preventing the further spread of coarse fish is a high priority, as already established populations will be very difficult to eradicate, and were willing to try communicating with coarse anglers via a network or forum to help get this message across. The ideal behind this was summarised in a DOC interview:

> 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, those being the fishermen that return their fish, they 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, yeah… 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).

Fish and Game was the organisation least willing to consider some form of compromise with coarse anglers, which is interesting given their mandate to advocate for sports fishing. 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. This occurred when the New Zealand Fish and Game councils were established in place of acclimatisation societies under the Conservation Act 1987:

> At that stage it was considered that we were after their 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. 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).

It has now been more than quarter of a century since this occurred, and it may be time to reconsider this position.

Most managers considered a forum or network would be valuable in improving inter-agency communication and collaboration, as well as relationships with coarse anglers. It was noted that if a network was to be set up it would need to be as inclusive as possible including, for example, aquarists. Suggestions included modelling a network on the Aquatic Pest Coordination Group (APCG, then the Aquatic Pest Technical Advisory Group) of the eastern regions of the North Island with monthly meetings, or setting up a common database accessible to all organisations to facilitate that fast and efficient transfer of information.

Designated coarse fisheries

One possible solution, suggested by some freshwater managers and the scientist as well as coarse anglers, involves establishing a designated, well-managed coarse fishery. This could (i) be done in existing freshwater areas of low conservation value, such as quarry pits and other constructed habitats or degraded lakes already containing coarse fish (existing highly valued coarse fishing sites were identified in the internet survey, e.g. Lake Ngaroto, Otaki Lakes, Whitby Lakes, Rotokohatu Lakes; see Carter, 2009), or (ii) alternatively be a specifically created fishery. Anglers noted the contribution that attributes of an area provide to the way the sites are valued in the internet survey (Figure 2). These characteristics may be just as important as specific valued sites and are important factors to consider if a new fishery was specifically created. Plentiful fish stocks, good sized fish, peace and quiet, and convenient access are all significant factors:

> 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).

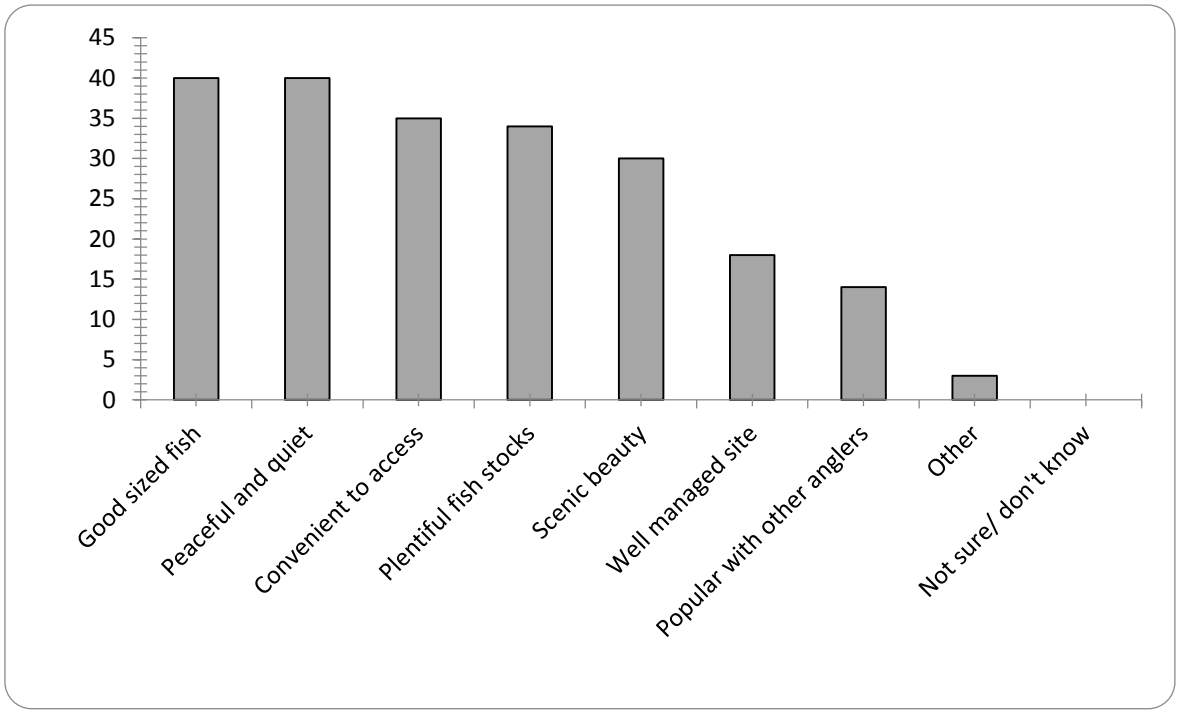

Figure 2. The aspects of fishing sites most valued by coarse anglers (y-axis indicates number of respondents).

Coarse anglers view the construction of a designated fishery very favourably, as it would go some way towards legitimising their sport and relieving their concerns that their favourite coarse fisheries might be subject to fish eradication techniques at any moment. Several anglers reported in interviews that they had already invested considerable time and energy investigating the practicalities of designing a completely contained fishery and the potential economic value that could be gained by such a venture (e.g. Coarse angler interview 17-07-08). However, it is likely that anglers would expect to be able to return koi carp live to a designated fishery. That freshwater managers and the scientist also see value in keeping coarse anglers satisfied by confining the sport to specific areas reflects the increasing realisation that, once established, fish are very difficult to eradicate. It also recognises that providing for coarse angling is likely to reduce the risk of illegal spread that its previous marginalisation may have contributed to, and increases the legitimacy (from the coarse anglers perspective) of fish control operations in areas outside of these designated fisheries. As one informant conceded:

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

Conclusions

Coarse anglers and freshwater managers hold very different perceptions of coarse fish. However, there appears to be scope to reconcile these diverse perspectives to negotiate agreements considered legitimate by all participants. Pathways to achieve this include undertaking legislation review, including genuine communication and engagement alongside education campaigns, and investigating the feasibility of establishing a designated coarse fishery. All participants agreed that the management of non-indigenous invasive fish in New Zealand would benefit from legislation review. In particular, gains could be made by addressing the confusion caused by complex and overlapping legislation, establishing clear guidelines regarding the role of the different agencies involved in freshwater management, and considering revising Section 67B, Freshwater Fisheries Regulations 1983.

Anglers are eager to learn about the aspects of fish and the freshwater environment of interest to them and there is scope for freshwater managers to address coarse angler knowledge with educational material targeted appropriately using existing popular information pathways.

However, it is recognised that it is attitude and behaviour change that is required more than increasing coarse angler knowledge. This is more likely to be achieved by recognising the skills and knowledge already held by anglers and using these as a foundation to negotiate a workable relationship. All participants indicated interest in engaging in communication and it is possible that, as well as reducing the risk of deliberate spread of fish, coarse anglers could provide valuable assistance to generally under-resourced conservation programmes. A further possibility involves the creation of designated coarse fisheries. This would be a complex endeavour. However, legitimising coarse angling in defined areas has the potential to improve relationships between anglers and managers, encourage peer monitoring among the coarse angling fraternity, and support freshwater management programmes by making the control of fish for conservation purposes in areas outside of these fisheries a less conflict-laden process. It is possible that the effectiveness of a coarse fishery could be investigated through a case study trial.

Two key areas for future work have emerged from this study: investigating the risk posed by 'Asian/Eastern European' coarse anglers, and working closely with iwi and Nga Whenua Rahui to develop a culturally appropriate framework for non-indigenous invasive fish management. As noted earlier, 'Asian/Eastern European' coarse anglers operate very differently to 'traditional' coarse anglers. Language and cultural differences pose barriers to engagement and their behaviours and perspectives have not been captured by this research. It is difficult to ascertain the degree to which this group of fishers understand the legislation relating to non-indigenous invasive fish in New Zealand, and understanding the practices and risks posed by this group is an important area for future research.

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