
Advancing Marine Policy Toward Ecosystem-Based Management by Eliciting Public Preferences

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ABSTRACT

The implementation of marine protected areas, such as marine reserves and customary fishing areas, is considered an important step toward advancing ecosystem-based management (EBM), but has proven difficult due to resistance from well-organized fishing interests. This raises the question of how the values of less well-organised parties can be brought into the political decision-making process. We summarise the results of a discrete choice survey of the general public in New Zealand that elicits willingness to make trade-offs among taxes and four socio-ecological attributes: biodiversity, maintenance of Maori customary practices, and restrictions on commercial and recreational fishing. We apply cluster analysis, which provides information about political 'market shares' of respondent preferences, and derive estimates of average public willingness to pay for various policy scenarios. Both analyses reveal broad-scale support for conservation of biodiversity and cultural practices, providing quantifiable input from the public in the process of marine space reallocation.

Key words: Fisheries, spatial conflict, choice experiment, public preferences.

JEL Codes: Q22, Q51, Q57.

INTRODUCTION

Unregulated access to a scarce resource, such as a marine fishery, often leads to its inefficient use. Hardin's metaphor of the "tragedy of the commons" (Hardin 1968) and Gordon's analysis of an "open-access fishery" (Gordon 1954) expose the fundamental causes. Unrestricted access to harvest leads to economic inefficiency as each individual fisher lacks incentive to respond to low fish stock levels or damage to the marine ecosystem, subsequently lowering future economic returns. Most recent efforts to manage marine areas have focussed on improving or maintaining commercial returns from fishing. Fisheries management is, however, evolving from regulatory controls on fishing inputs and outputs, to a more holistic approach, known previously as ecosystem management (Grumbine 1994) and more recently as ecosystem-based management (EBM) (Curtin and Prellezo 2010). The goal of EBM is not only to take into account the effects of fishing on the broader ecosystem, and vice versa, but also to consider the broader range of human interactions with the ecosystem, including, for example, maintenance of customary practices, tourism, and public non-use values.

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Implementation of EBM has, however, been slow (e.g., Garcia and Cochrane 2005; Arkema, Abramson, and Dewsbury 2006; Curtin and Prellezo 2010). One could argue that achieving sustainable socio-ecological systems requires a “seismic shift in the mind-set of humans” (Grumbine 1994). Such a large shift may have to occur through incremental changes in policy. One option is to extend practices already established on land to marine areas. Protection of biodiversity is a critical part of EBM, and networks of protected marine areas could be built around a system of core marine reserves and buffer zones connected by habitat corridors (Grumbine 1994; Macleod, Lynch, and Hoagland 2009). Marine space could also be allocated to maintain sustainable social interactions with the marine environment, such as longstanding traditional or customary uses. The implementation of such spatial zoning to implement these various management tools within a framework of marine protected areas (MPAs) or, more broadly, Biosphere Reserves that take the interests of multiple stakeholders into account, has been credited with playing a crucial role in putting the EBM concept into practice (Bridgewater 2002; Douvère 2008; Angulo-Valdés and Hatcher 2010).

However, establishing MPAs has often proven difficult due to opposition from well-organized incumbent fishing interests (e.g., Wolfenden, Cram, and Kirkwood 1994; Suman, Shivlani, and Milon 1999; Taylor and Buckenham 2003; Grafton, Kompas, and Schneider 2005). This raises the question of how the political process can be influenced to continue to work toward economic efficiency on a broader scale; i.e., one that includes the values of interested parties in addition to commercial and recreational fishers. Large-scale nationally or regionally representative surveys offer the opportunity to canvas the preferences of the general public. Non-market valuation techniques allow the expression of those preferences in monetary terms, which is useful both politically and from a cost-benefit perspective.

In this article, we summarise the previously reported results of a discrete choice survey of the general public in New Zealand that elicits stakeholder preferences to make tradeoffs among changes in taxes and four socioecological attributes: biodiversity, maintenance of Māori customary cultural practices, and restrictions on commercial and recreational fishing in nearshore marine areas. We extend the analysis by exploring the heterogeneity in preferences across respondents. Specifically, we use cluster analysis of individual respondent preferences to distinguish those with a relatively strong preference for each of the four socioecological attributes, essentially providing information about political ‘market shares.’ The analysis shows that the cluster of respondents who value biodiversity quite highly is at least twice as large as any other group, though commercial and recreational fishers together also form a relatively large group. We also estimate average public willingness to pay (WTP) for various policy scenarios (useful in cost-benefit analysis), revealing public willingness to financially support ecosystem-based policies that focus on conservation of biodiversity and cultural practices.

The following section provides an overview of the evolution of fisheries management and the problems associated with EBM implementation. We then describe the choice experiment used to elicit the preferences of the general public, and the final section concludes the article.

THE EVOLUTION OF FISHERIES MANAGEMENT

Wilen (2000) summarises the evolution of fisheries management. Input controls, such as restrictions on the size and number of boats, types of equipment, and time allowed fishing, were the earliest and most commonly used type of regulation. Controls on specific inputs,

however, incentivise the expansion of inputs left unregulated (e.g., Pearse 1981), which raises production costs and reduces fish stocks thereby dissipating resource rent (Gordon 1954; Copes 1986; Wilen 2000). The inadequacy of input controls has, over time, motivated the adoption of direct control over output in the form of quota management systems (QMS), where individual rights to catch a pre-specified quantity of fish prior to harvest, more generally known as catch shares, eliminate the race for fish and allow fishers to concentrate on minimising production costs and maximizing profit (Pearse 1981; Wilen 2000).

While comprehensive QMSs have been shown to halt and reverse declines in some commercial fish stocks (Costello, Gaines, and Lynham 2008), problems associated with implementing QMSs have been discussed extensively in the literature (e.g., Copes 1986; Clark and Major 1988; Copes 1995; Symes and Crean 1995; Lock and Leslie 2007; Helson et al. 2010). Increasingly, interest has focused on issues emanating from the incentive the QMS generates to minimise production costs: bycatch of non-commercial species and damage to the wider ecosystem, such as damage to habitat structures from trawling (Mangi and Roberts 2006; Reiss et al. 2010). Ryan, Holland, and Herrera (2014) use a bioeconomic model to show how such ecosystem externalities affect open-access equilibria and optimal fishing regulation, and there is a growing literature on bioeconomic models of habitat-fisheries interactions (see Foley et al. (2012) for an overview).

The issues of bycatch and ecosystem impacts of fishing have motivated the growing consensus that sustaining marine resources requires management based on understanding the effects of human actions on the entire ecosystem, rather than only target species (Grumbine 1994; Curtin and Prellezo 2010). The case for EBM rests on the complex interconnectedness and interdependence of ecosystem components, which generally remain poorly understood. Networks of MPAs are considered an important step toward advancing EBM by addressing environmental effects and conflicts across resource users, as well as overlapping objectives among stakeholders (Grumbine 1994; Douvere 2008). We focus here on two types of MPAs: marine reserves (no-take areas) and customary management areas (CMAs).¹

The benefits of marine reserves have been described extensively in the literature (see Grafton, Kompas, and Schneider (2005) for an overview). The main ones include: (1) protecting ecosystem structure and restoring overexploited stocks (e.g., Alcala and Russ 1990), (2) increasing stocks outside the reserves (e.g., Roberts et al. 2001), and (3) potentially increasing returns to fishing. See Grafton, Kompas, and Schneider (2005) for extensive discussion of bioeconomic models of marine reserves, including deterministic models (e.g., Sanchirico and Wilen 2001), spatial economic models (e.g., Smith and Wilen 2003), and uncertainty and stochastic models (e.g., Hannesson 2002).

CMAs represent a form of marine protection based on “local practices that are designed to regulate the use, access, and transfer of resources” (Cinner and Aswani 2007, 202). These local practices include spatial, temporal, gear, effort, species, and catch restrictions, which have been handed down through generations via cultural transmission (Walters and Holling 1990; Berkes, Colding, and Folke 2000; Berkes and Turner 2006; Turner and Berkes 2006; Moller, Kitson, and Downs 2009). Compliance is relatively high (Cinner and Aswani 2007),

1. Marine parks, marine mammal sanctuaries, customary take areas, etc., all offer varying levels of protection and are grouped under MPAs in this article as opposed to marine reserves, which are strictly no-take areas.

and it is argued that social-ecological resilience is one of the key advantages of customary management.² A meta-analysis of common-pool resource case studies concludes that self-organising local institutions often perform better than more remote governmental institutions in managing common property, especially in settings where trust is established and institutional rules have evolved that are well matched to the ecological systems being used (Ostrom 2010).

There has been a strong push toward adopting large-scale MPAs, primarily in terms of marine reserves. Countries including Australia, Canada, China, the US, and several in Europe have adopted management measures, such as marine spatial planning and zoning, as a start in the process (Douvere 2008), but actual progress has been slow (Jones 2014).³ In New Zealand, the government had committed to protecting 10% of the coast through its MPA policy by 2010; however, to date only 0.3% of its marine area is protected in marine reserves, and nearly all of this protection is located offshore (Eddy 2014).

Part of the problem is technical: the designation of marine reserves and CMAs to implement EBM has been constrained by concerns about the limited knowledge of marine systems and by the difficulties of matching the appropriate scale of society governance with that of ecosystems (e.g., Garcia and Cochrane 2005; Curtin and Prellezo 2010).

Possibly the biggest part of the problem, however, is political; marine space has already been allocated, explicitly or implicitly, to certain users of marine resources, usually commercial and recreational fishing, and implementation of MPAs imposes additional costs on these current resource users due to the loss of fishing opportunities. Smith et al. (2010), for example, apply a bioeconomic model to isolate the economic factors that lead to opposition at the time of marine reserve creation, focusing on how fishermen weigh short-term costs (which depend on the availability of alternative fishing and non-fishing income) against uncertain long-term gains in stock abundances outside reserves.

The potential cost implications of marine reserves have led to often passionate resistance from the commercial fishing industry, and negotiations among stakeholders have been difficult (Halpern et al. 2008; Macleod, Lynch, and Hoagland 2009). As a practical matter, public discussions are often strongly influenced by well-organised businesses and user groups (Emerton 2003; Turner and Weninger 2005), and MPA restrictions are often rejected on the basis of a “Not-In-My-Back-Yard” attitude (Wolfenden, Cram, and Kirkwood 1994; Sant 1996; Suman, Shivlani, and Milon 1999).

From society’s point of view, the decision to implement MPAs should be guided by a social benefit-cost analysis (Sanchirico, Cochran, and Emerson 2002). One way to influence the political process is to bring the views of other, less well-organised types of marine area users and non-users into the debate. Indeed, non-use values that the general public hold toward preservation of ecosystem integrity, biodiversity, and cultural practices may be a critical input into the political process. National environmental agencies of the UK and other countries have been working to employ cost-benefit analysis that includes a relatively broad spectrum of the social costs and benefits associated with the reallocation of marine space (Hanley and Barbier

2. Resilience refers to the capacity of ecosystems to absorb recurrent natural and human perturbations and continue to regenerate without slowly degrading or unexpectedly flipping into alternate states (Hughes et al. 2005; Gibbs 2009).

3. About 2% of marine areas are currently protected, compared to approximately 13% on land (Jones 2014).

2009; TEEB 2010). Some costs and benefits are more difficult to measure than others. For example, the costs of implementing a marine reserve or CMA to commercial fishing can be estimated using trends in market input and output prices, historical production data, and information from bio-economic models that capture the effect of redistributed fishing effort. In contrast, the lack of credible values of intangible, and therefore non-marketed, benefits, such as those from higher levels of biodiversity and traditional cultural practices, has been a barrier to conservation because the lack of information about a value often leads to it being treated effectively as ‘no value’ (TEEB 2010).

ELICITING PUBLIC PREFERENCES TO HELP MOVE EBM FORWARD

Estimating the values of a wide variety of public goods benefits associated with environmental resources has become an important part of environmental economics. Aside from academic interest, motivation for the development of non-market valuation techniques in natural resource settings has come from the need for plausible estimates of dollar damages to settle lawsuits associated with environmental disasters and to fulfil regulatory requirements that cost-benefit analyses be undertaken as part of public decision-making processes. There are two broad approaches: (1) estimating values from related market data, such as house sales or travel expenditures (revealed preference); and (2) recruiting people from a relevant population to participate in a survey about their preferences (stated preference). Both methods have strengths and weaknesses (see Louviere, Hensher, and Swait (2000) and Bennett and Blamey (2001) for a discussion), and the most appropriate method depends on the circumstances. Jobstvogt, Watson, and Kenter (2014), for example, combine revealed preference (travel cost survey) and stated preference (contingent valuation survey) methods to estimate both the use and “stewardship” values of MPAs of both fisherman and divers in the UK.

One form of stated preference survey, discrete choice, is particularly useful for evaluating alternative policy scenarios. Analysis of policies to manage marine areas requires consideration of the various tradeoffs involved. Establishment of an MPA, for example, imposes costs in the form of greater restrictions, usually on current users, such as commercial and recreational fishers, to generate benefits to others, such as customary resource users who value the resource both for harvest and for maintenance of traditional cultural practices, and/or the general public who value protection of biodiversity as well as maintenance of current and customary practices (existence values). Estimates of stakeholders’ willingness to trade off attributes allow evaluation of each policy (defined in terms of attributes) relative to the others (Kiker et al. 2005; Linkov et al. 2006), and a single discrete choice survey can be designed to estimate the values of the policy effects under consideration in monetary terms (Morrison, Bennett, and Blamey 1998; Rolfe, Bennett, and Louviere 2000; Bennett and Blamey 2001; Mallawaarachchi et al. 2001; Wang et al. 2007; Mansfield et al. 2008; Zander, Garnett, and Straton 2010).

A growing literature reports results of choice surveys to value biodiversity and ecosystem services. Many studies apply to a terrestrial context (e.g., Dachary-Bernard and Rivaud 2013; Mallawaarachchi et al. 2001; Mansfield et al. 2008; Rolfe, Bennett, and Louviere 2000; Wang et al. 2007), but a growing number of studies addresses issues in a freshwater or marine context (e.g., Birol, Karousakis, and Koundouri 2006; Groeneveld 2011; Hynes, Tinch, and Hanley 2013; Wielgus et al. 2009). Of particular relevance to this study, McVittie and Moran (2010), Groeneveld (2011), Börger et al. (2014) implement choice experiments to examine preferences for various types of restrictions on fishing for biodiversity benefits in northern

European fisheries. Jobstvogt et al. (2014) estimate both existence and option values of deep-sea biodiversity, and Zander, Garnett, and Straton (2010) include culture as an attribute in their survey that focused on improvements in the water quality of a river system in Australia.

No such survey has been applied to the New Zealand marine context. We recently implemented a discrete choice survey of the general public in New Zealand that elicits willingness to make tradeoffs among biodiversity, maintenance of customary cultural practices, and restrictions on commercial and recreational fishing in nearshore marine areas. The method used to implement the survey allows unusually close attention to the heterogeneity across respondents in their willingness to make tradeoffs. The details of the survey and its implementation can be found in Chhun, Thorsnes, and Moller (2013). In this article, we summarise the results and focus on their potential for influencing policy. We extend the analyses reported in the previous paper in two ways. First, we report the results of a cluster analysis of respondent preferences that reveals the relative sizes of groups with relatively strong preferences for each of the attributes, essentially providing information about political ‘market shares.’ Second, we report estimates of the public’s WTP through higher taxes for the outcomes associated with several scenarios of relevance in New Zealand.

To summarise, the choice survey consisted of four socio-ecological attributes and one ‘price’ attribute: (1) health of the nearshore marine ecosystem (biodiversity), (2) maintenance of Māori (customary) practices, (3) restrictions on recreational fishing, (4) restrictions on commercial fishing, and (5) level of taxes paid by households. As shown in table 1, each of the four socio-ecological attributes was defined on three levels, ranging from worst to best. For example, for the attribute ‘restrictions on commercial fishing in the coastal area,’ the level ‘not allowed anywhere’ corresponds to a ‘good’ condition of marine life (see first attribute in table 1) but represents the worst outcome from the perspective of commercial fishers. In contrast, the current relatively light controls on fishing (‘no change’) represent the best outcome for commercial fishers, but correspond to a relatively ‘poor’ condition of marine life.

Table 1. Attributes and Levels (worst to best) used in the Choice Experiment

Attribute	Levels
Condition of marine life (number and variety) in the coastal area	Poor (large drop in numbers and some species gone altogether) Medium (some drop in numbers and some species might disappear) Good (Original number and variety of fish and plants remain)
Māori cultural management in the coastal area	No longer practiced anywhere Practiced in partnership with locals in some locations Practiced exclusively by Māori in some locations
Restrictions on recreational fishing in the coastal area	Many more restrictions (much lower bag limits and some locations closed) More restrictions (lower bag limits and all locations open) No change from existing bag limits and allocations open
Restrictions on commercial fishing in the coastal area	Not allowed anywhere More restrictions (some locations closed and reduction in quota) No change (allowed anywhere at the existing quota levels)
Your taxes (e.g., annual property tax or rent on your house)	Increase by \$120 per year (i.e., \$10 more per month) Increase by \$60 per year (i.e., \$5 more per month) Do not change Fall by \$60 per year (i.e., \$5 less per month)

Thus, the survey inquires generally about the respondent's willingness to trade off, for example, more restrictions on fishing in a nearby marine area for improvements in biodiversity or for maintenance of Māori traditional cultural practices.

The survey was implemented using web-based decision analysis software called 1000Minds (www.1000Minds.com), which is based on an algorithm with the acronym PAPRIKA.⁴ The algorithm presents the respondent with a series of discrete choices, such as those shown in figures 1 and 2. Each choice requires the respondent to trade off more of one attribute for less of another, assuming all other attributes are the same. Comparing only two attributes at a time makes the ranking exercise as simple as possible. There are 122 such pairs in this choice survey, one of which is chosen at random to start the survey. When the respondent ranks a choice pair, the algorithm automatically identifies and eliminates all other choice pairs whose ranking is implied via transitivity. The process continues until all pairs that require a tradeoff are ranked either explicitly by the respondent or implicitly via transitivity. The key advantage of the PAPRIKA algorithm is that it minimises the number of explicit rankings needed (27, on average, in this case) to compute the relative weight each respondent places on each level of each attribute. The survey thus yields a complete set of relative weights (utilities) of each level of each attribute *for each respondent*.

In addition to a variety of potential sources of bias in all stated preference surveys, the algorithm has disadvantages as a result of tradeoffs in the design (Hansen and Omblor 2008).⁵ The very simple two-attribute ranking exercises require the assumption that each respondent's underlying utility function is strictly additive across attributes and levels, which eliminates the possibility of interactions among attributes. In addition, minimizing the number of explicit rankings by implicitly ranking pairs via transitivity raises the potential for bias from ill-considered rankings. This, of course, is a concern in all choice surveys, and in this case each ranking is relatively simple. Though the exercise yields a complete set of relative weights for each respondent, we focus on averages among groups, rather than individuals, to reduce the impact of bias.

The choice survey was conducted by a market-research firm that operates an online rewards programme in New Zealand. About 5% of New Zealand adults actively participate in the program. A demographically and regionally representative sample was invited to complete the choice survey followed by a more standard demographic survey. The response was stronger than expected, with 1,055 completed choice surveys, representing an approximately 60% response rate. The characteristics of the sample were broadly representative of the population, though people self-identifying as of Māori ethnicity were underrepresented. This group was 'topped up,' resulting in modest over-sampling of this group.

Table 2 reports the means of the relative weights on each level of each socio-ecological attribute. The decision software scales the estimated utility weights so that the values of the best outcome of each attribute sum to 100. There is some suggestion of diminishing marginal utility moving from the worst to the best outcomes (e.g., the mean utility for biodiversity

4. Though relatively recently developed, 1000Minds has a significant track record in academic research. See <https://www.1000minds.com/academic/peer-reviewed-publications>.

5. For example, bias from non-random or non-representative sampling, bias due to the hypothetical nature of the survey questions, respondent fatigue leading to incorrect choices, unknown functional form of utility functions, and so on (e.g., Bennett and Blamey 2001; Hanley and Barbier 2009; Louviere, Hensher, and Swait 2000).

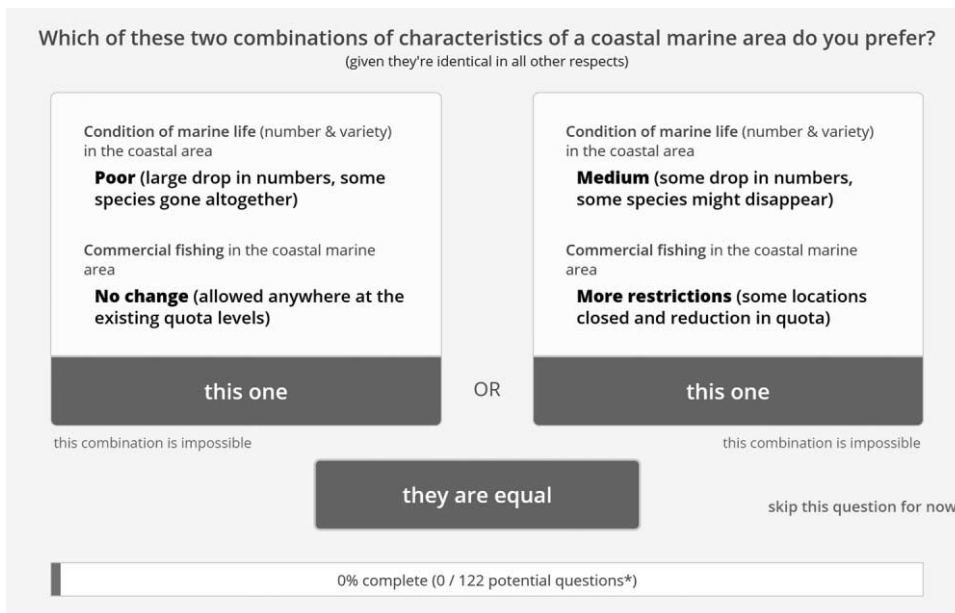


Figure 1. Screenshot of Tradeoff between Two Socio-ecological Attributes

increases by 16.3 from worst to medium and by 14.5 from medium to best). On average, the sample respondents value preventing the level of biodiversity dropping from ‘best’ to ‘worst’ in a nearby marine area about twice as much as they value preserving a best-to-worst drop in any other socio-ecological attribute. The mean values corresponding to the tax attribute indicate that a tax increase of \$180 (from \$60 less than current to a \$120 more) per annum

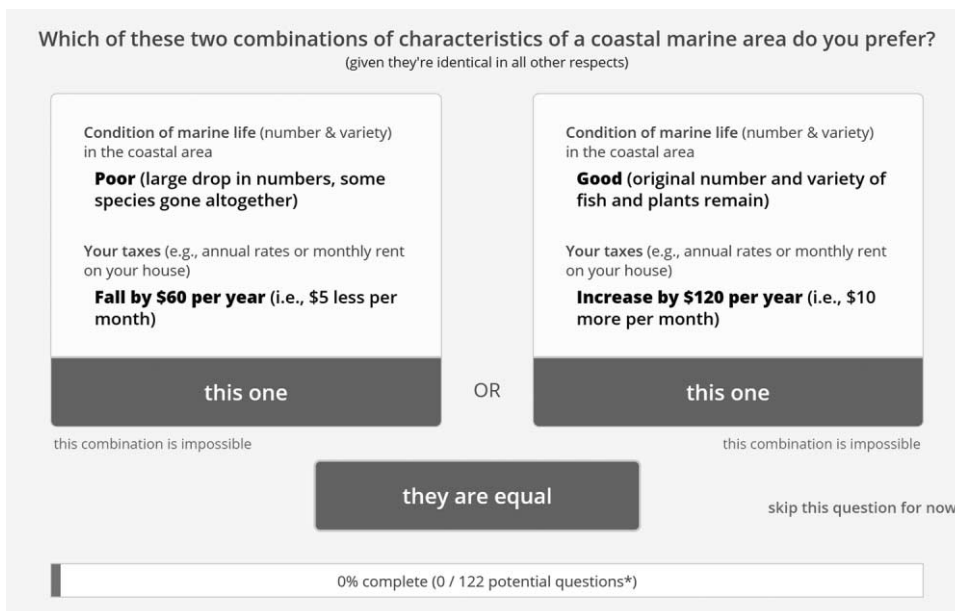


Figure 2. Screenshot of Tradeoff between a Socio-ecological Attribute and Tax Payment

Table 2. Mean Relative Utility of Each Level of Each Attribute (n = 1055)

Attribute	Levels (from low to high)	Mean Scaled Utility Scores
Biodiversity	Poor condition (Worst)	0
	Medium condition (Medium)	16.3
	Good condition (Best)	30.8
Māori cultural management	No longer practiced (Worst)	0
	Practiced in partnership with locals (Medium)	9.3
	Practiced exclusively by Māori (Best)	13.4
Recreational fishing	Many more restrictions (Worst)	0
	More restrictions (Medium)	7.7
	Current restrictions (Best)	14.1
Commercial fishing	Not allowed (Worst)	0
	More restrictions (Medium)	8.2
	Current restrictions (Best)	13.1
Tax	Increase \$120 per annum (+\$120)	0
	Increase \$60 per annum (+\$60)	11.6
	No change (+\$0)	21.0
	Decrease \$60 per annum (-\$60)	28.6

reduces relative utility by less than a drop in biodiversity from best to worst, implying a WTP, on average, to maintain biodiversity. Weighting to the demographic characteristics of the New Zealand population has only minor effects on these mean scores.

Of potential interest from a political perspective are the proportions of the population that have relatively strong preferences for each of the four socio-ecological attributes. Table 3 reports the results of a cluster analysis of individual respondent preferences. The first column of numbers shows the mean utility weights on the 'best' outcome of each of the socio-ecological attributes rescaled to add to 100 in the absence of the tax attribute (their sizes relative to each other remain unchanged from table 2). Each value shows the relative value of improving that attribute from worst to best. To explore the variation in values across respondents, we used a k-means clustering routine to sort respondents according to patterns in the relative utility weights of the socio-ecological attributes. For example, cluster 1 consists of respondents who value preservation of biodiversity highly (in terms of improvement from worst to best), relative to maintenance of Māori cultural practices, and light restrictions on recreational and commercial fishing. The other three clusters consist of respondents who

Table 3. Results of a Cluster Analysis

	Mean	Means of Four-cluster Solution			
		1	2	3	4
Biodiversity	42.9	60.2	30.9	26.1	33.5
Maintenance of Māori practices	18.5	12.1	38.0	17.7	11.6
Restrictions on recreational fishing	20.1	15.5	14.6	37.5	17.8
Restrictions on commercial fishing	18.5	12.2	16.5	18.7	37.2
Respondents (%)	100	42.7	20.9	19.8	16.5

Note: Each number represents the relative value of an improvement in that attribute from worst to best.

value each of the other attributes highly (in bold), respectively. Note in particular that the group with a high value of biodiversity is at least twice as large as any other group and that biodiversity is valued highly even in the other three groups. That said, commercial and recreational fishers together form a relatively large group at 36.3%.

Adding consideration of respondents' estimated willingness to trade off money, in the form of higher taxes, for a better package of socioecological outcomes contributes to cost-benefit analysis of the policies needed to obtain those outcomes. For each individual respondent, we used the estimated values on the levels of the tax attribute to interpolate or extrapolate (conservatively) dollar values of any changes in the socioecological attributes.⁶ These dollar values can be used to conduct scenario analyses, where scenarios of interest are each defined (admittedly roughly) by the levels of each of the attributes in the choice survey. Table 4 provides an example of a scenario analysis in the New Zealand context.

Scenario analysis requires definition of a reference case or status quo. In this case, the assumption is that use of nearshore marine areas has effectively been allocated to fishers. Restrictions on recreational and commercial fishing are in place mainly to protect target fish stocks. From the fishers' perspective, these light restrictions can be considered to be the best policy outcome. The controls are, however, imperfect, and some legal fishing practices damage the marine ecosystem, so the level of biodiversity in the base case is considered poor (worst). Similarly, the status quo provides local Māori no influence in management of traditional fishing areas. Thus, in the base case, for the sake of demonstration, conditions for fishers are best, but worst for other stakeholders.

Each of the four scenarios in table 4 trade additional restrictions on fishing for improvements in other attributes. Consider scenarios 1 and 2. Both scenarios involve allocation of nearshore marine areas of historical significance to management by local Māori. This provides the best opportunity for local Māori to maintain historical cultural practices and traditions, which has value both to Māori and, to a lesser extent, to the general public. Māori management will, however, most likely result in more restrictions on recreational and commercial fishers. As a practical matter, political considerations likely limit these to a 'medium' level of restrictions.

The difference between scenarios 1 and 2 is the impact of Māori management on biodiversity. Estimates from the choice survey indicate a considerable net mean social benefit in scenario 1, in which a 'medium' level of biodiversity is maintained under Māori management. Monetizing this net benefit using information about respondents' willingness to accept higher taxes for improvements in socioecological outcomes indicates a mean annual WTP of about NZ\$130 per year for scenario 1; that level of tax increase would leave respondents, on average, indifferent between the status quo and scenario 1. This amount could be aggregated across the roughly two million households in New Zealand to obtain a total annual WTP. However, if Māori management results in no improvement in biodiversity, the average dollar benefit to the general public from maintaining Māori cultural practices just offsets the dollar cost of harm to the more conventional fishing culture. This difference reflects the importance of maintaining biodiversity to the survey sample.

6. Refer to Chhun (2014) for a detailed discussion of the estimated functional relationships between relative utility and level of tax for each respondent, from which the WTP estimates have been derived.

Table 4. Estimated Willingness to Pay (NZ\$/household) for Selected Management Scenarios

Scenario	1	2	3	4	
Outcomes	Biodiversity	Medium	Worst	Best	Best
	Maintenance of Māori practices	Best	Best	Worst	Medium
	Restrictions on rec. fishing	Medium	Medium	Medium-Worst	Worst
	Restrictions on comm. fishing	Medium	Medium	Medium	Medium
Mean willingness to pay/annum (\$)	128	6.2	117	138	

Note: All changes relative to a base scenario of the current low restrictions on recreational and commercial fishing (best outcome), a worst level of biodiversity, and a worst level of Māori customary practices.

Scenarios 3 and 4 focus on restoration/maintenance of biodiversity. Doing so in these scenarios involves imposition of stronger restrictions on fishing and less support for Māori cultural practices. Scenario 4 produces the largest estimate of average net dollar benefit to our survey respondents. This scenario is roughly consistent with a network of marine reserves embedded in areas allocated to Māori customary management that is effective at maintaining biodiversity. The restrictions on fishing are relatively high, but apparently worthwhile to respondents in this sample. The estimated WTP higher taxes could provide revenues that might go toward mitigating the negative effects on fishers, such as through purchase of commercial quota and/or supporting recreational fishing in other areas.

Of most interest is that scenarios 1 and 4 suggest that a change in policy toward EBM could yield significant net values that the general public would be willing to pay for. The public, to the extent represented by this sample, appear willing to trade restrictions on fishing for conservation of both biodiversity and Māori cultural practices, with especially strong preference for biodiversity conservation. Having estimates of intangible benefits comparable to tangible benefits aids cost-benefit analysis and could potentially provide justification for reallocating marine space to protect biodiversity and cultural practices. However, the extent to which results such as these can influence decision making remains to be seen.

CONCLUSIONS

The discussion of fisheries policy has come a long way from its historical focus on the needs of commercial fishers to one that seeks to accommodate the values and preferences of multiple stakeholders, including perhaps both the use and non-use values of the public. Many countries at least aspire to some form of EBM, but implementation of policies leading in that direction has been stalled by difficulties in negotiation and insufficient political will to impose costs on current users. Nevertheless, the general public, who represent the vast majority of voters and are typically poorly organised in the context of political discussions, may have sufficiently strong preferences for the outcomes of fisheries policy to matter. Discrete choice experiments represent the state of the art in research that elicits these preferences. Bringing the results of these experiments into the mainstream discussion may present one step toward advancing EBM.

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