INSTITUTE FOR MARINE AND ANTARCTIC STUDIES
UNIVERSITY OF TASMANIA

A Contingent Valuation of Recreational Fishing in Tasmania

Satoshi Yamazaki, Steven Rust, Sarah Jennings, Jeremy Lyle & Sven Frijlink

September 2011

translatingnatureintoknowledge

www.imas.utas.edu.au

A Contingent Valuation of Recreational Fishing in Tasmania

Satoshi Yamazaki, Steven Rust, Sarah Jennings, Jeremy Lyle and Sven Frijlink

September 2011

A Contingent Valuation of Recreational Fishing in Tasmania

Satoshi Yamazaki[a], Steven Rust[a], Sarah Jennings[a], Jeremy Lyle[b] and Sven Frijlink[c]

a. School of Economics and Finance, University of Tasmania, Private Bag 85, Hobart, TAS 7001, Australia
b. Institute for Marine & Antarctic Studies, Fisheries Aquaculture & Coasts (IMAS-FAC), University of Tasmania, Private Bag 49, Hobart 7001, Australia
c. School of Geography and Environmental Studies, University of Tasmania, Private Bag 78, Hobart, TAS 7001, Australia

Institute for Marine and Antarctic Studies, University of Tasmania, Private Bag 49, Hobart, Tasmania 7001. E-mail: Jeremy.Lyle@utas.edu.au

Ph. (03) 6227 7277 Fax (03) 6227 8035

A Contingent Valuation of Recreational Fishing in Tasmania

Executive Summary

Overview

- The best economic outcome is achieved in a fishery when the *total allowable catch* has been allocated among competing groups so the value of the last fish caught to each group is the same.
- Estimating the total value to recreational fishers of additional fish caught is complicated by the fact the recreational fishing experience is not bought or sold in a market (i.e. is a non-market good).
- This means that a special method of determining its value must be used which does not rely on price data that is usually available from market transactions.

Methodology and Sampling

Contingent Valuation

- Contingent valuation is an established survey-based methodology that can be used to determine the value of non-market goods which are derived from natural and environmental resources, such as recreational fishing.
- We used the *double-bounded dichotomous-choice contingent valuation method* to determine fishers' willingness to pay for the most recent (last) day they spent recreational fishing.
- We conducted the survey twice,
    - Once for the state's *inshore saltwater fishery;*
    - Then again using a different (but related) sample of fishers, in the state's *rock lobster fishery.*
- The mean willingness to pay for a day's recreational fishing is reported in both of these fisheries.

Inshore Saltwater Fishery

- 604 fishers were followed up at the completion of the *2007/2008 Survey of Recreational Fishing in Tasmania* to complete a telephone-based economic survey.
- Discounting non-contacts and ineligible respondents, 98.7 per cent of the net sample of fisher households fully responded to the survey.
- Of the 480 fully responding fisher households, 314 had participated in the inshore saltwater fishery.
- After removing protesters and responses for which daily cost information was contradictory, a net sample of 293 fisher households was available for estimating the contingent valuation model.

Rock Lobster Fishery

- 674 fishers was followed up at the completion of the *2008-09 Survey of Recreational Rock Lobster and Abalone Fishing in Tasmania* to complete a telephone-based economic survey.
- Discounting non-contacts and ineligible respondents, 97.3 percent of the net sample fully responded to the survey.
- Of the 622 fully responding fishers, 423 had participated in the rock lobster fishery.
- After removing protesters and responses for which daily cost information was contradictory, a net sample of 384 fishers was available for estimating the contingent valuation model.

Results[1]

Inshore saltwater fishery

- The mean willingness to pay for the most recent day of inshore saltwater fishing was between $63.53 and $108.38, with the most likely value being $78.18.
- This compares with the average amount spent on consumable items for that day's fishing, which was $42.79.
- The mean willingness to pay for the most recent day's fishing was higher if the respondent:
    - was male;
    - was working full-time;
    - had spent more money on the day's fishing;
    - was with more people in the fishing party;
    - was not fishing with his or her own children; and
    - had fished from a boat (rather than from the shore).
- Respondents who indicated that they were specifically targeting flathead or were not targeting any species had a lower willingness to pay ($16.38 for those targeting flathead, and $22.31 for those not targeting any species) than those who were targeting a number of species simultaneously.
- The number of fish caught did not significantly affect mean willingness to pay.

Tasmanian Rock lobster fishery

- The mean willingness to pay for the last day of rock lobster fishing was between $81.14 and $95.12, with the most likely value being $87.43.
- This compares with the average amount spent on consumable items for the most recent day's rock lobster fishing, which was $80.76.
- The mean willingness to pay for the day of rock lobster fishing was higher if the respondent:
    - had a higher income;
    - believed the quality of the fishing experience was better; and
    - spent more money on the last day's fishing.
- The use of alternative fishing methods (dive, pot, ring or a mixture of these methods) did not have a significant effect on mean willingness to pay.
- Respondents who expected to remain active in the fishery for at least a further 10 years had a higher willingness to pay than those who thought they were likely to cease fishing for rock lobster within this time period.

[1] All results have been reported at the 5 per cent level of significance.

- In contrast to results for the inshore saltwater fishery, neither the number of people in the fishing party nor the presence of fishers' own children affected fishers' mean willingness to pay.
- The number of rock lobsters caught (either kept or released) had no effect on mean willingness to pay.

Conclusions

- For both the *inshore saltwater fishery* and the *rock lobster fishery*, the level of daily catch did not contribute to a higher willingness to pay for the last day's fishing.
- Recreational fishers' motivations for going fishing are complex and include both consumptive and non-consumptive purposes (for instance enjoyment of spending time with family or friends), and thus the number of fish actually caught of a given species may not be the only determining factor in their willingness to pay.

Table of Contents

1 Introduction

With an estimated 3.36 million participants each year, and a catch of approximately 136 million aquatic animals, recreational fishing is an important leisure activity for many Australians (Henry and Lyle, 2003). In 2000, Tasmania had a per capita participation rate of 29 per cent, which gave it the second highest proportion of recreational fishers in Australia. By 2007 this proportion of population had declined to 26 per cent but owing to population growth there was little difference between years in the number of recreational fishers (around 120,000 persons) (Lyle *et al*. 2009).

In recent years, the growing pressure on some fish stocks in Tasmania has highlighted the need for managers to consider a range of factors when allocating fishing rights between commercial and recreational users. There is increasing support for considering economic factors and maximising the value of the fish resource; and this has lead to calls for more information.

Economic theory suggests that the value of a catch controlled fishery is maximised when fishing rights are distributed to commercial and recreational fishers in such a way that catching one more fish gives them the same benefit each. In practice, this means allocating the total allowable catch in a fishery such that the profit earned by commercial fishers is equal to the benefit gained by recreational fishers for the last fish caught. Achieving the economically best allocation of fishing rights between commercial and recreational fishers therefore requires regulators to have an idea of the value of additional fish to both groups.

More generally, information about the value of recreational fishing may be a useful policy input to assist regulators in making decisions regarding policies and programs that impact on the experiences of the affected fishers in the state.

Unlike some activities, fishing is not bought or sold in a market. Where goods are traded on a market, price data is available that can be used directly in determining participants' willingness to pay for an additional unit. By their very nature, however, non-market goods require the use of methods that do not rely on observed data from market transactions.

A number of such methods exist, and in this report we present results from two survey based approaches that were used to determine a valuation for Tasmanian recreational fishers in both the *inshore saltwater fishery* and the *Tasmanian rock lobster fishery*.

Tasmanians, in general, may value recreational fishing for a number of reasons other than for the actual experience of fishing. They may not currently go fishing, but value that they can go fishing should they ever want to. Alternatively they may have no inclination to ever go fishing, but simply believe that it is valuable because, for instance, they are related to individuals who regularly fish. These values are types of non-use value. Contrary to this, the present report focuses on measuring use value derived by Tasmanian fishers for the actual experience of going fishing.

Our results are reported, by fishery, in terms of the contribution each variable makes to the value respondents place on their last fishing day.

2 Recreational fishing in Tasmania and survey design

2.1 Recreational fishing in Tasmania

The *2007/08 Survey of Recreational Fishing in Tasmania* (Lyle *et al*. 2009) is the most comprehensive survey of Tasmanian recreational fishing to date. According to this survey, the major characteristics of recreational fishers in Tasmania is that they are more likely to be male (with a participation rate of 38 per cent, compared to 18 per cent for females), between the ages of 30 to 44 years. Regionally participation rates vary between 24 per cent in the Mersey-Lyell area (north-west) and 33 per cent amongst residents of rural southern Tasmania.

Lyle *et al*. (2009) report a measure of fishing effort known as total fisher-days, that is the cumulative number person days spent recreational fishing by Tasmanian residents. Between December 2007 and November 2008 approximately 128 000 Tasmanians accounted for around 640 000 fisher-days of effort, the median number of days fished being five days per person. The distribution of fishing effort within the fisher population is, however, highly skewed, with just 20 per cent of all fishers accounting for 56 per cent of the total effort (fisher-days).

For the purposes of the research reported here, we have broadly disaggregated fishing activity in Tasmania into seven major classifications: dive fishing, freshwater fishing, game fishing, inshore saltwater fishing, net fishing, offshore bottom fishing and fishing for rock lobster using pots and/or rings. As outlined in the introduction, this valuation exercise has focussed on two fisheries: the *inshore saltwater fishery* and the *rock lobster fishery*. The latter of which encompasses components of the dive fishery and the use of rock lobster pots and rings.

Inshore saltwater fishery

The inshore saltwater fishery is defined as line-fishing in marine waters within five kilometres from the coast targeting a range of inshore marine and estuarine fish species. As such, the inshore saltwater fishery attracts both shore and boat based fishing and is often associated with a range of other fishing activities (e.g. dive collection, spearing, and recreational netting). A disproportionately high amount of fishing effort in this fishery is concentrated in the waters off Tasmania's south-east coast (Lyle *et al*. 2009), reflecting the relatively unrestricted fishing access provided by sheltered waters, close proximity to the largest population centre in Tasmania, and a diverse array of fish species and habitats within the south east. Despite a diversity of species taken by the fishery, flathead (*Platycephalus* spp.) accounted for 76 per cent of the recreational scalefish caught (by number) within the inshore saltwater fishery in the most recent state-wide fishing survey (Lyle *et al*. 2009).[2]

[2] Refer to Lyle (2005) and Lyle *et al*. (2009) for more information about the inshore saltwater fishery in Tasmania.

Rock lobster fishery

Southern rock lobster (*Jasus edwardsii*) are highly prized by Tasmanian recreational fishers for their excellent eating qualities. Lobsters are primarily targeted using three capture methods; dive collection and the use of lobster pots and lobster rings (hoop nets). Recreational access to the fishery is largely boat based and participants require a method-specific licence, *i.e.*, separate licences are required for each capture method. The popularity of lobster fishing in Tasmania has increased markedly in recent years. Since the present licensing system was introduced in 1995, the number of licensed fishers has increased from around 8500 to over 21,000.[3]

2.2 Survey design

The survey instrument for both fisheries was a structured questionnaire composed of five parts that was administered by telephone. The first provided an introduction and background to the survey; the next two sections asked questions about respondents' general attitudes toward fishing, and their fishing activities over the previous twelve months. The fourth section required a series of answers about the respondents' experience on their most recent day's fishing and posed two willingness to pay questions. The final part collected demographic, occupation and income information from each respondent.

The surveys were designed as inputs into two separate contingent valuation exercises known as double bounded dichotomous choice contingent valuations. These can be used to measure marginal values per fish, as well as the average values of a fishing day to recreational fishers in both fisheries. The questions are described as 'bounded' because they cannot measure willingness to pay above or below a certain level, 'dichotomous' because they can only be answered as either 'yes' or 'no', and 'double' because the question is asked twice using different payment values.

The 'double' questions used for the survey are reproduced below as (Q1) and (Q2):

"Bearing in mind that you have many calls on your income, if it had cost you an extra $XX on [the total cost of consumable items purchased for the day's fishing] for this day's fishing only would you still have gone fishing on that day?" (Q1)

"... and would you have still gone fishing on that day if it had cost you an additional $YY?" (Q2)

In both cases the survey was pre-tested and a range of values were chosen for $XX in (Q1) above. These values were then randomised according to a uniform probability distribution, and a unique set of valuation questions was generated in which $YY was calculated as either double of half of $XX[4] respectively, depending upon whether the participant responded in the affirmative or negative to the initial bid.

[3] Concurrent with this rise in popularity, six comprehensive biennial catch and effort surveys of the recreational lobster fishery have been conducted since 1996. See Lyle and Tracey (2010) for the most recent survey report. A recent socio-economic evaluation of Tasmanian lobster fishers has also been completed (Frijlink and Lyle, 2010).

[4] Initial bid amounts of $10, $20, $30, $40, $50 or $60 were used for both surveys. These 'initial bid values' were determined by survey pretesting.

Selection of the Survey Groups for the Contingent Valuation Surveys

The survey group for the inshore saltwater fishery were chosen from a sample of fishers used in the *2007/08 Survey of Recreational Fishing in Tasmania* (Lyle *et al*., 2009). At the completion this survey all respondents were asked if they would participate in a follow-up socio-economic survey. Those indicating that they would be interested and had done some fishing during 2007/08 were included in the sample group for the follow-up study which was conducted in mid-2009 (some six months after the completion of the 2007/08 survey). This group consisted of 604 households, which became a net sample of 486 households after non-contacts and ineligible households[5] were removed. Of these, 480 (98.7 per cent) households fully responded, with 314 reporting that their most recent day's fishing included activities that met the definition of the inshore saltwater fishery and hence were considered in scope. Excluding those who provided inconsistent responses or gave answers protesting the valuation component of survey, the usable sample was reduced to 293 households.

In the case of the rock lobster fishery, the survey group were selected from those licence-holders surveyed for the *Tasmanian Recreational Rock Lobster and Abalone Fisheries: 2008/09 Fishing Season* (Lyle *et al*., 2010). The valuation survey was conducted after the completion of the 2008/09 survey in late 2009/early 2010, with 674 licence-holders identified in the sample group. Discounting non-contacts and ineligible respondents, 97.3 percent of the net sample fully responded. Of the 622 fully responding licence-holders, 423 had actively fished for rock lobster during 2008/09 and were considered in scope. After removing protesters to the valuation questions and responses for which daily cost information was contradictory, a usable sample of 384 fishers was available for the contingent valuation exercise.

[5] i.e. .households in where the respondent answering the survey was less than eighteen years of age.

3 Data description

3.1 Inshore saltwater fishery

Demographics

The demographic characteristics of the sample are summarised in Table 1. The predominance of males (79 per cent) among the survey group was consistent with a general trend observed in Australian recreational fisheries (Henry and Lyle 2003; Lyle *et al.* 2009). The median age range of survey participants was 40-50 years and the median range of average annual personal income was $40 000 to $60 000, which was higher than the average total income for Tasmanian adults reported by the Australian Bureau of Statistics for 2007/08 ($37 718). About 60 per cent of the sample worked full-time.

Table 1 Demographic characteristics – inshore saltwater fishery

	Description	Mean	Std Dev
Male	Gender (male = 1, female = 0)	0.79	0.41
Age[a]	Age (< 20 = 1, 20-29 = 2,…, 60-69 = 6, > 69 = 7)	5	1.34
Income[a]	Income (< $20k = 1, $20k-$40k = 2, $80k-$100k = 5, > $100k = 6)	3	1.33
Fulltime	Currently working full time (yes = 1, no = 0)	0.6	0.49

[a] These variables are categorical variables and the median values, instead of the mean values, are reported.

Annual Fishing Activity

On average, respondents reported fishing 14.7 days in the 12 months prior to July 2009 (Table 2), substantially more days than that determined by Lyle *et al.* (2009) for Tasmanian fishers. The primary reason for the higher value is that the current estimate was based on recalled activity and thus subject to the effects of recall bias. Average annual fishing related expenditure by fishers (households) was estimated at $2 641[6] ,while the median value was $600. The great dispersion between the mean and median values indicates a skewed distribution of annual expenditure[7]. Approximately 80 per cent of respondents indicated that inshore saltwater fishing was their main fishing activity in the 12 months prior to July 2009. Nonetheless, 64 per cent of respondents also did some other type(s) of fishing in Tasmania. Nearly half of the survey sample indicated owning a boat used for recreational fishing.

Respondents were also asked how often they generally practised voluntary catch and release fishing, *i.e.*, the volitional non-retention of fish that are of legal size and within possession limits. From the five point Likert-type scale presented to respondents, the median value of two corresponded with "rarely". Whilst catch and release fishing is growing in popularity as a means of minimising one's impact on fish populations, especially for 'sport' fish such as tunas and trout (Arlinghaus *et al*. 2007), the species caught by respondents within the inshore saltwater fishery are generally caught for consumptive purposes (Lyle *et al*. 2009).

[6] This value is much greater than that in Campbell and Murphy (2005). This is partly because the annual expenditure value reported in Campbell and Murphy is based on 6.55 fishing days per year, whereas the average fishing days is 14.7 in this study.

[7] The total annual expenditure on fishing and fishing related items by all Tasmanian fishing households (not just those in scope with this study) was estimated to the order of $170M during 2008/09.

Table 2 Annual fishing activity and characteristics of the last day's fishing.

Variable	Description	Mean	Std Dev
a) Annual fishing activity			
Days	The number of days spent fishing in the last 12 months	14.67	18.31
ISF_main	Inshore saltwater fishing is the main fishing activity	0.80	0.40
OtherFishing	Respondent did in other type of fishing (yes = 1, no = 0)	0.64	0.48
CatchRelease[a]	How often catch and release is practiced (never = 1,…, always = 5)	2	1.17
AnnualCost	Annual spending on recreational fishing ($)	2641	10508
OwnBoat	Own any boat(s) used for fishing (yes = 1, no = 0)	0.46	0.50
b) Last days fishing activity			
Hours	The amount of time spent fishing on the most recent day of fishing	4.47	1.34
FH_Target	Specifically targeted flathead (yes = 1, no = 0)	0.48	0.50
Oth_Target	Specifically targeted other species (yes = 1, no = 0)	0.19	0.39
Non_Target	Did not target any species (yes = 1, no = 0)	0.10	0.29
AverageKept	Average number of fish kept	4.60	5.99
AverageRel	Average number of fish released	4.89	6.99
Boat	Fished from boat (yes = 1, no = 0)	0.65	0.48
Shore	Fished from a shore (yes = 1, no = 0)	0.23	0.42
Jetty	Fished from a jetty (yes = 1, no = 0)	0.13	0.33
Importance[a]	How important fishing was on that fishing day (most important = 3,…, less important = 1)	3	0.62
OtherPersons	The number of other persons in the fishing party	2.03	1.81
Children	Respondent went fishing with his/her children (yes = 1, no = 0)	0.38	0.49
Cost	Total amount spent for the last day of fishing	42.79	41.97

[a] These variables are categorical variables and the median values, instead of the mean values, are reported.

Most recent day's fishing activity

Table 2 summarises the characteristics of the most recent or last day's fishing activity prior to interview in July 2009. The table shows that respondents spent an average of nearly 4.5 hours engaged in fishing activity on that day and boats were the most popular fishing platform. About 88 per cent of respondents reported fishing with other people, suggesting that social values are an integral aspect of fishing activity within the inshore saltwater fishery. On average, respondents reported fishing with two other people and almost 40 per cent of respondents further indicated that their children accompanied them on their last fishing trip. Respondents were asked to rate the importance of fishing relative to other activities undertaken on that day, the median response suggested that fishing was, overall, the most important activity undertaken.

Respondents reported spending an average of $42.79 on personal expenditure items for their fishing day (Table 2)[8]. The items include terminal tackle[9] (i.e. leaders, hooks, swivels, and lures),

[8] This includes items purchased prior to the fishing day for consumption on the fishing day.
[9] Major fishing tackle items such as rods and reels were excluded.

bait, food and drinks, ice, car and boat fuel. As expected, boat based fishers incurred greater average costs ($44.04) than shore based fishers ($36.25).

About 90 per cent of respondents reported targeting specific fish species (Table 2). Flathead (*Platycephalus* sp.) were the most popular target species with almost half of the survey population reporting targeting them. This observation is consistent with the predominance of flathead among all species caught (Fig. 1). The next most popular target species were Australian salmon (*Arripis trutta*), squid (*Nototodarus gouldi* and *Sepioteuthis australis*) and black bream (*Acanthopagrus butcheri*). Table 2 shows that the mean number of fish caught by individuals was 4.6, but this was highly variable among respondents. The mean number of fish released was 4.9 and was also highly variable[10].

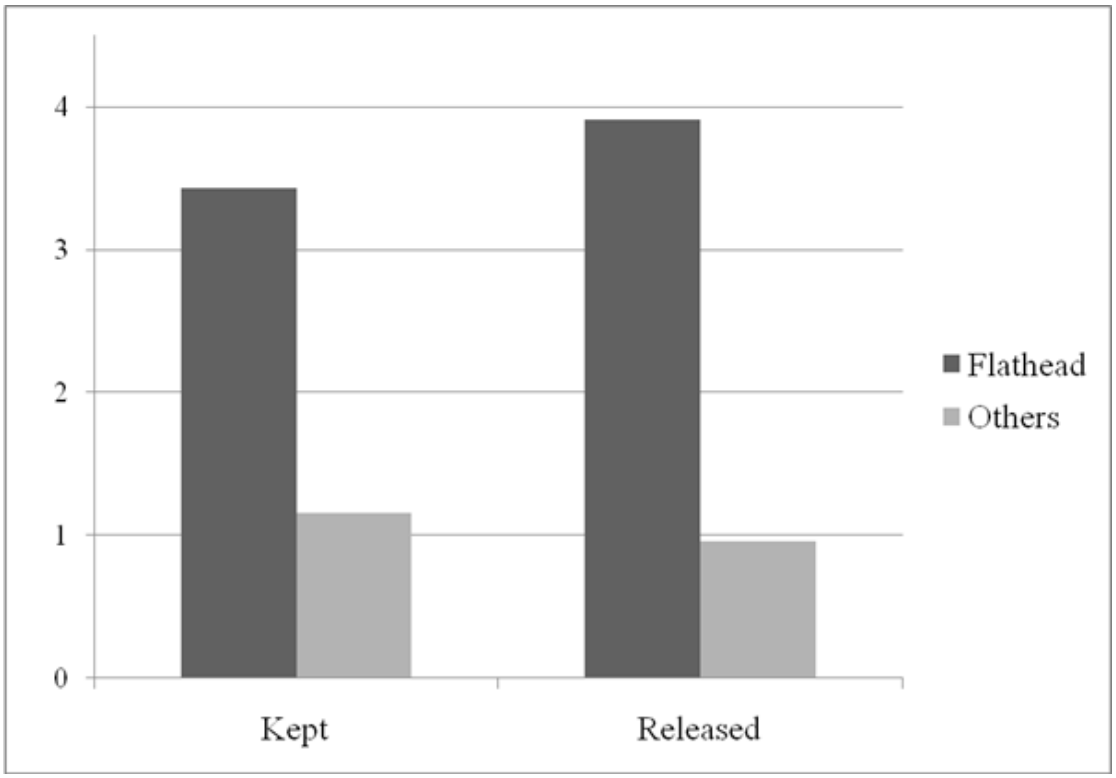


Fig. 1. Average numbers of fish personally kept and released in the most recent day's fishing by all respondents.

The main motivation for the most recent day's fishing is summarised in Fig. 2. Spending time with friends and family was the most popular motivational factor, a finding that is consistent with results observed for the wider Tasmanian fishing population (Frijlink and Lyle 2010b). In descending order, the next most prominent motivations were "to enjoy the outdoors" (28 per cent), "to catch fish for eating" (18 per cent) and "to fish for sport" (3 per cent). This further stresses the importance of social dimensions within recreational fishing in the inshore saltwater fishery.

[10] It should be noted that this statistic does not distinguish between voluntary and involuntary releases. Nonetheless, based on participants' responses to the catch and release question it is probable that most fish released were done so as a results of adherence to regulations, namely release of sub-legal sized fish (refer also to Lyle *et al.* 2009).

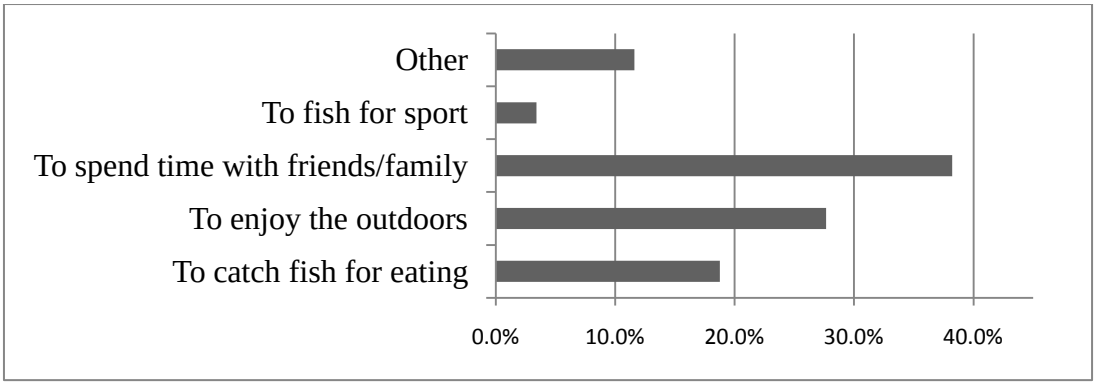


Fig. 2 Relative importance (%) by stated main motivation for the most recent day's fishing

3.2 Rock lobster fishery

Demographics

In the rock lobster fishery the sample group was dominated by males (92 per cent). The median annual gross income value range was $40 000 – $60 000, higher than the average personal income for Tasmanian adults. Furthermore, 74 per cent of respondents were employed on a full time basis.

Table 3 Demographic characteristics – rock lobster fishery

	Description	Mean	Std Dev
Male	Gender (male = 1, female = 0)	0.92	0.27
Income[a]	Income (< $20k = 1, $20k-$40k = 2, $80k-$100k = 5, > $100k = 6)	3	1.45
Fulltime	Currently working full time (yea = 1, no = 0)	0.74	0.44

[a] The variables with asterisk are categorical variables and the median values, instead of the mean values, are reported.

Rock lobster fishing details

On average, survey participants reported over 20 years fishing experience for rock lobster (Table 4). About 77 per cent of respondents reported owning a boat used for lobster fishing. The mean and median values of personal annual fishing related expenses were $7 376 and $2 000, respectively[11].

Only 17 per cent of respondents indicated that lobster fishing was their main recreational fishing activity, a result reflecting the diversity of fishing types undertaken by many Tasmanian fishers (Lyle *et al*. 2009) and the observation that trips involving lobster fishing were generally undertaken associated with other types of fishing (Frijlink and Lyle, 2010a). When asked about the likelihood of continuing to fish for rock lobster in one year, five years and ten years time, the

[11] Similar to the inshore saltwater fishery, the great dispersion between the mean and median values is because of the highly skewed distribution of the annual expenses.

percentages of respondents who responded positively were 93, 89 and 78, respectively, implying a high level of commitment and interest in the rock lobster fishery.

Table 4 Lobster fishing details and characteristics of the most recent (last) day's fishing activity

Variable	Description	Mean	Std Dev
a) Lobster fishing details			
Experience	Years of experience in rock lobster fishing in Tasmania	20.79	15.06
Plan1	Plan to still go lobster fishing in the next season (yes = 1, no = 0)	0.93	0.26
Plan5	Plan to still go lobster fishing in 5 years time (yes = 1, no = 0)	0.89	0.31
Plan10	Plan to still go lobster fishing in 10 years time (yes = 1, no = 0)	0.78	0.41
Management[a]	Satisfaction with the overall management of the recreational lobster fishery (very satisfied = 1,…, not at all satisfied = 4)	2	0.61
RLmain	Rock lobster fishing/diving is the main fishing activity (yes = 1, no = 0)	0.17	0.37
AnnualCost	Annual spending on lobster fishing ($)	7376	21523
OwnBoat	Own any boat(s) used for fishing/diving (yes = 1, no = 0)	0.77	0.42
b) Last day's fishing activity			
FishOthers	Did other types of fishing (yes = 1, no = 0)	0.68	0.47
Importance[a]	How important fishing was on that fishing day (most important = 3,…, less important = 1)	3	0.64
Condition[a]	Overall whether and water conditions (excellent = 5,…, terrible = 1)	4	1.00
OtherPersons	The number of other persons in the fishing party	2.51	1.89
Children	respondent went fishing with his/her children (yes = 1, no = 0)	0.18	0.38

[a] The variables with asterisk are categorical variables and the median values, instead of the mean values, are reported.

The variable "Management" shown in Table 4 corresponded to fishers personal satisfaction with the overall management of the lobster fishery. The mean response of 2 indicated that, on average, respondents were generally "satisfied" with management.

To elicit recreational fishers' preferences towards management options to reduce the catch, if necessary, in the fishery, respondents were asked:

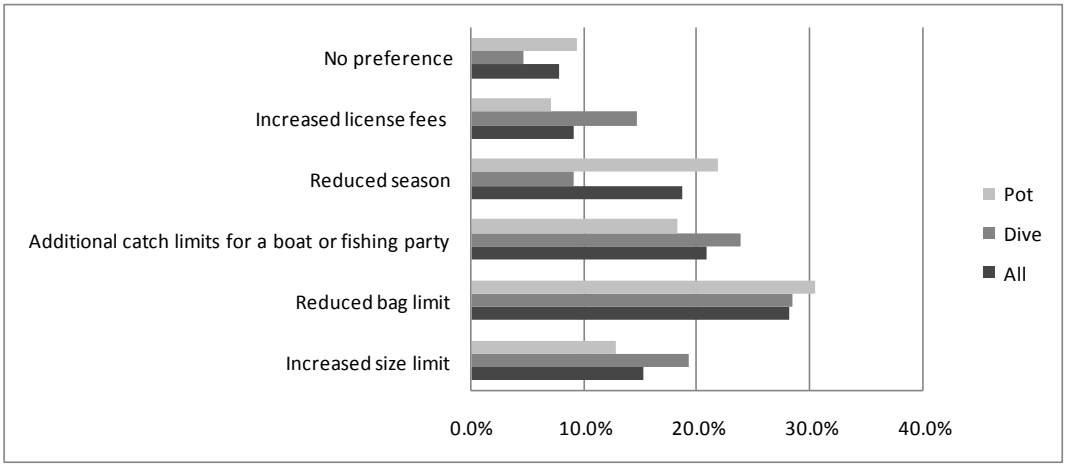
"Suppose there was a clearly demonstrated need to reduce the recreational catch of rock lobsters, such as concerns over low stock numbers. Of the following management options which would be your least preferred option? What about your most preferred option?"

Fig. 3 describes the most and least preferred options for reducing the recreational catch in the fishery and is also reported by respondents' primary fishing method. In decreasing order, the three most preferred measures were to: reduce bag limits, introduce additional possession limits for large fishing parties or to reduce season length.

More than 30 per cent of respondents reported that increasing license fees would be their least preferred option. Reducing bag limits and increasing size limits were the second and third least preferred options amongst respondents. The option of reducing bag limits appeared both in the most preferred and least preferred set of management options and highlights the dichotomy in views amongst rock lobster fishers.

Responses for pot and dive fishers were similar for the management options proposed, with the exception of reductions to season length. Dive fishers were much less likely to endorse this management option than pot fishers.

(a) Most preferred management option



(b) Least preferred management option

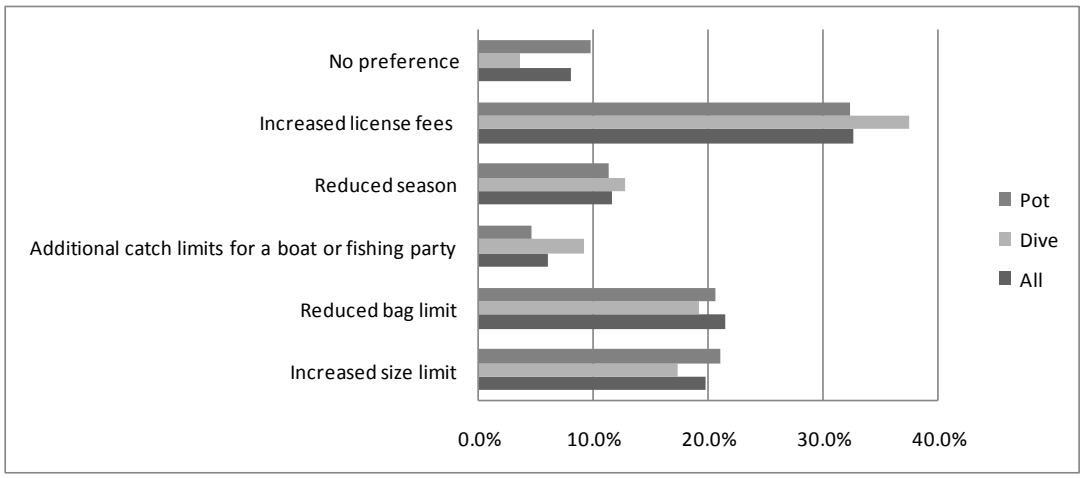


Fig. 3. Most preferred and least preferred management options to reduce the recreational catch of rock lobsters

Most recent day's fishing activity

The proportion of respondents using the different rock lobster fishing methods and numbers of rock lobsters kept and released on their most recent (last) day's fishing for rock lobster during the 2008/09 season is summarised in Table 5. Pot fishing was the most commonly used fishing method (65.0 per cent) among respondents, followed by dive-only (27.7 per cent). Less than 5 per cent of the respondents reported using other fishing methods, including rings, or combined fishing methods during their last day's fishing. The average number of lobsters caught by dive-only fishers was over double that for pot-only fishers, a finding that is consistent with the observations reported by Lyle and Tracey (2010). It should be noted that the number of rock lobsters caught was highly variable between respondents, with a large proportion of respondents catching no rock

lobsters on their last day's lobster fishing (e.g., 56.7 per cent for pot-only and 42.2 per cent for dive-only fishers).

Table 5 Proportion (%) of respondents using the different rock lobster fishing methods and the numbers of rock lobsters kept and released for the last day's fishing

		Dive	Pot	Ring	Dive and Pot	Ring and Pot	Others
Fishing methods		27.7%	65.0%	2.8%	2.0%	1.8%	0.8%
Kept	mean	1.71	0.68	-[a]	-[a]	-[a]	-[a]
	std dev	1.96	1.13				
Released	mean	0.31	0.36	-[a]	-[a]	-[a]	-[a]
	std dev	1.02	0.99				

[a] The sample size is too small to obtain reliable estimates.

Other fishing and non-fishing activities are often pursued on rock lobster fishing trips. For example, dive fishers often also target abalone (*Haliotis* spp.) and pot and ring fishers often line fish for scalefish while the rock lobster gear is fishing. In recognition of this behaviour, fishers were asked to rate the importance of lobster fishing relative to other activities undertaken on their latest rock lobster fishing day. The median response suggests that fishing for lobsters was, overall, the most important activity undertaken for most respondents. Furthermore, 61 per cent of respondents indicated that the day surveyed was part of a multiple day fishing trip. With regard to social factors, respondents reported fishing with an average of 2.5 other persons, and almost 20 per cent of fishers reported fishing with their own children (Table 4). Only 4.4 per cent of respondents reported fishing by themselves. These results underscore the importance of social factors as key components of the lobster fishing experience (Frijlink and Lyle, 2010a).

Survey participants reported spending an average of $80.76 on personal expenditure items for their fishing day (Table 4)[12]. Mean daily expenditures were not significantly different between pot fishers ($76.66) and dive fishers ($84.21), despite different expense items incurred by virtue of fishing method.

Fishers were also asked to disclose what they considered to be their main motivation for fishing on the day (Fig. 4). Of the nine items used in this study, the five most prominent motivators in descending order were "to spend time with family" (16.3 per cent), "to be outdoors" (15.4 per cent), "for the enjoyment or challenge of catching lobsters" (14.2 per cent), "to catch lobsters to eat" (13.5 per cent) and "to spend time with friends" (12.5 per cent). The relatively high result pertaining to catching lobsters to eat suggests a consumptive focus among Tasmanian lobster fishers, an observation also recognised by Frijlink and Lyle (2010a). The two least prominent motivations were "to catch a trophy sized lobster" (1 per cent) and "to be on your own" (2 per cent). Divers tended to rate the enjoyment or challenge of catching lobsters more highly than pot fishers while pot fishers rated the importance of catching lobsters to eat and spending time with family more highly than divers.

[12] This included items purchased prior to the fishing day for consumption on the fishing day. The purchased items included bait, food and drinks, ice, car and boat fuel, air tank fills for SCUBA divers and compressor fuel for hookah divers

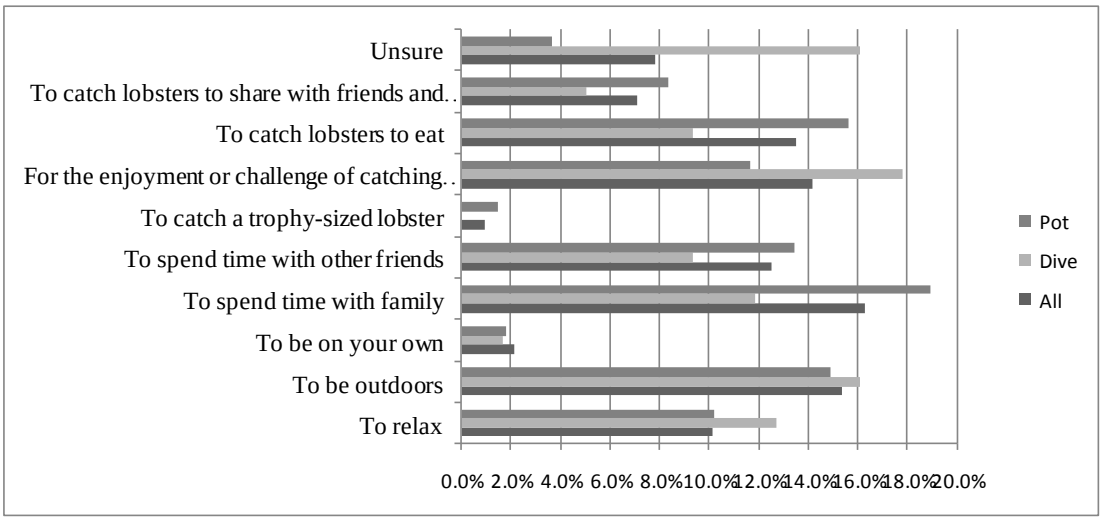


Fig. 4. Main motivations for the most recent (last) day's rock lobster fishing based on fishing methods used.

4 Recreational value of fishing in Tasmania

4.1 Non-market valuations of recreational fishing activity

Decisions about allocating fishing entitlements to the recreational fishing sector and about policies that will affect the quality of the recreational fishing experience ideally need to be informed by some knowledge of the value of recreational fishing. However, while demand curves can be estimated from market data for goods and services such as bread, international travel and fish, we cannot turn to the information reflected in actual market transactions to tell us how people's welfare will be effected by a change in either the availability or quality of recreational fishing experiences.

Economists have responded to the challenge of providing empirical estimates of the value of traditionally non-marketed outputs by developing a number of non-market valuation techniques, which have been broadly classified as relying on either *revealed* or *stated* preferences. Revealed preference methods use observations of recreational fisher's behaviour in actual or related markets to infer economic value while stated preference methods draw inferences about value from responses to hypothetical questions.

Within the set of revealed preference methods, the major techniques are the travel cost model and hedonic pricing. The travel cost model uses the costs of travel to the site of a recreational activity to develop a trip generation function (Perman *et al*. 2003), which can be used to simulate demand and subsequently measure consumer surplus. Hedonic pricing (due to Rosen 1974) is where the value of non-market goods is inferred from prices of related (market) goods, for example the value of an estuary is inferred from the price of the abutting real estate.

Within stated preference methodologies, the major approaches are choice experiments and the contingent valuation method. Choice experiments present a respondent with a series of decisions between different versions of the same good. For example, in the case of a fishing day, a choice experiment might proceed by asking a respondent to identify their preferred day from two alternatives which differ in at least one of, say, weather conditions, total catch or the cost of consumables.

The contingent valuation method has been applied in this research, and it involves the use of either open ended or closed ('yes'/'no' style) survey questions. We have used a double-bounded dichotomous-choice contingent valuation method in order to estimate respondents' willingness to pay for the most recent day that they spent fishing. This has been the case for both surveys (for inshore saltwater fishing and the rock lobster fishery)[13].

The format of the valuation question is similar to that which was used by Wheeler and Damania (2001). The mechanism which was used in these surveys to represent an increase in the "price" or recreational fishing was a change in the cost of consumable items[14] purchased for the most recent day's fishing. To simulate a price rise, respondents were asked "would you still go fishing if the cost of fuel, bait, tackle, etc.. increased by $XX for your last day's fishing?." If they answered 'yes' the value $XX was doubled, and the survey respondent was asked the same

[13] It is generally well accepted that the double-bounded format is preferred to the open-ended question format (Arrow *et al* 1996).
[14] Those include, for example, bait, fuel for boat/car, food and fishing tackle (but excluding major items such as rods and reels).

question again. If they answered 'no' to the initial question, the value $XX was halved for the second question.

An important issue which has been discussed in the contingent valuation literature is whether asking a follow-up question improves the model estimates. The follow up question provides additional information regarding people's willingness to pay for the non-market good and this makes the estimates more accurate for a survey conducted over a set number of people. It has been observed, however, that the bid amount proposed by the first question can influence respondents' idea of what the non-market good is worth. To test and control for this, we have used a model developed by Whitehead (2002) [15] which includes two common response biases: the *anchoring bias* and the *shift effect*.

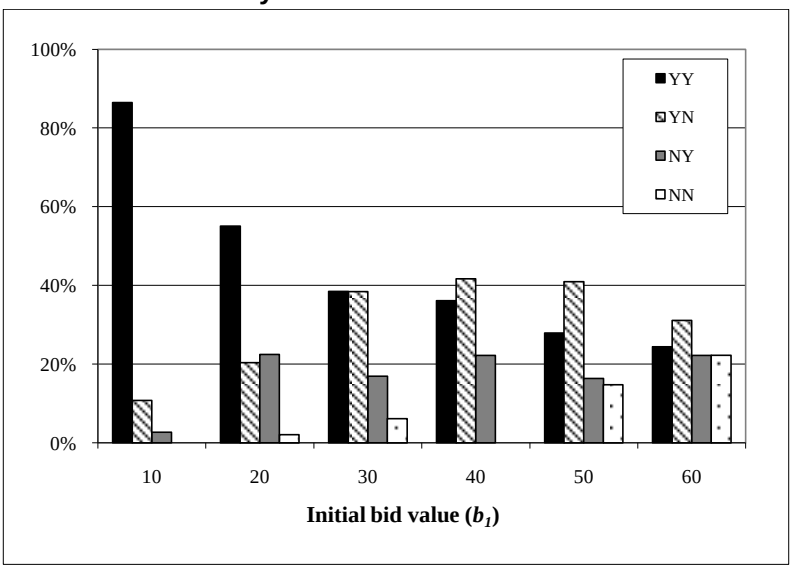
Responses to contingent valuation questions

Fig. 5 shows respondents' answers to the valuation questions for both surveys disaggregated over the initial bid amounts. These graphs have some encouraging features. In particular, the proportion of responses in the {Yes, Yes} category decreases with increases in the initial bid amount. Also, the absence of {No, No} and the low incidence of {No, Yes} responses among people receiving initial bids of $10 suggest that the range of bids has been reasonably well chosen in both cases.

These responses were input to an econometric model developed by Whitehead (2004), and results were estimated using the method of maximum likelihood.

[15] The estimation method was lately corrected by Aadland and Caplan (2004) and Whitehead (2004).

(a) Inshore saltwater fishery



(b) Rock lobster fishery

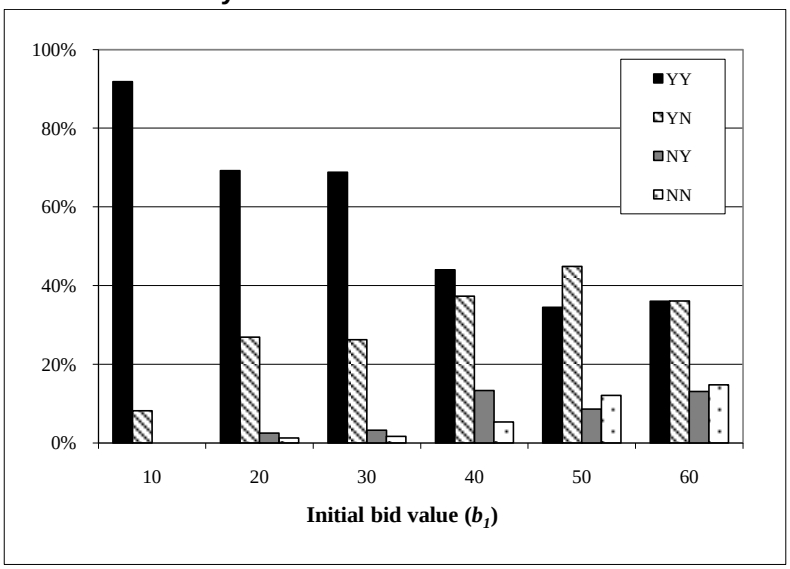


Fig. 5. Distribution of responses to contingent valuation questions for each initial bid

4.2 Estimation results

Inshore saltwater fishery

Table 6 summarises the estimation results for the inshore saltwater fishing[16]. The model estimated that the mean willingness to pay for the most recent day's fishing in the inshore saltwater fishery was $78.18, with a 95 per cent confidence range of $63.53 to $108.38. Table 6 also shows that respondents who specifically targeted flathead, or who did not identify any specific target species, had a lower mean willingness to pay than those who targeted multiple species.

[16] The anchoring and shift effect parameters are both statistically significant, suggesting that the estimates from the model without controlling the anchoring bias and shift effect are likely to be biased.

None of the catch variables were statistically significant, which implies that catching additional fish did not lead to higher willingness to pay for the fishing day. This contrasts with the results found by some other studies (e.g., Wheeler and Damania 2001), where the quantity of fish caught was significant in determining the value of a fishing day. A potential reason for this may be that the fact that the motivation for going fishing is not solely catch related, an observation suggested by the importance of social and environmental factors as motivators for going fishing (refer Fig. 2). Another potential reason is the observation that catch rates for many respondents were relatively high (mean of 7.37 per trip in the case of flathead), and as such additional fish did not make much difference to the amount respondents' were willing to pay for their last day of fishing.

Male respondents showed significantly higher willingness to pay for their last day of fishing than female respondents and willingness to pay was higher if the respondent was working full-time, had spent more on their last day's fishing and had fished from a boat. Furthermore, willingness to pay was positively correlated with the number of people in the fishing party, however the presence of one's own children decreased the value of the fishing day.

Whether the stated main motivation for going fishing was consumptive or non-consumptive did not affect respondents' mean willingness to pay. By contrast, respondents who indicated that their main motivation for going fishing was some reason(s) other than those offered by the interviewer had significantly lower willingness to pay.

Table 6 Estimation results – inshore saltwater fishery

Independent variable[a]	Estimate	*Standard Error*[b]	
Constant	17.12	*30.59*	
As_Caught	-1.21	*3.23*	
Fh_Caught	0.03	*0.44*	
Oth_Caught	1.09	*1.35*	
As_Target	-4.44	*18.58*	
Fh_Target	-16.38	*13.41*	*
Oth_Target	-16.49	*16.80*	
Non_Target	-22.31	*16.05*	*
Male	16.63	*12.61*	**
Age	-3.63	*4.25*	
Fulltime	19.58	*13.45*	*
Income	3.17	*4.65*	
Days	0.05	*0.25*	
Hours	-0.81	*3.24*	
Importance	5.15	*7.91*	
OtherPersons	11.89	*5.29*	***
Children	-15.38	*11.35*	*
MotivOther	-27.93	*16.60*	**
BoatUse	17.55	*12.34*	**
Conditions	1.85	*2.29*	
Cost	0.24	*0.15*	**
σ	52.05	*16.30*	***
γ	0.66	*0.15*	***
δ	3.73	*1.78*	**
log-likelihood	-312.30		
Observations	293		
Mean WTP	78.18		
95% confidence interval[c]	[63.53, 108.38]		

[a] Definitions of the independent variables are presented in Appendix.

[b] *** = 1% level of significance, ** = 5 % level of significance, * = 10 % level of significance

[c] 95% confidence interval is bootstrapped with 500 replications.

Rock lobster fishery

Table 7 summarises the estimation results for the rock lobster fishery. The model estimates that the mean willingness to pay for the most recent (last) day of lobster fishing was $87.43 with a 95 per cent confidence range of $81.14 to $95.12.

Table 7 also shows that respondents who expected to continue fishing for rock lobster for at least the next 10 years had a significantly higher willingness to pay than those who expected to cease fishing for rock lobster sometime within that period. Not unexpectedly, willingness to pay was positively correlated with the quality of the fishing experience on the last day's fishing.

Furthermore respondents who spend more and whose income is higher are likely to have higher willingness to pay.

Unlike inshore saltwater fishing, the number of people in the fishing party and the presence of children did not affect respondents' willingness to pay in the rock lobster fishery. The use of different fishing methods to target rock lobster or the inclusion of other fishing activities on the last day's fishing also did not have a significant effect on willingness to pay.

Interestingly, the number of rock lobster kept and released was not significantly correlated with respondents' willingness to pay for a day of rock lobster fishing. There are several potential reasons for this. Firstly, similar to inshore saltwater fishing, catching lobsters is often not the main motivation for going lobster fishing. For example, around 60 per cent of respondents reported that the main motivation for their last day of lobster fishing was to relax, enjoy the outdoors or spend time with family and/or friends. A recent socio-economic survey also shows that 'relaxation' and 'socialising with friends' are more important motivations than 'catching lobsters to eat' or the 'experience of catching lobsters' (Frijlink and Lyle, 2010a).

Another potential reason for the lobster catch not being a significant determinant of respondents' willingness to pay is that there may have been insufficient variation among respondents in terms of how many lobsters were caught to allow for the effect of these lobsters on willingness to pay to be estimated. Around 75 per cent of pot-only fishers and 54 per cent of dive-only fishers either did not catch a lobster or caught only one lobster on their last fishing day.

Table 7 Estimation results – rock lobster fishery

Independent variable[a]	Estimate	*Standard Error*[b]	
Constant	46.98	*20.98*	**
Kept	-1.82	*2.11*	
Release	0.46	*2.51*	
Experience	0.17	*0.19*	
Plan10	14.13	*6.71*	**
MotOther	1.53	*7.65*	
Rlmain	1.51	*7.37*	
BoatOwn	8.31	*6.45*	
Dive	-15.34	*11.95*	
Pot	-9.35	*11.05*	
OtherFishing	-2.10	*6.19*	
Trip	2.06	*5.91*	
Importance	-7.26	*4.45*	
Quality	5.92	*2.60*	**
OtherPersons	2.04	*1.83*	
Children	-6.06	*7.53*	
Cost	0.11	*0.04*	**
Male	0.15	*9.85*	
Income	4.95	*2.12*	***
σ	41.60	*2.86*	***
γ		_[d]	
δ	-5.29	*1.92*	***
log-likelihood	-352.95		
Observations	384		
Mean WTP	87.43		
95% confidence interval[c]	[81.14, 95.12]		

[a] Definitions of the independent variables are presented in Appendix.

[b] *** = 1 % level of significance, ** = 5 % level of significance

[c] 95% confidence interval is bootstrapped with 500 replications.

[d] The anchoring parameter was statistically insignifncant so that it is excluded from the model.

5 Concluding remarks

We report results of two contingent valuation studies which estimate fishers' willingness to pay for their most recent day's fishing in the Tasmanian *inshore saltwater* and *rock lobster fisheries***.** The mean willingness to pay for the last day of inshore saltwater fishing was $78.18 and for the last day of rock lobster fishing was $87.43. These amounts represent an estimate of the total willingness to pay for the most recent day's fishing. The total willingness to pay is composed of two components. The first is the total fixed and consumable costs *already being paid* for the day's fishing, and the second is the (unobserved) amount that is currently not payed for the recreational fishing good. Since our survey only collected information on respondents' total consumable costs for their last day's fishing, the estimates derived here do not account for the fixed component of costs that is already being paid for that day's fishing. Therefore willingness to pay estimates presented in this report are conservative, and do not represent the total loss of welfare a fisher would experience were they to not have had access to the last day's fishing.

Importantly the level of daily catch did not significantly affect the mean willingness to pay for the last day's fishing in either fishery. In other words, given the current levels of catch (kept and released) reported by respondents, catching additional fish did not significantly affect mean willingness to pay for the day's fishing. This is consistent with the observations that recreational fishers' motivations for going fishing are complex and multi-faceted, and include both consumptive and non-consumptive purposes. *Our result must not, however, be interpreted as implying that fishers do not place a positive value on fish caught as a part of the recreational fishing experience or that they would not be willing to pay to maintain or enhance catch rates, or improve catch composition or quality.*

Unfortunately, our estimation results do not provide a direct explanation for additional catches not being a significant determinant for respondents' willingness to pay for the last day's fishing. While we provide several potential reasons for this in Section 4, another possible reason may be that fishers' willingness to pay is related to their *expectations* of what they will catch rather than what they do catch. If this 'lottery' effect, in which fishers pay for the *chance* to catch fish, is significant, changing the quantity or quality of fish at a given spot may change fishers' willingness to pay for a day's fishing.

We see a need for further investigation into the value of recreational fishing in Tasmania. Extensions of the work presented in this report are needed to deepen our understanding of the value of the fishing experience to individual fishers and of the way in which resource attributes, and the management and governance environment, will affect this. Further non-market valuation studies, incorporating a broader set of methodologies such as choice modelling, can be used here. We also suggest a need for research that explores the impact of changing resource availability on the contribution of recreational fishing activity to regional and State economies, that properly accounts for the adaptive behavioural responses of both fishers and managers.

References

Aadland, D. and Caplan, A.J., 2004. Incentive incompatibility and starting-point bias in iterative valuation questions: comment. *Land Economics*, **80**: 312-315.

Arlinghaus, R., Cooke, S.J., Lyman, J., Policansky, D., Schwab, A., Suski, C.D., Suttton, S. and Thorstad, E.B., 2007. Understanding the complexity of catch and release in recreational fishing: an integrative synthesis of global knowledge from historical, ethical, social and biological perspectives. *Reviews in Fisheries Science*, **15**: 75-167.

Arrow, K., Solow, R., Portney, P.R., Leamer, E.E., Radner, R. and Schuman, H., 1993. Report of the NOAA panel on contingent valuation. *Federal Register*, **58**: 4601-4614.

Campbell, D. and Murphy, J.J., 2005. The 2000/01 national recreational fishing survey: economic report. Department of Agriculture, Fisheries and Forestry, Canberra.

Frijlink, S.D. and Lyle, J.M., 2010a. A socio-economic assessment of the Tasmanian recreational rock lobster fishery. *TAFI Report*, Tasmanian Aquaculture and Fisheries Institute, Hobart.

Frijlink, S.D. and Lyle, J.M., 2010b. An evaluation of motivations, attitudes and awareness of Tasmanian recreational fishers. *TAFI Report*, Tasmanian Aquaculture and Fisheries Institute, Hobart.

Henry, H and Lyle, J.M., 2003. The National Recreational and Indigenous Fishing Survey, Australian Government Department of Agriculture, Fisheries and Forestry, FRDC Project No. 99/158.

Lyle, J.M., 2005. 2000/01 survey of recreational fishing in Tasmania, *TAFI Technical report*, Tasmanian Aquaculture and Fisheries Institute, Hobart.

Lyle, J.M., Tracey, S.R., Stark, K.E. and Wotherspoon, S., 2009. 2007-08 survey of recreational fishing in Tasmania, *TAFI Technical Report*, Tasmanian Aquaculture and Fisheries Institute, Hobart.

Lyle, J.M. and Tracey, S.R. 2010. Tasmanian recreational rock lobster and abalone fisheries: 2008/09 fishing season. *TAFI* Report, Tasmanian Aquaculture and Fisheries Institute, Hobart.

Perman, R., Ma, Y., McGilvray, J. and Common, M., 2003. *Natural resource and environmental economics*. Person, London.

Wheeler, S. and Damania, R., 2001. Valuing New Zealand recreational fishing and an assessment of the validity of the contingent valuation estimates. *The Australian Journal of Agricultural and Resource Economics*, **45**: 599-621.

Whitehead, J.C., 2002. Incentive incompatibility and starting-point bias in iterative valuation questions. *Land Economics*, **78**: 285-297.

Whitehead, J.C., 2004. Incentive incompatibility and starting-point bias in iterative valuation questions: reply. *Land Economics*, **80**: 316-319.

Appendix: independent variables

A1 Inshore saltwater fishery

Independent variable	Description
Constant	A constant term
As_Caught	The number of Australian salmon caught
Fh_Caught	The number of flathead caught
Oth_Caught	The number of other species caught
As_Target	Specifically targeted Australian salmon (yes= 1, no = 0)
Fh_Target	Specifically targeted flathead (yes= 1, no = 0)
Oth_Target	Specifically targeted other species (yes= 1, no = 0)
Non_Target	Not targeted any species (yes= 1, no = 0)
Male	Gender (male = 1, female = 0)
Age	Age (<20 = 1, 20-29 = 2, …, 60-69 = 6, >70 = 7)
Fulltime	Currently working full time (yes= 1, no = 0)
Income	Income (<$20k = 1, $20k-40k = 2, …, $80k-100k = 5, >$100K = 6)
Days	The number of days spent fishing in the last 12 months
Hours	The amount of time spent fishing on the most recent day of fishing
Importance	How important fishing was on the most recent day of fishing
OtherPersons	The number of other persons in the fishing party
Children	Respondent went fishing with his or her children (yes = 1, no = 0)
MotivOther	The main motivation for going fishing was other than the ones listed in the survey (yes = 1, no = 0)
BoatUse	Fished from boat (yes = 1, no = 0)
Conditions	Overall fishing condition (excellent = 5,…, terrible = 1)
Cost	Total amount spent for the last day of fishing

A2 Rock lobster fishery

Independent variable	Description
Constant	A constant term
Kept	The number of rock lobsters kept
Release	The number of rock lobsters released
Experience	Years of experiemce in rock lobster fishing in Tasmania
Plan10	Plan to go lobster fishing in 10 years time (yes = 1, no = 0)
MotOther	The main motivation for going lobster fishing/diving was other than the ones listed in the survey (yes = 1, no = 0)
Rlmain	Rock lobster fishing/diving is the main fishing activity (yes = 1, no = 0)
BoatOwn	Own any boat(s) used for fishing/diving
Dive	Fishing method on the last day of lobster fishing was 'dive' (yes = 1, no = 0)
Pot	Fishing method on the last day of lobster fishing was 'pot' (yes = 1, no = 0)
OtherFishing	Did other types of fishing on the last fishing day (yes = 1, no = 0)
Trip	The last lobster fishing was a part of a multi-day trip (yes = 1, no = 0)
Importance	How important fishing was on that fishing day (most important = 3,…, less important = 1)
Quality	Overall fishing quality based on number of lobsters and fish caught on the last day of fishing/diving (excellent = 5,…, terrible = 1)
OtherPersons	The number of other persons in the fishing party
Children	Respondent went fishing with his or her children (yes = 1, no = 0)
Cost	Total amount spent for the last day of lobster fishing
Male	Gender (male = 1, female = 0)
Income	Income (<$20k = 1, $20k-40k = 2, …, $80k-100k = 5, >$100K = 6)