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The Policy Relevance of Choice Modelling: An Application to the Ningaloo and Proposed Capes Marine Parks

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Abstract:

One issue surrounding the use of Choice Modelling (CM) in policy is whether public and expert preferences diverge regarding particular environmental attributes. To investigate this issue two case studies use CM to value ecological attributes for the Ningaloo and proposed Capes marine parks in Western Australia. Public and expert populations are sampled, with consideration of information effects. Attention is also given to whether policy relevance can be improved by considering not only desired outcomes of the hypothetical policy options in the CM exercise, but also the management process used to achieve these outcomes. Preliminary results of the public sample identify significant impacts of both information and management process effects.

Keywords: Choice modelling, public, experts, preferences, marine parks, non-use values.

1. Introduction

Choice Modelling (CM) is a commonly used technique for valuing public or environmental goods. It is popular among academic researchers', however it is rarely used by policy and decision makers (Adamowicz 2004). The debate over its use in policy stems from the hypothetical nature of the technique – a hypothetical market scenario is used to identify how much people are willing to pay for proposed changes to the environmental good in question. It is exceptionally difficult to validate these estimated willingness to pay (WTP) values, as they are dealing with goods that are not traded in a regular market place and as such have no 'price tag' attached to them in the real world. This may suggest CM to be inappropriate for informing policy given its' potentially unstable nature, however, it is one of only a few techniques capable of quantifying non-use values in economic terms (Bateman *et al*. 2002). Non-use values refer to conservation or existence type values, which are of great importance when considering unique environmental goods with few substitutes. It is becoming commonplace to require reporting on environmental and non-use values through Cost Benefit Analyses in Government (Australian Government 2007). As such, CM is seemingly a necessary technique to account for these non-use values in policy decisions.

Given the difficulty in validating CM results, the technique needs to be better understood if we are to improve its policy relevance. Various questions surround the use of CM in policy. One question is to ask if it is appropriate to use it in the first place – do we need CM to gather information on the public's reactions to environmental management changes when we could simply use an expert scientist's

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opinion? The democratic society that we live in coupled with the fact that the general public fund Government activity through taxes suggests that public preferences do count and should be incorporated into policy. Then the next question to consider is whether public preferences are different to those of the expert community. This study attempts to answer this question by applying a CM survey to both general public and expert populations, with consideration of how varying levels of information may affect public preferences.

Another avenue for improving CM policy relevance may be within the tool itself. CM considers the value of different attributes of an environmental good by making trade-offs between different combinations of various levels of each attribute. These levels typically refer to the desired outcome of the management change being proposed. However, it is possible that people may react not only to the outcome of the management change, but also to the process by which that outcome is achieved (Johnston and Duke 2007). As such, this study compares valuations of attributes with and without types of management.

Two case studies are utilised for the investigations noted above, the Ningaloo and proposed Ngari Capes Marine Parks in Western Australia (WA), both of which are considered to hold substantial ecological values. Within these case studies, publicity factors are also examined based on a comparison of ecological values for the iconic Ningaloo and the newly proposed Capes.

The paper will first discuss the background of the study including the CM technique and the issues of public and expert preferences, and outcome and process levels. This will be followed by a description of the case studies and survey methodology. Section four will discuss some preliminary findings of the public sample analysis, followed by a discussion of results in section five.

2. Background

2.1 Choice Modelling

CM estimates how much people are willing to pay for various attributes of a good. In a CM questionnaire the respondent is presented with a series of questions called choice sets. The choice sets contain a list of attributes of interest regarding the good, and a series of options or alternatives that vary according to the different levels of the attributes listed (Bateman *et al*. 2002). One of the attributes included is usually a payment vehicle or price for the option, and generally one of the options in each choice set is a status quo, or ‘choose none’ alternative (Bennett and Blamey 2001). The respondents are faced with a number of choice sets that have the same attributes in each set, but different options that vary in the levels of the attributes offered.

The choices made within the choice sets are analysed in accordance with Random Utility Theory (RUT) (Bateman *et al*. 2002). In RUT, utility (U) is a function of the vector of attributes (X) of an option (i), the parameters (β) and the unobservable utility (ε), or error component, of option ‘i’:

$$U_i = \beta X_i + \varepsilon_i$$

It can be assumed that the probability of an individual choosing option '*i*' depends upon the utility of '*i*' in relation to the utility of all possible alternatives (*A*) (Morrison *et al*. 1996). Therefore individual '*Y*' will choose '*i*' over option '*j*' if the individual's utility for '*i*' exceeds the utility associated with '*j*' (Morrison *et al*. 1996). The vector of attributes and individual characteristics, or the deterministic utility (βX_i), is represented by '*V*':

$$P(i / i, j \in A) = P[(V_{iY} + \varepsilon_{iY}) > (V_{jY} + \varepsilon_{jY})]$$

This implies that the individual (*Y*) will choose '*i*' over '*j*' if their combined deterministic and random utility for '*i*' is greater than that for '*j*'. This can be rearranged to show that the probability of an individual choosing alternative '*i*' over '*j*' is equal to the probability that the difference in the deterministic utilities of the alternatives is greater than the difference in their random utilities (Morrison *et al*. 1996):

$$P(i / i, j \in A) = P[(V_{iY} - V_{jY}) > (\varepsilon_{jY} + \varepsilon_{iY})]$$

Given that the error is unobservable assumptions must be made as to its distribution, so error terms are generally assumed to be independently and identically distributed and take on the form of a Gumbel distribution. This leads to a conditional logit model (Bateman *et al*. 2002). The probability of option '*i*' being chosen by an individual (*Y*) increases as the level or number of desirable attributes increase and undesirable attributes decrease in '*i*' in comparison to all alternatives (*A*) (Bennett and Blamey 2001):

$$P(Y = i) = \frac{\exp(\lambda \beta' x_i)}{\sum_{A=1} \exp(\lambda \beta' x_A)}$$

Note that a scale parameter (λ) exists in the conditional logit model that is inversely proportional to the standard deviation of the distribution of the error term (Bateman *et al*. 2002). It is not possible to independently identify both the scale and the β without some normalisation rule, hence estimated parameters can only be interpreted as scaled marginal utilities. It is possible to identify changes in the *relative* value of the variance of the error term within the sample if one is prepared to posit a parametric relationship between it and individual/sampling/experimental design characteristics that vary across the sample. The impact of respondent socio-economic variables on the probability of choosing an alternative (*i*) is introduced as a modifier for the marginal utility (β) of an attribute (Bennett and Blamey 2001).

We are able to estimate how much people are willing to pay to receive one unit more of a particular attribute with the inclusion of the price attribute. Termed a partworth, the (negative) ratio of the coefficient for the non-monetary attribute (*a*) to that of the price coefficient (*b*) provides this dollar value (Bennett and Blamey 2001):

$$Partworth = -(\beta_a / \beta_b)$$

In a similar fashion, we can also calculate the rate at which other attributes may be traded off against one another, for example to receive less of one attribute in place of more of another, by applying this calculation to two non-monetary attributes. Note that the model must be linear in parameters for this relationship to apply.

Essentially, CM allows us to determine which attributes are of most value for a particular good, and the ranking of these attributes relative to one another. By varying the levels of attributes in the choice sets it is also possible to determine the value that people hold for changing multiple attributes simultaneously. The values, or partworths, of the individual attributes can also be summed to give a total economic value for the good (Bateman *et al*. 2002).

2.2 Expert and public preferences

Kontoleon *et al.* (2002) discuss the issue of whether public preferences should count in decision making processes, and if so to what extent they should count in comparison to that of the relevant experts in the field. This discussion takes place primarily with reference to the use of non-market valuation in legal situations such as damage assessment, where it is noted that economic standing is much more broadly defined than legal standing (Kontoleon *et al*. 2002). Any individual who suffers a loss of welfare from a particular change is considered to have economic standing, and as such that individual is entitled to be included in the aggregate population that provides input to the decision process regarding that change (Kontoleon *et al*. 2002). One could then consider that where management changes are being proposed for a unique environmental good and non-use values are of importance, many members of the general public are likely to experience some change in welfare, and consequently should be able contribute their preferences.

Having justified that in certain situations public preferences are important, the next argument in the literature reflects whether public and expert opinions diverge. If the public form similar preferences to that of experts, then commissioning an expensive CM study may be unwarranted. However, if differences exist then tools like CM are essential to account for public preferences in a policy setting.

Several valuation studies have considered both public and expert opinion, including Goodman *et al*. (1998) who compare comments made by scientists and the public regarding two coastal conservation areas. They find that although the public are able to identify coastal areas in good and bad condition, in agreement with the experts, they tend to have different preferences for management strategies (Goodman *et al*. 1998). Kenyon and Edwards-Jones (1998) take things a step further by directly comparing public Contingent Valuation (CV) results with an expert ranking of ecological characteristics of four different sites in a regional park. They vary the amount of information provided to the public respondents in the survey, starting with textual information and photographs, then adding ecological data and on-site visits, with the hypothesis that public preferences will converge upon the expert rankings as knowledge increases (Kenyon and Edwards-Jones 1998). Findings suggest that the lower levels of information may not be adequate for an informed judgement, while the inclusion of ecological data led the public to value the sites similarly to the expert rankings (Kenyon and Edwards-Jones 1998). Johnston *et al*. (2002) use a similar approach to Kenyon and Edwards-Jones, in that they ask experts to rate the ecological potential of various wetland habitats, while the public take part in a CM survey.

There are issues associated with these previous comparisons of expert and public preferences in the valuation literature. Firstly, the public and experts are often valuing different aspects of the good in question. For example, in the Kenyon and Edwards-Jones (1998) study the CV payment vehicle is an entry fee, suggesting that the public are valuing use aspects of the park sites, while the experts are specifically referring to the ecological condition of the sites which relate strongly to non-use aspects. For a direct comparison of public and expert preferences, the two populations need to be addressing the same aspects of the good.

A second issue is the mechanism for collecting preference information from the public and experts. The Goodman *et al*. (1998) study uses a similar technique to collect comments from both the public and experts, but these are collected in a qualitative fashion and do not directly compare WTP for both groups. Kenyon and Edwards-Jones (1998) and Johnston *et al*. (2002) use a different collection mechanism for each group – ranking or rating for the experts, and CV or CM for the public. Again, a direct comparison would be achieved better by using an identical data collection mechanism.

The health valuation literature shows some evidence of direct comparisons of this nature. Araña *et al*. (2006) compare CM results for a cervical cancer screening program between experienced medical practitioners and undergraduate social science students. They found similar preferences amongst both samples, despite the obvious knowledge gap (Araña *et al*. 2006). It is possible that this convergence is due to health issues being of a more familiar nature to the general public, and the same may not be true of complex environmental issues. There appears to have not been any direct comparisons of public and expert preferences using CM in the environmental valuation literature.

2.2 Outcome and process levels

In CM studies it is common practice to describe attributes in terms of the outcomes that we are interested in valuing. Attribute levels usually consist of various policy outcomes, and it is more often than not assumed that the policy process used to achieve these desired outcomes is irrelevant in terms of peoples' utility (Bulte *et al*. 2005). For example, policy outcome X may be achieved by process A or process B. Typically the value of the outcome only is measured in CM studies, and does not take into account that although respondents may hold a particular positive (or negative) value for the outcome, they might receive greater (or lesser) utility if it is achieved by process A rather than process B.

It has been argued that utility should be concerned only with the outcome, and not with the manner in which it is achieved, however the omission of policy process from a CM survey may bias the WTP estimates (Johnston and Duke 2007). The exclusion of process levels for an attribute may lead to respondents making unobservable assumptions about the processes underlying a policy outcome, and in turn that may influence their WTP (Johnston and Duke 2007). Furthermore, the exclusion of process levels may have a prolific influence on the relevance of using CM results to guide policy decisions (Johnston and Duke 2007). Relating to the previous example, if only outcomes are measured in a study, the information guiding policy will only suggest that an outcome has particular positive value and should be implemented. This could result in policy makers implementing process B rather than the preferred process A which will not provide the greatest level of utility given that a more complete set of information was not available. Johnston and Duke (2007) test the hypothesis that policy processes are utility-neutral in a study on agricultural land preservation. They find that in many cases the inclusion of process as an attribute level significantly changes respondents' WTP and conclude that the process levels should be included for accurate policy information.

3. Case studies

3.1 The case studies and attributes

Two marine parks were chosen as ideal case studies to explore non-use values which are inherently important, but underrepresented, in the marine literature (Spurgeon 2001). The Ningaloo Marine Park, situated in the north-west of WA, was chosen for its iconic status and its important contribution to marine ecology, with the park containing over 90% of the Ningaloo Reef - the largest fringing reef in Australia and a proposed world heritage site (MPRA 2005). The proposed Ngari Capes Marine Park, situated in the south-west of WA, was chosen similarly for its ecological importance, but in contrast to Ningaloo's iconic status as it has not yet been designated an official marine park (at the time of this study) (MPRA 2004). The Ningaloo and Capes parks run for roughly 260km and 200km, respectively, adjacent to the coastline, and have a seaward boundary of three nautical miles from the coast. A comparison of these two case studies is intended to reveal if publicity, in the sense of prior public awareness, has an impact on public and expert preferences.

To capture the non-use values of the parks, attributes were generally chosen according to their importance in each relevant ecosystem. The marine park management plans for the two marine parks identify Key Performance Indicators (KPI's), from which three ecological attributes were chosen for each park (Table 1) (MPRA 2005 and 2004). Some of these attributes are assumed to be comparable across the two parks in terms of their function, for example both seagrass and coral are vital as a food source and habitat for many other marine creatures. The fourth ecological attribute for each park was chosen not for its ecological importance to the local marine system, but for its iconic status (Table 1). The ecological importance of the KPI's and the iconic status of the megafauna attributes were expected to aid the comparison of public and expert preferences in relation to information and publicity effects.

Appropriate levels for each ecological attribute were developed upon consultation with expert marine scientists. Levels included a conservation improvement or outcome component, and a management process that was used to achieve the conservation improvement (Table 1). This resulted in five levels for each ecological attribute. For the outcome only comparison, the process component was dropped from the levels, resulting in three conservation levels for each attribute.

A status quo option was included in each choice set, containing the 0% conservation improvement levels for the ecological attributes, and the zero dollar cost level. Note that the zero dollar level only appears in the status quo, as it is illogical to assume that some level of conservation improvement can be achieved at zero cost for the other alternatives in the choice sets.

Table 1: Attributes and levels for the Ningaloo and Capes Marine Parks.

Ningaloo attributes and levels	**Capes attributes and levels**
Coral (KPI)	*Seagrass (KPI)*
0% more coral	0% more seagrass
5% more coral due to 5% new no go zones	5% more seagrass due to 5% increase in sanctuary zones
5% more coral due to 7% increase in sanctuary zones	5% more seagrass due to Government spending $1,000,000 on cleaner drainage
10% more coral due to 10% new no go zones	10% more seagrass due to 10% increase in sanctuary zones
10% more coral due to 12% increase in sanctuary zones	10% more seagrass due to Government spending $2,000,000 on cleaner drainage
Target fish stocks (KPI)	*Target fish stocks (KPI)*
0% more fish	0% more fish
5% more fish due to 2 month seasonal closure	5% more fish due to 5kg reduction in fish catch possession limit
5% more fish due to 10% increase in sanctuary zones	5% more fish due to 10% increase in sanctuary zones
10% more fish due to 3 month seasonal closure	10% more fish due to 10kg reduction in fish catch possession limit
10% more fish due to 15% increase in sanctuary zones	10% more fish due to 15% increase in sanctuary zones
Marine turtles (KPI)	*Abalone (KPI)*
0% more turtles	0% more abalone
5% more turtles due to 50km beach closure	5% more abalone due to reducing recreational abalone fishing season to 5 months
5% more turtles due to 3 extra fox bait zones	5% more abalone due to 5% increase in sanctuary zones
10% more turtles due to 100km beach closure	10% more abalone due to reducing recreational abalone fishing season to 3 months
10% more turtles due to 6 extra fox bait zones	10% more abalone due to 10% increase in sanctuary zones
Whale sharks (Iconic)	*Whales (Iconic)*
0% more whale sharks	0% less whales struck by boats
2% more whale sharks due to 25% reduction in whale shark tours	25% less whales struck by boats due to 15% reduction in whale watch tours
2% more whale sharks due to Government donating $1,000,000 to their international conservation	25% less whales struck by boats due to maximum boat speed of 12 knots around whales
5% more whale sharks due to 50% reduction in whale shark tours	50% less whales struck by boats due to 30% reduction in whale watch tours
5% more whale sharks due to Government donating $2,000,000 to their international conservation	50% less whales struck by boats due to maximum boat speed of 9 knots around whales
Cost	
$0 (status quo option only), $20, $40, $60, $80	

3.2 Survey and experimental design

The questionnaire contained three sections: a section for each marine park, followed by socio-demographic questions. Within each marine park section, there were a variety of questions relating to the respondent's past experience and intentions for future use of the park, information about the ecological attributes, the choice sets, and follow-up questions including whether they were confused by the choice sets and how certain they were of their responses to them. The socio-demographic section included questions such as age, gender, income, education level and memberships to environmental organisations. For the experts, questions regarding their particular areas of expertise were also included.

Five split samples of the survey were created:

- Sample 1: Public, low information, process and outcome levels
- Sample 2: Public, medium information, process and outcome levels
- Sample 3: Public, high information, process and outcome levels
- Sample 4: Public, medium information, outcome levels only
- Sample 5: Experts, high information, process and outcome levels

The information levels varied according to the detail respondents received regarding the ecological attributes: the low information level included a basic description of the attributes; medium information included a description and introduced some of the conservation issues and threats associated with the attributes; and high information elaborated on these issues as well as describing the ecosystem function and importance of the individual attributes. As each survey included questions about both Ningaloo and Capes, there was also a separate split within each of the five samples where respondents were randomly assigned to the order in which the marine parks were included.

The survey was pretested in a focus group format with eight subjects to determine an appropriate number of choice sets and alternatives. Five choice sets for each marine park, totalling ten choice sets in the complete survey, were considered to be reasonable numbers. The pretesting determined that a four alternative choice set was preferable – three options plus a status quo.

For samples one, two and three a main effects fractional factorial design was created using the Discrete Choice Experiments software (Burgess 2007). A 25 choice set design resulted and was blocked into five. The design had an efficiency score of 98.9% in comparison to the optimal design for the choice set size. A 15 choice set design was created also using the Discrete Choice Experiments software (Burgess 2007) for sample four. This was blocked into three to maintain consistency with the number of choice sets per respondent and had an efficiency score of 95.5%.

The designs for sample five were generated separately for each marine park using Ngene 1.0 (Rose *et al.* 2008). Coefficient estimates from an initial analysis of the sample three data for each marine park were used to generate designs that were optimised to minimise the sample size necessary to achieve significant results (Scarpa and Rose, 2008). This was deemed important, as it was anticipated that the available sample may be small for this group. Again 25 choice set designs blocked into five were created, with an estimated sample size of 5.26 respondents needed per block for Ningaloo, and 28.4 per block for the Capes. The sample size required was noticeably higher for Capes primarily due to the estimated coefficients for the abalone attribute being small. The remaining Capes attributes required an estimated sample size of 11.3 respondents per block or lower.

3.3 Sampling

The survey was designed as a web-based questionnaire using Sensus 4.2 (Sawtooth Technologies 2006). A market research company was employed to administer the survey to the public samples. The samples were drawn from the WA population, with the majority from the Perth Metropolitan region (approximately 75%). Subjects were randomly emailed with an invite to participate in a survey about a local issue, and were offered a five dollar gift voucher and ten entries into a prize draw hosted by the research company if they completed the survey. These incentives were intended as minimal compensation for the half hour survey. Of the total invites sent the response rate was 7.8%. However, of those that responded to the invites there was a 73.7% completion rate. A total of 1,250 responses were received across the four samples, with 921 complete responses.

The expert sample list was constructed from publicly available contact lists of marine experts, such as from marine research websites and conference proceedings. The sample typically consisted of local experts with knowledge of Ningaloo and/or the Capes. The experts were sent a direct invite to the survey *via* email. This aspect of the research is ongoing, and results from the expert sample are not yet available.

4. Results

The data were analysed using Intercooled Stata 10.1 to estimate the coefficients of several conditional logit models (StataCorp 2008). The following section reports on the results for Ningaloo and Capes concerned with samples one, two and three that compare attribute information levels and different management options. Following this are the results from investigating samples two and four, so that the significance of including management process can be determined.

4.1 Information effect models: Ningaloo Information Model (NIM) and Capes Information Model (CIM)

Models for the Ningaloo and Capes data are estimated independently, although the process followed is similar. Initially data from the three samples (1, 2 and 3) were estimated separately, and attribute variables were allowed to vary according to their original five level form (as in Table 1). However log likelihood ratio tests determined that it is possible to combine the three samples into one, with the only information effects manifesting themselves in the status quo. One can also employ restricted models with continuous conservation levels, and independent management levels. The implication is that preferences acknowledge scale of the conservation outcomes, and that the consequence of management is independent of outcome level. The restricted models of combined sample data and continuous conservation levels were not significantly different. Interactions from socio-demographic variables were introduced based on prior assumptions of possible relationships between variables. Heterogeneity in the error variance was likewise modelled, through a parameterization of the scale variable: such that $\lambda = \exp(\beta X)$. The significant socio-demographic explanatory variables are described in Table 4. The following models will be referred to as the Ningaloo Information Model (NIM) and Capes Information Model (CIM).

Table 2: Explanatory attribute variable descriptions for Ningaloo

Variable	**Description**
Conservation variables:	
Corlev	% more coral (continuous – 0, 5, 10%)
Nfislev	% more fish, Ningaloo (continuous – 0, 5, 10%)
Turlev	% more turtles (continuous – 0, 5, 10%)
Wshlev	% more whale sharks (continuous – 0, 2, 5%)
Management variables: (baseline = zero level of management)	
Corman	Corman1 = no go zone, Corman2 = sanctuary zone
Nfisman	Nfishman1 = seasonal closure, Nfishman2 = sanctuary zone
Turman	Turman1 = beach closure, Turman2 = fox bait
Wshman	Wshman1 = tour reduction, Wshman2 = Government donation

Table 3: Explanatory attribute variable descriptions for Capes

Variable	**Description**
Conservation variables:	
Sealev	% more seagrass (continuous – 0, 5, 10%)
Cfislev	% more fish, Capes (continuous – 0, 5, 10%)
Abalev	% more abalone (continuous – 0, 5, 10%)
Whalev	% less whale collisions (continuous – 0, 25, 50%)
Management variables: (baseline = zero level of management)	
Seaman	Seaman1 = sanctuary zone, Seaman2 = government donation
Cfisman	Cfishman1 = possession limits, Cfishman2 = sanctuary zone
Abaman	Abaman1 = reduced fishing season, Abaman2 = sanctuary zone
Whaman	Whaman1= tour reduction, Whaman2 = boat speed

The estimation for NIM shows some evidence of information effects on the status quo (Table 5). Namely respondents that receive more detailed information are less likely to select the status quo option, as are those that received Capes first in the marine park order, those that believe the CM results will influence future marine policy decisions, and those that belong to an environmental group. Generally respondents have a positive reaction towards improving conservation of the ecological attributes. Particularly, respondents who have seen live coral before support coral conservation. In contrast, respondents who have seen live whale sharks before view whale shark conservation more adversely than those who haven't. Respondents involved in recreational fishing and boating activities in the marine park place less value on fish conservation.

Management processes used to achieve the conservation outcomes have an impact (Table 5). However, those who partake in four-wheel driving along the beach place less weight on the turtle management options than other respondents, particularly on the beach closure management type. Tests of linear hypotheses were performed to reveal if management type one coefficients were significantly different to type two coefficients for each attribute in Table 5, with all reporting a significant difference at a 5% level except for fish management which was significantly different at a 10% level.

Table 4: Explanatory socio-demographic variable descriptions for Ningaloo and Capes, with mean values noted

Explanatory variable	**Description**	**Mean**	
Info	Information level: 0 = low & medium, 1 = high	0.34	
Split	Order in which marine parks were included: 0 = Ningaloo 1st , 1 = Capes 1st	0.50	
Group	Belong to an environmental group: 0 = no, 1 = yes	0.06	
		Ningaloo	Capes
Policy	Believe results will influence policy: 0 = no, 1 = yes	0.50	0.49
Visit	Have visited park before: 0 = no, 1 = yes	0.35	0.61
Seecor	Have seen live coral before: 0 = no, 1 = yes	0.87	n/a
Seewsh	Have seen live whale sharks before: 0 = no, 1 = yes	0.29	n/a
Rec	Have fished recreationally and/or been on a private boat into the park before: 0 = no, 1 = yes	0.13	n/a
4wd	Have taken a 4wd onto the beach of the park before: 0 = no, 1 = yes	0.05	n/a
Fish	Have fished recreationally in the park before: 0 = no, 1 = yes	n/a	0.16
Boat	Have been on a private boat in the park before: 0 = no, 1 = yes	n/a	0.05
Certainty	Certain of choice set responses: 0 = no, 1 = yes	0.76	0.74
Confusion	Thought the choice sets were confusing: 0 = no, 1 = yes	0.12	0.12

The CIM results display some similar findings as reported for NIM (Table 6). Again respondents are less likely to choose the status quo option if they are well informed, see Capes first in the park order, believe results will influence policy and belong to an environmental group. Those that have visited the area proposed to be the Capes marine park are also less likely to select the status quo. It is unclear why seeing the Capes questions first should have the same impact on both models, in terms of the interaction on the status quo. Again, there is general support for conservation, although coefficients are not significant for fish and abalone conservation. More weight is placed on seagrass conservation if the respondent belongs to an environmental group.

Table 5: Conditional logit results for NIM

Variable	**Coefficient**	**P>|z|**
Status quo	1.948	0.000
Info*status quo	-0.457	0.000
Split*status quo	-0.237	0.020
Policy*status quo	-0.724	0.000
Group*status quo	-1.069	0.000
Corlev	-0.007	0.924
Seecor*corlev	0.191	0.005
Nfislev	0.110	0.017
Rec*nfislev	-0.136	0.027
Turlev	0.138	0.002
Wshlev	0.091	0.060
Seewsh*wshlev	-0.187	0.000
Corman1	0.812	0.000
Corman2	0.920	0.000
Nfisman1	0.685	0.000
Nfisman2	0.752	0.000
Turman1	0.724	0.000
Turman2	0.644	0.000
4wd*turman1	-0.825	0.000
4wd*turman2	-0.406	0.015
Wshman1	0.623	0.000
Wshman2	0.770	0.000
Price	-0.013	0.000
Het		
Certainty	0.140	0.035
Confusion	-0.232	0.019

Note: Number of observations = 3,770; Number of respondents = 754; Log-likelihood = -4,302.038.

There is also an impact for the management options (Table 6). Particular interest groups place less weight on abalone and whale management, respectively being respondents who recreationally fish and those who have been on a private boat in the park area. Linear hypothesis testing suggests that for fish, management type has an impact and for whales this is true if they are not private boaters (significant at a 5% level). For Abalone, management types are significantly different at a 10% level for respondents who are recreational fishers in the park, but not for those who are not.

There are a number of significant effects identified within the error heterogeneity models. A positive coefficient within the error heterogeneity equation implies a positive relationship between the variable and scale, and hence an inverse one with variance. In both models, it is suggested that respondents that report that they are more certain of their choice set responses have a lower variance while within the

Ningaloo model, those that are confused have a higher variance. In the Capes model, the sub-sample who see the Capes questions first have a higher variance than those who complete it second, suggesting there may be some learning effects in place. However, there is no corresponding effect identified within the Ningaloo sample. One possible explanation is that there is an interaction effect between unfamiliarity with the marine park, and the complex choice experiment structure: those confronted with a challenging cognitive process and an unfamiliar environment exhibit higher variance, while the more familiar Ningaloo context, or a period of exposure to the CM set up reduces this.

Table 6: Conditional logit results for CIM

Variable	Coefficient	P>|z|
Status quo	1.770	0.000
Visit*status quo	-0.529	0.000
Info*status quo	-0.421	0.001
Split*status quo	-0.746	0.000
Policy*status quo	-0.679	0.000
Group*status quo	-1.045	0.010
Sealev	0.145	0.001
Group*sealev	0.243	0.035
Cfislev	0.029	0.556
Abalev	0.021	0.672
Whalev	0.266	0.000
Seaman1	0.656	0.000
Seaman2	0.687	0.000
Cfisman1	0.775	0.000
Cfisman2	0.858	0.000
Abaman1	0.547	0.000
Abaman2	0.483	0.000
Fish*abaman1	-0.398	0.002
Fish*abaman2	-0.201	0.102
Whaman1	0.470	0.000
Whaman2	0.712	0.000
Boat*whaman1	-0.590	0.004
Boat*whaman2	-0.562	0.003
Price	-0.018	0.000
Het		
Certainty	0.168	0.008
Split	-0.303	0.000

Note: Number of observations = 3,775; Number of respondents = 755; Log likelihood = -4,347.3913.

Respondents are willing to pay more for a 1% increase in coral conservation (if they have seen it before) than for other ecological attributes for Ningaloo (Table 7). Similarly, they have the highest WTP for seagrass, considered to be equivalent to coral in ecological function, if they belong to an environmental group for Capes. Interestingly, WTP associated with the management type is typically higher for Ningaloo than Capes, except for when respondents take part in four-wheel driving on the beach with respect to turtle management, although note these particular results are not significant.

Table 7: Partworths for the NIM and CIM models: 1% increase in conservation outcome, or discrete change in management action.

Ningaloo	**Part-worth**	**Capes**	**Part-worth**
Increase in coral populations: - Have not seen coral before - Have seen coral before	 $1 $15***	Increase in seagrass populations: - Do not belong to an environmental group - Do belong to an environmental group	 $8*** $22***
Coral management: - No go zones - Sanctuary zones	 $61*** $69***	Seagrass management: - Sanctuary zones - Government donation	 $36*** $38***
Increase in fish populations: - Have not been recreationally fishing or on a private boat in the park before - Have been recreationally fishing or on a private boat in the park before	 $8** $-2	Increase in fish populations	$2
Fish management: - Seasonal closure - Sanctuary zones	 $51*** $56***	Fish management: - Possession limits - Sanctuary zones	 $43*** $48***
Increase in turtle populations	$10***	Increase in abalone populations	$1
Turtle management: - Beach closure, if you have not been on beach with 4wd before - Beach closure, if you have been on beach with 4wd before - Fox baiting if you have not been on beach with 4wd before - Fox baiting if you have been on beach with 4wd before	 $54*** $-8 $48*** $18	Abalone management: - Fishing season reduction, if have not fished recreationally in park before - Fishing season reduction, if have fished recreationally in park before - Sanctuary zones, if have not fished recreationally in park before - Sanctuary zones, if have fished recreationally in park before	 $30*** $8 $27*** $16**
Increase in whale shark population: - Have not seen whale sharks before - Have seen whale sharks before	 $7* $-7*	Decrease in whale collisions	$15***
Whale shark management - Tour reduction - Government donation	 $47*** $58***	Whale management: - Tour reduction, if have not been on private boat in park before - Tour reduction, if have been on private boat in park before - Reduced boat speed, if have not been on private boat in park before - Reduced boat speed, if have been on private boat in park before	 $26*** $-7 $40*** $8

*,**,*** = significant at 10, 5 and 1% levels respectively.

Some care is needed in interpreting the impacts of management in these models. Management is obviously only undertaken in association with increased outcomes, and it is not possible to increase outcomes without some form of management. Thus, from a policy perspective one has to “reconstruct” values of policy interventions from these results. Thus, a 10% increase in fish stocks in Ningaloo would be valued at either $80+$51 or $80+$56, depending on the management form (for people who do not fish or take boats in the park). In the case of the Capes, there appears to be complete scope insensitivity to fish levels, although fisheries management intervention *per see* is valued. A similar effect is observed for abalone.

4.2 Management effect models: Ningaloo Management Model (NMM) and Capes Management Model (CMM)

To examine the effect of including a management process, for both Ningaloo and Capes, data from samples two and four were merged. Models were estimated for each in which a parameter was included for all possible interactions between conservation level and management type, with an additional management level being generated to represent 'no management' for the sample four 'outcome only' data. This resulted in six parameters for each ecological attribute, and a baseline level of zero conservation/zero management. The models will be referred to as the Ningaloo Management Model (NMM) and Capes Management Model (CMM).

Table 8: Conditional logit results for NMM.

Variable	Coefficient	P>|z|
Status quo	1.458	0.000
Coral 5%*corman1	1.008	0.000
Coral 5%*corman2	0.948	0.000
Coral 5%*no management	1.342	0.000
Coral 10%*corman1	1.123	0.000
Coral 10%*corman2	1.371	0.000
Coral 10%*no management	1.571	0.000
Fish 5%*nfisman1	0.662	0.000
Fish 5%*nfisman2	0.792	0.000
Fish 5%*no management	1.065	0.000
Fish 10%*nfisman1	0.937	0.000
Fish 10%*nfisman2	0.900	0.000
Fish 10%*no management	1.131	0.000
Turtle 5%*turman1	0.746	0.000
Turtle 5%*turman2	0.500	0.000
Turtle 5%*no management	1.031	0.000
Turtle 10%*turman1	0.790	0.000
Turtle 10%*turman2	0.828	0.000
Turtle 10%*no management	1.117	0.000
Whale shark 2%*wshman1	0.734	0.000
Whale shark 2%*wshman2	0.902	0.000
Whale shark 2%*no management	0.655	0.000
Whale shark 5%*wshman1	0.863	0.000
Whale shark 5%*wshman2	0.924	0.000
Whale shark 5%*no management	0.664	0.000
Price	-.016	0.000

Note: Number of observations = 2,116; Number of respondents = 423; Log likelihood = -2,416.3791; and Pseudo R^2 = 0.1763

NMM results are presented in Table 8. Note that, with the exception of whale sharks, a larger coefficient results for outcomes when the respondent does not have an explicit management process included. Further investigation using linear hypothesis testing suggests that, overall, the inclusion of a management process results in significantly different coefficient estimates for conservation improvements than if management is not considered (at a 1% level). Although the coefficients for CMM (Table 9) are not organised in as neat a pattern as for NMM, the linear hypothesis testing reaches the same conclusion.

Table 9: Conditional logit results for CMM

Variable	Coefficient	P>|z|
Status quo	0.547	0.000
Seagrass 5%*seaman1	0.711	0.000
Seagrass 5%*seaman2	0.752	0.000
Seagrass 5%*no management	0.910	0.000
Seagrass 10%*seaman1	0.885	0.000
Seagrass 10%*seaman2	0.757	0.000
Seagrass 10%*no management	1.137	0.000
Fish 5%*cfisman1	0.661	0.000
Fish 5%*cfisman2	0.979	0.000
Fish 5%*no management	0.861	0.000
Fish 10%*cfisman1	0.676	0.000
Fish 10%*cfisman2	0.756	0.000
Fish 10%*no management	0.996	0.000
Abalone 5%*abaman1	0.437	0.000
Abalone 5%*abaman2	0.374	0.001
Abalone 5%*no management	0.320	0.003
Abalone 10%*abaman1	0.376	0.001
Abalone 10%*abaman2	0.376	0.001
Abalone 10%*no management	0.517	0.000
Whale 25%*whaman1	0.576	0.000
Whale 25%*whaman2	0.834	0.000
Whale 25%*no management	0.767	0.000
Whale 50%*whaman1	0.864	0.000
Whale 50%*whaman2	1.135	0.000
Whale 50%*no management	0.962	0.000
Price	-0.018	0.000

Note: Number of observations = 2,111; Number of respondents = 422; Log likelihood = -2,468.4663; and Pseudo R^2 = 0.1565

The partworth's for NMM and CMM show a similar pattern to the information effect models, in that people are generally willing to pay more for improvements in Ningaloo than Capes (Table 10). Also noticeable is that respondents are typically willing to pay more for a higher level of conservation, and on average WTP increases as the management process becomes less restrictive on human use – i.e. lower WTP for management type one than two, and higher WTP for no management process. Within each management type, there is statistically significant evidence that respondents' value an increased conservation outcome, with the exception of abalone with fishing season management and fish with sanctuary zone management in the Capes.

Table 10: Partworths for NMM and CMM (compared to a baseline level of 0% conservation improvement). All results are significant at the 1% level.

Ningaloo			**Capes**		
% more	**Management type**	**Part-worth**	**% more***	**Management type**	**Part-worth**
Coral			*Seagrass*		
5%	No go zone	$62	5%	Sanctuary zone	$39
	Sanctuary zone	$58		Government donation	$41
	None	$82		None	$44
10%	No go zone	$68	10%	Sanctuary zone	$48
	Sanctuary zone	$83		Government donation	$41
	None	$96		None	$62
Fish			*Fish*		
5%	Seasonal closure	$40	5%	Possession limit	$36
	Sanctuary zone	$48		Sanctuary zone	$53
	None	$65		None	$47
10%	Seasonal closure	$57	10%	Possession limit	$37
	Sanctuary zone	$55		Sanctuary zone	$41
	None	$69		None	$54
Turtles			*Abalone*		
5%	Beach closure	$45	5%	Fishing season	$24
	Fox bait	$30		Sanctuary zone	$20
	None	$63		None	$17
10%	Beach closure	$48	10%	Fishing season	$20
	Fox bait	$50		Sanctuary zone	$20
	None	$68		None	$28
Whale sharks			*Whales*		
2%	Tour reduction	$45	25%*	Tour reduction	$31
	Government donation	$55		Boat speed	$45
	None	$40		None	$42
5%	Tour reduction	$53	50%*	Tour reduction	$47
	Government donation	$56		Boat speed	$62
	None	$40		None	$52

*Note: % refers to % reduction in boating collisions for Whales.

5. Discussion and conclusion

The preliminary data analysis of the public respondent samples suggests there are some significant effects resulting from varying information levels and the inclusion of management processes. There is some evidence of publicity influencing peoples preferences also, based on the WTP estimates of the two marine parks.

Although information effects were not so obvious that separate models resulted for each information level, there was a significant interaction of information on the status quo with the recipients of detailed information less likely to choose it in both the NIM and CIM. It could be that the more knowledgeable respondents are, the more comfortable they are with making decisions regarding alternatives over the current situation. A belief that the results of the study would influence policy had a similar impact, which could imply that respondents attempted to choose the alternatives more often than the status quo based on the chance that the hypothetical conservation improvement may actually eventuate in the future. It was also reassuring to see that a lower error variance resulted when respondents were certain of their choices.

It was not surprising to see in the NIM and CIM that respondents with more environmental experience, such as those that had viewed live coral before and belong to an environmental group, valued conservation more highly. Likewise, it is understandable that a more negative approach was adopted by respondents whose leisure activities may be interrupted by the proposed conservation and management efforts, such as those involved in recreational fishing and boating, and four-wheel driving on the beach. Interestingly, respondents who had seen live whale sharks before placed less weight on their conservation. Possible explanations include that their experience of having seen the sharks has made them more knowledgeable about other aspects of the ecosystem and recognise that other attributes may be more important ecologically, or they may not have enjoyed their whale shark experience.

The NMM and CMM support previous evidence that the inclusion of management processes do influence welfare estimates (Johnston and Duke 2007). The need to infer the management process in the outcome only version of the survey seems to increase WTP. There is an issue that it is unclear as to what this management option is, and whether it is homogenous across the population. It may well be that people are assuming the best in regard to the unstated management option. Generally WTP was highest when no management process was included, and often higher for a less restrictive management processes (in terms of human-use restrictions), suggesting that WTP rises as restrictions on how the conservation outcome is achieved diminish. These findings suggest that in future CM studies careful consideration of management processes should be taken. If a particular policy process is being considered *a priori* to a CM study, then its inclusion in the survey may be vital to giving reliable welfare estimates.

Public respondents were willing to pay more to protect aspects of Ningaloo rather than the Capes, which could be reflective of the publicity that Ningaloo has received over the past few decades as the iconic marine park in WA, as opposed to the Capes which has not been widely advertised as a proposed marine park to date. In continuance with the public awareness theme, it is interesting to observe that coral and seagrass were generally considered more important to conserve than the megafauna attributes in each park – which are often publicised as tourist attractions.

The public respondent results support the concept that knowledge, including that gained by information provided in a CM study and personal experience, can influence preferences. Awareness seems to also play a role in determining environmental values. Future analysis with an expert sample of marine scientists will explore these issues further, and help to determine the importance of public preferences in relation to complex environmental decisions. An important finding of this study is the significant influence of including management processes in welfare estimates. It may be possible to make CM more accessible to policy and decision makers by including information of this kind in future studies.

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