Commerce Division

Discussion Paper No. 99

MARINE RECREATIONAL FISHING: PERCEPTIONS AND CONTINGENT BEHAVIOUR

Geoffrey N. Kerr
Ken F.D. Hughey
and
Ross Cullen

September 2003

Commerce Division
PO Box 84
Lincoln University
CANTERBURY

Telephone No: (64) (3) 325 3627
Fax No: (64) (3) 325 3847
E-mail: kerr@lincoln.ac.nz

ISSN 1174-5045
ISBN 1-877176-76-1

Abstract

The 2002 biennial survey of citizen perceptions of the environment and its management (Hughey *et al*., 2002) assessed perceptions about the marine environment, participation in marine recreational fishing, and responses to introduction of a recreational marine fishing licence. Information on perceptions of the marine environment and its management was obtained in a form consistent with the pressure-state-response model used widely for state of the environment reporting.

Citizens perceive that fishery quality is adequate, but may be getting worse. Fish numbers are moderate to low and harvest is getting more difficult. Fishers believe that the quality of marine fisheries management is adequate to poor. Although fishery quality is judged to be declining, people do not rank the need to spend additional money on marine fishery management differently to other potential recipients of environmental and conservation expenditures.

About 34% of survey respondents participate in recreational marine fishing. Survey responses suggest high levels of poaching if a marine recreational fishing licence were introduced, with about a third of current fishers stating intentions to fish without a licence. Licence purchases decline as the licence fee increases, which has implications for licence revenues and fishery quality.

Contact Author: Geoffrey Kerr, Senior Lecturer in Environmental Economics, Environmental Management Group, Lincoln University, PO Box 84, Canterbury, New Zealand. Tel: +64 (3) 325 3627 extn. 8688. Email: kerr@lincoln.ac.nz

Contents

List of Tables

List of Figures

1. Introduction

Proposals to change the management of New Zealand recreational marine fisheries have generated heated exchanges between fisheries managers, commercial fishers, recreational fishers, conservationists and Maori. Problems have arisen because the Quota Management System (QMS) implemented in 1986 did not clearly identify how total allowable catch would be shared between commercial, cultural and recreational harvesters, or how the recreational harvest was to be allocated (McMurran, 2000). Many recreational fishers have been upset by proposals to introduce marine recreational fishing licences and to limit recreational harvests[1].

There is much at stake in the marine recreational fishery. A study of recreational anglers who target five major species (SACES, 1999; Wheeler & Damania, 2001) revealed that annual expenditures on those five species exceeded $970 million. This expenditure resulted in net benefits from fishing in the order of $220 million per year. Recreational harvests can be large relative to commercial harvests. For example, recreational blue cod harvests in management area 7 have been estimated to be "more than ten times the reported commercial harvest" (Boyd & Reilly, 2002: 6).

Recreational fishing participation and harvests are not well understood, with widely varying estimates of each. Kearney (2002) provides an overview of studies that have attempted to measure participation in marine recreational fishing. Estimates from the 1996 and 2000 national marine recreational fishing surveys range from 13.9% to 51.4% of households active (Kearney, 2002).

In the 2002 biennial survey of citizen perceptions of the environment and its management, Hughey *et al*. (2002) assessed perceptions about the marine environment, participation in marine recreational fishing, and responses to introduction of a recreational marine fishing licence. The data collected by Hughey *et al*. (2002) provide some pragmatic insights into the outcomes of implementation of a marine recreational fishing licence.

[1] A group representing some recreational anglers' interests has named itself Option4 (www.option4.co.nz). The 4 principles endorsed by Option4 are:

1. A priority right over commercial fishers for free access to a reasonable daily bag-limit to be written into legislation.
2. The ability to exclude commercial methods that deplete recreationally important areas.
3. The ability to devise plans to ensure future generations enjoy the same or better quality of rights while preventing fish conserved for recreational use being given to the commercial sector.
4. No licensing of recreational fishers.

This paper introduces the methods employed by Hughey *et al*. (2002), presents and analyses responses to survey questions, and discusses implications for the introduction of a marine recreational fishing licence.

2. Methods

In March 2002 a self-completed survey was mailed to 2000 randomly selected people registered on the New Zealand electoral roll. After accounting for known non-delivered surveys, a 45% response rate (n=836) was obtained. Females and people over the age of 40 were over-represented in responses to the survey.

The bulk of the survey was based on the Pressure-State-Response (PSR) framework (Ministry for the Environment, 1997), which is used for state of the environment reporting. In order to measure citizen perceptions consistent with the PSR framework, the survey asked questions about causes of environmental problems, the state of the environment, current management of the environment, and how the environment and its management have changed. These questions addressed marine fisheries, as well as several other aspects of the environment.

Budget Allocation

Citizen preferences for reallocation of government spending were measured by inviting respondents to reallocate government spending on items associated with *Conservation and the Environment*. The 11 items amongst which the budget could be reallocated included three directly related to the marine environment; *Beaches and Coastal waters, Marine Fisheries,* and *Marine Reserves*. The question wording was:

> Now we would like to know how you would **reallocate the Government's expenditure on Conservation and the Environment**. Total spending on Conservation and the Environment would not change. Please tick one box for each spending category to show how you would change the allocation of government spending if **total spending is the same as now.**

Response categories were:

- We should spend far more.
- We should spend more.
- No change from now.
- We should spend less.
- We should spend far less.
- Don't know.

The categories of spending across which expenditure could be reallocated were:

- Pest and weed control
- Endangered species
- Air quality
- Native forests and bush
- Soils
- Beaches and coastal waters
- Marine fisheries
- Marine reserves
- Fresh waters
- National parks
- Wetlands

Marine Environment

The 2002 Environmental Perceptions Survey included a special section targeting the marine environment. Amongst other items addressed in the special section, data were collected on participation in marine recreational fishing, perceptions of fish availability and change in fish availability, and willingness to purchase a marine recreational fishing licence.

Behaviours

A contingent behaviour approach was used to identify responses to licence implementation. The procedure closely followed the dichotomous choice format for contingent valuation (Arrow *et al.*, 1993), but allowed 4 categories of response rather than the normal two. Each survey participant was given an identical description of the licence proposal, except that the licence fee differed amongst participants.

In order to gauge fisher responses to introduction of a marine recreational fishing licence it was necessary to establish a set of parameters defining the outcomes of licence implementation. Key parameters of interest to fishers are the price of the licence and the uses to which licence revenues are put. Fishers are likely to be more receptive to a licence that channels licence revenues into fishery management rather than into non-specific government revenue generation, particularly if they believe that fishery management will result in increases in fish abundance. Price is also expected to affect licence purchase behaviour, with licence sales declining at higher prices. In order to identify the impact of pricing, the

contingent behaviour question about intended fishing licence purchase behaviour randomly varied the annual price across nine different values in the set {$10, $15, $20, $25, $30, $40, $50, $70, $100}. Each survey participant faced only one of these prices.

The scenario for revenue dispersal was the same for each survey participant. It did not define outcomes in terms of changes in fish abundance or fishing regulations, but entailed a scenario in which fishers could use licence revenues to fund self-management of the recreational fishery. This scenario is a marine analogue to freshwater fisheries management by Fish and Game councils. The scenario presented to respondents was:

> Imagine the government has just changed and the new administration has introduced a marine recreational fishing licence. Funds collected from licence sales are used to enable fishers to manage their own resources. Marine fishing licence holders elect a board that decides how to use licence fees to manage and improve marine recreational fisheries. Suppose the marine fishing licence cost $X per adult per year, **would you buy one?** Remember, it would be illegal to fish in the sea without a licence.

Four response categories were provided. They are:

No, I wouldn't fish in the sea, so I wouldn't need a licence.
No, I wouldn't buy a licence, but I would still fish in the sea.
Yes, I would buy a licence.
Don't know.

In contingent valuation and contingent behaviour procedures of this type it is normal practice to obtain information to test the veracity of the response to the hypothetical scenario (Arrow *et al*., 1993). Typically, verification takes the form of open-ended questioning of the reasons underlying the offered response in order to identify adverse responses to the payment vehicle, failure to accept the hypothetical scenario, and strategic responses. Verification was not attempted in this case due to space restrictions in what was already a very large survey. However, the response category *No, I wouldn't buy a licence, but I would still fish in the sea* is a protest response of the type that would normally be excluded from contingent valuation analysis. Interpretation of this response is addressed in the results section.

3. Results

3.1 State of the Environment

Marine fisheries were considered to be in the worst condition of all the environment sectors that were addressed in the perceptions survey. People appeared to be less well informed about marine fisheries than other environment sectors, with questions about marine fisheries receiving the highest frequency of *don't know* responses.

Perceptions of the quality of marine fisheries were generally *adequate* to *good* (Figure 1). Don't know responses were much more common from non-fishers. For people who made an evaluation, fishers rated fishery quality less positively than did non-fishers. There were highly significant differences between ethnic groups ($p<0.0001$). Whereas New Zealand Europeans judged the state of the resource more favourably than Maori, their views were not as favourable as people of other ethnic origin. About 65% of 'others' thought the condition of marine fisheries was good or very good.

Fishery quality and fish abundance are related, but differ because of factors other than abundance that affect fishery quality, including items such as fish size, fish condition, catchability, environmental conditions, species mix, and so forth. Only about 6% of survey respondents thought fish abundance was better than moderate (Figure 2), although about one third of respondents gave a *don't know* response (46% for non-fishers). Nearly 60% of fishers rated abundance as moderate or better, while only 29% of non-fishers were of the same opinion.

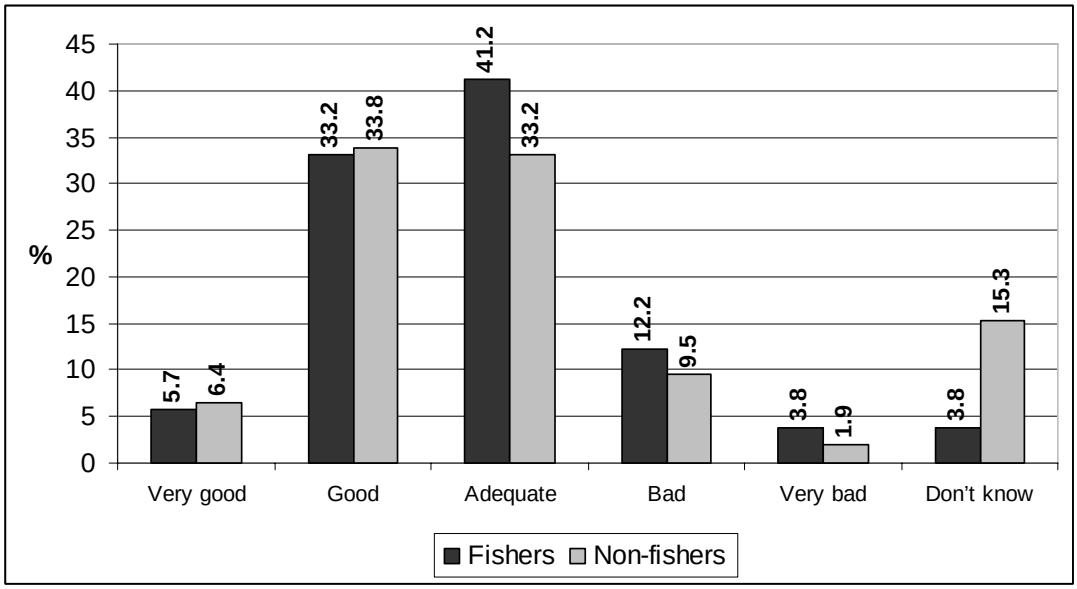


Figure 1
Perceived Quality of Marine Fisheries

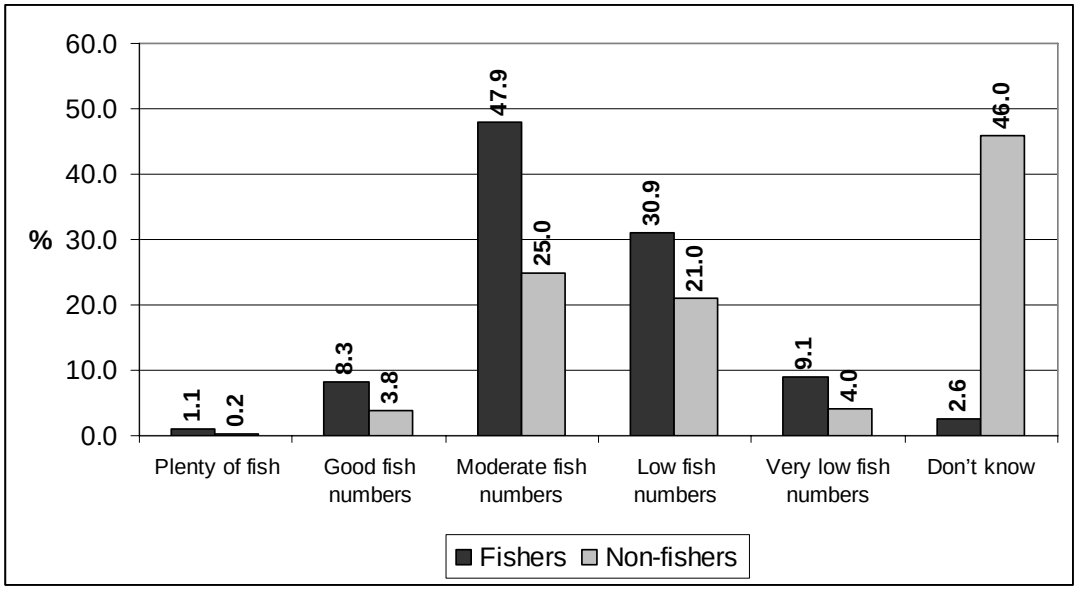


Figure 2
Perceived Fish Abundance

Perceived changes in the state of New Zealand's marine fisheries over the last five years are shown in Figures 3 and 4. Most respondents considered the state of marine fisheries had either not changed or had got worse over the last five years and that it is more difficult to catch fish now than it was five years ago. There were large numbers of *don't know* responses from non-fishers in both cases.

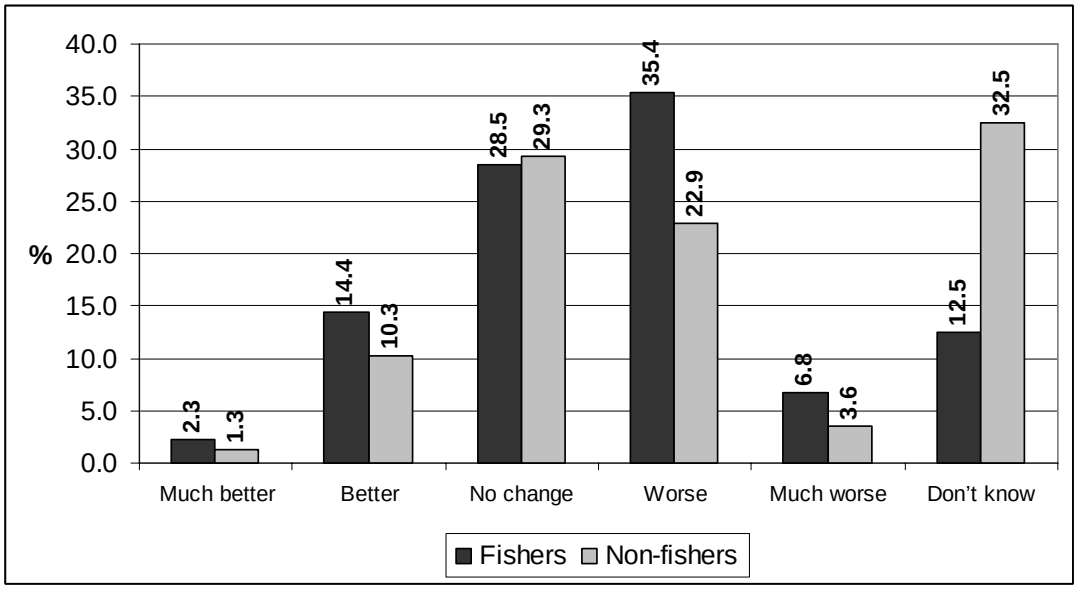


Figure 3
Perceived Change in Quality of the Fishery Over the Last Five Years

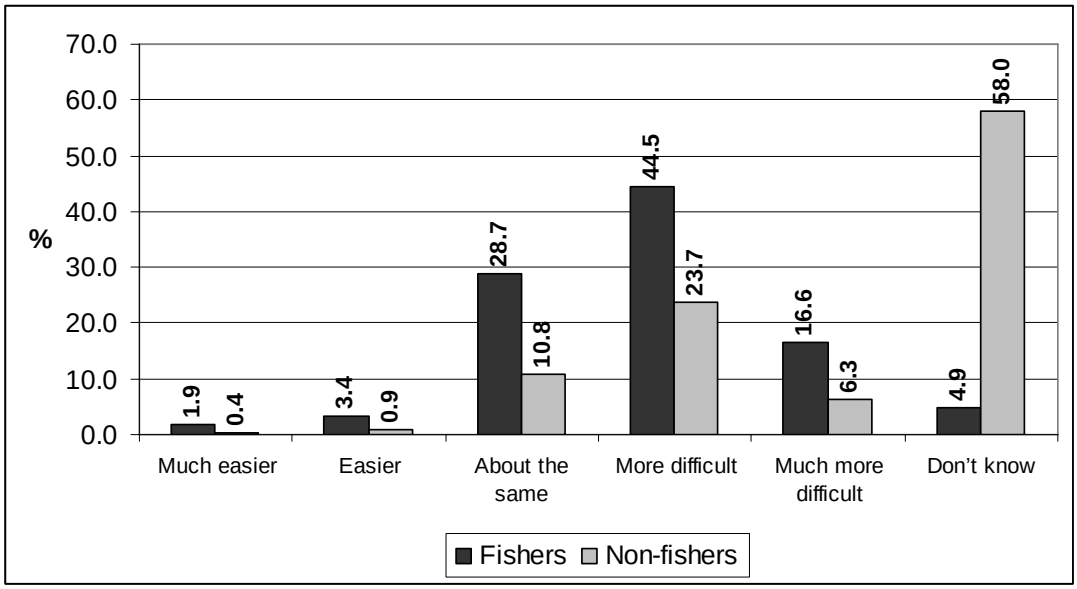


Figure 4
Perceived Change in Ease of Fish Harvest Over the Last Five Years

Perceptions of quality of management of marine fisheries are shown in Figure 5, which indicates that marine fisheries management was considered to be poor to adequate. Fishers were more likely than non-fishers to rate management as poor. Analysis of perceived management quality by ethnicity showed that while 36% of 'others' thought fisheries were well managed, only 29% of Maori and 18% of New Zealand Europeans thought so ($p<0.002$).

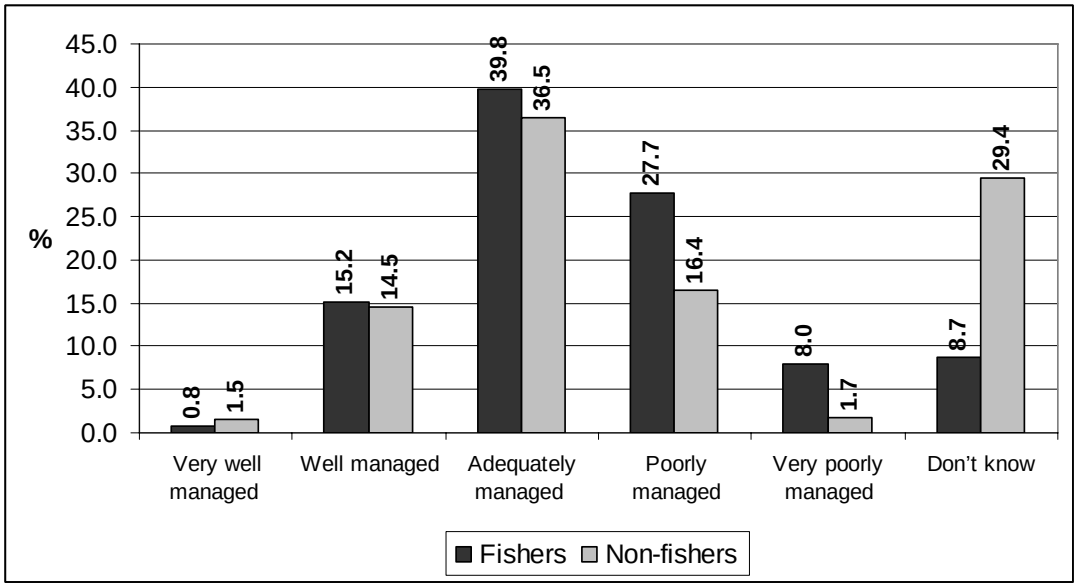
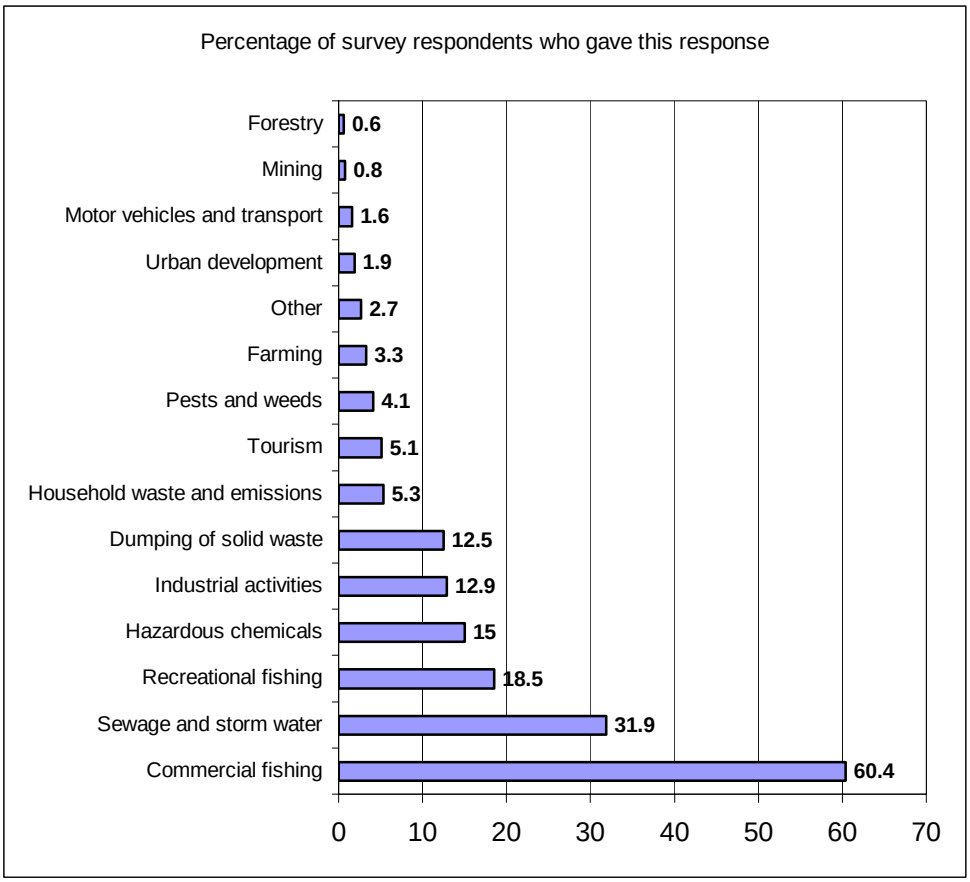


Figure 5
Perceived Quality of Marine Fisheries Management

Respondents' judgements of the main causes of damage to marine fisheries are reported in Figure 6. Sixty percent of respondents viewed commercial fishing as a major contributor of damage to marine fisheries. One third of respondents attributed fisheries damage to sewage and storm water. While recreational fishing was seen to be an important cause of damage, it was significantly less important than either of these other items.



Note: Percentages add to more than 100 because respondents could nominate up to 3 causes.

Figure 6
Perceived Main Causes of Damage to Marine Fisheries

3.2 Allocation of Government Spending

Preferences for changes in expenditure on eleven conservation and environmental items were tested (Figure 7). Most people wanted spending on marine fisheries to remain the same, although a sizeable minority wanted additional spending on marine fisheries. There are highly significant differences in ethnic perspectives on expenditure on marine fisheries ($p<0.0001$), with most Maori wanting more spent while most New Zealand Europeans and 'others' did not support additional spending on marine fisheries.

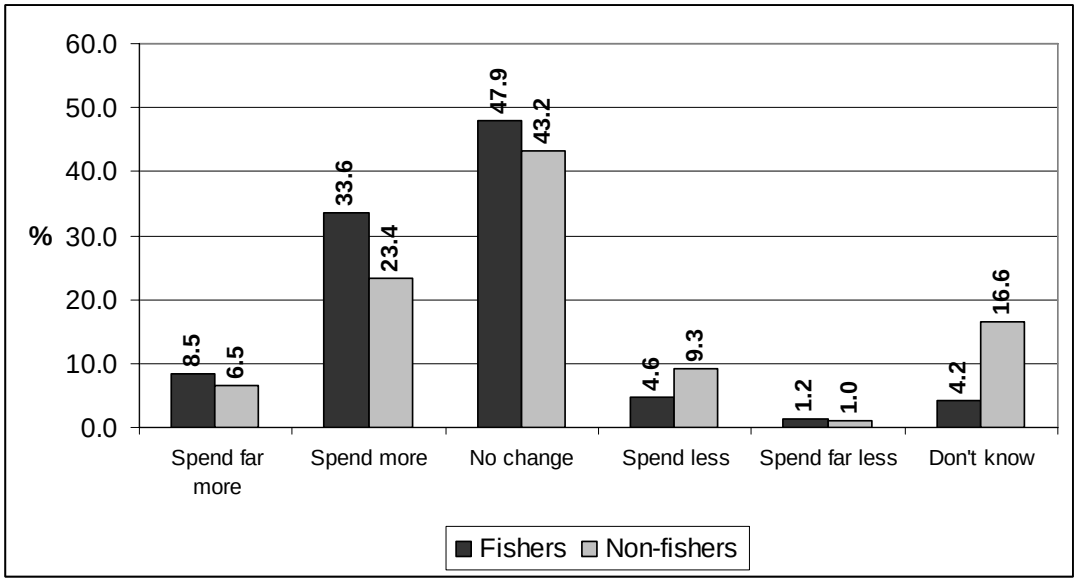


Figure 7
Preferences for Government Spending on Marine Fisheries

The relative importance of allocating government expenditure to marine fisheries is illustrated by comparing mean Likert scale scores for each of the eleven environmental items addressed in the survey. The Likert scale was identical for each item. Scores were: Spend far more (1), Spend more (2), No change (3), Spend less (4) and Spend far less (5). Mean scores are reported in Table 1. Lower mean scores indicate the strongest preferences for additional spending. The community appears to want slightly more government spending on all these environmental items. However, there is very little difference in desire to spend on different items, or in standard deviations.

Table 1
Preferred Government Spending on Environmental Items

Item	Mean Likert score	Standard Deviation
Fresh waters	2.30	0.73
Pest and weed control	2.31	0.78
Air quality	2.35	0.81
Endangered species	2.42	0.84
Beaches & coastal waters	2.42	0.78
Marine reserves	2.61	0.80
Native forests and bush	2.63	0.73
Marine fisheries	2.64	0.80
Soils	2.68	0.76
Wetlands	2.71	0.84
National parks	2.72	0.77

3.3 Participation

Recreational marine fishing is a popular activity, with 33.7% of respondents participating. The female participation rate of 24.5% is markedly lower than males at 44.2% [Z=5.82]. New Zealand Europeans are slightly more active (34.7%) than people of other ethnic origins (28.4%), however this difference is not significant at the 95% confidence level [Z=1.43]. There are significant differences in participation by age (Figure 8). The under thirties and over seventies have participation rates of about 20%, while about 35%-40% of other age groups participate in marine recreational fishing.

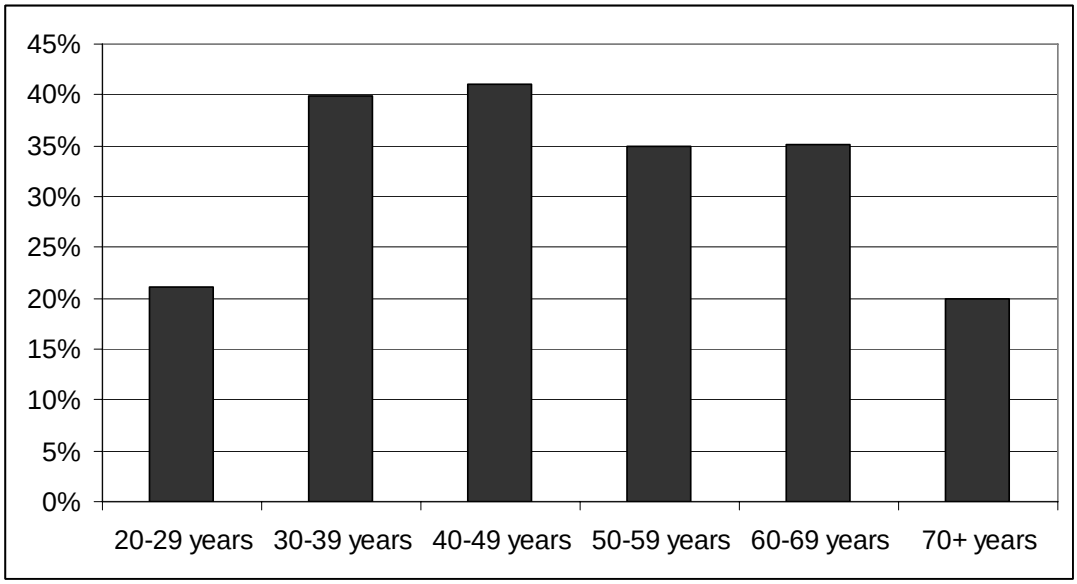


Figure 8
Participation Rates by Age

Participation rate estimates from the 1996 and 2000 national marine recreational fishing surveys range from 13.9% to 51.4% of households (Kearney, 2002). The 1996 survey utilised a telephone survey, but two methods were employed in the 2000 survey. A telephone survey produced the 51.4% household participation rate (39% individual participation rate), while a personal interview survey produced a household participation rate of 38.7% (31% individual participation rate). The 1996 survey found 1.97 marine recreational fishers per active household, while this increased to 2.07 fishers per active household in 2000 (Kearney, 2002).

Our individual participation rate of 33.7% (for people 20 years or older) is dramatically different to the suspect 1996 national survey individual participation rate of 9.7% (Boyd & Reilly, 2002; Kearney, 2002). However, our findings do not assist in resolving the matter of whether the 2000 telephone or personal interview estimates are superior. Our postal survey-derived participation rate falls approximately in the centre of the range between the two, but it is also drawn from a different population, so is not directly comparable.

Based on responses to our survey, there are approximately 920,000 active adult recreational marine fishers in New Zealand. The 2000 national marine recreational fishing survey indicates that there are probably about 1.2 million active marine fishers in total.

3.4 Marine Recreational Fishing Licence

There is very little support for the concept of a recreational fishing licence. Seventy one percent of respondents answered "No" to the question "Do you think that recreational fishers should have to obtain a licence to fish in the sea?" Not surprisingly, recreational fishers are more strongly against licences (85.1% of fishers against) than are non-fishers (63.9%).

The contingent behaviour data can be used for two main purposes: prediction of outcomes of implementation of a marine recreational fishing licence (including compliance and revenue generation), and valuation. In the case of valuation, price-induced changes in behaviour amongst fishers who are willing to purchase a licence can be used to measure the benefits that fishers obtain from recreational marine fishing under the licence scenario.

3.5 Outcomes in the Presence of a Marine Recreational Fishing Licence

Only data from active marine fishers (n=269) were retained for analysis. For the 241 respondents who provided a clear indication of whether they would participate in the fishery[2], three different models were fitted to predict behaviours as functions of licence price (Table 2). One model was fitted to predict licence purchase behaviour (Purchase), a second model was fitted to predict poaching behaviour (Poacher), and the third model was fitted to predict participation rates, whether legal or illegal (Participation). Logit models were fitted in each case.

Table 2
Fitted Models (t-scores in parentheses)

	Purchase	**Poacher**	**Participation**
Dependent variable	Purchase a fishing license	Fish without a license	Fish, with or without a license
Constant	2.8444 (6.29)	-0.7676 (-3.33)	3.1705 (7.31)
COST	-0.02529 (-3.20)	0.00648 (1.35)	-0.01957 (-2.73)
N	151	241	241
LL_R	-62.691	-159.244	-73.626
LL_{UR}	-57.612	-158.338	-70.083
McFadden's R^2	0.081	0.006	0.048

[2] There were 18 "don't know" responses (i.e. less than 7% of current fishers).

In the Purchase and Participation models the sign on COST is negative and highly significant, as expected. This is not the case with the Poacher model. While the sign on COST is expectedly positive[3], it is not significant, indicating that the quantity of poaching is not systematically related to the licence fee.

Goodness-of-fit is measured using McFadden's R^2. Care must be taken in interpreting this measure because, while it falls in the [0,1] range, it cannot be interpreted as the percent of variance explained, as in normal linear regression. McFadden's R^2 greater than 0.2 indicates a good fit, while a score of 0.4 or better indicates an excellent fit to the data. The Poacher model is an extremely poor fit, and the Participation model is poor, but the Purchase model provides a reasonable fit to the data. The large t-scores on COST in the Purchase and Participation models indicate that COST is an important explanatory factor in the modeled behaviours, but the low McFadden R^2 scores indicate that there are other important drivers of behaviour that are not explained by these simple models.

If a free licence were required, then participation and licence acquisition rates predicted by these models are 96.0% and 66.5% respectively. However, it should be noted that rates of 100% are not possible with the logit model, so 96% participation could be an underestimate. Participation and licence purchase behaviour models are illustrated in Figure 9. The amount of poaching is equal to the difference between the two lines showing participation and licence purchase. Poaching is approximately constant at around 35% of existing fishers[4]. Once the licence fee is in the order of $70 numbers of poachers and licence holders are approximately equal and at $150 poachers are approximately twice as numerous as licence holders.

[3] As the price of a licence increases there is more incentive to poach rather than buy a licence.
[4] Figure 9 appears to show a slight increase in poaching frequency as the licence fee increases to around $50. While the "Poacher" model (Table 2) predicts a small increase in poaching as the licence fee increases, it is not statistically significant.

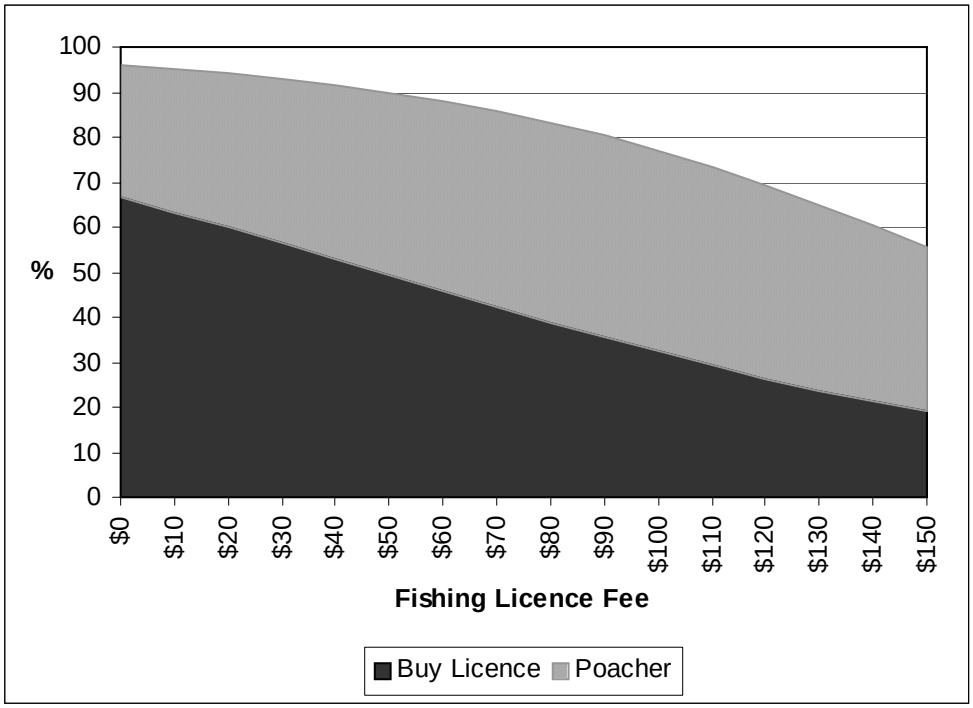


Figure 9
Behaviours Contingent Upon Licence Fee

Valuation

Annual recreational fishing expenditures on the five most commonly caught species exceed $970 million and results in net benefits from fishing in the order of $220 million per year (SACES, 1999; Wheeler & Damania, 2001). Participation is in the order of one million people. Expenditure in the order of $1000 per fisher per year is a substantial portion of many households' disposable income, reflecting the importance that is placed on fishing. However, expenditures do not measure benefits obtained by fishers.

Valuation analysis proceeded by deleting from the sample all respondents who were not marine fishers. The data set was further reduced by removal of cases with non-valid responses, i.e. respondents who answered "*No, I wouldn't buy a license, but I would still fish in the sea*", or who gave a "*Don't know*" response were removed from the sample. This reduced the sample size to 151 cases, which is marginal for dichotomous choice analysis.

Survival functions were fitted to the data using maximum likelihood regression (Table 3, Model A is the Purchase model in Table 2). Link functions utilised were logistic, log-logistic and Weibull. The log-logistic and Weibull functions fitted poorly, so the following analysis addresses only the logistic model. A wide range of independent variables, as well as the cost

of a marine fishing licence, were entered into the models, but all except OVER60 (indicating the respondent was 60 years of age or older) were non-significant. This may be an artifact of the relatively small dataset. The coefficient on COST was always highly significant and negative, indicating decreasing willingness to purchase a licence at higher prices.

Table 3
Survival Functions (t-scores in parentheses)

	Model A	**Model B**
Constant	2.8444 (6.29)	3.5790 (6.32)
COST	-0.02529 (-3.20)	-0.03017 (-3.51)
OVER60		-1.697 (-3.02)
N	151	149
LL_R	-62.691	-60.593
LL_{UR}	-57.612	-50.275
McFadden's R^2	0.081	0.170
Median fisher's benefit	$112	$108
95% confidence interval	$85 ~ $281	$83 ~ $192
Mean fishers' benefit	$115	$109
95% confidence interval	$86 ~ $293	$84 ~ $196

In both models the sign on COST is negative and highly significant, as expected. Model B shows a significant improvement over Model A and fits the data reasonably well. There is no appreciable difference in the estimated medians or means from these two models. However, Model B provides somewhat narrower confidence intervals.

The mean provides an estimate of the expected average annual benefit that would be obtained from marine fishing with the additional benefits of management enhancements flowing from licence fees, for those recreational marine fishers who would obey the law. Mean and median benefits are about $110 per existing fisher per year. Extrapolation of these benefits to all recreational marine fishers provides an estimate of aggregate use benefits of over $101 million [0.337*2.73 million[5]* $110] per annum under the self-management scenario, but without a licence fee.

Care should be exercised in interpreting benefit measures. Firstly, they assume that poachers and people who provided a *"don't know"* response obtain benefits from fishing similar to benefits for people who would either quit fishing or would purchase a licence. Secondly, if

[5] The usually resident New Zealand population aged 18 years and over at the 2001 census was 2,728,887 people (www.stats.govt.nz).

the level of licence fee is systematically related to perceived fishery quality, then estimates are suspect. For example, if higher licence fees are associated with higher quality fishing then the benefit measures derived here overstate the benefits of fishing (and vice versa). There appears to be skepticism amongst the recreational fishing community that licence revenues would be used to enhance recreational fisheries, indicating that this assumption is not overly restrictive. Finally, the estimated benefit measures do not apply to the status quo, because the self-management scenario does not currently apply.

A conservative approach to benefit measurement is to assume that those fishers who indicated they would poach or who provided don't know responses receive no benefits at all, even if the licence were free. In that case, annual marine recreational fishery benefits are in the order of $58 million.

Alternative Measures

One advantage of a licence fee is that it generates revenue for fishery management. The quantum of revenue generated is dependent on the level at which the licence fee is set. Figure 10 illustrates this dependency. Total benefits are the sum of revenue from licence sales and benefits obtained by active recreational marine fishers (fisher benefits). Fisher benefits decline as the licence fee increases because some fishers quit fishing, while for others benefits decline by the cost of the licence.

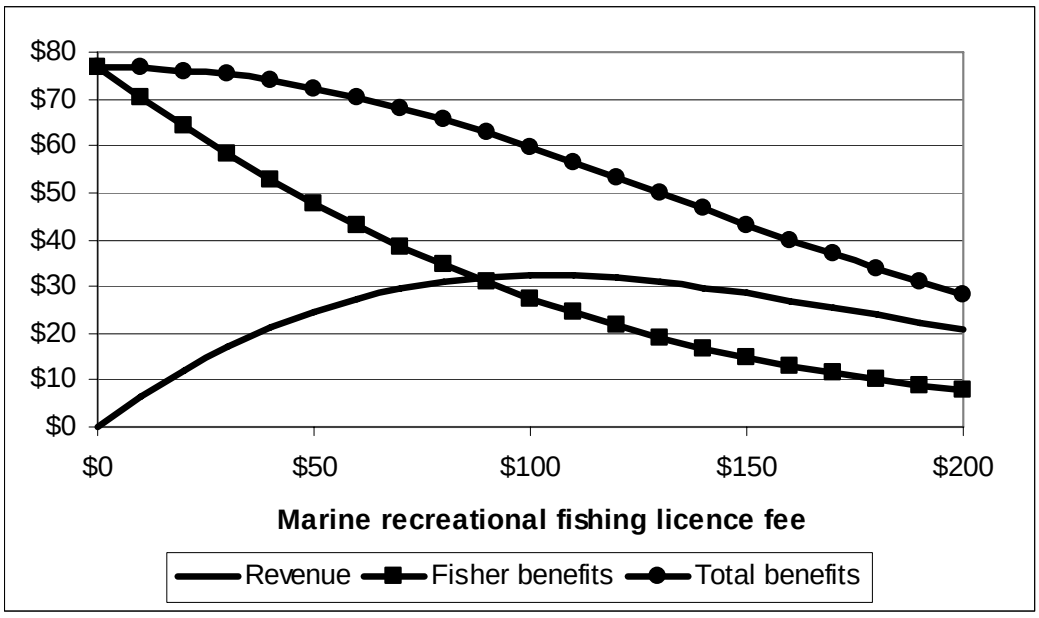


Figure 10
Benefits Per Current Fisher by Licence Fee

The maximum revenue from licence sales is generated at a price of about $100 per year. Increasing the licence fee beyond $100 reduces purchases sufficiently to more than offset increased revenue from remaining licence buyers. This suggests that a licence fee of more than $100 should not be set. This conclusion should be treated with caution. First, monitoring and enforcement costs are likely to be related to fisher numbers. Because poaching frequency is largely unaffected by licence fee levels, monitoring and enforcement costs will decrease at higher fee levels[6]. Second, fish availability and congestion costs potentially affect the quality of fishing. In some fisheries, such as the Hauraki Gulf snapper fishery, where there are high levels of recreational use and recreational harvest is a large proportion of total harvest, the nature of the fishing experience may change dramatically with decreased participation.

Assuming constant quality fishing, it is possible to estimate total benefits from fishing at a range of licence fee levels – the sum of revenue generated plus consumers' surplus (the boxed line in Figure 10). In the absence of fishery stock and congestion effects total benefit is maximized when the licence fee is zero.

In some areas recreational fishing represents a minor component of total harvest, in others it is the predominant factor. Where recreational fishing is significant any reduction in effort as a consequence of increased licence fees is likely to result in future increases in fish stocks. If fish stock increases result in improved recreational harvest rates there may be a subsequent increase in recreational fishing effort. Even if effort does not rebound, those who do fish are likely to obtain enhanced benefits from their fishing experiences with increased fish stocks. Consequently, benefit estimates derived here, which do not account for potential improvements in fishing quality, are under-estimates of benefits that would occur under a fishing licence regime. Better approximations could only be obtained subsequent to bioeconomic modeling of fish and fisher responses to changed fishery conditions.

Fishing licences have two effects: they reduce the amount of fishing activity, and they produce revenue. Both of these effects can result in improved recreational experiences, although some fishers will necessarily become worse-off. Reduced pressure on the fishery may increase numbers and quality of fish. Revenue can be used to monitor, protect and enhance fisheries through activities such as research, enforcement, habitat restoration, and pollution management. These actions all shift the demand curve further from the origin. The

[6] Because a smaller total number of fishers would need to be monitored the probability of detecting illegal fishing activity would be higher.

licence fee reduces consumers surplus, but better quality fishing increases consumers' surplus. Further research is needed to identify how fisheries can benefit most from expenditure of licence fee revenues and whether those benefits are adequate to offset the benefits foregone from paying the licence fee or from losses incurred by people who quit fishing because of the cost of purchasing a licence. It is not surprising that fishers react warily to proposals to manage the fishery differently, particularly if the benefits of fishing are likely to be transferred from fishers via licence fees.

4. Conclusions

The 2002 biennial survey of citizen perceptions of the environment and its management provides marine fisheries information that is consistent with the pressure-state-response model. Citizens perceive that fishery quality is adequate, but may be getting worse. Fish numbers are moderate to low and harvest is getting more difficult. By far the most important perceived cause of damage to marine fisheries is commercial fishing, although sewage and storm water are also believed to be important causes of damage. Fishers believe that the quality of marine fisheries management is adequate to poor.

Although fishery quality is judged to be declining, people do not rank the need to spend additional money on marine fishery management differently to other potential recipients of environmental and conservation expenditures. This may be because of the low perceived quality of marine fishery management or other reasons. No evidence is presented in support of this conjecture, which will be the subject of future analysis.

Survey findings provide considerable information about fishery participation. Our findings are consistent with the 2000 national marine recreational fishing surveys, with 34% of respondents participating in recreational marine fishing. Over 40% of 30-50 year old males participate.

Survey responses predict high levels of poaching if a marine recreational fishing licence were introduced, with about a third of current fishers stating intentions to fish without a licence. Responses were not verified, so fishers may have taken the opportunity to make a statement about their displeasure at the concept of introduction of a marine recreational fishing licence. For those who do intend to protest by continuing to fish without a licence, the protest could

be a short-term symbolic response. The high levels of protest behaviour signaled here suggest that a marine recreational fishing licence is very unpopular and indicates the need for more research into the motivations, nature and longevity of illegal activities subsequent to introduction of a licence.

As predicted by economic theory, licence purchases decline as the licence fee increases. This has implications for licence revenues and fishery quality. Changes in the quality of the marine recreational fishery caused by introduction of a marine recreational fishing licence are not captured by the estimates developed here. We believe this is an important area for future research. It is important to know how fishers' behaviours (including licence purchases) would change as fishery quality changes. It is also important to understand if, and how, fishery quality would change because of introduction of a fishing licence that generates management income. Valuable lessons may be learned from the existing fresh water fishery management model in this respect.

Overall, our findings are that the marine fishery is evaluated somewhat negatively, as is its management. High levels of fishery use indicate the potential significance of these evaluations. Proposals to manage the recreational fishery through licencing are unpopular and have the potential to decrease total benefits from fishery use unless licencing results in improved fishery quality.

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