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Non Use Economic Values of Marine Protected Areas in the South-West Marine Area

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ABSTRACT

Australian governments are committed to the expansion of marine protected areas (MPAs) in Australian waters and have already established over 200 MPAs. However, this policy direction has a range of costs and benefits for the community which have largely remained unquantified. One of the main benefits of establishing MPAs are the non use values that the community for the protection of marine biodiversity. This study uses a dichotomous choice contingent valuation format with follow-up open-ended willingness to pay question to estimate these non use values for the establishment of MPAs in South-west Marine Region of Australia.

It was found that on average Australian households would be WTP $104 for the establishment of MPAs that cover 10% of the South-west Marine Region. Aggregating this mean WTP estimate to 50% of the population of Australian households gives an aggregate WTP of $400M.

However, whether the establishment of MPAs in the South-west Marine Region is economically efficient requires a consideration of all the potential costs and benefits. Other relevant costs and benefits for inclusion in a benefit cost analysis would include those associated with displacement of commercial and non-commercial uses, additional planning, compliance and monitoring costs as well as any predicted increases in commercial and non-commercial use values.

If the net costs of establishing MPA over 10% of the South-west Marine Region are less than $400M, then the non-use benefits of establishing MPAs would exceed the other net costs and it would be considered to be economically efficient and desirable from a community welfare perspective.

Given the difficulties of estimating precise WTP values from dichotomous choice data, any BCA of MPAs in the South-west Marine Region, incorporating the results of this study, should undertake sensitivity testing that includes the range of values reported including dichotomous choice and open-ended means to determine the robustness of BCA results to variations in the welfare estimate.

1.0 INTRODUCTION

Australian governments are committed to the expansion of marine protected areas (MPAs) in Australian waters. Already over 200 MPAs have been established. However, this policy direction has a range of costs and benefits for the community which have largely remained unquantified. Most economic studies of MPAs are partial in nature, focusing on economic conceptual issues, base line data collection, specific economic values such as recreation, cost analyses of displaced fishing effort or licensing regimes, and economic impact studies that focus on regional economic activity rather than economic values. Few studies that examine costs and benefits of MPA would appear to have been undertaken ex ante to assess the relative merits of establishing new MPAs. One particularly important aspect of any exante BCA of new MPA is their non use values.

The Commonwealth Government is currently examining the establishment of new MPAs in the South-West Marine Region. A preliminary BCA of marine protection in the region using benefit transfer identified the potential significance of non-use benefits of MPAs. This study undertakes a primary non-market valuation studied to assess the non-use economic benefits of three MPA scenarios for the South-West Marine Bioregion. While choice modelling (CM) was the preferred non-market valuation method, the absence of required biophysical information led to the use of the contingent valuation (CV) method. A dichotomous choice (DC) format with follow-up open-ended (OE) willingness to pay (WTP) question was used. A number of methodological issues with the application of CV – estimation methods for WTP, scope sensitivity and anchoring - were explored in the course of the study.

This report is structured as follows. Section 2 identifies the coverage of MPAs in Australia and the characteristics of the South-West Marine Region. Section 3 discusses the costs and benefits of establishing new MPA in the South-West Region and the role for non-market valuation methods such as CM and CV. The CV method used in this study is then described. The questionnaire development and implementation is outlined in section 4 with the results provided in section 5. The discussion in section 6 focuses on issues around the WTP estimates from the DC and follow-up OE WTP question, scope insensitivity of the results and anchoring effect of the follow-up WTP question. Conclusions are then provided.

2.0 MARINE PROTECTED AREAS IN AUSTRALIA

2.1 Introduction[1]

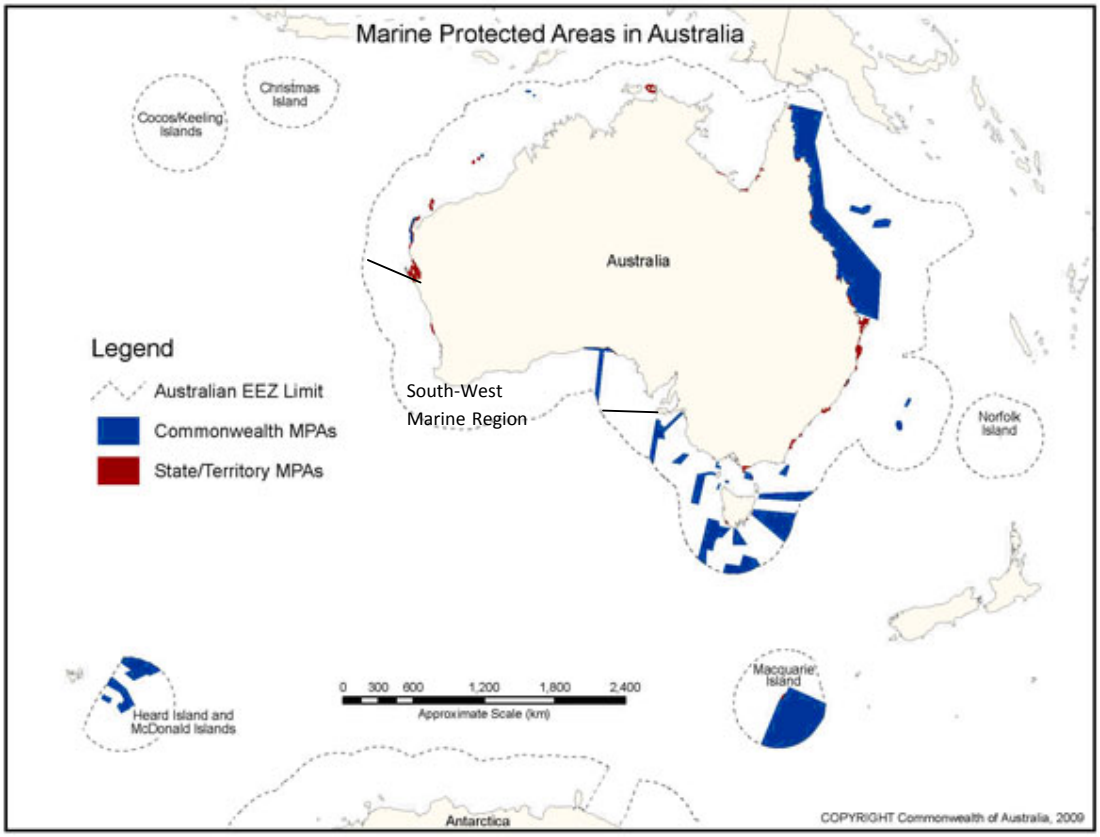
In Australia, State and Territory Governments manage marine areas out to 3 nautical miles and the Commonwealth Government is responsible for areas from 3 to 200 nautical miles of the coast of Australia.

The Australian Government has a commitment to expand Australia's existing marine reserve system through the establishment of a National Representative System of Marine Protected Areas (NRSMPA).

The primary goal of the NRSMPA is to establish and manage a comprehensive, adequate and representative system of MPAs to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia's biological diversity at all levels.

Currently, there are over 200 MPAs in Australian Waters covering approximately 88 million hectares or 10% of Australia's exclusive economic zone (EEZ), excluding the Australian Antarctic Territory.

Figure 1 – Marine Protected Areas in Australia



[1] This section is based on DEWHA (2008)

While waters off the South-East of Australia and off the Queensland coast have a number of MPAs, other areas of Australia's waters, such as the South-West Marine region, do not have the same levels of protection.

2.2 South-West Marine Region

The South-West Marine Region stretches from Kangaroo Island (off the South Australian coast) to Shark Bay (in Western Australia) and is located 3 nautical miles to 200 nautical miles off the coast of Australia. It is therefore remote from many users of the coastline. The region is 1.3 million km^2 in size.

There is currently one MPA in the South-West Marine Region that covers 19,700 km2 or 1.5% of the region.

Planning for the South-West Marine Region indicates that it is home to many species that occur nowhere else. Known species in the region include:

- 600 species of fish;
- 22 species of seagrass;
- 110 species of starfish, sea urchins and sea cucumbers;
- 189 species of sea-squirts;
- 1,000 species of micro-algae.

A total of 105 species that live in the region are protected under existing conservation laws. Of these 26 are listed as threatened under these laws.

The South-West Marine Region is an area for breeding or feeding of a number of threatened marine mammals including Australian sea lions and southern right whales. The area is also habitat for the threatened white shark.

Within the region are a number of identified ecological features including:

- habitats for marine species;
- areas that are sources of food;
- unique seafloor features; and
- important species or groups of species.

Five known historic shipwrecks that are of regional conservation value and protected under existing laws also occur in the region.

Current and potential use of the South-West Marine Region includes commercial and recreational fishing, marine-based tourism, shipping, oil and gas exploration and production, defence activities and aquaculture.

DEWHA (2008) identifies that these uses can potentially harm the marine environment through direct reductions in fish stocks, destruction of habitat, indirect capture and entanglement of marine mammals and ship collisions with marine mammals such as whales. However, the main threat to marine biodiversity is considered to be fishing.

One way that the Government could protect biological diversity in the South-West Marine Region is to establish new MPAs to protect representative areas of the marine environment. This would include some of the major ecosystems and key ecological features of the region.

These new MPAs would be managed through a zoning plan which would include:

- **sanctuary zones** which are managed primarily for scientific research and monitoring, and passive recreational uses such as scuba diving and snorkelling. Commercial fishing, recreational fishing and oil and gas production are prohibited;

- **special purpose zones** which allow recreational fishing and oil and gas production but prohibits all commercial fishing; and

- **multiple use zones** which allow recreational fishing and oil and gas exploration as well as limited low impact commercial fishing.

3.0 ECONOMICS OF MPAS

3.1 Economic Efficiency

While the establishment of NRSMPAs is a commitment of the Federal Government, robust policy analysis requires the consideration of the economic efficiency of any MPA proposals. BCA is the main technique use by economists to evaluate the economic efficiency of policy options and is concerned with comparing the incremental costs and benefits of any MPA proposal to the "without" MPA scenario. Table 1 summarises these potential costs and benefits.

Table 1 – Potential Costs and Benefits of MPAs

Costs		***Benefits***	
C1	Foregone producers' surplus to any commercial activity that is restricted e.g. commercial fishing, charter boats, dive boats, etc.	B1	Additional producers' surplus to any commercial use that gains from enhanced Marine Protection e.g. spill over benefits to commercial fishers outside no take zones, or benefits to non-consumptive commercial uses within no-take zones e.g. diving charters
C2	Foregone consumers' surplus to any non commercial activity that is restricted e.g. recreational fishing.	B2	Any additional consumers' surplus to any non commercial activity that may gain from MPAs.
C3	Any additional planning, compliance and monitoring costs.	B3	Any additional consumers' surplus to non-users.

In relation to the South-West Marine Region, the Allens Consulting Group (2009) estimated the following potential economic costs and benefits of marine sanctuaries in Region, although the area assumed to be protected remained unspecified.

Table 2 - Potential Costs and Benefits of a Marine Protected Area

	Costs	Loss in Economic Surplus ($M pa)		Benefits	Gain in Economic Surplus ($M pa)
C3	**Government administration, monitoring and enforcement**	Not estimated	B1	**Spill over to commercial fisheries** Will vary from fishery to fishery and b e highly dependent on design of the protected area. A 5% increase in catch per unit effort in the Rock Lobster fishery is estimated to increase economic rent by $2.4M.	Up to $2.4M
C1	**Displacement of commercial fishing** Assumed that sanctuaries may result in a 15% reduction in economic rent. This equates to $8M in the Rock Lobster Fishery and $1M in other commercial fisheries.	$9M	B1	**Fishery buffer benefits** Likely to result in more stable catches and provide insurance against stock depletion. Improved catch stability would give professional fisherman better planning certainty for their business and possibly reduce the need for overdraft finance in low catch years. The buffer effect of marine protected areas could leave greater room for management error and buffer against adverse environmental events.	Not estimated
C2	**Displacement of recreation fishing** 15% reduction in recreation boat catch in offshore waters, valued at $10 per fish (base on various non-market valuation studies)	$1.8M	B1	**Ecotourism direct benefits** Currently $45M in commercial revenues, with perhaps a net value of $10M. Protected areas would support continued growth of the industry (relative to a scenario of a ceiling in visitor numbers).	$5M to $10M
C1	**Displaced charter fishing** A 30% to 50% reduction in current aggregate profits for the industry (assumed to be $2.5M)	$0.75M to $1.25M	B1	****Biodiscovery** Marine sanctuaries protect genetic material for possible future screening and subsequent development of commercially valuable products. The value of preserving this future option is likely to be significant, but difficult to estimate.	Not estimated
	***Reduced demand for fisheries support services** Upstream and downstream businesses supporting the commercial and recreational fishing sector may be affected. However, most if not all of these fisheries will continue to operate, so flow-on impacts are likely to be modest.	Not estimated	B3	**Environmental non-market values** A recent choice modelling study (McCartney, 2009) estimated that respondents were WTP, on average, $140 per year for a modest set of ecological improvements in Ningaloo MP. When extrapolated to the State population aged 19 years and over, this equates to $222 M.	$100M to $200M

Source: Allens Consulting Group (2009)

NB: Displacement in the above table does not refer to relocation of effort but values that are lost to society.

*This would normally be considered to be secondary effects outside the scope of a BCA

** While these benefits are often referred to in relation to natural environments there are good economic reasons why the value may be modest (Polski 2004).

While only indicative, the key economic message that emerged from the study was that the direct economic losses to recreational and commercial fishing sectors due to displacement are likely to be in the order of tens of millions of dollars as opposed to hundreds of millions. On the benefit side of the ledger, the figures were dominated by the non-market values the community holds for non-harvest aspects of the marine environment.

However, the study relied on benefit transfer from McCartney (2009) and no primary non-market valuation study was undertaken.

3.2 Non-Market Valuation

A number of methods exist for valuing non-market environmental resources (Hanley, 1999). For non-use values, stated preference methods that rely on surveys of individuals to elicit values for a hypothetical environmental change, are used (Bennett 1999). There are two main stated preference techniques, the CV method and CM (Whitten and Bennett 2001).

The CV method establishes a hypothetical market for an environmental good or service and uses a questionnaire to elicit people's WTP for some change in the supply or quality of the good or service. It values one environmental change at a time (Whitten and Bennett 2001) and cannot disaggregate the value that individuals hold between the different attributes of an environmental change.

CM is similar to CV but instead of asking a single willingness to pay question respondents are presented with a series of questions (choice sets), where each question shows the outcome of two or more alternative policy scenarios including a 'status quo' or 'no policy change' scenario. These outcomes are described in terms of different levels of a monetary attribute (cost) to be borne by the respondent and several non-marketed attributes. Respondents are asked to choose their preferred option from the array of alternatives. By observing people's choices between alternatives with differing levels of each attribute it is possible to determine the trade-offs respondents make between attributes (Bennett and Blamey 2001). Because one of the attributes is a monetary one, the trade-off between changing levels of a non-market attributed and money can be observed i.e. the implicit price for the attribute.

CM has a number of reported advantages over CV including:

- that a single application can result in welfare estimates for a number of alternatives (Rolfe et al 2004);
- that values can be obtained for individual attributes of the environmental good as well as the environmental good as a whole (Hanley et al 1998; DeShazo and Fermo 2002);
- that the utility function of individuals is more completely specified providing greater scope for benefit transfer (Hanley et al 1998; DeShazo and Fermo 2002);
- avoidance of yea saying, since respondents are faced with multiple choices rather than an all or nothing choice. (Hanley et al 1998);
- reduction in hypothetical bias and strategic behaviour (Kragt and Bennett 2008);
- reduction in embedding effects as respondents are constantly reminded of the range of levels of attributes (Hanley et al 1998; Hanley et al 2001; Morrison et al 1996, Kragt and Bennett 2008);
- "repeated sampling allows for internal consistency tests in the sense that models can be fitted on sub-sets of data" (Hanley et al 1998, p. 416);
- increased information provision, more communication of scope issues and increased realism (Hanley et al 2001); and
- enabling researchers to collect comparable or higher quality valuation information at a lower cost (DeShazo and Fermo 2002).

CM was therefore the preferred approach to examine values the community may hold for the establishment of MPAs in the South-West Marine Region.

To progress a CM study it is necessary to determine the benefits of establishing MPAs, identify a set of relevant attributes to represent the benefits and estimate how the levels of these attributes may change over time "with" and "without" establishment of MPAs. In identifying potentially relevant attributes, reference was made to the literature on the benefits of MPA and recent CM studies in relation to MPs.

Scientific studies have shown that MPAs can have a positive effect on biomass, numerical density, species richness, and size of organisms within the protected area, particularly target fish species, as well as improve ecosystems and habitats (Possingham 2010, NSW MPA 2008, Edgar and Stuart-Smith 2009, Lester et al 2009). MPAs may also provide benefits to adjoining areas via spill over of individuals from within the reserve to outside of it, and export of larvae from the reserve (Lester et al 2009). However, the intensity of fishing outside the reserve and inside the reserve before implementation effects the direction and magnitude of the reserve response (Lester et al 2009). While commercial fisheries are currently managed through licensing and quotas, determining appropriate levels of catch is very difficult. Establishing MPAs provides a "second line of defence" should current fisheries management fail (AMSA 2002).

There are relatively few CM studies of MPAs. These include of Ningaloo Reef (McCartney 2009; Gazzini and Marinova (2007), the proposed Capes MP (McCartney 2009) in Western Australia, the size of MPA networks in the North East Region of USA (Wallmo and Edwards (2008)) and the values of changes in marine ecotourism resources in Malaysia (Yacob and Shuib 2009)

These studies give some indication of types of attributes that may be relevant.

Table 3 – Attributes Used in CM Studies of MPAs

Ningaloo MP	Capes MP	Ningaloo	NE Region of USA	Malaysia	Great Barrier Reef
Area of coral;	Area of seagrass;	Percentage of reef in sanctuary zone (%);	MPA network size as a % of the total federal waters of the Northeast Region (5% up to 40%)	Ecological management (different levels of solid waste disposal, sanitation and sewage system;	Area of coral reef in good health;
Fish abundance;	Fish abundance;	Percentage of coral reef coverage (%);	Allowable uses within the MPA network (no-take, science and education, recreation and tourism, limited fishing);	Recreation activity congestion (different congestion levels at picnic places, beach areas etc);	No. of fish species in good health;
Marine turtle abundance;	Abalone abundance; and	Decrease in marine life biomass (low, low, high);	Voluntary charge.	Provision of employment to local people (% increase);	Area of seagrass in good health;
Whale shark abundance;	% less collisions with whales.	Decrease in income of local fisheries (high, high, none);		Conservation charge.	Cost.
Cost	Cost	Loss of income from Mining (high, high, none);			
		Park entrance fee.			
McCartney (2009)	McCartney (2009)	Gazzini and Marinova (2007)	Wallmo and Edwards (2008)	Yacob and Shuib (2009)	Rolfe and Windle (2010)

Initial attributes identified as potentially relevant from a policy-makers perspective for the South-West Marine Region were:

- Marine area in good health (km2);
- Ecological features protected (no.); and
- The size of the threatened mammal populations.

However, following review of the Bioregion Profile for the South-West Marine Region and discussions with DEWHA, the Commonwealth Government agency responsible for the establishment and management of MPA in the South-West Marine Region, it was not possible to identify upper and lower bound levels for the first and third potential attribute. Indeed, it was not clear whether the levels of these attributes would change "with" and "without" the establishment of a MPA.

As identified by Gillespie (2003) before the impact of options on human well-being can be estimated using stated preference techniques, it is necessary for projections to be made of:

- the biophysical condition of the environment under the current policy regime; and
- the range over which the biophysical condition may change under alternative policies that will be considered by policy makers.

In the absence of an adequate level of information on the physical benefits of establishing MPA in the South-West Marine Region and the likely current and future levels of attributes "with" and "without" establishment of a MPA it was not possible to continue the study as a CM study.

Instead, the study collapsed to a CV study where the respondents were asked their willingness to pay for establishment of MPAs over representative areas of the marine environment in the South-West Marine Region, to protect biological diversity.

3.3 Contingent Valuation

There are a range of potential formats for the WTP question in the CVM. These range from OE question, where respondents are simply asked to identify their maximum WTP for the environmental good in question, to DC where respondents are presented asked whether they would be WTP a dollar amount for an environmental improvement, with the dollar amount rotated between respondents. OE questions were one of the earliest WTP question formats while DC formats were developed later and are the most commonly employed question format (Boyle et al 1996).

The DC approach was endorsed by the NOAA panel who were concerned about protest responses and incentive compatibility issues with other methods. They considered that there is no strategic reason for an individual to answer untruthfully (Reaves et al 1999). However, the gain in incentive compatibility comes at a cost. While for OE data the mean and the median can be directly estimated from the bids that respondents make, with DC, estimates of WTP are not directly revealed by respondents and hence more complicated econometric approaches are required to reveal WTP (Haab and McConnell 2002). However, these econometric techniques can influence estimates of mean and median WTP (Reaves et al 1999).

DC data is generally analysed based on the standard random utility model. In this model, a yes response from respondent j occurs if the utility of the change, net of the required payment, exceeds utility of the status quo:

$$u_1 (y_j - bid_j, z_j, e_{1j}) > u_0 (y_j, z_j, e_{0j})$$

Where:

- u_1 is the indirect utility for the environmental improvement;
- u_0 is the indirect utility function of foregoing the environmental improvement and maintaining income y;
- z_j is a vector of household characteristics;
- bid_j is the amount paid for the environmental improvement; and
- e_{1j} and e_{0j} are a component of preference known to the individual but not observed by the research (Haab and McConnell (1998).

The probability of a yes response from respondent j becomes:

$$Pr(yes) = Pr(u_1 (y_j - bid_j, z_j, e_{1j}) > U_0 (y_j, zj, e_{0j}))$$

Parameter estimation requires specification of the functional form of the utility functions and the distribution of $e_{1j.}$

This study specified the deterministic and stochastic components of the utility function as additively separable and the deterministic component as linear in income and covariates. e_{1j} and e_{oj} were assumed to have an extreme gumbel distribution with the difference having a logistic distribution.

Assuming that the marginal utility of income is constant between the two CV states (which is reasonable unless the CV scenario provides a substantial change) the probability of a yes becomes

$$Pr(yes) = Pr(\alpha z_j - \beta bid_j + e_j > 0)$$

Where:
- αz_j vector of parameters for the variables related to the individual
- e_j is difference between e_{1j} and e_{0j}

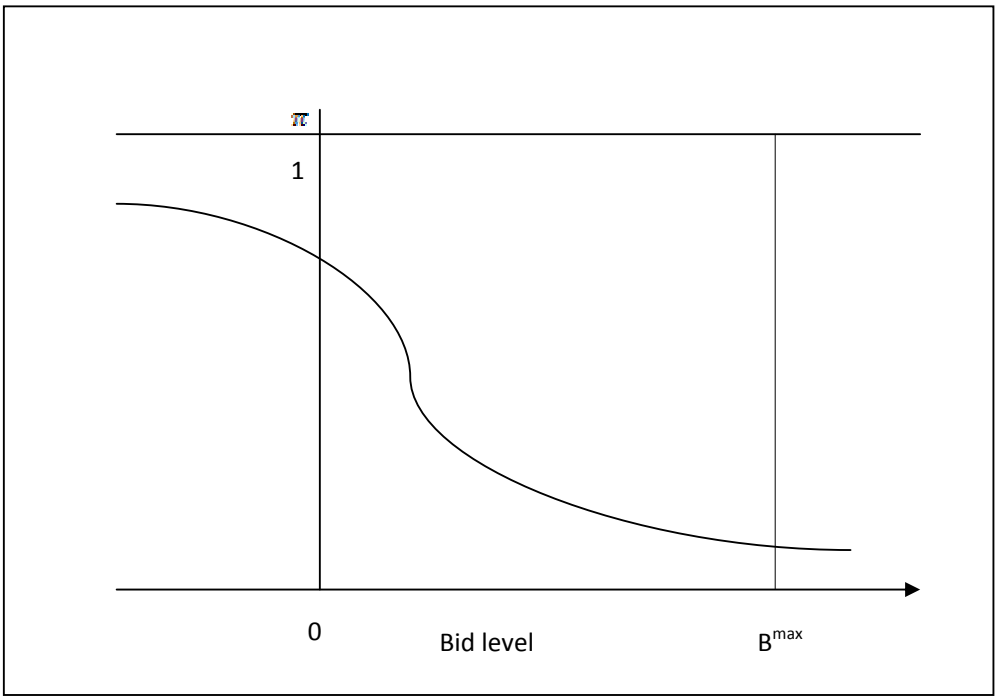
With this specification of a linear random utility model, the mean and median WTP for the sample are the same, as the function is symmetrical about its mean (Langford and Bateman 1993), and is given as follows:

$WTP= \alpha z/ \beta$ based on the mean vector of exogenous variables for the sample.

When bid level specification results in near 100% acceptance at the lower level and near zero acceptance at the higher level then mean and median calculation from the RUM will be a good representation of true WTP.

However, an issue with the above RUM is that it allows ej to vary between positive and negative infinity and hence WTP can also vary between positive and negative infinity. Refer to Figure 2.

Figure 2 – Linear Logistic Functional Form for Modelling DC Data



If an unconstrained mean or median is calculated from an underlying model where WTP includes negative values then it is possible to obtain a negative mean or median WTP[2]. In any case, in most situations allowing for a negative WTP model specification is an incorrect representation of the choice situation and the resulting WTP estimate will not represent a true reflection of WTP.

An alternative is to estimate an unconstrained linear logistic model and truncate mean WTP at zero and the maximum bid level (or income) at the WTP calculation stage. This is considered acceptable as long as Fwtp(Bmax)-Fwtp(Bmin) is close to one (i.e. bid range results in near 100% acceptance for low bid and near zero acceptance for the upper bid level), because under this scenario the inconsistency between estimation of the model and calculation of WTP is of small consequence (Haab and McConnell 2002). However, where this is not the case then the method of truncation can cause big differences in means and divergence of means and medians.

A log transformation of the bid variable truncates the logistic model at zero and therefore avoids negative WTP. However, estimation of mean and median WTP is sensitive to how the upper tail is truncated.

Another approach is to estimate a model that has the correct bounds and impose the same bounds in the model estimation and WTP calculation stage. WTP estimates from this approach are more plausible than means from linear logistic models and the exponential of WTP models. But Haab and McConnell (2002) regard them as a repair of a difficult data set rather than well-founded estimates of WTP.

[2] This is the case if at a zero bid level the predicted acceptance rate is less than 50% (Vaughan et al 1999).

Because there are many cases where the estimates of WTP will be highly sensitive to the choice of distribution for the unobserved random component of preferences and the functional form of the utility specification, Haab and McConnell (2002) suggest the approach known as the Turnbull distribution-free estimator. This approach is considered to provide a lower bound estimate of sample mean WTP directly from raw data without assuming any distribution for the unobserved component of preferences or adhoc assumptions about the tail of the distribution.

While for OE data the mean and the median can be directly estimated from the bids that respondents make, modelling of this data is complicated. Ordinary Least Squared (OLS) regression enables values to range from positive to negative and assumes constant variance across all estimates of the dependent variable, neither of which is likely to be met with count data (Gardner et al 1995). The application of OLS to OE CV data can therefore result in inefficient, inconsistent and biased estimates (Long 1997). The most basic model for addressing these deficiencies of OLS is the Poisson regression model followed by the negative binomial regression model (Long 1997). Both these models assume that the dependent variable is an exponential function of the independent variables with the latter model allowing the variance of the dependent count variable to be different to the mean. However, with CV data there may be a relatively large number of zero counts which exceeds the number predicted by Poisson or negative binomial regression. The zero inflated negative binomial regression model addresses this issue by generating two separate models and then combining them. The first explicitly models the number of predicted certain zeros using a logit regression. A negative binomial model is then generated that predicts the counts for those respondents who are not certain zeros. The mean count can be estimated from the model by estimating the probability that respondents will not be a certain zero from the logit regression and multiplying this probability by the mean predicted count from the negative binomial regression.

4.0 QUESTIONNAIRE DESIGN AND IMPLEMENTATION

The questionnaire design in this study was based on the recommendations of USA National Oceanic and Atmospheric Administration panel regarding the use of the CVM in environmental litigation[3] and to take account of conditions which Bennett et al (1997) identified as being significant in Australian applications.

Information was provided on the existing MPAs in Australia, the South-West Marine Region and its conservation values, pressures and threats. The questionnaire identified that one way that the Government could protect biological diversity in the South-West Marine Region is to establish a specified area of new MPA to protect representative areas of the marine environment. These new MPAs would be managed through a zoning plan which would include sanctuary zones, special purpose zones and multiple use zones. This information was primarily sourced from Bioregion Profile for the South-West Marine Region (DEWHA 2008).

The questionnaire stated that establishing and managing new MPAs would cost money for adjustment payments to displaced fishers, scientific research, preparation of a zoning plan and monitoring and enforcement of the zoning plan. If the new MPAs were to be established the respondent would be required to pay a one-off marine park levy payable via their annual income tax assessment. The provision rule was:

The new MPAs would only be established if more than 50% of households across Australia are WTP for them. Once a decision is made to establish the new MPAs all households would be required to make a one-off payment.

A DC WTP format, rotating seven bid levels of $20, $50, $100, $150, $200, $300 and $400, was used, with a follow-up OE WTP question. Research undertaken by Bennett et al (1997) indicated that respondents may find the DC choice format difficult to answer because the choices they are being asked to make may involve conflicts with their belief systems. This has been described as respondent dissonance.

Respondent dissonance was addressed in the questionnaire by adapting the DC WTP question to enable respondents who were not WTP the bid amount to select a response which most closely represented their view. This approach is referred to as the dissonance-minimising (DM) elicitation format (Blamey et al 1997).

The five alternatives presented to respondents were adapted from Bennett et al (1997):

(i) support the proposal and can afford payment;
(ii) support the proposal but it is not worth $x to me;
(iii) support the proposal but cannot afford payment;
(iv) support the proposal but object to the method of payment;
(v) oppose the proposal, regardless of cost.

To create a DC format for logit estimation from responses to the DM format, (i) is considered to be a 'yes', while (ii), (iii), (iv), and (v) and (vi) are considered to be a 'no'. The fourth response category (allowing objection to the payment vehicle) was included to permit respondents to protest against the payment vehicle used.

In order to provide value estimates that are not biased downward due to the exclusion of category (iv) respondents, a specially designed follow-up question was included immediately after the WTP question for category (iv) respondents only to answer.

[3] An example of this approach is found in Carson et al (1994).

What was sought was a positive way of treating payment vehicle protest respondents that did not necessitate their rejection from the data set at the model estimation stage. This is especially important given the high number of such rejections reported in some studies (Loomis, Lockwood and DeLacy (1993). In focus groups that were conducted by Bennett et al (1997) there was considerable protest over the payment vehicle. Those protesters often stated that they would need to be more convinced that government couldn't, or wouldn't pay, before they would consider paying themselves.

The category (iv) follow-up question sought respondent's views on whether their non WTP was because they could not afford it or whether they are WTP provided:

- they could be convinced that the Government was not prepared to pay for it out of existing revenue
- they could be convinced that the Government doesn't have enough money to pay for it; or
- an alternative, acceptable way of collecting the money could be found.

If any of the latter three reasons applied, responses were recoded as a 'yes'.

Regular embedding, where the value of the good under consideration is affected by its "positioning" relative to substitute and complementary goods, was addressed by inclusion of a simple framing statement prior to the WTP question reminding respondents to keep in mind their available income and all the other things they have to spend money. Respondents were reminded that it is also possible that other MPAs and environmental projects may one day cost them additional money through increases in rates, levies and taxes.

Perfect embedding, where respondents are insensitive to the scope of the good they are asked to value, was tested by split-sample estimation of the value of three different levels of MPAs in the South-West Marine Region,130,00 km2, 260,000 km2 and 390,000 km2 (representing 10%, 20% and 30% of the South-West Marine Region. These levels were chosen because Australia has committed, through international agreements to, 'effectively protect' at least 10% of its oceans and coastal areas (Possingham 2010). The Australian Marine Science Association has also called for Australian governments to protect at least 10% of State and Commonwealth marine waters in no-take (sanctuary) zones, with rare or vulnerable ecosystems protected by higher levels (AMSA 2008).

Following-up questions were designed to detect problems that respondents may experience in answering the questionnaire, specifically the adequacy and bias of the information provided, the level of the payment, and the difficulty of the WTP question. The final section of the questionnaire sought attitudinal and socio-economic data.

Two focus groups were held on 13 October 2010 in Parramatta, Sydney to refine and test the questionnaire. Key amendments that resulted from the focus groups included the provision of additional information on how a zoning plan would be use to manage the MPA and what cost categories would be involved with the establishment of new MPAs. Bid levels were also adjusted downwards to reflect the very low level of yes responses in the focus groups.

The questionnaires were implemented via an online panel, by PureProfile between 20 October 2010 and 29 October 2010. The sample was stratified by age, gender and State/Territory to reflect the Australian population aged 18 years and above.

5.0 RESULTS

5.1 Biases and Protests

To test for problems that respondents may have had in answering the questionnaire, specifically in relation to adequacy and bias of the information provided, the level of the payment, and the difficulty of the WTP question, a Likert scale from 1 to 5 was used, where:

- 1 was strongly disagree
- 2 was disagree
- 3 was neither agree or disagree
- 4 was agree; and
- 5 was strongly agree

Table 4 summarises the mean response to a number of statements. On average respondents understood all the information provided, did not need additional information, did not consider the information biased, were comfortable with the level of payments presented to them and did not have difficulties answering the payment question.

Table 4 – Mean Response to Questions 6

	10% MPA	20% MPA	30% MPA
I understood all the information provided	3.9	3.9	3.9
I need more information than was provided	3.1	2.9	3.0
I thought the information was biased towards the proposal for new marine protected areas	3.1	3.1	3.2
I thought the information was biased against the proposal for new marine protected areas	2.6	2.6	2.6
The amount of the payment seemed unrealistically low	2.5	2.5	2.5
The amount of the payment seemed unrealistically high	3.3	3.3	3.3
I found answering the payment question confusing	2.6	2.4	2.5

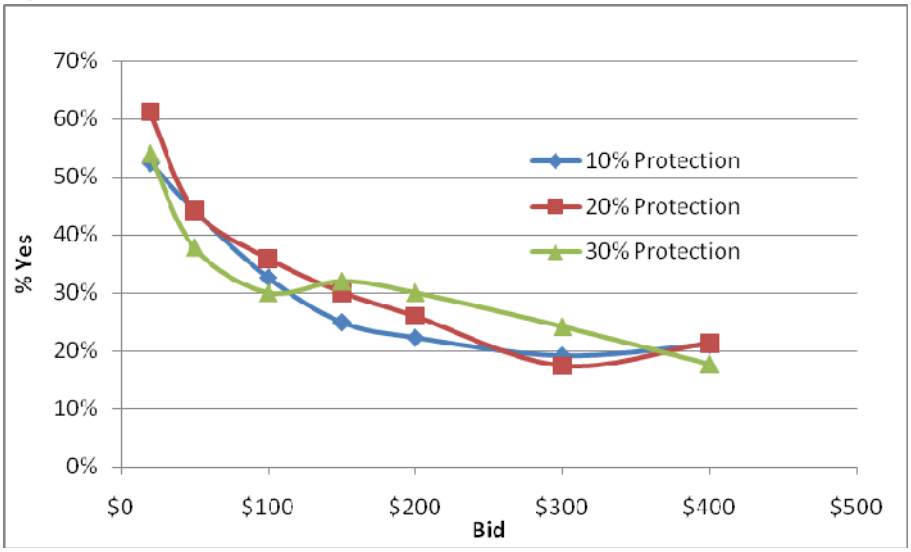
The dissonance minimisation format of the questionnaire explicitly allowed for protests against the payment vehicle. Across the survey splits, between 26% and 28% of respondents selected the payment vehicle protest option. With the follow-up question, 75% of these responses were able to be coded as a ‘no’ – cannot afford a payment, while the remainder were able to be recoded as a ‘yes’.

5.2 Data Analysis

Proportional analysis

A proportional analysis, summarised in Figure 3, indicates that as the bid level increased a smaller proportion of respondents were willing to pay. However, the bid curves did not vary significantly between the splits and so respondents were insensitive to higher levels of protection.

Figure 3– Bid Curves for MPAs



Logit Analysis

Models for the three splits were estimated using NLOGIT4.0 (Econometric Software, 2007). The variables tested for significance shown in Table 5.

Table 5 – Variables Considered in Models

Variable code	Description
Bid	Bid level
Age	Age as continuous variable
Gender	Respondent gender (1 = female)
Locat2	Respondent State/territory of residence (1=South Australia and Western Australia)
Int	Respondent interest in marine conservation (1=interested)
Child	Respondent has children (1 = children)
HHsize	Number of people living in the respondents household
Nukids	Number of people living in the respondents household who are under 18 years of age
Houseown	Respondent house ownership (1 = owned outright)
Housetype	Respondent house type (1 = house)
Educ	Respondent education level (1 = post school qualification)
Envdev	Respondent attitude to development and the environment (-1= favour of development, 0=favour neither, 1=favour protection of the environment more frequently)
Envorg	Respondent or close family a member or contribute to an environmental organisation (1= yes)
Fishorg	Respondent or close family associated with commercial fishing (1= yes)

Initially all attributes were included in linear utility models with insignificant variables being systematically excluded. Preferred models for each split are provided in Table 6.

Table 6 – RUM Models with Linear Utility Function

Variables	10% MP Protection	20% MP Protection	30% MP Protection
Bid	-0.004*	-0.005*	-0.004*
Locat2			0.495*
Child	-0.371**		-0.548*
Houseown			0.395**
Educ	0.363***	0.415**	0.428**
Envdev	0.515*	0.646*	0.571*
Envorg	0.730**		0.929*
Inter		1.711*	0.744**
Constant	-0.460***	-2.118*	-1.479*
N	726	729	718
LL	-417	-417	-405
McFaddens Pseudo R-squared	0.072	0.104	0.104

Significance: * !%, ** 5%, ***10%

All preferred models were statistically significant as indicated by a LLR of over 60 compared to chi-squared statistics (at 5% significance) of less than 16. Parameters that were statistically significant varied between questionnaire splits. However, the bid variable was highly significant in all splits. Where parameters were common between splits they had the same sign. The respondent living in South Australia or Western Australia (where the MPA would be located) was found to increase the probability of saying yes to a bid level, as was owning their house outright, post school education, favouring protection of the environment when there are conflicts between development and the environment, the respondent or close family being a member of an environmental organisation or contributing regularly to this type of organisation and having an interest in marine conservation. Having a child and increasing bid levels was found to reduce the probability of saying yes to a bid level.

Zero Inflated Negative Binomial Regressions

As for the logit modelling reported above, initially all attributes were included in the zero inflated negative binomial regression models with insignificant variables being systematically excluded. Preferred models for each split are provided in Table 7.

Table 7 – Results of Zero Inflated Negative Binomial Regressions

	10% MP Protection		20% MP Protection		30% MP Protection	
	Coefficient	P[|Z|>z]|	Coefficient	P[|Z|>z]|	Coefficient	P[|Z|>z]|
Negative Binomial Regression						
GENDER	-0.254	0.00	-0.182	0.02		
INCOME					3.25E-06	0.01
BID	0.004	0.00	0.004	0.00	0.004	0.00
INT	0.339	0.04	0.795	0.01	-0.908	0.00
ENVDEV	0.193	0.00	0.374	0.00	0.197	0.02
ENVORG	0.274	0.04	0.278	0.02	0.444	0.00
HHSIZE			-0.161	0.01		
NUKIDS			0.157	0.02		
Constant	3.442	0.00	3.269	0.00	4.305	0.00
Dispersion Parameter						
Alpha	0.779	0.00	0.815	0.00	0.800	0.00
Zero Inflated Model						
LOCAT2	-0.276	0.03			-0.543	0.00
BID	0.001	0.02	0.002	0.00		
INT	-1.115	0.00	-1.959	0.00	-1.115	0.01
CHILD	0.556	0.00			0.513	0.00
AGE			0.020	0.00	0.019	0.00
GENDER					-0.438	0.00
EDUC	-0.356	0.00				
ENVDEV	-0.671	0.00	-0.697	0.00	-0.751	0.00
NUKIDS			0.097	0.04		
ENVORG	-0.863	0.00			-0.666	0.01
Constant	0.634	0.01	0.276	0.39	0.061	0.90
R2 NB	0.92		0.92		0.92	
LLPOIS	-38929		-39736		-37790	
LL ZINB	-2864		-2870		-2756	
Vuong	10.5		10.3		11.4	

Parameters that were statistically significant varied between questionnaire splits and between the zero inflation models and the negative binomial models. For the zero inflation models, variables which increased the probability of having a certain zero WTP were facing a higher DC bid amount, having a child, being older and the number of children living in the house. Living in South Australia or Western Australia, having an interest in marine conservation, being female, favouring the environmental over

development, being associated with an environmental organisation and having a higher level of education decreased the probability of having a certain zero WTP. For the negative binomial models, having a higher income, facing a higher DC bid level, favouring the environment over development, being associated with an environmental organisation and a greater number of kids living at home increased the respondent WTP. Being female and increased household size decreased respondent WTP. Having an interest in marine conservation had a mixed impact on WTP between sample splits.

The ZINB models from all sample splits was significant as indicated by a significantly lower LL than a poison or negative binomial model alone and a significant Vuong statistic (greater than 1.96).

Estimates of Willingness to Pay

Three estimates of willingness to pay are reported in Table 7:

- the mean from the open-ended WTP question;
- the mean from truncating the logit regression above zero and at the maximum bid level; and
- the mean from the Turnbull estimator calculation.

Following Haab and McConnell (2002) the calculation from the Turnbull estimator is the preferred measure of mean WTP. 95% confidence intervals are reported for this estimate and for the open-ended WTP question.

Table 7 – Mean WTP Per Household (One-off Payment)

	10% MPA Protection	20% MPA Protection	30% MPA Protection
Open-ended	$61.51 ($52.62 to $70.41)	$60.43 ($51.90 to $68.96)	$57.06 ($48.45 to $65.67)
RUM Linear in bid, truncated mean between zero and max bid	$119.56	$117.02	$114.77
Turnbull Estimator	$104.15 ($86.72 to $121.58)	$110.17 ($92.76 to $127.59)	$110.35 ($90.29 to $130.42)

6.0 DISCUSSION

The results indicate that based on the Turnbull estimator, the Australian community has a WTP of around $100 per respondent household for additional MPAs in the South-West Marine Region. These WTP estimates from the DC format are in the order of two times those from the OE follow-up questions, consistent with O'Conor et al (1999). The result is also reflective of the finding in the literature where the DC method has been found to produce higher estimates of WTP than open-ended methods (Boyle et al 1996, Langford and Bateman 1993; Desvouges et al 1992, McFadden 1994)). Cameron et al (2002) report that the DC/OE WTP ratios can range from 1.1 to 5.0.

However, regardless of the WTP format or estimation method, WTP did not vary significantly between 10% MPA protection and 30% MPA. On face value, the study therefore shows inadequate responsiveness to the scope of the environmental good, a result which could lead to the findings being judged as "unreliable" (Arrow et al 1993). If sensitivity to scope effects were present the bid curves should be parallel and separable, indicating a higher WTP at each bid level for a greater conservation outcome.

The issue of scope sensitivity goes back to concerns raised by Kahneman (1986) about the insensitivity of CV generally to the scope of the good being valued. Kahneman suggested that respondents to CV questionnaires were expressing ideological rather than economic values.

However, evidence of scope sensitivity in CV is supported by, among other things, numerous split sample studies, the correlation between CV and revealed preference estimates for the same good and the systematic variance of WTP with respondent characteristics in numerous CV studies (Carson, 1997).

Nevertheless, scope insensitivity in particular CV studies can arise from respondents confusing the good being valued with the larger good (part-whole bias), the good being poorly described and being perceived as symbolic of a larger good (symbolic bias), the researcher defining the good in a different metric than that used by respondents (metric bias) and that respondents might by sceptical about the good actually being provided (probability of provision bias) (Carson 1997). In all cases the issue is a design one, requiring a better description of the good and a more plausible provision context (Carson 1997).

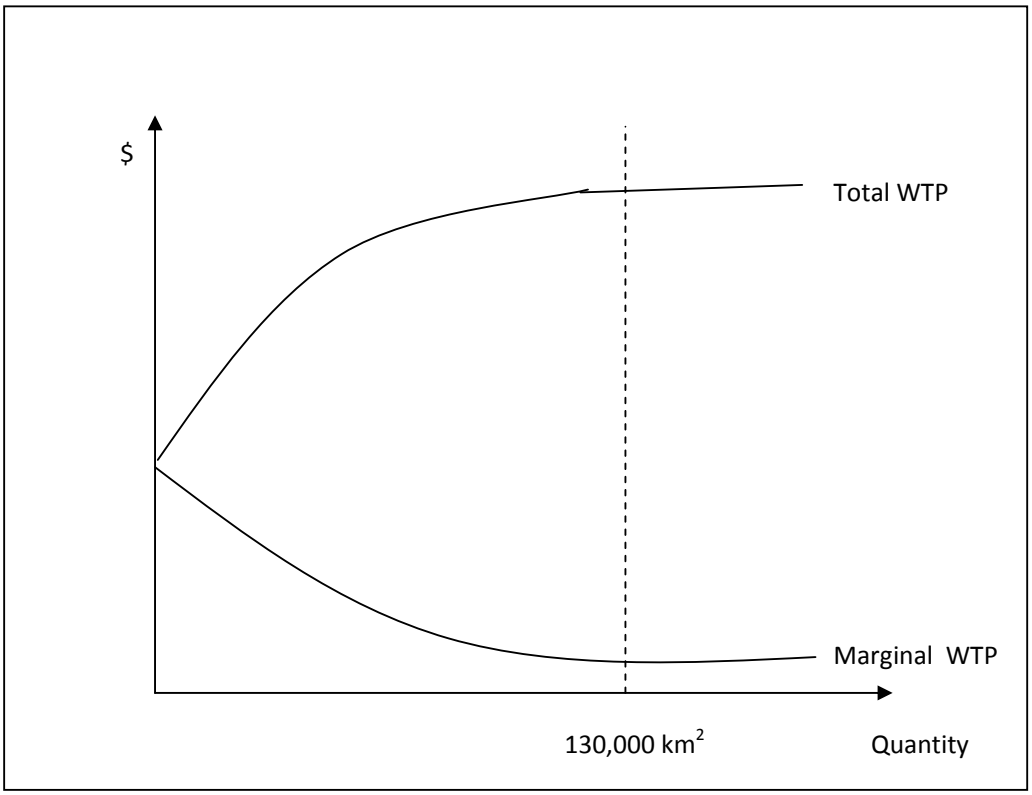
However, these potential reasons for scope insensitivity do not appear to be present in this study. The good be valued was clearly described as the establishment of 130,000km2 (260,000km2 and 390,000km2) of new marine protected areas (10%, 20% and 30% of the South-West Marine Region) to protect representative areas of the marine environment. It was clear from the figure provided in the questionnaire and the contextual information that the South-West Marine Region was only one part of the marine regions of Australia. Respondents were reminded prior to the WTP question of their budget constraint and all the other things they have to spend money on, including that it is possible that other MPA and environmental projects may one day cost them additional money through increased rates, levies and taxes. The metric used to describe the good was presented in both square kilometres as well as a percentage of the region to provide context. A clear provision rule was also included. With scope insensitivity it would be expected that WTP would not vary significantly with respondent characteristics (Carson 1997) or bid levels. However, this is clearly not the case in this situation. The variation of WTP with respondent characteristics and bid levels can also be taken as a sign of construct validity (Carson 1997).

An alternative and plausible explanation is that the survey is actually accurately representing respondent preferences and that they are insensitive to the scope presented in the split samples. Two situations can be envisaged where scope insensitivities may be observed and be considered to accurately represent consumer preferences. The first of these is where the scope difference provided

in split samples is minor and therefore are valued similarly. The second situation is where the first quantity level of the good offered is considered by the respondents to be very large and the respondents have zero marginal utility for even greater levels of the good.

This latter situation may be the case for this study as the lowest quantity of MPA offered to respondent is extremely large, hundreds of thousands of square kilometres. The respondent utility obtained from gaining extra marine protection above and beyond the very large base level of marine protection may therefore be negligible. In this situation the study may be eliciting WTP values along the marginal and aggregate WTP curves as indicated in Figure 4.

Figure 4 – Position of MPA Scenarios on Total and Marginal WTP Curves



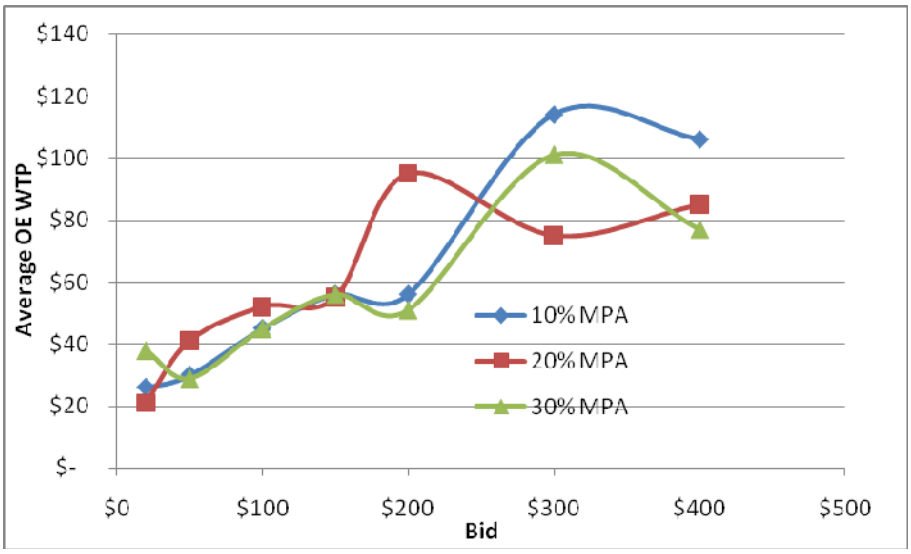
While the DC format has been the preferred format since the support of the NOAA panel, it is not without its challenges. Apart from its statistical inefficiency compared to open ended formats (i.e. it requires substantially larger samples to achieve the same levels of precision) (Green et al 1998) it requires more complex econometric techniques to estimate mean and median WTP and modelling assumptions can influence mean and median estimates. Methods to get around this statistical inefficiency include double and triple bounded dichotomous choice as well as DC with follow-up open-ended question, the underlying assumption being that the starting bid focuses response without biasing it (Green et al 1998). The latter approach was used in this study.

However, single bounded DC, double bounded DC and DC with open-ended follow-up questions can suffer from psychometric anchoring effects. For single bounded DC the bid value offered may suggest to the respondent that the quantity to be estimated lies near this value and pulls the respondent to the nearest end of their a priori range of possible values (Green et al 1998). For double-bounded DC Cameron and Quiggin (1994) showed that the second choice is not independent of the initial bid levels. Similarly, when respondents answer a DC question followed by an open-ended question, the bid amount in the initial question can influence the response to the follow-up open-ended question

(Green et al 1998; Langford and Bateman 1993), although it has been found that the mean of open-ended follow-up questions may not be significantly different from the mean of the a pure open-ended question (O'Conor et al 1999) even though they exhibit anchoring effects to the DC bid levels. Kuriyama (1999) found that with DC followed by OE leads to free riding in the OE questions. Furthermore, strategic behaviour in the follow-up OE responses will be affected by the payment offered in the first DC.

Anchoring effects of DC format are generally analysed with respect to pure open-ended WTP formats. However this is not possible here as no pure-open ended WTP split was undertaken. However, the anchoring effect of DC format on the follow up OE question can be evaluated in a number of ways. Firstly, Anchoring in the follow-up question is indicated by the mean OE WTP of respondents increasing as higher bid levels are offered to them in the initial DC question (Refer to Figure 5).

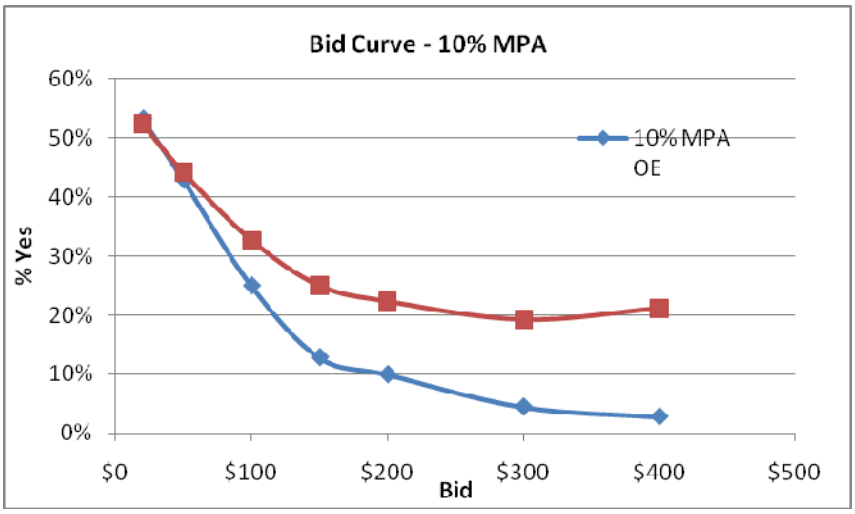
Figure 5 – Mean OE WTP Relative to DC Bid Levels

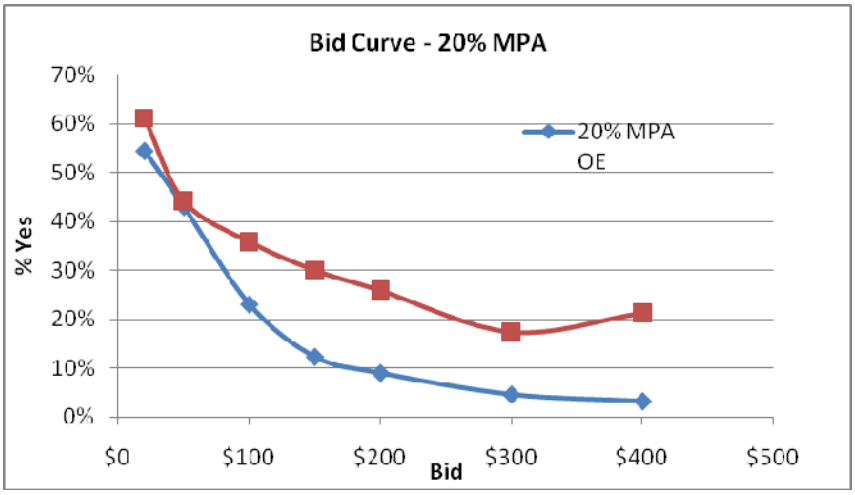


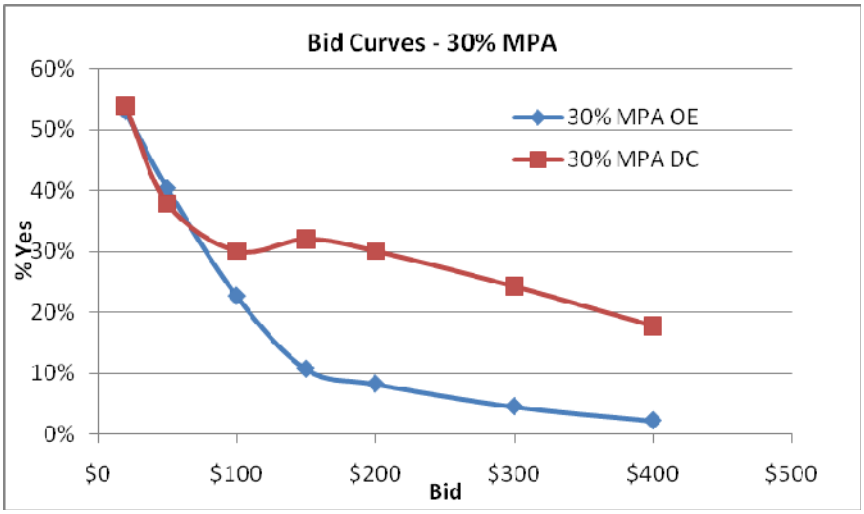
Zero Inflated Negative Binomial regression of the open-ended follow-up response on the bid level indicates a significant (at the 1% level) and positive impact of the bid level on the open-ended response.

Evidence of the existence of anchoring effects in the OE responses is also provided by lower proportions of yes responses at each bid level compared to the distribution in the DC questions, (refer to figure). Similar to the findings of O'Conor et al (1999), Langford and Bateman (1993) this pattern was found at all but the lowest bid level, with Green et al (1998) suggesting that uncertainty around WTP amount is asymmetric around a lower bound of zero.

Figure 6 – DC and OE Bid Curves







7.0 CONCLUSION

The Australian community would appear to have a positive WTP for the establishment of new MPAs in the South-West Marine Region. Given the anchoring effect of the follow-up OE WTP question the mean estimate from the Turnbull estimator for the DC data is the preferred estimate of this WTP.

This study indicates that on average Australian households would be WTP $104 for the establishment of MPAs that cover 10% of the South-west Marine Region. Aggregating this mean WTP estimate to 50% of the population of Australian households[4] gives an aggregate WTP of $400M. This supports the finding of The Allens Consulting Group that non-use values for MPA are likely to be considerable and potentially dominate the other costs and benefits of new MPAs.

However, whether the establishment of MPAs in the South-west Marine Region is economically efficient requires a consideration of all the potential costs and benefits. Other relevant costs and benefits for inclusion in a benefit cost analysis would include those associated with displacement of commercial and non-commercial uses, additional planning, compliance and monitory costs as well as any predicted increases in commercial and non-commercial use values.

If the net costs of establishing MPA over 10% of the South-west Marine Region are less than $400M, then the non-use benefits of establishing MPAs would exceed the other net costs and it would be considered to be economically efficient and desirable from a community welfare perspective.

Given the difficulties of estimating precise WTP values from DC data, any BCA of MPAs in the South-west Marine Region incorporating the results of this study should undertake sensitivity testing that includes the range of values reported including DC and OE means (Langford and Bateman 1993) to determine the robustness of BCA results to variations in the welfare estimate.

The scope insensitivity between sample splits suggests that the marginal utility of conservation areas greater than 10% of the region is zero. Therefore the same estimate of non-use benefits would be relevant to options that involve establishment of MPA with greater geographic scope than 10%. Because the protection of less than 10% of the marine region was not considered in the study it is not clear at what point marginal utility declines to zero. Application of the results to options that involve less than 10% coverage of MPAs is therefore problematic.

With a greater level of biophysical information on the current and future conditions of the South-West Marine Region “with” and “without” conservation scenarios it would have been possible to utilise the CM method instead of the CV method and more fully explore the community WTP for a range of MPA levels. This level of information is considered desirable for good environmental policy analysis as well as for economic evaluation.

The study results are consistent with the literature, with the WTP estimate from the DC being considerably greater than that from the OE question and anchoring evident in follow-up OE data.

While the CV method has been used extensively to value non-market effects of environmental programs, particularly overseas, its application is not without its methodological issues, particularly in

[4] Values from CV studies are not generally aggregated to the entire population from which the sample is drawn. This is because it is unclear whether non-respondents hold the same values as those of respondents. Some studies therefore conservatively only aggregate WTP values to the proportion of the population given by the survey response rate (e.g. Bennett 2008). However, this may understate community willingness to pay as it assumes that all non-respondents have a zero willingness to pay. An alternative method is suggested by Morrison (2000) who found that about one-third of non-respondents have value estimates similar to respondents.

the model estimation and calculation of WTP. Any comparison of the results here with other CV studies therefore needs to be mindful of the modelling and estimation assumptions used.

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