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Is Choice Modelling Really Necessary? Public versus expert values for marine reserves in Western Australia

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Abstract

One of the motivations for choice modelling is to provide values that can be used to inform decision-makers about the non-market costs and benefits of proposed projects or policies. However, the question must be asked as to whether decision-makers consider choice modelling to be a policy relevant tool. There may be more cost-effective and convenient means of providing comparable policy guidance than commissioning a choice modelling study. For example, advice on decision options may be sought from experts, such as scientists. However, expert advice may not accurately reflect the value judgements of the public.

The aim of this study is to investigate whether public and expert preferences diverge, using the choice modelling technique. Two case studies are utilised – the Ningaloo Marine Park and the proposed Ngari Capes Marine Park in Western Australia. Evidence of both divergence and convergence between public and expert values is found in different instances, with public awareness factors playing a role in this divide. Where preference divergence appears likely, decision-makers should consider choice modelling as a useful tool to inform policy.

Keywords: Choice modelling, valuation, experts, public, marine parks

1. Introduction

The primary purpose of environmental valuation mechanisms such as choice modelling (CM) is to quantify environmental assets in monetary terms, providing the ability to directly compare these values to other costs and benefits of proposed policies or projects. However, the use of CM in natural resource management policy has been limited, with the majority of the technique's influence centred on academic interests, for example, theoretical and methodological advances (Adamowicz 2004). Such advances are important in terms of informing appropriate use of CM, but ideally researchers would like to see their results influencing environmental policy.

For CM to be considered a useful component in environmental policy, it must provide valid and relevant information to decision-makers. One would think that the ability of CM to capture non-market values, particularly non-use values, would be appealing from a policy perspective. However, decision-makers may be of the opinion that the types of information gathered from CM studies could be obtained via other avenues. In an environmental context, scientific advice from experts is often relied upon to inform policy decisions (Adamowicz 2004). Consultation with experts is a more cost-effective approach to obtaining information than public consultation methods such as CM.

Indeed, expert consultation is an essential component of environmental decision making, particularly in relation to technical advice.

However, the advice of experts may not adequately represent the value judgements of the public. Accounting for public preference is inherently essential in public environmental policy. The democratic nature of Australian society, and the public taxation system used to fund management of many of our environmental assets, provides the public with the right to have a say. Therefore, if expert advice is found to misrepresent public values, public consultation methods such as CM become highly policy relevant.

This study investigates the potential for preference divergence between the public and experts to address the question of whether CM is really necessary[1]. A marine focus was considered suitable to explore preference divergence given that marine policy currently operates in a strong science-based climate, and information regarding non-market (especially non-use) values is often lacking (DEWHA 2010, Spurgeon 2004). Two marine reserves in Western Australia (WA) – the iconic Ningaloo Marine Park and less well known proposed Ngari Capes Marine Park – were selected as case studies as they offered an opportunity to explore whether the potential for preference divergence may be related to knowledge and awareness in the general public. It is also anticipated that other knowledge related factors may influence public preferences, such as an individual's experience with either Marine Park or the amount of information provided in the CM survey. As such, these factors are captured within the study framework.

This paper firstly presents some background information relating to public/expert preference comparisons (Section 2), followed by a description of the methods used to deliver the study (Section 3). The CM results are reported in Section 4, followed by a discussion of the results (Section 5) and conclusions (Section 6).

2. Background

Although an important topic, there has been relatively little focus on public/expert preference comparisons in the environmental valuation literature to date. The topic received some attention in the late 1990's, when valuation studies emerged considering the issue. In a contingent valuation (CV) study, Goodman *et al*. (1998) compare qualitative comments made by scientists and the public regarding two coastal conservation areas. They find that the public are in agreement with the experts with respect to identifying coastal areas in good and bad condition, however, they tend to have different preferences for management strategies.

Kenyon and Edwards-Jones (1998) make a quantitative comparison, comparing public CV results with an expert ranking of ecological characteristics of four different sites in a regional park. They form the hypothesis that information will affect public preferences with public samples receiving different amounts of information about the park, starting with textual information and photographs, then adding ecological data and on-site visits. Their findings suggested that the lower levels of information were not adequate for an informed judgement, while the inclusion of ecological data led

[1] The study is part of a PhD thesis (McCartney 2010).

the public to value the sites similarly to the expert rankings. Multi-mode approaches are also used by Johnston *et al*. (2002), who ask experts to rate the ecological potential of various wetland habitats while a CM survey is applied to a public sample, and Colombo *et al*. (2009) who use the Analytic Hierarchy Process (AHP) to determine expert judgements for public rights of way and again use CM to elicit citizens' preferences.

The multi-mode approach of these studies presents some complications in making a direct comparison of public and expert preferences. The different approaches are effectively asking different questions of the respondents, which may result in the public and expert samples valuing different aspects of the environment. For example, Kenyon and Edwards-Jones (1998) use an entry fee payment vehicle in the public CV, suggesting that the respondents are valuing use aspects of the park sites. On the other hand, the experts are asked to rate sites referring specifically to their ecological condition, which relates strongly to non-use aspects. The Goodman *et al.* (1998) study uses the same approach to collect preference information from the public and experts; however it does not offer a quantitative result in the form of willingness to pay (WTP). For a direct comparison of public and expert preferences, the two populations need to be addressing the same aspects of the good, ideally through the same quantitative mechanism.

A recent study by Carlsson *et al*. (2008) is the only known attempt in the environmental valuation literature using CM to value both public and expert preferences. Two Swedish case studies, valuing marine environment balance and clean air, are used to compare citizens' preferences with Environmental Protection Agency (EPA) administrators. Significant differences in WTP are found, with values typically being higher for the experts.

The experts in the Carlsson *et al.* (2008) study are asked to complete the CM survey acting as they would in their assigned position as an administrator – *recommending* the alternatives in the choice scenarios that they would implement as a policy, rather than selecting according to their personal preferences. This approach is sensible and valid if the aim is to compare how public preferences compare to policies that are likely to be implemented in the future. However, an alternative set of preferences may exist for experts, in the sense that they are a 'super-charged' well-informed individual. These individual expert preferences may well be different to those that are recommended through an administrative role. Individual expert preferences are also subject to a budget constraint, as are public preferences in a typical CM survey, which improves incentive compatibility. It is this set of individual expert preferences that are required for a direct comparison of expert and public preferences.

A direct comparison of this nature exists in the health valuation literature where Araña *et al*. (2006) compare CM results for a cervical cancer screening program between experienced medical practitioners and undergraduate social science students. They find similar preferences exist for both samples, despite the obvious knowledge gap. 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[2]. The undergraduate student sample may also not reflect the preferences of the various demographics prevalent in the broader community.

[2] For example, both the public and experts are likely to value similar outcomes for health issues (e.g., better health service provision, preventions rather than cures), while the public and experts may prioritise the wide and varied outcomes for environmental issues quite differently (e.g., public focus on iconic assets, expert focus on integral ecosystem functions).

The evidence from the literature suggests there is more work to be done in this area – there are conflicting findings in terms of public/expert divergence existing, and direct comparisons are required where an identical quantitative mechanism is applied to both the public and expert samples. Following on from Kenyon and Edwards-Jones (1998), information provision should be considered in public/expert comparisons to determine whether potential divergence is due to a lack of public knowledge or a true divergence in values.

3. Methodology

The marine park case studies utilised for the public/expert preference comparison are described in Subsection 3.1 below, along with a description of the attributes selected for each case study. Subsection 3.2 reports the survey methodology, including aspects of survey design, experimental design and sampling procedure. The model form employed is described in Subsection 3.3.

3.1 Case Studies

The Marine Parks

Ningaloo, situated in the north-west of WA, is one of the state's iconic marine reserves, and is thus well known by the public (MPRA 2005). The Marine Park and Ningaloo Reef are the prime focus of the region, which has emerged as an eco-tourism hub (Jones *et al*. 2009). On the other hand, the area proposed to become the Capes Marine Park is in a popular tourist region in the south-west of the state; however, specific ecological marine resources within the area are not well promoted to the general public. Also, the general WA community is unaware of the area proposed to become a marine park, with the exception of the local Capes community and self-interested individuals.

Attribute Selection

Adhering to Spurgeon's (2004) recommendation that more information regarding marine non-use values is required, the attributes selected for the study were framed on ecological components of the marine system, with the expectation that these would have some relationship with non-use values[3]. Each marine park has a management plan that identifies a number of ecological Key Performance Indicators (KPI's) which are attributes of importance in terms of ecosystem function (MPRA 2006, MPRA 2005). It was necessary to narrow down the selection of KPI's for the choice scenarios, and as such three were chosen for each marine park based on the following criteria: (1) the attribute applied to the whole marine park area, and was not localised; (2) the attribute was not too broad or complex to define for the context of the study; and (3) the attributes for each marine park are, wherever possible, complementary in terms of ecosystem function (e.g., coral performs a similar role at Ningaloo as seagrass does at Capes). A fourth attribute was also selected for each

[3] That is not to say that these ecological resources do not have a use value component. People may value them both for their existence and for aesthetic or recreational pleasure.

park, adhering to the criteria above, but being an ecological attribute of iconic status rather than one deemed important from an ecosystem integrity perspective.

Table 1: Attributes and levels for the Ningaloo and Capes Marine Parks, with the two management processes for each attribute specified as type T1 and T2.

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 (T1)	5% more seagrass due to 5% increase in sanctuary zones (T1)
5% more coral due to 7% increase in sanctuary zones (T2)	5% more seagrass due to Government spending $1,000,000 on cleaner drainage (T2)
10% more coral due to 10% new no go zones (T1)	10% more seagrass due to 10% increase in sanctuary zones (T1)
10% more coral due to 12% increase in sanctuary zones (T2)	10% more seagrass due to Government spending $2,000,000 on cleaner drainage (T2)
Target fish stocks (KPI)	*Target fish stocks (KPI)*
0% more fish	0% more fish
5% more fish due to 2 month seasonal closure (T1)	5% more fish due to 5kg reduction in fish catch possession limit (T1)
5% more fish due to 10% increase in sanctuary zones (T2)	5% more fish due to 10% increase in sanctuary zones (T2)
10% more fish due to 3 month seasonal closure (T1)	10% more fish due to 10kg reduction in fish catch possession limit (T1)
10% more fish due to 15% increase in sanctuary zones (T2)	10% more fish due to 15% increase in sanctuary zones (T2)
Marine turtles (KPI)	*Abalone (KPI)*
0% more turtles	0% more abalone
5% more turtles due to 50km beach closure (T1)	5% more abalone due to reducing recreational abalone fishing season to 5 months (T1)
5% more turtles due to 3 extra fox bait zones (T2)	5% more abalone due to 5% increase in sanctuary zones (T2)
10% more turtles due to 100km beach closure (T1)	10% more abalone due to reducing recreational abalone fishing season to 3 months (T1)
10% more turtles due to 6 extra fox bait zones (T2)	10% more abalone due to 10% increase in sanctuary zones (T2)
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 (T1)	25% less whales struck by boats due to 15% reduction in whale watch tours (T1)
2% more whale sharks due to Government donating $1,000,000 to their international conservation (T2)	25% less whales struck by boats due to maximum boat speed of 12 knots around whales (T2)
5% more whale sharks due to 50% reduction in whale shark tours (T1)	50% less whales struck by boats due to 30% reduction in whale watch tours (T1)
5% more whale sharks due to Government donating $2,000,000 to their international conservation (T2)	50% less whales struck by boats due to maximum boat speed of 9 knots around whales (T2)
Cost	
$0 (status quo option only), $20, $40, $60, $80	

The attributes and their corresponding levels are presented in Table 1. Attribute levels were based on percentage increases in population, with the exception of whales in the case of the Capes. Whale populations are steadily increasing without additional conservation support, and so the focus was on decreasing the rate of injuries and fatalities to whales through boating collisions. Note that each attribute level also includes a management component. Another aspect of this study considers the impact of management process on conservation preferences. For the purposes of interpreting results, it is useful to note that of the two management processes defined for each attribute, management type T1 is more restrictive on human use of the marine park than type T2 (for further information see McCartney 2010). A cost attribute was included with values ranging from $0 to $80, with the payment vehicle defined as an annual environmental tax.

3.2 Survey Methodology

Survey Design

The survey comprised of three sections: (1) a set of information and questions relating to Ningaloo; (2) an equivalent set of information and questions relating to Capes; and (3) socio-demographic questions. A split design was used so that respondents were randomly allocated to see either the Ningaloo or Capes questions first in the survey, to account for any ordering effects. Within each marine park section, questions were asked relating to respondents' awareness and experience with the park. Following the choice questions within each marine park section, there was a set of debriefing questions to investigate respondent uncertainty and decision heuristics such as attribute non-attendance (i.e., where a respondent reports that they ignored a particular attribute whilst making their choices). The software program Sensus 4.2 (Sawtooth Technologies 2006) was used to create the questionnaire for web-based administration.

Experimental Design

The choice scenarios, consisting of the four ecological attributes and cost, were designed with four alternatives – three conservation programs and a status quo option that consisted of 0% conservation levels and a $0 cost. Note that the $0 cost only ever appears in the status quo option based on the assumption that all other programs require some amount of funding for their conservation improvements. An example choice scenario is shown in Figure 1.

Choice Set 1 - Consider the following options. Assuming these are the only options available to you, which one would you be most likely to choose and which one would you be least likely to choose?
Please keep your financial circumstances in mind while answering.

	OPTION 1 status quo	OPTION 2	OPTION 3	OPTION 4
Conservation of coral reef	0% more coral	10% more coral due to 10% new no go zones	5% more coral due to 5% new no go zones	0% more coral
Conservation of target fish stocks	0% more fish	10% more fish due to 15% increase in sanctuary zones	5% more fish due to 2 month seasonal fishing closure	0% more fish
Conservation of turtle populations	0% more turtles	10% more turtles due to 6 extra fox bait zones	10% more turtles due to 100km beach closure	0% more turtles
Conservation of whale shark population	0% more whale sharks	0% more whale sharks	2% more whale sharks due to Government donating $1,000,000 to their international conservation	5% more whale sharks due to 50% reduction in whale shark tours
Cost to you per year	$0	$20	$60	$80
Most preferred option:	○	○	○	○
Least preferred option:	○	○	○	○

Figure 1: Format for the choice sets: an example for Ningaloo.

A split sample design was utilised to capture the expert and public target populations, and provide the public with varying amounts of information describing the attributes (Table 2). The samples consisted of public low (L), medium (M) and high (H) information, and the expert (E) sample that contained an equivalent amount of information as public sample H.

Table 2: Survey samples according to the target population and information included in attribute descriptions.

Sample	**Population**	**Ecological attribute descriptions**
Low information (L)	Public	Basic definition of the attribute (couple of sentences)
Medium information (M)	Public	Attribute defined more thoroughly, conservation status and threats described (a few paragraphs)
High information (H)	Public	Thorough attribute definition, conservation status and threats described, quantitative scientific information and figures provided, management options discussed (approx. 1 page)
Expert (E)	Expert	Thorough attribute definition, conservation status and threats described, quantitative scientific information and figures provided, management options discussed (approx. 1 page)

An efficient experimental design was generated for the public samples using the Discrete Choice Experiments software (Burgess 2007). The D-optimal design created had 25 choice sets with an efficiency measure of 98.89%, and balance maintained for all ecological attributes. The design was blocked by a factor of five, so that respondents were presented with five choice sets for each marine park. As the same design was used for both Ningaloo and Capes, blocks were staggered to avoid similarities in the composition of the conservation programs presented in the choices (i.e., if a respondent saw 'block 1' for Ningaloo, they would see 'block 2' for Capes).

In anticipation of the expert sample size being quite small, a different tactic was used to generate the choice design. The Ngene 1.0 program (Rose *et al*. 2008) is capable of estimating designs for S-efficiency, or in other words, designs that aim to minimise the required sample size necessary to estimate significant results. By informing a design with prior coefficient estimates, in this case the coefficients estimated from a preliminary analysis of the public high information samples, a new 25 choice set design was created for both Ningaloo and Capes, again blocked into sets of five. For Ningaloo, it was estimated that 5.26 full replicates were required, or 26 respondents across all five blocks. For Capes, it was estimated that 28.41 full replicates were required, or 142 respondents, which was due to the prior coefficients used for the abalone attributes being less significant than other attributes. It is worth noting that if we consider the estimation of the remaining three ecological attributes, ignoring abalone, the estimated required sample size was only 56 respondents in total. For both of the Ningaloo and Capes designs balance was maintained for the ecological attributes.

Sampling Procedure

The public samples were collected through a market research company, the Online Research Unit (ORU), in July/August 2008. Members of the ORU's West Australian panel were randomly invited via email to participate in what was described as a survey about a local issue (to minimise self-selection bias by not including marine parks in the description). Respondents received a $5 gift voucher and ten entries into a prize draw hosted by the ORU as compensation for their time if they completed the lengthy questionnaire. For the three public samples collected (L, M, and H), from 12,020 invitations a total of 1,025 individuals responded to the survey[4], with 770 (75%) completing the full questionnaire.

The expert sample consisted of Australian marine scientists. The scientists were invited to participate in the survey via an initial email, and were sent up to five reminders. Sampling began in December 2008 and was completed in August 2009. Of the 204 experts invited to participate, 118 (58%) responded. The survey was completed in full by 90 (76%) of those experts.

3.3 Model Form

The data were analysed using a mixed multinomial logit (ML) model. In a ML, particular coefficients are specified as random, so that there is a distribution of marginal utilities across the sample allowing for heterogeneity of tastes. Following the notation of Train (2009), one can specify a utility function with individual specific marginal utilities:

[4] Note that the response rate appears quite low (9%); however, this does not account for invitations lost in junk email inboxes or individuals that may have attempted to enter the survey after the quota was already full, and the survey closed off. Given that each split of the survey was only open for about four days, it is likely that a significant number of individuals may have tried to respond after the quota was full.

$$U_{nj} = \beta_n' x_{nj} + \varepsilon_{nj}$$

where:

x_{nj}= observed variables for individual *n* and alternative *j*

β_n' = vector of marginal utilities of the variables, *x*, for individual *n*

ε_{nj} = unobserved utility for individual *n* and alternative *j*

The error term (ε) is unobservable so assumptions must be made as to its distribution, typically taking on the form of a Gumbel distribution (Hensher *et al*. 2005). As per Train (2009), the probability of an alternative (*i*) being chosen by individual *n* is represented as follows:

$$P_{ni} = \int \left(\frac{e^{\lambda \beta' x_{ni}}}{\sum_j e^{\lambda \beta' x_{nj}}} \right) f(\beta) d\beta$$

where the random beta coefficients are evaluated at different values determined by the density *f*(*β*). The distribution function is specified by the researcher, typically as a normal or lognormal distribution (Train 2009). Lambda (λ) is a scale parameter that is inversely proportional to the standard deviation of the error term. That is, it scales the attribute coefficients according to the variance of the unobserved utility. Estimated parameters are interpreted as scaled marginal utilities as it is not possible to separately identify the scale and beta parameters.

In this study, the alternative specific constant (ASC, or status quo parameter) was specified as a random parameter. There were too many permutations possible to consider any logical approach to apply random parameters to the ecological attributes: four attributes with four parameters each, over eight data sets (the four L, M, H, and E samples for Ningaloo and Capes), with potential for correlations to exist between them (e.g., if an individual values one coral parameter positively, they are also likely to value other coral parameters positively).

4. Results

Using the statistical package Stata 11.0 (Statacorp 2009), the data were modelled according to a two-step process that (1) identified possible sample restrictions (Subsection 4.1), and (2) introduced socio-demographic information into the resulting models. The final models and partworths are presented in Subsection (4.2).

4.1 Preference Homogeneity across Samples

The first consideration in the analysis was whether preferences were homogeneous across the samples collected. Likelihood ratio tests were performed on the potential combinations of the public low (L), medium (M), high (H) information and expert (E) samples for Ningaloo and Capes, using basic models[5] for each sample that consisted of the random ASC parameter, ecological attributes and cost. The tests attempt to determine if the choices observed in the varying public information level and expert samples can be described using the same model (implying homogeneous preferences) or similar models with error variance heterogeneity. The tests were executed (for each marine park separately) as a series of steps:

1) Imposing a restriction to combine all possible subsets (i.e., LMHE), including a restriction that holds variance constant across samples (i.e., the scale parameter is assumed equal);
2) For combinations that were rejected in Step 1, the scale restriction was relaxed to determine if the subsets could be combined once allowing for a variation in sample variance;
3) If the combination was still rejected in Step 2, alternate combinations were tested repeating the steps above. Specifically, it was found that the subsets of LMH could be combined with E held separate.

The first step restricts both utility parameters and scale to be equivalent across the samples. For Ningaloo this restriction was possible for the LMHE samples, with a likelihood ratio test statistic of 58.04, effectively combining the samples into one model (Table 3). This suggests that preferences are homogeneous for Ningaloo. The Capes LMHE combination was rejected in Step 1, with a likelihood ratio statistic of 118.81 (Table 3).

Table 3: Public/expert sample combination likelihood ratio test statistics.

	Restricted Model Log Likelihood	**Likelihood Ratio Test Statistic**	**Degrees of Freedom**	**χ^2 Critical Value (p=0.05)**	**Outcome**
Ningaloo individual model log likelihoods: *L = -1521.79, M = -1223.96, H = -1189.68, E = -427.27*					
Combined LMHE	-4121.72	58.04	57	75.62	Accept restriction
Capes individual model log likelihoods: *L = -1255.21, M = 1253.36, H = -1232.54, E = -423.55*					
Combined LMHE	-4224.07	118.81	57	75.62	Reject restriction
Combined LMHE with scale differences λ(E)=0.91	-4223.76	118.21	56	74.47	Reject restriction
Combined LMH	-3757.89	33.55	38	53.38	Accept restriction

The Capes samples were then subjected to the test in Step 2, where scale was allowed to vary between samples. That is, if one sample is assumed to have a scale equal to one, another sample can be rescaled to a different value to account for variance between samples. Altering the scale parameter rescales all parameters within the particular sample. To find the appropriate relative scale

[5] Note: the regression output for the separate LMHE subsets for Ningaloo and Capes can be seen in Appendix 1. The regression output for the resulting combined models is included in Tables 6, 8 and 10.

values, the Capes LMH subsets were fixed with a scale equal to one, and the scale for the experts (E) was allowed to vary according to the grid search method[6]. The scale value associated with the maximum log likelihood from the grid search regression output is the optimal scale value, which in this case was *λ=0.91* for E and *λ=1* for L, M and H. A likelihood ratio test still rejects the restrictions on the marginal utilities across the combined model despite controlling for variance effects (Table 3).

The above test determines that the experts hold a different set of preferences for conserving the Capes than the public. Next, we test to see if preferences are homogenous amongst the public LMH samples for the Capes, as per Step 3. It was found that samples L, M and H could be combined, suggesting that information level had no significant impact on public respondent preferences. This was again a joint test on utility parameters and scale, with the likelihood ratio statistic of 33.55 permitting the restriction (Table 3).

The series of tests for preference homogeneity result in three final 'base models', consisting of the random ASC parameter, ecological attributes and cost. The three models are represented diagrammatically in Figure 2. These models are used to test for socio-demographic conclusions in the next subsection.

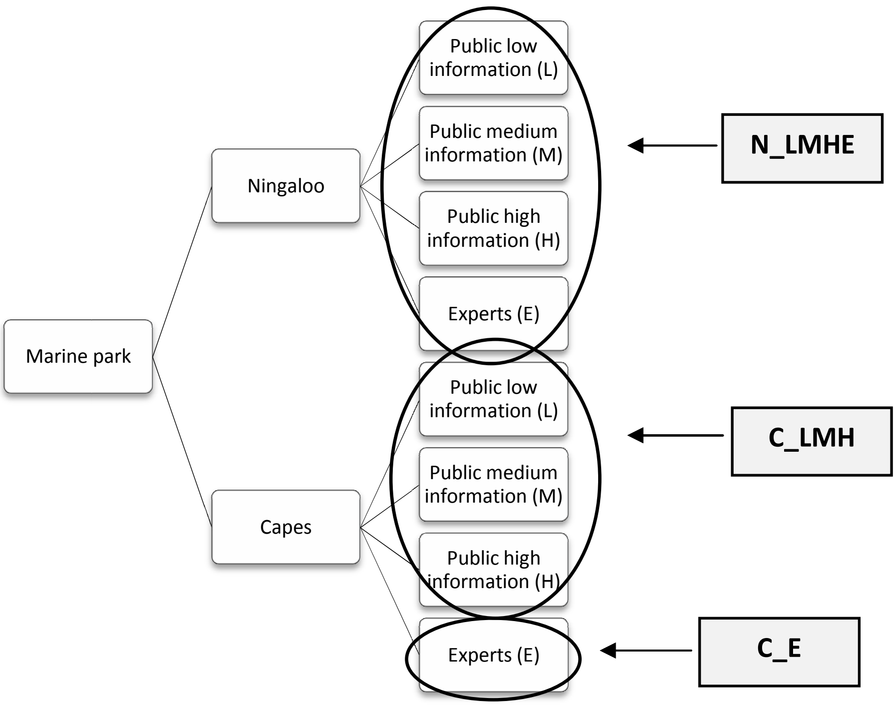

Figure 2: Diagrammatical representation of accepted sample combinations and resulting models: N_LMHE, C_LMH, C_E.

[6] Stata can estimate heterogeneity in random parameters, and in the variance of the error term, but not both simultaneously. Therefore, because the ML model was being used, a grid search method was required. The grid search allows the scale of one sample to remain fixed, while another specified sample is allowed to vary iteratively over a range of values to search for the best fit. Comparison of results from a simple data set estimated in Biogeme (which is capable of estimating both random parameters and error variance simultaneously, but not practical for large models) and the Stata grid search showed convergence in estimates between the two.

4.2 Final Choice Models

Additional questions were included in the survey with the expectation that they would explain preference heterogeneity (see Subsection 3.2). For each of the N_LMHE, C_LMH and C_E models, several socio-demographic variables were found to be significant inclusions in the models. The explanatory variable descriptions for the attributes can be seen in Table 4, and for the socio-demographic covariates in Table 5. Utility functions for each of the final N_LMHE, C_LMH and C_E models can be found in Appendix 2. The regression output and partworths for each of these models are presented below.

Table 4: Explanatory variable descriptions for the Ningaloo and Capes ecological attributes for the low, medium, high and expert samples.

Variable	Conservation level	Management T1	Management T2
		Dummy variables taking a value of 1, for each conservation and management level:	
Ningaloo attributes			
Coral	5%	Coral1	Coral2
	10%	Coral3	Coral4
Fish	5%	Nfish1	Nfish2
	10%	Nfish3	Nfish4
Turtle	5%	Turtle1	Turtle2
	10%	Turtle3	Turtle4
Whale shark	2%	Wshark1	Wshark2
	5%	Wshark3	Wshark4
Capes attributes			
Seagrass	5%	Seagrass1	Seagrass2
	10%	Seagrass3	Seagrass4
Fish	5%	Cfish1	Cfish2
	10%	Cfish3	Cfish4
Abalone	5%	Abalone1	Abalone2
	10%	Abalone3	Abalone4
Whale	25%	Whale1	Whale2
	50%	Whale3	Whale4

Table 5: Explanatory socio-demographic variable descriptions for the N_LMHE, C_LMH and C_E final models, with mean values noted where applicable.

Explanatory Variable	Description	N_LMHE mean	C_LMH mean	C_E mean
Policy	Believe results will influence policy: 0 = no; 1 = yes (1 = 7 or greater on scale from 1-10)	0.34	0.32	
Confidence	Have confidence in the government to enforce conservation measures: 0 = no; 1 = yes	0.67		
Gender	0 = male; 1 = female	0.47	0.49	
Children	0 = no children; 1 = have children	0.69	0.71	
Group	Belong to an environmental group: 0 = no; 1 = yes	0.10		
University	Experts employed or affiliated with a university: 0 = no; 1 = yes	0.07		
Research	Experts employed or involved in research specifically related to Ningaloo Marine Park: 0 = no; 1 = yes	0.08		
Medium	Medium information sample: 0 = no; 1 = yes	0.30		
High	High information sample: 0 = no; 1 = yes	0.30		
Expert	Expert sample: 0 = no; 1 = yes	0.11		
Aware	Aware that the area is proposed to become a marine park: 0 = no; 1 = yes		0.23	0.67
Visit	Have visited the marine park before: 0 = no; 1 = yes		0.48	
Future	Intend to/might visit the park in the future: 0 = no; 1 = yes		0.96	
Finance	Considered their financial circumstances while completing the choice sets: 0 = no; 1 = yes		0.83	
4wd	Have been on Ningaloo beach before with four wheel drive: 0 = no; 1 = yes	0.07		
Ignore_c	Ignored coral attribute: 0 = no; 1 = yes	0.04		
Ignore_nf	Ignored fish attribute: 0 = no; 1 = yes	0.07		
Ignore_t	Ignored turtle attribute: 0 = no; 1 = yes	0.06		
Ignore_ws	Ignored whale shark attribute: 0 = no; 1 = yes	0.08		
Ignore_s	Ignored seagrass attribute: 0 = no; 1 = yes		0.06	
Ignore_cf	Ignored fish attribute: 0 = no; 1 = yes		0.06	
Ignore_a	Ignored abalone attribute: 0 = no; 1 = yes		0.11	
Ignore_wh	Ignored whale attribute: 0 = no; 1 = yes		0.06	
Ignore	Ignored at least one attribute: 0 = no; 1 = yes			0.21

N_LMHE Model: Ningaloo public low, medium, high information and expert samples

Regression results are reported in Table 6 for both the final N_LMHE model with significant socio-demographic inclusions, and for the equivalent base model with only the ASC random parameter, cost and ecological attribute parameters (i.e., the base model that resulted from the sample combinations in Subsection 4.1, Figure 2). A comparison of the log likelihoods for the two models provides a likelihood ratio test statistic of 149.20 (for 30 degrees of freedom), rejecting the restricted base model. As such, subsequent discussion of the results focuses on the final model.

Table 6: ML results for the N_LMHE final model, with explanatory socio-demographic interactions, and base model.

Variables	**Final Model Mean (Standard Error)**		**Base Model Mean (Standard Error)**	
ASC	-3.63***	(1.38)	-7.69***	(1.22)
ASC*policy	-3.99***	(0.82)		
ASC*confidence	-2.29**	(1.12)		
ASC*gender	-2.62***	(0.77)		
ASC*children	2.24***	(0.71)		
ASC*group	-3.73***	(1.12)		
ASC*university	-7.48***	(1.66)		
ASC*research	-9.36***	(2.12)		
ASC*medium	-1.02	(0.92)		
ASC*high	-2.81***	(0.92)		
ASC*expert	8.83***	(2.10)		
Standard deviation of the ASC	*8.73****	*(1.08)*	*9.13****	*(0.96)*
Coral1	1.22***	(0.08)	1.18***	(0.08)
Coral2	1.24***	(0.08)	1.22***	(0.08)
Coral3	1.33***	(0.08)	1.29***	(0.07)
Coral4	1.55***	(0.08)	1.51***	(0.08)
Coral1*ignore_c	-1.30***	(0.40)		
Coral2*ignore_c	-0.40	(0.34)		
Coral3*ignore_c	-0.68*	(0.35)		
Coral4*ignore_c	-0.75**	(0.37)		
Nfish1	0.94***	(0.07)	0.87***	(0.07)
Nfish2	1.09***	(0.08)	1.01***	(0.07)
Nfish3	1.09***	(0.08)	1.03***	(0.07)
Nfish4	1.10***	(0.07)	1.02***	(0.07)
Nfish1*ignore_nf	-0.74***	(0.26)		
Nfish2*ignore_nf	-0.99***	(0.29)		
Nfish3*ignore_nf	-0.48*	(0.27)		
Nfish4*ignore_nf	-0.87***	(0.26)		
Turtle1	0.95***	(0.08)	0.88***	(0.07)
Turtle2	0.88***	(0.08)	0.80***	(0.08)
Turtle3	1.16***	(0.08)	1.05***	(0.07)
Turtle4	1.07***	(0.07)	0.99***	(0.07)
Turtle1*ignore_t	-0.54**	(0.27)		
Turtle2*ignore_t	-0.69**	(0.31)		
Turtle3*ignore_t	-0.83***	(0.30)		
Turtle4*ignore_t	-0.84***	(0.28)		
Turtle1*4wd	-0.42*	(0.25)		
Turtle2*4wd	-0.20	(0.28)		
Turtle3*4wd	-0.70***	(0.27)		
Turtle4*4wd	-0.35	(0.25)		
Wshark1	0.76***	(0.07)	0.68***	(0.07)
Wshark2	0.89***	(0.07)	0.78***	(0.07)
Wshark3	0.76***	(0.08)	0.67***	(0.07)
Wshark4	1.00***	(0.07)	0.89***	(0.07)
Wshark1*ignore_ws	-0.87***	(0.23)		

Wshark2*ignore_ws	-1.34***	(0.25)		
Wshark3*ignore_ws	-0.83***	(0.25)		
Wshark4*ignore_ws	-1.40***	(0.25)		
Cost	-0.01***	(0.00)	-0.01***	(0.00)
Log Likelihood	-4037.34		-4111.94	

Note: n = 844; number of observations = 4220.
***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

Overall, there is preference to conserve the ecological attributes, indicated by the positive coefficient estimates for ecological parameters that are not interacted with covariates (Table 6). Support for conservation is also shown with reference to the ASC, where there is a tendency to choose conservation programs over the current situation. There is, however, variance in the response to the ASC with the standard deviation for the final model ASC being 8.73 (significant at the 99% confidence level). This suggests that a proportion of the population holds a preference for the current situation, although the general tendency is to opt for the conservation alternatives, discussed in more detail below in terms of socio-demographic interactions.

For any given level of attributes, there is a baseline preference towards choosing conservation programs in favour of the status quo and this effect is enhanced by several significant interactions (Table 6). In particular, respondents who believe the results of the study will influence policy, have confidence in the government to enforce conservation measures, belong to an environmental group, or are female, are more likely to select conservation programs (*ceteris paribus*). For respondents with children, the negative response to the status quo was not as strong.

Referring back to the claim that homogeneous preferences exist among public and expert respondents in Subsection 4.1, it is interesting to note that there is a significant interaction in the final N_LMHE model that splits the samples apart again, to some extent, with respect to the status quo (Table 6). Public high information respondents have a stronger inclination than others towards choosing conservation programs, all else held equal. The experts responded positively to the status quo option with the exception of those that are affiliated with a university institution or involved in Ningaloo research activities where the additive ASC coefficient is smaller. This finding suggests that there is some divergence between public and experts in terms of the probability of selecting a conservation program; however, marginal utilities for the attributes are still homogeneous.

Attribute non-attendance was a significant explanatory variable in the final model (Table 6). Respondents who reported that they ignored a particular attribute displayed less positive conservation preferences for the attribute than those who did not, and had a negative response towards conservation for whale sharks in particular. Activities undertaken within the marine park also explained preference heterogeneity. Specifically, respondents who have taken a four wheel drive on to the beach at Ningaloo before responded less positively towards turtle conservation, particularly when management type T1 is in play for Turtle1 and Turtle3. Management T1 for the turtle attribute is a restriction in beach access during turtle breeding season.

The partworths for the N_LMHE model generally show significant and positive willingness to pay (WTP) values for the attributes, with the exception of WTP associated with attribute non-attendance (Table 7). Where an attribute was ignored, respondents generally were not willing to pay to conserve it, or otherwise had a reduced WTP for the attribute. Focussing on the instances where attributes were not ignored, and for individuals that have not been on the beach with a four wheel drive, one can see that coral is the most highly valued attribute in terms of WTP. Under the same circumstances, and at the 5% level of conservation (which is common across all attributes), the iconic whale shark attribute has the lowest WTP amounts in all cases where management T1 is in play, and most cases under management T2 (with turtles the exception).

Table 7: Partworths for the N_LMHE model.

	$/year	
Increase in coral populations	**5%**	**10%**
T1: No go zone management:		
- If did not ignore the coral attribute	85***	92***
- If did ignore the coral attribute	-5	45*
T2: Sanctuary zone management:		
- If did not ignore the coral attribute	86***	108***
- If did ignore the coral attribute	58**	56**
Increase in fish populations		
T1: Seasonal closure management:		
- If did not ignore the fish attribute	65***	75***
- If did ignore the fish attribute	14	42*
T2: Sanctuary zone management:		
- If did not ignore the fish attribute	76***	76***
- If did ignore the fish attribute	7	16
Increase in turtle populations		
T1: Beach closure management:		
- Have not been on beach with 4wd before, and did not ignore the turtle attribute	66***	81***
- Have been on beach with 4wd before, and did not ignore the turtle attribute	37**	32*
- Have not been on beach with 4wd before, and did ignore the turtle attribute	27	23
- Have been on beach with 4wd before, and did ignore the turtle attribute	-1	-25
T2: Fox baiting management:		
- Have not been on beach with 4wd before, and did not ignore the turtle attribute	62***	74***
- Have been on beach with 4wd before, and did not ignore the turtle attribute	48**	50***
- Have not been on beach with 4wd before, and did ignore the turtle attribute	13	16
- Have been on beach with 4wd before, and did ignore the turtle attribute	-1	-9
Increase in whale shark populations	**2%**	**5%**
T1: Tour reduction management:		
- If did not ignore the whale shark attribute	53***	53***
- If did ignore the whale shark attribute	-7	-4
T2: Government donation management:		
- If did not ignore the whale shark attribute	62***	70***
- If did ignore the whale shark attribute	-31*	-28

Note: ***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

C_LMH Model: Capes public low, medium, high information samples

The regression output for the C_LMH final model and equivalent base model (i.e., without socio-demographic interactions) is reported in Table 8. Likelihood ratio testing between the two models suggests the C_LMH final model has the best explanatory power (ratio test statistic of 95.77 for 23 degrees of freedom). Focus is therefore maintained on the final accepted C_LMH model.

Table 8: ML results for the C_LMH final model, with explanatory socio-demographic interactions, and base model.

Variables	Final Model Mean (Standard Error)		Base Model Mean (Standard Error)	
ASC	-5.61***	(1.60)	-7.14***	(1.05)
ASC*aware	-2.78***	(0.80)		
ASC*visit	-1.82**	(0.73)		
ASC*future	-3.55***	(1.31)		
ASC*finance	3.73***	(0.92)		
ASC*policy	-2.48***	(0.74)		
ASC*gender	-2.16***	(0.71)		
ASC*child	2.92***	(0.82)		
Standard deviation of the ASC	*8.13****	*(0.96)*	*8.06****	*(0.91)*
Seagrass1	0.88***	(0.08)	0.81***	(0.08)
Seagrass2	0.93***	(0.08)	0.84***	(0.07)
Seagrass3	1.04***	(0.07)	0.98***	(0.07)
Seagrass4	1.10***	(0.08)	1.01***	(0.08)
Seagrass1*ignore_s	-1.15***	(0.32)		
Seagrass2*ignore_s	-1.48***	(0.30)		
Seagrass3*ignore_s	-0.83***	(0.28)		
Seagrass4*ignore_s	-1.38***	(0.31)		
Cfish1	0.82***	(0.08)	0.77***	(0.07)
Cfish2	0.98***	(0.08)	0.94***	(0.08)
Cfish3	0.91***	(0.08)	0.87***	(0.08)
Cfish4	0.93***	(0.08)	0.89***	(0.07)
Cfish1*ignore_cf	-0.61**	(0.30)		
Cfish2*ignore_cf	-0.57*	(0.31)		
Cfish3*ignore_cf	-0.47	(0.31)		
Cfish4*ignore_cf	-0.48*	(0.29)		
Abalone1	0.51***	(0.07)	0.48***	(0.07)
Abalone2	0.46***	(0.08)	0.41***	(0.07)
Abalone3	0.48***	(0.08)	0.42***	(0.07)
Abalone4	0.52***	(0.07)	0.47***	(0.07)
Abalone1*ignore_a	-0.25	(0.21)		
Abalone2*ignore_a	-0.38	(0.23)		
Abalone3*ignore_a	-0.44*	(0.23)		
Abalone4*ignore_a	-0.37*	(0.21)		
Whale1	0.73***	(0.08)	0.69***	(0.07)
Whale2	0.98***	(0.08)	0.94***	(0.08)
Whale3	1.01***	(0.08)	0.97***	(0.08)
Whale4	1.29***	(0.08)	1.24***	(0.07)
Whale1*ignore_wh	-0.63**	(0.30)		
Whale2*ignore_wh	-0.69**	(0.31)		
Whale3*ignore_wh	-0.73**	(0.32)		
Whale4*ignore_wh	-0.84***	(0.30)		
Cost	-0.02***	(0.00)	-0.02***	(0.00)
Log likelihood	-3710.00		-3757.89	

Notes: n = 755; number of observations = 3775.
***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

Following trends from the N_LMHE model, the negative ASC coefficient shows there is an inclination for choosing the conservation program alternatives rather than the status quo (Table 8). Also in line with the N_LMHE model, there is support for conservation of the ecological attributes as shown by the positive coefficients (where covariates are not interacted). Further, attribute non-attendance is again an important explanatory variable in the final model, following similar patterns to the N_LMHE model where preferences for conservation are less positive when an attribute is ignored, and are tending to negative for the seagrass attribute.

Several variables play a role in explaining preferences with regards to the ASC in the C_LMH final model (Table 8). Respondents react more negatively towards the status quo option if they are aware of the area being proposed as a marine park, have visited the marine park before, intend to or are unsure whether they will visit the park in future (as opposed to not planning on visiting the park in future), believe the results of the study will influence policy, and are female. The reaction is less adverse if individuals have children and considered their financial circumstances while answering the choice set questions. Although all responses tend towards a negative association with the ASC, the significant standard deviation of the ASC suggests that individuals in the positive tail of this distribution hold a partiality for the status quo option.

For the C_LMH model, respondent WTP was lowest for the abalone protection program and highest for the iconic whale attribute at its maximum conservation level under management type T2 (Table 9).Once again, WTP was generally not significantly different from zero when an attribute was not attended to – a sensible result given that one would assume an individual is not willing to pay for something they are ignoring.

Table 9: Partworths for the C_LMH model.

	$/year	
Increase in seagrass populations	**5%**	**10%**
T1: Sanctuary zone management - If did not ignore the seagrass attribute - If did ignore the seagrass attribute	 49*** -15	 58*** 12
T2: Government donation management - If did not ignore the seagrass attribute - If did ignore the seagrass attribute	 52*** -30*	 61*** -16
Increase in fish populations		
T1: Possession limit management - If did not ignore the fish attribute - If did ignore the fish attribute	 46*** 12	 51*** 25
T2: Sanctuary zones management - If did not ignore the fish attribute - If did ignore the fish attribute	 55*** 23	 52*** 25
Increase in abalone populations		
T1: Fishing season reduction management - If did not ignore the abalone attribute - If did ignore the abalone attribute	 29*** 14	 27*** 2
T2: Sanctuary zone management - If did not ignore the abalone attribute - If did ignore the abalone attribute	 26*** 5	 29*** 8
Decrease in whale collisions	**25%**	**50%**
T1: Tour reduction management - If did not ignore the whale attribute - If did ignore the whale attribute	 41*** 6	 56*** 16
T2: Reduced boat speed management - If did not ignore the whale attribute - If did ignore the whale attribute	 55*** 16	 72*** 25

Note: ***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

C_E Model: Capes expert sample

The regression output reported in Table 10 shows the coefficients for the final C_E model, with socio-demographic explanatory variables interacted on the ASC, and the coefficients for an equivalent base model with no interaction terms. A likelihood ratio test statistic of 6.55 (two degrees of freedom) supports the final C_E model in favour of the restricted base model, and is the subject of discussion.

Table 10: ML results for the C_E final model, with explanatory socio-demographic interactions, and base model.

Variables	Final Model Mean (Standard Error)		Base Model Mean (Standard Error)	
ASC	-20.47**	(9.55)	-13.85	(8.93)
ASC*ignore	-16.21**	(6.50)		
ASC*aware	8.22**	(3.72)		
Standard deviation of the ASC	*12.83***	*(5.02)*	*13.20**	*(6.77)*
Seagrass1	1.14***	(0.29)	1.13***	(0.29)
Seagrass2	1.66***	(0.36)	1.66***	(0.36)
Seagrass3	1.96***	(0.34)	1.96***	(0.34)
Seagrass4	1.79***	(0.32)	1.79***	(0.32)
Cfish1	0.66**	(0.29)	0.66**	(0.29)
Cfish2	0.87***	(0.31)	0.87***	(0.31)
Cfish3	1.03***	(0.29)	1.03***	(0.29)
Cfish4	1.54***	(0.30)	1.54***	(0.30)
Abalone1	0.64**	(0.31)	0.63**	(0.31)
Abalone2	0.91***	(0.23)	0.91***	(0.23)
Abalone3	0.99***	(0.17)	0.99***	(0.17)
Abalone4	0.89***	(0.30)	0.88***	(0.30)
Whale1	0.25	(0.25)	0.24	(0.25)
Whale2	0.36	(0.24)	0.36	(0.24)
Whale3	-0.29	(0.29)	-0.29	(0.29)
Whale4	0.72***	(0.24)	0.72***	(0.24)
Cost	-0.01*	(0.00)	-0.01*	(0.00)
Log likelihood	-416.13		-419.40	

Notes: n = 89; number of observations = 445.
***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

Socio-demographic variables did not play a large role in explaining preferences for the Capes expert sample, with only two explanatory variables found to be significant – ignoring attributes and awareness of marine park status. The lack of socio-demographic inclusions could be expected, given that the experts' opinions are more informed, and could be considered less personal.

The ecological attribute coefficients indicate that experts positively view conservation benefits in most cases (Table 10). Although, the experts do not place a great weight on conservation of the iconic whale attribute, with only the highest level of conservation under management type T2 retaining a significant positive preference.

Interestingly, the cost attribute is only significant at the 90% level of confidence in the C_E model, possibly indicating that their preferences are aligned with conserving regardless of the costs proposed (Table 10). That is, although there may exist some level of cost which would impact on their choices, the range of costs presented in the design was not sufficient to provide a basis for discriminating between alternatives. Alternatively, they may not have been acting as 'individuals' reflecting on personal cost, but as 'citizens', and making judgements about ecological outcomes independent of personal considerations.

Preference to choose conservation programs is illustrated strongly by the experts in the C_E final model, with their reaction to the ASC being highly negative (Table 10). This is particularly the case if one or more of the attributes was ignored while making choices, and slightly less so if they were aware that the Capes had been proposed as a marine park. Because of the highly negative ASC, only those individuals that are aware of the marine park status and have an ASC coefficient of at least one (positive) standard deviation from the mean would have a positive status quo effect.

Partworths for the C_E model are presented in Table 11. The most obvious point to note is that they are generally not significant, likely due to the weakly significant cost coefficient. However, observation of the WTP figures that are (at least weakly) significant shows much higher values in comparison to the C_LMH partworths. Specifically, the significant seagrass and abalone partworths are up to four and a half times larger than the equivalent dollar values in the C_LMH model.

Table 11: Partworths for the C_E model.

	$/year	
Increase in seagrass populations	**5%**	**10%**
T1: Sanctuary zone management	166	287
T2: Government donation management	243*	261*
Increase in fish populations		
T1: Possession limit management	97	150
T2: Sanctuary zones management	127	224
Increase in abalone populations		
T1: Fishing season reduction management	93*	144
T2: Sanctuary zone management	134	130**
Decrease in whale collisions	**25%**	**50%**
T1: Tour reduction management	36	-43
T2: Reduced boat speed management	52	106

Note: ***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

5. Discussion

The results of the public/expert preference comparison appear to be conflicting at first glance, with convergence present for Ningaloo, and divergence for Capes. Here we discuss these results in more detail, and offer some interpretation of why there is inconsistency in the findings from each marine park.

Ningaloo and Capes generate different results in relation to the equivalence of public and expert models. For Ningaloo, the results suggest that the public information variants and the experts can be combined in a single model (N_LMHE). The Capes results, on the other hand, support the separation of the expert model from all the other samples (i.e., from C_LMH). Revisiting the purpose of investigating the two marine parks in the study, the key difference between Ningaloo and Capes is the public awareness factor.

It is entirely possible that the greater level of awareness that the public has for Ningaloo has led to a better understanding about the importance of conserving the park and its particular attributes. Ningaloo is a natural icon of WA and is well promoted through tourism campaigns advertising the vibrant coral reef. The enhanced knowledge and awareness that public individuals have as a result of

Ningaloo publicity could be responsible for the convergence of values between the public and experts for the Ningaloo attributes. Meanwhile, the Capes proposed park has not been heavily publicised and community awareness is likely to be low. Therefore, one would expect the knowledge gap between respondents from the public and expert groups to be heightened and preferences to be divergent.

In the case of the Ningaloo data, there are still some differences apparent between the general public and experts. Although preferences converged in terms of attribute weightings and marginal utilities, they diverged with respect to opting for conservation programs or the status quo. Experts have a weaker preference for the proposed conservation programs in the choice sets compared to the public. However, if the expert is affiliated with a university institution, or is a Ningaloo researcher, then the expert's preferences for conservation become similar to those of the public (*ceteris paribus*).

A commonality between the Ningaloo and Capes models was the ability to combine the public low, medium and high information samples. This may seem contrary to the claim of knowledge and awareness influencing preferences. However, it is suspected that in this instance the medium used to deliver the information variants was not effective enough to shift preferences, either due to there being insufficient difference between information levels or individuals simply not responding to the form of knowledge stimulation employed. Some reaction to information level is noted in the N_LMHE model, where individuals from the high information sample tended to prefer conservation options (i.e., not the status quo) in comparison to other individuals (*ceteris paribus*). This is probable evidence that the additional information has had at least some impact and improved individuals' awareness of Ningaloo, positively influencing their preference to choose options that achieve some level of environmental benefit.

Further verification that knowledge significantly impacts on preferences is seen through the individual characteristics that contribute to preference heterogeneity in the models. In the C_LMH model, evidence points to a stronger preference for improved conservation outcomes among respondents that are aware of the proposed marine park, have visited it in the past, or intend to visit in the future. Each of these characteristics relates to an existing knowledge base that the individual has of the marine park, giving weight to the relationship between pro-conservation preferences and knowledge. It should be noted, however, that for the individuals that intend to visit the parks in future, the stronger conservation preferences may also relate to use values, in terms of maintaining or protecting the site's characteristics for future use, rather than knowledge.

In the N_LMHE model, individuals belonging to an environmental group also react more negatively towards the status quo and prefer the conservation alternatives, suggesting their membership of the group has enhanced their environmental awareness. However, it should be noted that individuals belonging to environmental groups are also likely to hold more of a pro-conservation attitude than others, so this result may not solely relate to knowledge effects.

Turning attention to the attributes valued in each marine park, some interesting comparisons can be made. For Ningaloo, the highest WTP values were associated with coral. The iconic whale shark attribute was valued positively but generally not as highly in relation to the other attributes (i.e., when comparing the partworths for the equivalent 5% level of conservation across attributes for a particular management type). These relative values are understandable if considered in terms of conserving the broader ecological system. The coral, fish and turtle attributes are important for monitoring the health of the overall ecosystem and are defined as KPI's. Coral, in particular, forms the backbone of the local ecosystem and its protection will have positive flow on effects to other marine biodiversity. On the other hand, the whale sharks, while being an iconic species, do not impact greatly on the local ecosystem and are not as important in terms of conserving the marine park generally, mirrored by the CM results.

In this instance the public seem to have recognised the respective importance of each attribute in agreement with the experts, potentially due to the public awareness effects discussed above. However, there is an alternative interpretation of this result. The coral attribute may be appealing to the public in terms of its visual aesthetics, as coral reef systems are known for being colourful and vibrant[7]. Thus, the public may be valuing coral similarly to the experts, but for different reasons given that the experts are likely to be focussed on the coral's ecological importance.

The results from the Capes analysis show significant differences in what is deemed most valuable, with the expert and public models split apart for the Capes. The public appear to have more interest in the iconic attributes, and not the less vibrant KPI's. Intuitively, the experts instead place higher value on attributes that are fundamental for ecosystem function. These effects are most pronounced with respect to the whale, seagrass and abalone attributes.

The Capes whale attribute is similar to the Ningaloo whale shark attribute – iconic, but not as ecologically important for the local ecosystem as the KPI attributes. Unlike the Ningaloo case, the public samples value the iconic attribute quite highly in the Capes with whales recording the largest dollar value for the C_LMH model. It could be that the iconic megafauna is the most appealing attribute in this instance since there is no 'colourful coral' to consider, and a lack of general awareness for the marine park reduces understanding of the ecological system. The experts react as expected; with the iconic whale attribute coefficients generally not significant, presumably because the experts recognise that other attributes are more important to conserve to protect the broader ecosystem.

The Capes seagrass attribute performs a vital function like the coral attribute, but the results for these two attributes show some obvious differences. Seagrass is not the most valuable attribute in the public C_LMH model, while for the experts in the C_E model it represents one of the few instances with a significant dollar value that is relatively much larger than the public WTP amounts. This result supports the concept that the public have responded to the publicity of the Ningaloo coral, given the ecologically similar Capes seagrass is considered less important to conserve in comparison. It also shows a clear divergence between public and expert response.

The abalone attribute, another KPI, again shows divergence. The public C_LMH model reports abalone as the least valuable attribute in terms of WTP, while abalone provides the only other significant dollar values for the expert sample. Noting the recognition given to KPI's in the well publicised Ningaloo Marine Park, it could be concluded once more that a lack of awareness and understanding is responsible for divergence on this ecologically important, but perhaps visually unattractive, attribute.

[7] For example, the Great Barrier Reef is known worldwide for its aesthetic beauty (Kragt *et al*. 2006), and Indonesia consider their coral reefs as great natural treasures (Cesar 1996).

6. Conclusion

The most important finding from this study is that preference divergence exists between the public and experts, particularly with respect to the Capes. This is noted not only through the separate nature of the models that describe preferences among the two populations, but also through differences in the dollar value estimates for attributes. This result implies that decision-makers must be cautious of ensuring public opinion is adequately considered in public policy. The presence of divergence suggests that public consultation methods, such as CM, are an invaluable tool for decision-makers, and may indeed be necessary.

However, the statement that divergence exists should also be viewed with caution. For Ningaloo, there was a convergence of values between the public and experts. There is evidence suggesting that knowledge and awareness factors played a role in driving preferences, and may at least in part explain why public/expert values converged for the well publicised Ningaloo, and diverged for Capes. From a policy perspective, this might suggest that where evidence of divergence is found between public and expert opinion, awareness campaigns aimed at educating the public on a potential policy may be beneficial, rather than using uninformed preferences to drive policy decisions.

Further research is required in this space, particularly with respect to better identifying the cause of divergence. As discussed above, it is possible that the convergence of values for Ningaloo resulted not just because of awareness aligning public and expert preferences, but potentially because the ecologically important attributes were also aesthetically pleasing attributes. If convergence is mostly due to the latter then it is possible that for other environmental assets, even in cases where public awareness is high, the public may hold different values to experts. Future case studies should be aimed at identifying instances of true preference divergence and instances where divergence is due to lack of awareness, to aid development of a more targeted approach for applying CM (and other consultation mechanisms) or educational tools.

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APPENDIX 1: Mixed Logit Results for Individual Samples

Table A1: ML results for Ningaloo individual sample base models (consisting of ASC, cost and ecological attribute parameters).

Variables	Low Information (L) ML	Medium Information (M) ML	High Information (H) ML	Experts (E) ML
ASC	-5.12*** (1.49)	-7.79*** (2.40)	-10.64*** (3.37)	-10.76** (4.71)
ASC Standard Deviation	7.15***(1.22)	11.03***(2.34)	10.04***(2.32)	12.07***(3.50)
Coral1	1.00***(0.14)	1.14***(0.15)	1.31***(0.14)	1.80***(0.34)
Coral2	1.16***(0.14)	1.06***(0.14)	1.30***(0.14)	1.75***(0.33)
Coral3	1.19***(0.13)	1.24***(0.14)	1.31***(0.14)	1.95***(0.31)
Coral4	1.33***(0.14)	1.52***(0.15)	1.56***(0.15)	2.00***(0.31)
Nfish1	0.82***(0.13)	0.78***(0.13)	0.88***(0.13)	1.41***(0.27)
Nfish2	0.89***(0.14)	0.93***(0.14)	1.03***(0.13)	1.58***(0.27)
Nfish3	0.92***(0.14)	1.08***(0.14)	0.94***(0.13)	1.73***(0.30)
Nfish4	0.95***(0.13)	1.03***(0.13)	0.98***(0.13)	1.53***(0.26)
Turtle1	0.86***(0.13)	0.87***(0.13)	0.95***(0.13)	1.04***(0.27)
Turtle2	0.87***(0.14)	0.66***(0.14)	0.93***(0.14)	0.88***(0.29)
Turtle3	1.08***(0.14)	0.94***(0.14)	1.09***(0.14)	1.20***(0.25)
Turtle4	1.04***(0.13)	0.95***(0.13)	0.95***(0.13)	1.40***(0.27)
Wshark1	0.70***(0.13)	0.79***(0.13)	0.74***(0.13)	0.22(0.26)
Wshark2	0.76***(0.13)	0.97***(0.13)	0.87***(0.13)	0.50***(0.17)
Wshark3	0.62***(0.13)	0.91***(0.14)	0.64***(0.13)	0.52**(0.25)
Wshark4	0.91***(0.13)	0.97***(0.13)	0.96***(0.13)	0.75***(0.21)
Cost	-0.02***(0.00)	-0.01***(0.00)	-0.01***(0.00)	-0.01**(0.00)
Log Likelihood	-1251.79	-1223.96	-1189.68	-427.27
Number of Observations	1255	1275	1245	450

Note: ***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

Table A2: ML results for Capes individual sample base models (consisting of ASC, cost and ecological attribute parameters).

Variables	**Low Information (L) ML**	**Medium Information (M) ML**	**High Information (H) ML**	**Experts (E) ML**
ASC	-6.04*** (1.61)	-7.26*** (1.92)	-8.97*** (2.42)	-12.89* (6.98)
ASC Standard Deviation	7.72***(1.35)	9.05***(1.68)	9.03***(1.90)	12.37**(4.98)
Seagrass1	0.79***(0.14)	0.82***(0.14)	0.82***(0.13)	1.17***(0.29)
Seagrass2	0.91***(0.13)	0.85***(0.13)	0.78***(0.13)	1.69***(0.36)
Seagrass3	0.90***(0.13)	1.03***(0.13)	1.02***(0.12)	2.01***(0.34)
Seagrass4	1.11***(0.14)	0.91***(0.14)	1.02***(0.14)	1.79***(0.32)
Cfish1	0.71***(0.13)	0.73***(0.13)	0.90***(0.13)	0.62**(0.29)
Cfish2	0.77***(0.13)	1.08***(0.13)	0.97***(0.13)	0.84***(0.30)
Cfish3	0.95***(0.13)	0.77***(0.14)	0.90***(0.13)	1.01***(0.29)
Cfish4	0.86***(0.13)	0.82***(0.13)	1.00***(0.13)	1.51***(0.30)
Abalone1	0.48***(0.12)	0.53***(0.12)	0.44***(0.12)	0.64**(0.31)
Abalone2	0.51***(0.13)	0.49***(0.13)	0.26**(0.13)	0.91***(0.23)
Abalone3	0.58***(0.13)	0.40***(0.13)	0.28**(0.13)	0.99***(0.17)
Abalone4	0.50***(0.12)	0.43***(0.12)	0.47***(0.12)	0.88***(0.30)
Whale1	0.81***(0.13)	0.62***(0.13)	0.65***(0.13)	0.20(0.25)
Whale2	0.91***(0.14)	0.91***(0.13)	1.00***(0.13)	0.32(0.23)
Whale3	0.99***(0.14)	0.98***(0.14)	0.95***(0.14)	-0.33(0.29)
Whale4	1.29***(0.13)	1.24***(0.13)	1.22***(0.12)	0.70***(0.24)
Cost	-0.02*** (0.00)	-0.02*** (0.00)	-0.02*** (0.00)	-0.01 (0.00)
Log Likelihood	-1255.21	-1253.36	-1232.54	-423.55
Number of Observations	1255	1275	1245	450

Note: ***, **, * denotes significance at the 99%, 95% and 90% level of confidence respectively.

APPENDIX 2: Utility Functions for Final Choice Models

N_LMHE FINAL MODEL

For the N_LMHE model, utility (U) held by individual n over alternative j can be defined as (suppressing j subscript):

$$U_n = \beta_o^{'} ASC + \sum_{k=1}^{K} \sum_{l=1}^{4} (\beta_{kl} + \alpha_{kl} z_{nk}^{att}) x_{kl} + \sum_{l=1}^{4} \gamma_l \, z_n^{4wd} s_l + \varepsilon_n$$

where:

$\beta_o^{'}$ = ASC coefficient
k = the ecological attributes from the set K {Coral, Fish, Turtle, Whale shark}
l = the levels of k (e.g., Coral1, Coral2, Coral3, Coral4)
x_{kl} = vector of ecological attributes
β_{kl} = the vector of marginal utilities of the ecological attributes, x
$\alpha_{kl} z_{nk}^{att}$ = impact (α) of attribute non-attendance (z_{nk}^{att}) on the marginal utility of the ecological attributes, x
$\gamma_l z_n^{4wd} s_l$ = impact (γ) of four wheel drivers (z_n^{4wd}) on the marginal utility of the Turtle attribute (s)
ε_n = unobservable utility

The ASC marginal utility, $\beta_o^{'}$, can be further defined to be normally distributed (η) and include the impact of individual characteristics ($\delta^{'} z$):

$$\beta_{on}^{'} = \beta_o + \delta^{'} z_n + \eta$$

C_LMH FINAL MODEL

For the final C_LMH model with the public low, medium and high information samples combined, definition of the utility function U for individual n over each alternative j is as follows (suppressing j subscript):

$$U_n = \beta_o^{'} ASC + \sum_{k=1}^{K} \sum_{l=1}^{4} (\beta_{kl} + \alpha_{kl} z_{nk}^{att}) x_{kl} + \varepsilon_n$$

where:

$\beta_o^{'}$ = ASC coefficient
k = the ecological attributes from the set K{Seagrass, Fish, Abalone, Whale}
l = the levels of k (e.g., Seagrass1, Seagrass2, Seagrass3, Seagrass4)

x_{kl} = vector of ecological attributes
β_{kl} = the vector of marginal utilities of the ecological attributes, *x*
$\alpha_{kl} z_{nk}^{att}$ = impact (α) of attribute non-attendance (z_{nk}^{att}) on the marginal utility of the ecological attributes, *x*
ε = unobservable utility

$\beta_o^{'}$ is further defined:

$$\beta_o^{'} = \beta_o + \delta^{'} z_n + \eta$$

where:

$\delta^{'} z_n$ = impact of individual characteristics on the marginal utility of the ASC
η = normal distribution

C_E FINAL MODEL

The socio-demographic variables in the final C_E model both interact on the ASC parameter, resulting in a simplified utility function. Utility (*U*) for individual *n* for each alternative *j* is defined as follows (suppressing *j* subscript):

$$U_n = \beta_o^{'} ASC + \sum_{k=1}^{K} \sum_{l=1}^{4} \beta_{kl} \, x_{kl} + \varepsilon_n \qquad \text{Equation (7.4)}$$

where:

$\beta_o^{'}$ = ASC coefficient
k = the ecological attributes from the set *K*{Seagrass, Fish, Abalone, Whale}
l = the levels of *k* (e.g., Seagrass1, Seagrass2, Seagrass3, Seagrass4)
x_{kl} = vector of ecological attributes
β_{kl} = the vector of marginal utilities of the ecological attributes, *x*
ε = unobservable utility

$\beta_o^{'}$ is again further defined:

$$\beta_o^{'} = \beta_o + \delta^{'} z_n + \eta$$

where:

$\delta^{'} z_n$ = impact of individual characteristics on the marginal utility of the ASC
η = normal distribution