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Valuing New Zealand recreational fishing and an assessment of the validity of the contingent valuation estimates[†]

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This article presents estimates of the recreational value of fishing in New Zealand. The data was obtained from a large-scale interview conducted at boat ramps across New Zealand. The results suggest that the recreational value of a species depends critically on the motives for targeting a particular species. Species targeted for eating purposes have marginal values that appear to closely reflect the market price of the fish (i.e. the opportunity cost). In contrast, those species which are sought mainly for recreational purposes, have a higher value. Furthermore, values for these fish types were found to be greatest for scarce species and large species of fish. The article examines the robustness of the estimates to determine whether strategic bias, embedding effects or hypothetical bias influence the results.

1. Introduction

The growing scarcity of fish stocks has intensified the conflict between commercial and recreational fishers who compete for access to declining marine resources. Fishery managers are thus being increasingly called upon to determine the optimum allocation of fish stocks between the competing groups. An efficient allocation of fish stocks requires that the regulators compute and compare the marginal value of commercial fishing against that of recreational fishing (Anderson 1980; Edwards 1990; Bishop and Samples 1980). Internationally, much effort has been devoted to calculating the economic value of recreational fisheries (Bishop and Samples 1980; Cameron and James 1986; Connelly and Brown 1991; Edwards 1990; Mathews *et al.* 1997). Australian studies include Blamey and Driml (1998); Collins (1991);

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Dragun (1991); SACES (1997, 1999); Staniford and Siggins (1992); van Bueren (1999). This article seeks to augment the existing literature. We provide estimates of the marginal value of the recreational fishery in New Zealand and examine their reliability.

The analysis is based on a comprehensive contingent valuation study, with over 4,000 interviews conducted at boat ramps and various fishing spots across New Zealand. Interviews were conducted with fishers on their return from a day trip in the period December 1998 to April 1999.[1] The survey focused on the five main fish species that are targeted by recreational fishers and are often at the centre of resource conflicts with commercial fishers. The fish studied are snapper, rock lobster, kingfish, kawahai and blue cod. Snapper and blue cod are primarily caught for consumption (i.e. eating) purposes, while kingfish and kahawai are targeted mainly for sport; and rock lobster for both. Snapper, kingfish, rock lobster and kahawai are usually caught off the North Island, with blue cod caught mostly off the South Island. We provide separate estimates of the marginal and average willingness-to-pay for each of these species.

The willingness-to-pay (WTP) data used to determine the recreational value of each species was sourced from those people who either indicated that they had targeted a particular species and/or those who had caught or retained the fish species in question. The choice of variable to use to represent the contribution of fish catch to the value of a trip is largely an empirical one, and depends critically on the motivations of fishers targeting particular species. The survey obtained data on the number of fish caught, kept or given away to others on the fishing trip. Our final choice of variable used to represent the catch dimensions of the trip was based on various statistical tests and comparisons that are described in more detail in the following sections. It was hypothesised that if the fish was caught mainly for consumption (i.e. eating purposes), the appropriate specification to use was the 'Kept Fish' variable. On the other hand, if the fish was targeted mainly for sporting reasons, then the appropriate variable was hypothesised to be 'Caught Fish'.[2] The statistical results strongly supported this hypothesis. Thus, the marginal values reported in this article were obtained using the form of specification that was found to best reflect the reasons for targeting a particular fish, which was determined by the model's goodness of fit and statistical significance of the catch variable.

[1] Details of the interview and sampling process are in Appendix 1.

[2] The 'Kept fish' variable consisted of the fish that the fisher took home from the fishing trip. The 'Caught fish' variable was defined as the fish caught on the boat by the whole party fishing that day, including fish that were thrown back or given away to others.

Valuations based on the contingent valuation method have been the subject of much debate over the years (Mitchell and Carson 1989; Bennett *et al.* 1998). Among the litany of problems, one concern highlighted in the literature is the possibility of strategic bias. Strategic bias arises when respondents have an incentive to conceal their true WTP for a good and thus deliberately provide misleading information. Another problem is that of 'embedding effects'. Perfect embedding is said to arise when WTP responses do not vary between questions seeking the value of protecting a small element of the environment and a much larger component of the environment (Bennett *et al.* 1998). This implies that individuals do not distinguish between goods when the characteristics of one good are embedded in another 'larger' good. There are several explanations for this phenomenon. One is that the answers given by respondents do not represent true values, but merely reflect the 'warm glow' of giving (Kahneman and Knetch 1992). However, such problems will also occur if respondents are either not fully aware of what is supposed to be valued, or are unable to distinguish between small changes in a good (Bennett *et al.* 1998).[3] Finally, an associated difficulty, which is widely discussed in the contingent valuation literature, is the often hypothetical nature of the question, which it is argued, leads to unreliable responses. In this article the statistical estimates are examined to determine whether any of these biases undermine the results.

The remainder of this article is organised as follows. The survey process and methodology are described as well as the estimates of the value of each recreational fish. The next section deals with the issue of strategic bias, hypothetical bias and the embedding effects in more detail, and a conclusion is presented.

2. Methodology and estimated results

2.1 Survey issues

The recreational value of fishing was estimated using the dichotomous contingent valuation method (CVM).[4] The estimates are based on a question that nominated a single value (or bid) and offered respondents a binary

[3] A second type of embedding effect is due to 'regular embedding'. This describes the situation where a lower value estimate is obtained for a good when it is valued as part of a more inclusive good than when it is valued alone. This effect is consistent with economic theory in that values decrease when a consumer is provided with an increasingly larger array of substitute goods (Randall and Hoehn 1987). Thus, evidence of this type of embedding is not a bias but a consequence of rational behaviour. We are grateful to an anonymous referee for highlighting the significance of these issues.

[4] A copy of the survey is available upon request.

'take-it-or-leave-it' choice about whether they would be willing to pay this extra amount for the trip. Specifically, respondents were first asked how much they had spent on consumables (e.g. bait, fuel, ice, etc.) on the fishing trip on that day. They were then asked:

> If it had cost you an extra $X on these items, would you still have gone fishing today?[5]

Expenditure on consumables has been employed as the payment vehicle in a large number of studies on recreational fishing (see, e.g. Cameron and James 1986; Connelly and Brown 1991; SACES 1997, 1999). This has been justified on the grounds that fishing-related consumables are familiar and recurring items of expenditure which vary in price. The use of this payment vehicle thus eliminates many of the problems arising from the use of unfamiliar hypothetical payment mechanisms which respondents may find implausible.[6]

The 'take-it-or-leave-it' approach was used in preference to the more frequently employed multiple bid technique because of the potential biases which could emerge from the latter. Recent econometric work suggests that, when individual responses are correlated across bids, the estimated WTP functions may yield biased results if derived from multiple bids (Cameron and Quiggin 1994; Poe *et al.* 1997). These problems are avoided by eliciting answers through a 'take-it-or-leave-it' question. A further issue, which is known to influence the results of CVM studies, is the specification and distribution of bid amounts. The approach used in this study is based on an algorithm proposed by Cooper (1994). Stated briefly, this technique optimises information from bids in the centre of the distribution and those in the tails of the distribution. The greater is the negative (positive) skew of the data, the wider is the spacing of bids to the right (left) of the median. This process therefore maximises the information extracted from the survey across the distribution. Appendix 1 illustrates the responses to the bid distribution by fishers, and the range of bids posed. In what follows we present estimates of the value of each of these fish derived from separate regressions.

2.2 Model specification and results

All the variables collected from the survey were initially included in a general specification explaining respondents' binary responses to the WTP question.

[5] This question was accompanied by a budget constraint reminder.

[6] For a more detailed justification see SACES (1997).

(See Appendix 2 for a description of all variables collected.) The coefficients and standard errors were computed using the well-known method of Cameron and James (1986). The final results presented in the tables were arrived at through sequential testing down, as suggested by Hendry (1980).

As noted earlier, the variable used to represent the contribution of fish catch to the value of a trip is likely to depend on fishers' motivation for targeting a particular species. Snapper and blue cod are targeted mainly for consumption purposes, and the statistical results indicated that the 'Kept Fish' variable yielded the best fit. On the other hand, the 'Caught Fish' variable provided the best fit for kingfish, rock lobster and kahawai.[7]

The model specifications reported in table 1 are generally well determined and the explanatory variables have the expected signs and significance levels. The log likelihood ratio statistic was used to evaluate the null hypothesis that the independent variables jointly have no statistically significant effect on the dependent variable. Table 1 also reports the prediction success of each model.[8] Some fish species models, especially the snapper model, performed better than others. For reasons of brevity, only the snapper results are discussed in detail. The model presented in table 1 suggests that the following variables have a positive impact on the WTP for snapper:

- being a member of a fishing club;
- income;
- working full-time;
- owning a boat with an echo-sounder;
- a greater enjoyment associated with the fishing trip that day;
- targeting either kingfish or blue cod on the fishing trip;
- an increase in the amount of time spent fishing;
- the amount of time usually spent on fishing trips; and
- fishing with people other than members of the household.

The last relationship appears to suggest that the social interaction provided on fishing trips is an important component of the recreational benefits obtained by fishers. Similarly, WTP is higher when the main motivation for fishing was to enjoy the outdoors, or if fishing was regarded as a recreational activity of importance. Finally, as suggested by economic theory, WTP was found to be positively associated with a fisher's income.

The results in table 1 indicate that the following variables have significant, negative effects on the WTP for a snapper fishing trip. First, WTP is

[7] See note 2 and Appendix 2 for definitions of these variables.

[8] We report the prediction success of the model and the log likelihood ratio as alternatives to the 'pseudo R^2'.

Table 1 Influences on willingness to pay for a day's fishing trip

Variable	SNA	KIN	BC	KAH	RL
Particular species of fish kept	5.73 (3.0)*		1.61 (1.03)		
Particular species of fish caught		19.76 (2.0)**		3.44 (1.45)****	6.54 (2.08)**
Sum of all other species of fish kept				3.07 (2.1)**	0.49 (0.6)
Sum of all other species of fish caught	1.09 (1.3)****	1.41 (1.4)****	4.04 (2.3)**		
Income of fisher (logged)	89.46 (4.1)*	207.83 (4.3)*	80.72 (2.3)**	99.25 (2.9)*	210.60 (3.1)*
Importance of fishing as a recreational activity	21.53 (2.5)*	75.32 (2.9)*	4.04 (2.3)**	23.29 (1.8)***	64.25 (1.8)***
Main motivation to be with family & friends		129.02 (1.9)***	95.03 (2.0)**	67.05 (1.6)****	209.13 (1.7)***
Main motivation to enjoy the outdoors	34.59 (2.39)*	67.79 (1.8)***	61.99 (1.7)***	36.81 (1.6)****	
Member of a fishing club	69.98 (4.1)*	53.93 (1.7)***		77.39 (3.0)*	
Fishing with members apart from people from their household	43.96 (3.3)*			42.78 (2.1)**	226.51 (2.8)*
Increase in av. amount of time spent fishing	6.28 (1.7)***	15.51 (2.2)**		18.07 (3.2)*	
Owning a boat with an echo-sounder	28.53 (2.3)**		146.26 (2.7)*		
Increase in the enjoyment experienced on the trip	13.14 (1.86)***				45.35 (1.7)***
Fishing during the month of April	−40.91 (−1.9)***	−108.69 (−2.4)*	−94.28 (1.9)***		
Fishing during the month of March		−54.78 (−1.6)****		−37.46 (−1.7)***	
Main motivation was to catch fish to eat	−48.58 (−2.1)**			−124.8 (−2.9)*	−116.27 (−2.0)**
Had difficulties fishing & blamed it on personal skills		−72.47 (−1.7)***		−73.96 (−2.1)**	
Targeting rock lobster on the trip	−133.42 (−3.3)*				
Targeting snapper on the trip					−147.71 (−2.1)**
Targeting blue cod on the trip	127.48 (3.3)*			129.98 (2.9)*	
Targeting kingfish on the trip	38.39 (2.4)*	62.04 (1.9)***	191.01 (2.6)*	74.46 (2.8)*	
Targeting kahawai on the trip			−103.2 (−1.8)***		
Increase in time spent fishing on the day	8.42 (2.5)*				16.83 (1.8)***
Fishing from a diving platform					48.99 (1.1)
Being male				−63.53 (−2.0)**	
Fishing on the North Island			65.96 (1.7)***		−159.96 (−2.8)*
Being Polynesian				−199.31 (−1.9)**	
Main platform of fishing used was pots				−215.55 (−2.6)*	
Had difficulties fishing & blamed it on natural factors				−52.5 (−2.2)*	119.09 (1.9)***
Had difficulties fishing & blamed it on human factors				−59.83 (−2.3)*	
Weather					−29.98 (−1.4)****
Fishing during a competition		164.42 (2.0)**			−309.50 (−1.2)
Had no difficulties fishing that day					−48.8 (−1.0)
Fishing in a metropolitan area			87.51 (2.5)*		
Sample size	2,010	709	505	1,181	501
log-likelihood ratio statistic	394.4	124.0	124.3	254.7	161.0
prediction success:					
'no' answers correct	63%	53 %	72 %	65 %	90 %
'yes' answers correct	72 %	81%	68 %	74 %	46 %

Notes: Asymptotic t-statistics in brackets after coefficients
* t-statistic significant at 99 per cent level, ** t-statistic significant at 97.5 per cent level
*** t-statistic significant at 95 per cent level, **** t-statistic significant at 90 per cent level.

negatively related to the number of fishing trips undertaken in any year. This could suggest that the more people fish in a year, the lower is their marginal WTP. Fishing during the month of April; targeting rock lobster on the trip; and embarking upon the fishing trip in order to catch fish for eating all had a negative effect on WTP for a snapper fishing trip. This last result implies that fish caught for consumption purposes have a relatively lower value because there is the alternative of purchasing the same fish, or a close substitute, in the market at a modest price. Thus, as the cost associated with fishing increases, individuals are less likely to be willing to pay additional amounts for the fishing trip, as a close substitute exists in the form of fish purchased in the retail market.

2.3 Values for fish

Table 2 summarises the marginal and average WTP for all five fish species. The coefficient on the catch variable provides a measure of the marginal value of fish caught on the respondent's trip. Thus, using the results from the snapper model, an additional snapper taken home by a fisher adds $5.73 to the value of a fishing trip.[9] A snapper's average value, calculated as mean sample WTP divided by mean daily catch, was $30.85. There is a large difference between the average and marginal WTP estimates for all the fish species in this study. The low marginal WTP could either reflect diminishing marginal utility from catching fish, or the inclusion in average WTP of utility from non-catch sources.[10]

When valuing recreational fishing for policy purposes, both the marginal and the average values are important. If the objective is to value recreational *fishing*, then either consumer surplus, or the average WTP of fish may be of use. The average WTP, which is reported in this study, captures benefits from non-catch sources. On the other hand, if the objective is to estimate the value of recreational *fish* caught, the marginal WTP, which estimates the value of the additional fish caught, is the more appropriate measure. The choice of variable thus depends on the policy question.

The value estimates in table 2 reveal that rock lobster is the most highly valued fish (on a weight basis), followed by snapper, kingfish, kawahai and blue cod. These results accord with expectations and reflect what each species is used for, its abundance and its location. For instance, in addition to its sporting qualities as a diving fish, rock lobster is a valuable eating fish.

[9] All values are in New Zealand dollars.

[10] This issue is discussed in greater detail later in the article where it is shown that this difference arises partly from diminishing marginal utility.

Table 2 Recreational fishing values

	Value per fish kept/caught		Value on a fish weight basis*		Amount spent ($)**	
	MWTP $	AWTP $	MWTP $	AWTP $	Per trip	Annual expenditure
Snapper	5.73	30.85	5.79	31.16	35.80	417.25
Kingfish	19.76	181.10	3.26	29.83	49.68	128.08
Blue Cod	1.61	24.46	2.40	36.50	44.09	113.45
Kahawai	3.44	59.65	2.80	48.49	25.32	152.41
Rock Lobster	6.54	48.29	9.91	73.16	51.52	162.29

Notes: * Fish weights are from Bradford (1998), and are per kilogram.
** Amount spent is based on recurrent expenditure only.

Among all the fish examined in this study, rock lobster retails at the highest price. The relatively high WTP on a weight basis (both marginal and average) for lobster thus reflects its scarcity and opportunity cost, among other things.

In contrast, kingfish is pursued primarily for recreational and sporting purposes and grows to world record sizes in the New Zealand seas. The low likelihood of catching a large kingfish adds to its recreational value, hence the marginal WTP for a kingfish (per fish) is relatively large. Other studies have found that highly skilled fishers who target certain fish are satisfied with catching fewer fish so long as the catch includes the targeted species (Bryan 1977; Ditton *et al.* 1992). Our results tend to support this conclusion. Kingfish does not, however, have a relatively high marginal WTP when it is valued on a weight basis. This reflects the fact that much of its value comes from the fishing experience and that kingfish are large, further reducing the relative per kilo value.

Similarly, kahawai has a much higher value as a recreational fish than an eating fish. Kahawai is the only fish in this study that had a marginal WTP per kg which was higher than the average retail price in 1998–99 ($2.80 vs $2.31 per kilogram respectively). The kahawai estimates appear to support the validity of our overall results. Although it is valued highly as a recreational sporting fish, anglers also enjoy cooking and eating fresh kahawai. Commercially, kahawai is usually sold for bait and is not considered to be a palatable fish. Hence, kahawai caught recreationally represents a different product to kahawai purchased commercially. This is reflected in our results. The lower recreational value per kilogram for snapper, kingfish, rock lobster and blue cod illustrates that buying fish commercially to eat is a substitute for catching them recreationally. However, kahawai caught recreationally is not a substitute for kahawai bought commercially. Snapper, on the other

Table 3 Ratio of all other fish to individual fish value

	Individual fish kept or caught value $	All other fish kept or caught value $	All other fish/individual
Kingfish	19.76	1.41	0.07
Rock Lobster	6.54	0.49	0.08
Snapper	5.73	1.09	0.19
Kahawai	3.44	3.07	0.89
Blue cod	1.61	3.04	1.89

hand, is valued for both recreational and consumption purposes, and has similar values on a fish and weight basis. Blue cod can be caught with comparative ease in New Zealand, hence fishers place a relatively low value on blue cod.

The coefficient of the 'other fish kept or caught' on the trip also provides useful information about the value of individual fish caught. In each model, in addition to the particular fish studied, a variable was included for the sum of all 'other fish kept or caught' on the fishing trip. For snapper, kingfish and rock lobster the marginal value of all 'other fish kept or caught' was considerably less than the primary fish targeted. Kahawai also had a higher marginal value than the marginal value of all 'other fish kept or caught'; however, the difference was only slight, indicating that other fish caught on a kahawai fishing trip are valued almost as highly as an additional kahawai. The marginal value of all 'other fish kept or caught' was considerably higher than the value attached to an additional blue cod, once again illustrating blue cod's low recreational fishing value. Indeed, the ratio of all 'other fish kept or caught' divided by the primary fish in table 3 was ranked in the same order as their respective marginal values, i.e. kingfish, rock lobster, snapper, kahawai and blue cod, which confirms the recreational importance attached to each fishery.

While these results seem reasonable and accord with expectations, there remains the possibility that the estimates could be biased and unreliable as a result of the many problems that are known to undermine contingent valuation studies. Accordingly, in the following section we discuss and examine whether these estimates are affected by some of these biases.

3. Robustness of results

In this section we discuss and test the robustness of the results. Perhaps the strongest criticism of contingent valuation studies is concerned with strategic bias, but there are also considerable potential problems identified with embedding effects and hypothetical bias.

3.1 Strategic bias

Strategic bias arises mainly because of the public good nature of the resource being valued. The concerns focus on what respondents believe about their contributions and the perceived probability of actually having to pay for the good and influencing public policy more generally (Mitchell and Carson 1989). Thus, respondents will understate their true WTP if they believe that they will be asked to contribute to the good, when their contribution has a small impact on the supply of the public (or open access) good. The most commonly proposed method of minimising such strategic behaviour is to use the discrete elicitation format, as employed in this study (Kealy and Turner 1993). In this article we attempt to test for the presence of strategic bias. At the end of the survey a random subset of 260 individuals were asked a supplementary question:

> Do you believe that the government will impose a recreational fishing tax in the next year or so?

If strategic motives bias the results then it is hypothesised that those individuals who believe that a tax is likely to be introduced will understate their true WTP in order to minimise their contribution to the good. Moreover, given the information provided to respondents there is no obvious strategic reason for them to provide misleading answers to this particular question. Responses to this question thus provide some indication of the likelihood of strategic bias.

Table 4 summarises the results of two separate models, one estimated using data from those individuals who answered that a tax was likely to be introduced (17.5 per cent of the sample) and the other estimated using data from those who believed the reverse (82.5 per cent of the sample). We formally test the following hypothesis:

$$H_0 : WTP_A = WTP_B$$

$$H_1 : WTP_A < WTP_B$$

where: subscript A denotes the group who believe that a tax will be implemented and subscript B denotes the group who believe that a tax will not be implemented.

The F-test reported in the table reveals that it is not possible to reject the null hypothesis that there is no statistical difference between the WTP of the two groups (i.e. group A has a WTP of \$2.54, while group B has a WTP of \$3.85). This result is further confirmed in table 5 where a dummy variable is introduced. The dummy variable is given a value of 1 where respondents believe that a tax will be introduced. The t-statistic is insignificant, which implies that there is no statistical difference between the responses provided by group A and group B.

Table 4 Results of F-Chow test for strategic bias on sub-sample of fishers

	Answers to the tax question					
	Said yes		Said no		Pooled sample	
	Coefficient	Asymptotic t-statistic	Coefficient	Asymptotic t-statistic	Coefficient	Asymptotic t-statistic
No. of kept fish	2.54	1.35****	3.85	1.204	3.48	0.989
No. of given away fish	1.96	−1.751***	−4.19	−1.321****	−2.98	−1.601****
Fishing on the North Island	−7.82	−0.149	−203.09	−1.267	−90.43	−1.063
Being Maori	53.71	1.932***	120.46	1.233	92.70	1.647***
Length of time spent fishing	11.12	1.522****	46.87	1.865***	36.05	2.532*
Importance of recreational fishing to the fisher	4.18	0.338	42.32	1.259	26.41	1.305****
Experienced difficulties and attributed it to human factors	−22.79	−0.862	−66.23	−1.161	−43.46	−1.158
Age of fisher (logged)	46.23	1.615****	7.24	0.106	37.27	0.803
Income of fisher (logged)	37.05	1.565****	102.54	1.422****	69.84	1.686***
Member of a fishing club	−16.20	−0.644	74.45	1.181	38.81	1.086
Owned boat with colour video	60.91	1.921***	−147.32	−1.407****	−66.74	−1.258
Had difficulties trying to catch all targeted fish	−17.33	−0.557	−35.56	−0.628	−62.97	−1.424****
Level of enjoyment experienced on that fishing day	−0.34	−0.035	48.19	1.038	16.66	0.763
Main motivation for fishing was for sporting and eating purposes	−24.53	−1.073	−54.15	−0.917	−55.91	−1.356****
Residual sum squares		6.05		37.41		46.95
Sample		43		203		246
f test	1.08	(16,214)				
Prediction success:						
'no' answers correct		85%		57%		52%
'yes' answers correct		87%		82%		82%

Notes: * t-statistic significant at 99 per cent level.
** t-statistic significant at 97.5 per cent level.
*** t-statistic significant at 95 per cent level.
**** t-statistic significant at 90 per cent level.

Table 5 Strategic bias test — fish tax dummy

Variable		Coefficient	Asymptotic t-Statistic
No. of kept fish	b3	4.22	1.056
No. of given away fish	b2	−2.84	−1.509****
Indicated yes to fish tax	b4	−27.27	−0.718
Fishing during the month of April	b5	73.56	1.203
Fishing during the month of March	b6	98.97	1.105
Level of enjoyment experienced on that fishing day	b7	60.55	1.745***
Being Maori	b8	71.06	1.365****
Fishing on the North Island	b9	−208.54	−1.842***
Fisher's income (logged)	b10	46.24	1.033
Average time usually spent fishing	b11	22.86	1.632****
Length of time spent fishing	b12	35.07	2.491*
Importance of recreational fishing to the fisher	b13	36.77	1.586****
Sea conditions experienced	b14	−29.08	−1.342****
Experienced difficulties and attributed it to human factors	b15	−51.75	−1.306****
Working full-time	b16	83.48	1.292****
Had difficulties trying to catch all targeted fish	b17	−41.88	−1.047
Was a pensioner	b18	96.83	1.381****
Fished from a boat platform	b19	−131.77	−1.511****
Sample size	246		
Prediction success:			
'no' answers correct	61%		
'yes' answers correct	81%		

Notes: * t-statistic significant at 99 per cent level.
** t-statistic significant at 97.5 per cent level.
*** t-statistic significant at 95 per cent level.
**** t-statistic significant at 90 per cent level.

Table 6 Comparison between 'yes' and 'no' tax responses

	Said yes to the bid (%)	Said no to the bid (%)
People who believed the fishing tax would be implemented (yes)	55	45
People who did not believe the fishing tax would be implemented (no)	58	42

There remains the possibility that if respondents do *not* believe that a tax is to be introduced, then they will have an incentive to *overstate* their true WTP.[11] This would be indicated if a higher proportion of respondents belonging to group B agree to pay the bid amount offered. Table 6 compares the proportion of 'Yes' and 'No' responses between those in groups A and

[11] We are grateful to a referee for alerting us to this possibility.

B. The results suggest that there is a slightly higher proportion of Group A respondents that refused to pay the bid amount offered (45 versus 42 per cent respectively). However, the difference is small and is not statistically significant. It therefore seems reasonable to conclude that strategic considerations do not bias our results.

3.2 Embedding effects

A further problem identified with contingent valuation studies is that of 'perfect embedding'. In a number of studies, it has been discovered that respondents are willing to pay the same amount for (a) goods that differ in quality and (b) different amounts of the same good (Carson and Mitchell 1995; Bennett *et al.* 1998). The presence, or otherwise, of embedding effects should be identifiable from the data set.

First, the five New Zealand fish studied all differed in terms of their recreational fishing experience, consumption and sporting qualities. If embedding effects were present, there are unlikely to be such substantial differences between the marginal WTP of various fish. Moreover, the catch variable would not be significant, as statistical significance of the catch coefficients indicates that WTP is sensitive to the number of fish caught.[12] As can be seen from the results shown in tables 1 and 2, this was clearly not the case, and indeed the values obtained seemed to correctly reflect the differing qualities of each fish studied.

Also, if perfect embedding is dominant, then an individual with a catch of (say) one fish of a given species would have the same marginal WTP as an individual who has caught (say) ten fish. In contrast, if individuals value their catch in the manner suggested by consumer theory, then by the law of diminishing marginal utility, fishers with the larger catch should have a lower *marginal* WTP than those with a smaller catch. Table 7 summarises the results of a test on the snapper model for the presence of diminishing marginal utility.

In order to test for this, the sample of fishers was arbitrarily divided into two sets: those who caught and kept 4 or more snapper and those who caught and kept 3 or fewer snapper on the trip.[13] Table 7 illustrates that fishers who kept less than 3 fish have a marginal WTP of \$10.25 while those who kept more than 4 fish have a marginal WTP of \$2.94 for snapper. This result indicates that valuation of the catch is dependent on the number of fish

[12] However, as noted by a referee, this introduces the problem of population heterogeneity — an issue that is left for future work.

[13] This corresponds to approximately 40 and 60 per cent of the database respectively.

Table 7 Diminishing marginal utility of catching snapper

	Kept 4+ snapper		Kept from 0 to 3 snapper	
	Coefficient	Asymptotic t-Statistic	Coefficient	Asymptotic t-Statistic
No. of kept snapper	2.94	1.012	10.25	1.267
Total catch other than snapper	–0.17	–0.131	1.63	1.351****
Member of a fishing club	68.62	2.938*	81.77	3.071*
Owning their own boat with an echo-sounder	18.43	0.999	41.97	2.281**
Level of enjoyment experienced on that fishing day	29.93	2.324**	12.57	1.314****
Length of time spent fishing	16.21	3.510*	10.97	2.630*
Fishing with people other than household	35.77	1.827***	55.43	2.720*
Fisher’s income (logged)	71.17	2.245**	114.06	3.308*
Worked full-time	91.78	2.654*	39.89	1.434****
Main motivation for fishing is to enjoy outdoors	35.66	1.553****	41.92	2.024**
Was targeting kingfish on the trip	69.08	2.875*	28.38	1.211
Was targeting rock lobster on the trip	–169.18	–2.550*	–141.34	–2.403*
Was targeting blue cod on the trip	128.16	2.047**	137.27	2.445*
Sample size		776		1,240
Prediction success:				
‘no’ answers correct		56%		68%
‘yes’ answers correct		83%		63%

Notes: * t-statistic significant at 99 per cent level.
** t-statistic significant at 97.5 per cent level.
*** t-statistic significant at 95 per cent level.
**** t-statistic significant at 90 per cent level.

caught and/or kept, which confirms the results of many other studies that suggest values attached to fish by anglers are significantly influenced by the catch rate (see Freeman 1995, for a review).

These results appear to be consistent with the absence of perfect embedding. It is, however, recognised that these statistical exercises do not constitute a formal test for embedding effects. Such a test would require a comparison of the WTP for different catch rates across sub-samples (see, for example, Blamey and Driml 1998).[14]

3.3 Hypothetical bias

A final issue which warrants consideration is that of hypothetical bias. Hypothetical bias is said to occur because respondents are unfamiliar with the hypothetical situation they are being asked to value. It is argued that the accuracy of responses is improved when respondents are asked to value familiar and real world scenarios. In addition, van Bueren (1999) suggests that contingent valuation studies are ineffectual at disentangling the value of catching fish from the value of the total fishing experience. It is argued that the use of trip costs as a payment vehicle could cause anglers to value their trip *ex ante* rather than *ex post*, which would undermine subsequent efforts to elicit marginal values for fish.

While hypothetical bias can be a problem in contingent valuation studies, it does not appear to be a significant concern in the present study. Respondents were all interviewed at boat ramps at the end of their fishing trip and were asked their WTP for the day's fishing rather than some hypothetical situation. They were also well aware of the money that they had spent on fishing that day and the number of times they fish each year (hence had some idea of their demand for the environmental good). The instrument choice used for payment in the study was the amount spent on goods purchased for the day's fishing. This eliminates any problems arising from the use of payment mechanisms which respondents may be unfamiliar with. Respondents were reminded of their budget constraint and given careful explanations of the relevance of the WTP question. Thus, the current study appears to have minimised the problems identified by van Bueren (1999).

In addition, figures 1 and 2 in Appendix 1 clearly depict a downward sloping willingness to pay for recreational fishing. It therefore seems reasonable to conclude that respondents were familiar with the good being valued and that hypothetical bias was not present within the study.

[14] We are grateful to a referee for highlighting this fact.

4. Conclusion

This article has presented estimates of the recreational value of fishing in New Zealand. The data was obtained from a large-scale interview process conducted at boat ramps across New Zealand, following most of the NOAA (National Oceanic and Atmospheric Administration) guidelines and control measures. The results suggest that the recreational value of a species depends critically on the reasons why it is pursued. The marginal value of fish which are targeted for eating purposes appears to closely reflect the market price of the fish (i.e. the opportunity cost). In contrast, those species which are sought mainly for recreational purposes have a higher value the scarcer the fish is and the larger its average size.

The results appear to be both reliable and intuitively plausible. Moreover, an attempt has been made to test for the presence of biases. The statistical tests performed indicated that there was no evidence of either strategic bias, or embedding effects. It was further suggested that hypothetical bias is not likely to distort the estimates presented in this study. It is thus proposed that these results can be used as a reliable guide to allocate marine resources between commercial and recreational uses in the New Zealand fishery.

Appendix 1
Description of survey and responses to bid amount

The questionnaire was initially tested in a pilot survey involving 150 fishers on the North Island. Variants of this questionnaire were used in earlier studies to estimate the value of recreational fish in Australia (SACES 1997, 1999). The main survey was conducted from 28 December 1998 to 11 April 1999, by Kingett Mitchell and Associates Ltd (a company with extensive knowledge of the local fishing industry). The survey captured mainly boat fishers (94 per cent of the sample) who were interviewed at jetties and beaches, on their return from the day's fishing trip. A random sample of fishers were interviewed at over 50 locations, identified by the Department of Fisheries, on the North and South Islands. Excluding the results from the pilot survey, approximately 3,855 fishers were interviewed. The survey effort was distributed geographically to reflect the known distribution of the catch from each area. It was recognised that with the resources available, it would be difficult to obtain the required numbers of surveys for some species in certain areas. This problem was most acute for rock lobsters and kingfish. The rock lobster fishery is widely dispersed along the coast and divers fish from a range of locations along the coast rather than from recognised boat-ramps. This made it difficult to intercept returning lobster fishers. For kingfish, an increase in the minimum legal size meant that fewer fishers were expected to target this species. In some areas where fishing effort is low (e.g., the west coast of the South Island, the lower west coast of the North Island), it was recognised that it would not be productive to station surveyors because of the low population of recreational fishers.

Figure 1 illustrates that the proportion of people answering 'Yes' to the additional bid amount question falls consistently as the bid amount increases in value and provides an indication of the demand for recreational fishing.

Figure 2 illustrates the proportion of fishers answering yes to the additional bid question with their total spending for that day taken into consideration. The bid amount was divided by (a) the bid amount plus (b) how much they had spent that day. The figure therefore reflects answers to the bid question as a proportion of total spending. For example, figure 2 shows that when the bid amount represented 10 to 20 per cent of the fisher's total spending for that day, 100 per cent of fishers within the snapper model said 'Yes' to the additional bid question. When the bid amount represented half of what the fisher had spent on the day's fishing trip, the proportion of people answering 'Yes' fell to 72 per cent, and to 9 per cent when the bid amount represented 95 per cent of total expenditure. Interestingly, when the bid amount represented 100 per cent of the fisher's expenditure (i.e. they had not spent any money that day fishing), approximately half replied that they would have still gone fishing that day if it had cost them money to do so. This result is reasonable when one considers that many people go fishing for purely recreational purposes and do not spend large amounts of money, so that a large proportionate increase in the cost of the trip may represent a small absolute increase.

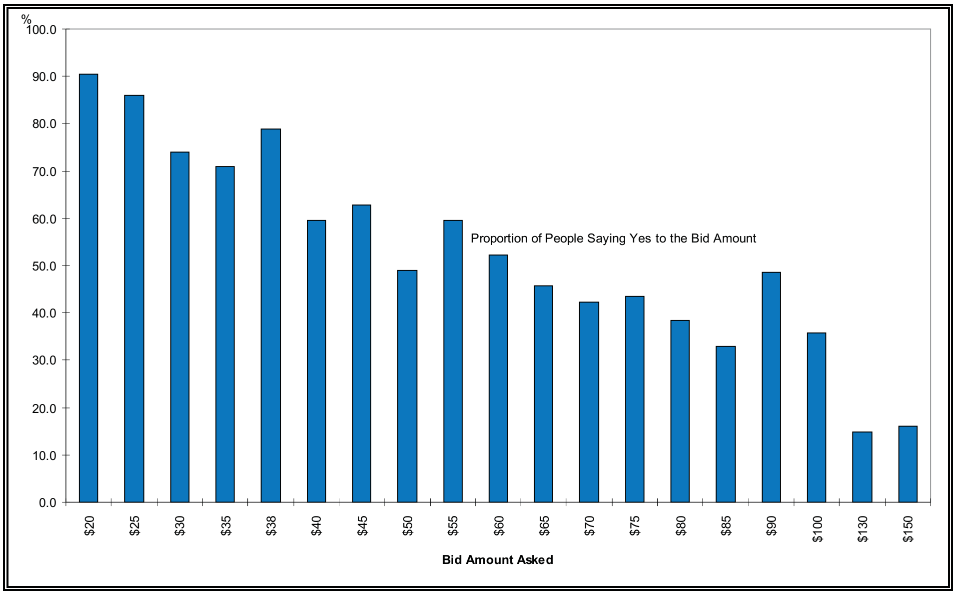

Figure 1 Percentage distribution of yes answers to the WTP question for the Snapper Model

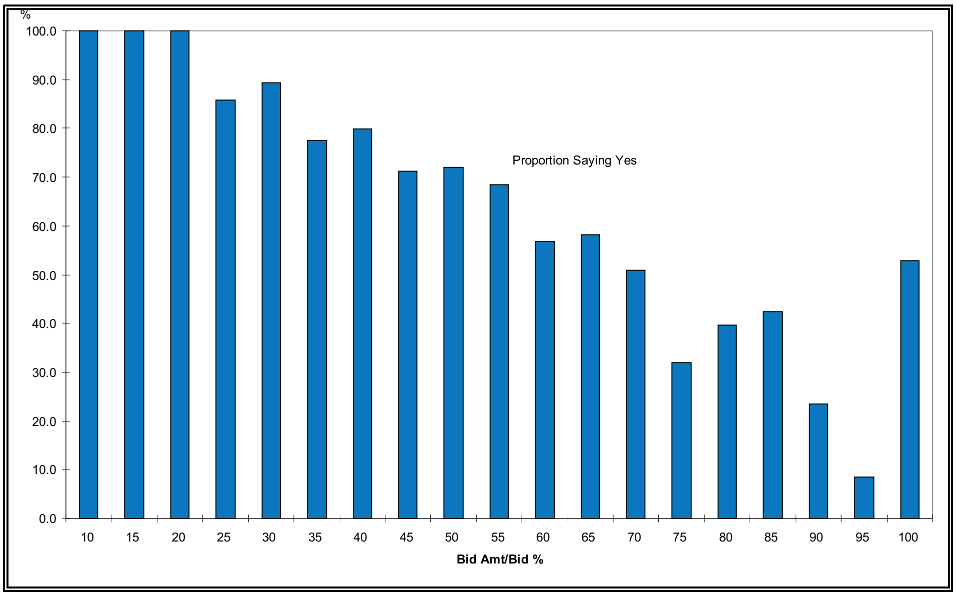

Figure 2 Percentage distribution of yes answers to the WTP question where the bid represents a proportion of their total spending for the Snapper Model

Appendix 2
Explanatory variables

Variable	Description of variable and how it was coded within the database
C	A constant term was included in each regression
WTP	Willingness to pay was the dependent variable used in the econometrics. If people answered yes to the additional bid amount asked the answer was Coded as 1 and no answers were Coded as 0
Bid	Bid was the bid amount asked in each survey plus the total amount spent that day by the respondent. Bid was included in all econometrics
Kept – Snap/RL/BC/Kah/Kf	Depending on the recreational fish being valued, the kept variable was the amount of that fish taken home by the respondent on that fishing trip
Kept Other Fish	Depending on the recreational fish being valued, this was the sum of all the other fish kept by the respondent on that fishing trip
Caught – Snap/RL/BC/Kah/KF	Depending on the recreational fish being valued, the caught variable was the amount of that fish caught by the entire boat on that fishing trip
Caught Other Fish	Depending on the recreational fish being valued, this was the sum of all the other fish caught by the entire boat on that fishing trip
Given Away – Snap/RL/BC/Kah/KF	Depending on the recreational fish being valued, the given away variable was the total catch amount minus the total kept amount of that fish
Pensioner	This was a dummy variable where a pensioner/retiree was Coded as 1 and all others 0
Notworking	This was a dummy variable where people who were classified as not working (pensioners, retirees, students and the unemployed) were Coded as 1 and all others 0
Fullparttime	This was a dummy variable where people who were classified as working full-time were Coded as 1 and all others 0
Age	This was a variable that was based on the average of the range of age indicated by the respondent
Ageˆ2	This was age squared
Avtime	Average time was the amount of time that the respondent usually spent fishing on a trip
Fishingtime	Fishing time was the amount of time that the respondent spent fishing on the trip that day
Boatown	This was a dummy variable, where fishers who owned a boat were Coded as 1 and all others 0
Club	This was a dummy variable, where fishers who were members of a fishing club were Coded as 1 and all others 0
Echo	This was a dummy variable, where fishers who owned their own boat which had an echo-sounder were Coded as 1 and all others 0
Cvtech	This was a dummy variable, where fishers who owned their own boat which had an echo-sounder with a colour video screen were Coded as 1 and all others 0

Econometric Variables Used (Continued)

Variable	Description of variable and how it was coded within the database
Competition	This was a dummy variable, where fishers who were participating in a fishing competition at the time of the survey were Coded as 1 and all others 0
Date – Dec/Jan/Feb/March/April	These were dummy variables where surveys that were conducted in a certain month were Coded as 1 and all others 0
Datecode	This was a scalar variable where surveys that were conducted in December were Coded as 1, January 2, February 3, March 4 and April 5
Log income	This was the log of income. The income variable was determined by the average of the range of income indicated by the respondent
Diff – All/None/Snap/KF/BC/Kah/RL/Oth	These were dummy variables where if difficulties were encountered with a particular fish it was given a value of 1 and all others 0
Enjoyment	This was a scalar variable of how much the fisher enjoyed the fishing trip they just undertook, where 1 = terrible and 5 = very enjoyable
Island	This was a dummy variable, where surveys conducted on the North Island were Coded as 1 and South Island surveys as 0
Ethnic – Asian/Eero/Maori/Poly/Oth	These were dummy variables where a 1 indicated that the respondent was of a particular ethnicity and 0 for all others
Gender	This was a dummy variable where male fishers were Coded as 1 and females as 0
Household	This was a dummy variable where fishers who fished with people from more than one household were Coded as 1 and those who did not as 0
Importance	This was a scalar variable of how important fishing was as a recreational activity to the respondent, where 1 = not important and 5 = extremely important.
Metro	This was a dummy variable where if surveys were conducted in metropolitan areas they were Coded as 1 and non-metropolitan areas as 0
Motivate – Enjoy/Eat/Sport&Eat/Family/Large/Customary/Oth/Explore	These were dummy variables, where a 1 indicated the main motivation for going fishing by the respondent, and a 0 for all others. Enjoy = to enjoy the outdoors, eat = to catch fish for eating purposes, sport and eat = to catch fish for sport and eating purposes, family = to do something with family and friends, large = to catch large fish, customary = to catch fish for customary reasons, explore = to explore the outdoors and oth = other reasons for going fishing
Platform –Boat/Land/Diving/Pots/Jetty	These were dummy variables, where a 1 indicated the main platform the fisher had used on his fishing trip that day, and 0 for all others

Econometric Variables Used (Continued)

Variable	Description of variable and how it was coded within the database
Reas – Human/Personal/ Natural/Oth	These were dummy variables, where if the respondent had indicated that they experienced difficulties in fishing for particular fish that day, they gave an explanation as to why they thought they experienced that difficulty. The main difficulty was Coded as 1 and all others 0. Human difficulties were attributed to commercial fishing and/or pollution, personal difficulties were attributed to a person's own fishing skills, natural difficulties were attributed to biological reasons and other difficulties included other reasons such as weather
Sea	This was a scalar variable of the sea conditions experienced by the fisher on the fishing trip, where 1 = terrible and 5 = excellent
Targ – All/None/Snap/KF/ BC/Kah/RL/Oth	These were dummy variables where if fishers indicated they were targeting a particular fish the record was given a value of 1
Weather	This was a scalar variable of the weather conditions indicated by the interviewer on that day, where 1 = rain and 5 = sunny
Yrtimes	This was the number of times the fisher indicated that they go fishing per year

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