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Assessing the Benefits of Improving Coral Reef Biodiversity: The Contingent Valuation Method

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ABSTRACT

A project was set-up to investigate whether contingent valuation was applicable to the valuation of the benefits of maintaining and improving coral reef biodiversity. Willingness to pay (WTP) for an improvement in coral reef quality was requested from both tourists and locals in Jamaica and Curaçao with samples of over 1000 in each case. The bid curve analysis showed the significance of rights and duties in explaining WTP. A substantial minority of the total sample who held strong duties towards protecting life and habitat in Marine Parks also desired educational and legal reforms to improve biodiversity. This poses a problem for CVM which sets the institutional context as part of the valuation exercise, and for interpreting the monetary values as a measure of the economic welfare associated with reef biodiversity.

1. INTRODUCTION

While the issue of the valuation of benefits from ecosystems has received considerable attention, particularly in recent years, only limited efforts have been devoted to marine systems in general, and to coral reefs in particular. One consequence of this relative neglect is that the available valuation methodologies fail to take full account of several key characteristics of coral reefs. The World Bank has conducted research projects to address this issue (e.g., Rijsberman & Westmacott, 1996) and one of these is the subject of this paper (Spash et al., 1998). In particular, the methodological issues encountered by the contingent valuation method (CVM) are reported for surveys carried out in Curaçao, the Netherlands Antilles and Montego Bay, Jamaica.

A key focus of this work was on the motives, which lay behind respondents' monetary valuations. One major difficulty with using CVM in the context of coral reef biodiversity relates to the existence of 'lexicographic preferences'. Stated simply, lexicographic preferences exist where respondents are unwilling to accept any trade-offs for the loss of a good or service. In the case of coral reefs, this means that such respondents feel that monetary compensation for lost reef biodiversity is not possible in principle. The literature demonstrates that such preferences can be common and create problems for the interpretation of CVM results (Stevens et al., 1991; Stevens, More & Glass, 1993; Spash & Hanley, 1995; Lockwood, 1996b; Lockwood, 1996a; Spash, 1997; Spash, 1998). Thus, this research tried to develop tests for the refusal to make trade-offs in the context of coral reef valuation, taking account of the possibility that contingent valuation of coral reef biodiversity in developing countries may be constrained by lexicographic preferences. These motives are particularly important because they imply the monetary values arising from the CVM exercise reflect broad moral concerns rather than a measure of welfare, which might be used in cost-benefit analysis.

Some respondents to CVM surveys normally give 'protest bids'. Protest bids are zero bids given for reasons other than a zero value being placed on the resource in question. For example, a respondent may refuse any amount of compensation for loss of an environmental asset, which they regard as unique or a species which they feel should be protected at all costs. Respondents may refuse to state a monetary amount because they reject the survey as an institutional approach to the problem, or because they have an ethical objection to the trade-off being requested, e.g. a lexicographic preference (Spash, 1998). These respondents have often been omitted from the mean bid calculation or treated as if they were actually zero bids. How responses should be treated requires investigation of the underlying motives behind bids and yet this kind of research has been lacking.

In addition to the concern for motives underlying zero bids the positive bids may also be given for a variety of reasons. The prevalence of a potentially moral motive has been raised as an explanation of the insensitivity of CVM results to the scale of project benefits (Kahneman & Knetsch, 1992). In such cases the positive bid fails to represent the willingness to pay for an environmental change which can be related to maintaining an individual's welfare constant (as required by economic welfare theory). In addition, if a moral motive, which conflicts with economic assumptions, is operative then a question arises over the treatment of positive bids as well as zero bids.

2. SURVEY DESIGN

Survey design requires framing a realistic decision concerning the environment where the monetary question to be asked is accepted as a possible state of the world in which individual respondents might find themselves. Thus, several decisions must be taken by the analyst including the reason for the payment requested, how funds will be raised, whether to use willingness to pay (WTP) or willingness to accept (WTA), and the arrangements for and regularity of payments (for details on conducting a CVM, see Hanley & Spash, 1993). Similar CVM surveys were designed for Jamaica and Curaçao employing the same layout and type of questions. The latter survey included versions in Dutch and Papiamentu. The main difference between the surveys, besides geographical and institutional context, arose in the development of the biodiversity improvement scenarios and management options to achieve them.

2.1 Institutional and Environmental Setting

The choice of an institutional setting was interconnected with the selection of an environmental problem responsible for reef degradation. The aim was to find a realistic scenario, which described a reason why the general public would need to pay for an improvement in marine biodiversity. Several anthropogenic causes of reef damage were identified as feasible for use in a CVM approach and could in theory have been used to request a WTP to improve coral reef biodiversity. These included: preventing over-fishing, stopping mining of the reef, treating sewage waste, and establishing a marine park.

The marine park was chosen as a realistic option, which could be given an institutional setting within the existing structures. A range of management options for restoration of the coral reef could be outlined and their expected consequences in terms of biodiversity described. Possible management options could be described avoiding the need to blame one issue for reef decline. However, the credibility of the trust fund was identified as a potential problem because it would be dependent upon whether, for example, the government or an independent charity was seen as most trustworthy to manage such funds

In Jamaica, Montego Bay Marine Park provided an actual institution with a record of marine ecosystem management and a realistic context within which a WTP scenario could be developed. In Curaçao at the time this research was being initiated, a plan had just been finished for a marine park along the whole southern coast of Curaçao. This was still awaiting implementation. Basing the survey on this new plan and including the whole south coast as a new Park therefore had the major advantage of adopting an actual project proposal with an expected range of biodiversity improvements.

2.2 Coral Reef Quality Change and the Benefits Payment Scenario

In order to design a payment scenario the project being paid for must be described in enough detail to allow respondents to understand the net benefits. This requires an understanding of the current environmental status quo and the institutional context. The overall aim must be a realistic, if hypothetical, proposal. Environmental quality within the proposed Parks was characterised to give a background picture. This included items such as species cover, damage to reefs in recent years and cited some historical incidents of note e.g., for Jamaica the in-filling between reefs for developments at Seawind Island and Freeport, and for Curaçao the spilling of rice on to the reef during the sinking of a ship, the Infinity. Other specific incidents relevant to reef quality were described such as bleaching of the reef, hurricane damage, urchin dieback, and threats to large species of coral or their absence.

A review of the literature and expert advice allowed the identification of a *status quo* scenario for the Parks from which a trade-off could be described. This was used to summarise the current situation in terms of coral reef quality and causes of degradation. The identification of causes of reef degradation simultaneously determined the type of management options available to the managers of the marine Park. Human pressure and changes were identified to have occurred in the following ways: bleaching events, over-fishing, sedimentation, mechanical damage, nutrification, dredging and filling of mangrove forests and islands, creation of artificial beaches, the reduction in the quality of water flowing into the sea, loss of coastal vegetation, and shipping accidents. In Jamaica hurricanes in the 1980's devastated the north coast with an immediate effect of a 95% reduction in staghorn coral populations on the forereef and space on the reef surface was quickly colonised by algae. The Diadema sea urchin, which feeds on algae, had been dying off for unknown reasons and thus, algae had become more dominant preventing coral regrowth.

The current state of reefs was characterised as low diversity with a small range of fish, lack of large coral colonies and low diversity of larger reef sponges. Occurrence of acute sedimentation and nutrient loading was know to be reducing the diversity of plant and animal life on the sea bottom. Significant anchor damage resulted where reefs were frequently visited e.g., for diving. Low coral diversity and the dominance of brown algae on reef crests near the shore were identifiable problems.

This meant two states of the coral reef could be described: the current degraded condition and an ideal healthy coral reef. However, impacts on biodiversity are more difficult to describe to the general public. Previous experience has shown the very term is often poorly understood by the general public and even amongst subgroups with high education levels (Spash & Hanley, 1995). Yet, people are quite often familiar with the ideas that lie behind the concept and this needs to be brought out before any WTP questioning.

A major concern in designing the CVM survey was the characterisation of the environmental change and its cause and the impacts on biodiversity. There was a period of consultation with marine biologists, ecologists and conservationists familiar with the sites and biodiversity degradation of coral reefs in general. On this basis the concept of coral reef abundance was used as the best approximation to a measure of coral reef species diversity and health. Coral abundance was then described in terms of area covered. An abundance of zero (ABU=0) would mean that all of the coral had disappeared, and an abundance of 100 (ABU=100%) that the reef was in its natural pristine state.

In order to achieve a stated improvement in marine biodiversity a set of management actions was described. This required some knowledge of the powers and jurisdictions of institutions so that management options attributed to the manager of a Park's trust fund were realistic. For example, such things as tourist development projects and designation and enforcement of shipping lanes were regarded as outside Park jurisdiction. The management options selected as examples for the surveys were:

- planting mangroves and coastal plants to reduce impacts of run-off;
- establishing monitoring of water quality, fish, plant life and mangroves;
- establishing mooring buoys for fisherman;
- enforcing and patrolling 'use' zones;
- enforcing fishing regulations.

As the coral abundance in the two countries was judged to be different the percentage change in coral abundance expected from the management options was also different. The quality changes were characterised in the following manner.

Jamaica: The current marine biodiversity of the Montego Bay reef is at about 75% of its full potential, that is about one quarter degraded. If we 'do nothing', scientists estimate that it will soon fall to a level of 60%, that is two-fifth degraded. Management strategies already planned should maintain the level of biodiversity at 75%. However, if contributions are adequate, a trust fund will be established by Montego Bay Marine Park for exclusive use on projects to increase biodiversity within the Park to 100% of its potential.

Curaçao: The current marine biodiversity of the proposed Curaçao South Coast Marine Park is at about 50% of its full potential, that is about one half degraded. If we 'do nothing', scientists estimate that it will soon fall to a level of 35%, that is two thirds degraded. Management strategies already planned should maintain the level of biodiversity at 50%. However, if contributions are adequate, a trust fund will be established for use by the South Coast Marine Park for exclusive use on projects to increase biodiversity within the Park to 75% of its potential.

Respondents were asked to contribute towards a trust fund, which would be managed by a marine park in order to increase marine biodiversity within the park boundaries. The payment was to be on a per annum basis for five years. The technique for elicitation of WTP was an open-ended question chosen as being straight forward and realistic.[1] The environmental improvement being purchased was a rise in marine biodiversity within the areas by 25% compared with a 15% reduction in biodiversity in the no-management scenario. The proposed park for Curaçao was relatively much larger than that for Jamaica while the level of increase in biodiversity was lower from 50% to 75%.

Thus the points at which this improvement was to occur were different with the Jamaican case being at the end of the marginal benefit function while for Curaçao the change was near the middle of the function. In theory, dependent upon functional form and continuity, the marginal benefits are generally expected to decline as environmental quality improves i.e., moving further along the function. On this basis the marginal WTP for improvements of the Curaçao reef beyond the 75% level would be expected to fall.

Information on physical changes was summarised using colour maps, descriptions read aloud by the interviewer and show-cards. One map showed the whole island, explained the location of the proposed Park and identified other coral and marine resources (reefs, seagrass beds, mangroves and for Curaçao the location of the endangered sea turtle). A second map detailed various use zones proposed within the Park itself (e.g., recreation, fishing, multiple use, and shipping).

2.3 Lexicographic Preferences and Rights

The surveys took a rights based ethical position as signifying an ethical stance compatible with the lexicographic preference hypothesis. More specifically, respondent were initially asked to use the following categories in attributing or denying rights:

a) An absolute right to be protected from harm applies to this case;
b) A right applies which depends upon the circumstances and may therefore be withdrawn under certain conditions;
c) No such rights to protection from harm applies to this case.

[1]While dichotomous choice has become popular there is no clear reason for choosing this format. See Desvouges (1993) for issues as to the usefulness of the dichotomous choice format.

Five groups were given and the respondent had to decide to whom which of these categories applied:

(i) other humans now living;
(ii) future human generations;
(iii) marine animals;
(iv) marine plants;
(v) marine ecosystems.

These general attributions of rights were then probed further in the context of the Marine Park because a general discontent with trade-offs may fail to apply to a specific case study. Follow-up questions were design to introduce the potential for needing to make trade-offs and to confront the respondent with a reasonably extreme case. The question was also made more specific and related to the Marine Park in order to give the rights based position a context linked to the WTP questions. Next respondents were asked to reflect upon the extent to which their refusal to trade was absolute by considering a potential conflict with their own standard of living. This allowed some refinement in the definition of various positions being adopted by the respondents and their stated acceptance of a position compatible with lexicographic preferences.

3. SURVEY RESULTS

A test run was conducted on a small sample (approximately 100) to see if respondents had problems, and special sections were included to pick out the occurrence of difficulties. Survey redesign was then conducted in light of the pre-tests. The Jamaican survey was designed and tested first and this experience used to design the Curaçao survey. The Curaçao survey was also then pretested prior to either of the final surveys. This procedure resulted in presentational changes concerning the information, which was made less technical, and show-cards were developed for use in both countries. The general level of detail in the descriptive material was reduced in the final surveys to maintain ease of comprehension.

While random samples are recommended, in practice a truly random sample is difficult to obtain and especially so in developing countries where significant sections of the population may lack telephones, fail to be registered for election or have a postal address. Sampling tourists also poses problems in terms of predefining and selecting a random sample. Even in developed countries the sample is often quota as this is less expensive (although a random element may be included e.g., random walk method). In the West Indies the difficulty of obtaining a representative sample via in-house interviews, and obtaining a tourist sample, meant the equivalent of 'in-street' surveying was required (i.e. approaching people in the street, at shopping centres and on the beach) in addition to in-house interviewing. In both Jamaica and Curaçao interviewers were trained and for the latter market research students formed the major part of the interviewing team.

3.1 Respondent Site Familiarity and Use

All respondents were asked about their familiarity with the marine parks under consideration. In general, familiarity was higher for the local respondents. Familiarity with the South Coast in Curaçao was greater than familiarity with the Montego Bay Marine Park Area in Jamaica for both locals and tourists. This was as expected given the relative size of the areas with respect to their islands.

Respondents were asked what type of benefits they gained from the area, see table 1. The most common answer for both tourists and locals alike was swimming. A higher percentage of tourists took part in diving and snorkelling activities. The consumption of seafood was an important function of the Montego Bay Marine Park Area; although illegal in the Park itself such fishing was known to occur. Thus, the question on the consumption of seafood was phrased in terms of having eaten seafood from the area in the past 5 years (i.e., prior to the ban) to try and illicit responses on the scale of the activity.

3.2 Knowledge of Coral Biodiversity and Degradation

The familiarity of the respondents with the causes of coral reef degradation was similar amongst tourist and

local respondents. In Jamaica fewer people were familiar with the causes of coral reef degradation giving a skewed frequency distribution. Also, in Jamaica 62% of respondents had never heard of the word biodiversity before with only 34% of tourists and 42% of locals claiming knowledge of the concept. In Curaçao 47% of tourists had heard of the concept but only 29% of locals which gave a sample average of 63.5% who had never heard of biodiversity. Thus, while the overall result was similar, the extent of knowledge of biodiversity amongst tourist and locals diverged between the two studies.

Table 1. Direct Benefits Gained from the Marine Parks (%)

	Curaçao		Jamaica	
	Locals	Tourists	Locals	Tourists
swimming	32	30	34	35
diving/snorkelling	11	21	6	12
use beaches/sunbathe	11	15	7	18
eat seafood	10	5	30	23
just visit/scenery	9	7	2	6
fishing	8	3	4	2
tourist related income	5	4	1	0
boating/sailing	3	5	3	2
other	1	2	0	2
no direct benefits	9	9	28	12
Total	100	100	100	100

Note: Failure to sum to 100 percent is due to rounding errors.

Respondents were also asked about their familiarity with a given definition of marine biodiversity, which was supplied. For Curaçao approximately 20% of the sample were totally unfamiliar with the concept described while tourists generally had a better understanding. In Jamaica 56% of the sample were totally unfamiliar with the concept, and there was relatively little difference between the tourists and locals.

The results showed a higher level of familiarity with the meaning of the concept of biodiversity (as opposed to the actual word itself) in both cases, but particularly for Curaçao. The Jamaican sample found the concept of coral reef biodiversity largely unfamiliar, and this was expected to reduce WTP. More seriously, an answer to the WTP question without an understanding of the environmental change being valued brings into question the valuations individuals then state they are prepared to pay.

3.3 Willingness to Pay

Table 2 summarises the WTP statistical data and gives the mean bid, which is the normal focus of attention in valuation studies (the median is typically lower than the mean in CVM studies). The results reveal a fairly even split between positive bids and those refusing to bid or bidding zero. This holds for both tourists and locals in the Curaçao study, and for Jamaican tourists. However, in the Jamaican case the local population was much more likely to bid positively with 76% of locals doing so.

Table 2. Statistical Summary of Willingness to Pay Bids, US$

	Mean ($)	Median ($)	5% Trimmed Mean ($)	Standard Deviation ($)	Max. ($)	Zero Bids	Positive Bids	Total *N*
Curaçao								
Locals	25.28	0.00	11.23	79.88	674	343	313	656
Tourists	25.12	1.12	12.65	80.58	1124	234	262	496
Total	25.21	0.00	14.92	80.14	1124	577	574	1152
Jamaica								
Locals	28.00	2.87	7.52	180.04	2866	138	427	565
Tourists	23.46	2.00	14.70	63.26	1000	240	253	493
Total	25.89	2.87	10.86	138.43	2866	378	680	1058

The total sample mean was similar across both case studies at around $25, although there was no reason why this should be so. While the percentage change in biodiversity has been kept at 25% in both case studies, the sites were very different (e.g. size and location) and the percentage improvement was, as noted above, for different levels of biodiversity. The local and tourist mean bids in Curaçao were very close, while in Jamaica the local bid was slightly higher. The effect of outliers was reasonably strong with the mean falling to around $11–$14 when the top and bottom 2.5% were cut. Outliers had very similar impacts across the studies with the exception of the Jamaican locals who were more seriously influenced. The reason can be seen from the maximum bid, which was almost three times higher for this group than any of the others, and a larger standard deviation.

The above results are interesting because a difference in bids for tourists and locals was hypothesised, and, early on in the project, the concern had been expressed that only tourist would be prepared to pay anything substantial (thus making a survey of locals a waste of time). As locals appeared to be either similar to tourists (Curaçao) or prepared to pay more (Jamaica) a test for differences in the mean WTP was conducted. No significant difference in means was found at the 95% confidence level. However, WTP regression analysis of the Jamaican data showed a dummy variable for tourists versus locals was significant. Thus, while the means were similar the variation in bids was different between tourist and locals but only in the case of Jamaica.

3.4 Reasons for Bids

Both positive and zero bids can result from a number of reasons and follow-up questioning was included in the survey design to enable analysis of the respondents' motivations. The main concern was for reasons behind zero bids because these have in the past formed part of a process of classifying lexicographic preferences. Zero bid reasons are normally split into those assumed to be in accord with economic theory and those which are more problematic representing a protest which cannot be taken as reflecting zero value.

Three reasons for zero bids were given which are generally accepted as consistent with economic theory: a lack of income, regarding the improvement as unimportant, and having a preference for spending money on other goods and services. The lack of income proved to be the largest overall category in both countries and seemed disproportionate in relation to the socio-economic profile of the samples. That is some of the respondents were above a minimum income level which might be acting as a budget constraint and were therefore using this justification more to reflect their preference for spending money on other things.

An unusual category specific to this project, and in addition to those above, was tourists who felt this was 'not my problem' but that they would contribute for a similar scheme to improve marine biodiversity in their own country (39% of tourists in Curaçao and 21% in Jamaica). In Jamaica a few individuals identified themselves as island residents living away from the Montego Bay area and used this reason for their zero bid. This category of response can be regarded as a protest by the tourists either because they feel locals/residents should pay or they will derive no benefits after leaving. While this response still falls generally within the classification of zero bid for reason of zero value, some respondents, when probed, did state they would be WTP a user fee for direct benefits.

The remaining set of reasons for zero bids constituted 'bias', often against an aspect of the WTP instrument. First were 'free riders' who believed the improvement would go ahead and they therefore could gain the benefits without contributing; only a very small percentage of the sample fell into this category (1–2%). Second was a more substantial set of respondents (the second largest set for Jamaica at 19% of the sub-sample) who felt paying was an inadequate solution and they therefore refused to give a WTP bid. Reasons here included such things as wanting identifiable culprits to pay or having legislation imposed, and seeing the problem as one which required a fundamental change in human behaviour which might be linked to a need for education. Third was a lack of faith in the proposed Marine Park

and trust fund which was seen as raising money which would go into an organisation or individual's pocket and never be spent on the actual project proposed. Distrust of this sort was slightly more common in Curaçao. The final reason under this general set of bias problems was the rejection of the payment mechanism. Here a strong protest was found amongst the Curaçao sample (16%) and studying the actual stated reasons showed a general feeling that the Marine Park trust should be a government responsibility and that their government had already raised taxes very high. Thus, even if the design had used a tax payment mechanism this would have failed to avoid the protest bid and would probably have resulted in a worse one due to the feeling against any increase in government taxation. The combined result of all these reasons under this category was to bias downward WTP because many of the respondents were concerned about biodiversity and placed a positive value upon it but refuse to give a positive WTP amount. This is quite important given that 32% and 27% of zero bids for Curaçao and Jamaica respectively fell into these four categories.

Other reasons form a miscellaneous category which include: difficulty in trying to calculate an exact number, the desire for more information on the project before making a commitment, seeing biodiversity degradation as outside their personal responsibility because some unspecified 'others' were to blame. Thus here also there would be a group of individuals who placed a positive value on biodiversity but were unwilling or unable to give a positive WTP. Note these individuals did specify reasons for their zero bid and this was in contrast to those who merely refused to answer the question or stated nothing more than an inability to do so without stating why.

Overall there was a similar distribution across the reasons in both countries with the exception of the protest against the institution in Curaçao and against individual monetary payment as a solution in Jamaica. Non-payment for 70% of the Curaçao zero bid sample and 65% of the Jamaican zero bid sample was attributed to three reasons: a lack of income and non-resident protest, which were common to both countries, and, two country specific third reasons for Curaçao that general taxes should be used and for Jamaica that paying would not solve the problem.

3.5 Willingness to Volunteer Time

Respondents were also given an alternative to monetary payment to the trust fund, which was especially relevant to a developing country context where the non-monetary sector may be important. Respondents were asked if they would volunteer time to help with work in the Marine Park or help raise funds. The possibility of working to raise funds was included to allow tourists a potential method of contributing time rather than money. The mean number of hours volunteered by the locals was higher than that of the tourists as might be expected (given the limited options for tourist to participate and the tourist protest problem identified above). The Jamaican mean number of hours was significantly greater than that for Curaçao, and may reflect those who claimed 'no spare income' but who did have spare time.

4. LEXICOGRAPHIC PREFERENCES AND WTP FOR MARINE BIODIVERSITY

4.1 Lexicographic Preferences and Rights

Respondents were asked to state the extent to which they saw rights as relevant to present and future generations of humans, marine animals, plants and ecosystems. Almost all the samples were prepared to attribute rights to humans. In Curaçao this declined moving from humans to marine ecosystems, while for Jamaica no decline occurred. More than just attributing rights the respondents in the majority of cases attributed an absolute right to protection from harm. Even marine animals, plants and ecosystems were seen as having these absolute rights by approximately 60% of the Curaçao sample and over 80% of the Jamaican sample. Respondents could answer that they just 'did not know' but only 0.2% in Jamaica and 2.1% in Curaçao found this necessary.

The respondents who had attributed any rights to

one of the five categories were next asked whether, in the case of the relevant Marine Park, they believed the rights they had attributed meant a personal responsibility to prevent harm regardless of the cost. This was equivalent to reflecting that a duty for an individual would result from enforcing a right. The result was similar to the previous general attribution of rights question that was approximately 79% of the Jamaican and 68% of Curaçao sample answered affirmatively.

4.2 Rights and Personal Duties

Next respondents were channelled into two separate questions. Those affirming that they had a personal responsibility regardless of the cost were asked whether they would accept harm to the relevant island's marine life and habitat if trying to prevent it would threaten their current living standard. The other group of respondents, who had denied rights in this case, were also asked to reconsider given a more specific scenario. In their case they were asked whether they would accept a personal duty to avoid harming the relevant island's marine life and habitat if their current standard of living would remain unaffected. The outcome of these questions was to enable the sample to be split into four categories.

These groups were:

1. those who attributed rights and accepted a strong personal responsibility to protect marine life and habitats from harm even when their standard of living was threatened;
2. those who attributed rights and accepted a personal responsibility to protect marine life and habitats from harm only if their own current standard of living was unaffected;
3. those who withdrew rights and any personal responsibility to avoid harm to marine life and habitats when the cost of doing so was in terms of their current standard of living;
4. those who rejected rights and any personal responsibility to protect marine life and habitats from harm regardless of whether their own current standard of living was unaffected.

In addition, there were those who rejected rights in general, rather than in this particular case who formed a minority fifth category.

The results for the two countries are broken down by locals and tourists in table 3. The two middle categories, 2 and 3 above, show a willingness to make trade-offs, which might be consistent with a modified lexicographic position, that is once a basic standard of living is obtained a stronger ethical position for other species is adopted (Spash, 1998). A readiness to consider the trade-off circumstances and the subjectivity of the relevant standard of living mean that individuals in these categories may be regarded as acting as consequentialist over certain ranges and weighing-up the trade-offs. The results for Jamaica showed a dramatic reduction in those attributing absolute or strong rights from 79% down to 14%. Similarly, although slightly less dramatically, for Curaçao the reduction was from 68% to 28%. Despite this large reduction there was still a sizeable hard core of individuals taking a position consistent with strong duties and lexicographic preferences.

4.3 Protest Zero Bids as Strong Duties

The approach taken by Spash and Hanley (1995) was to select respondents giving zero bids for non-zero value reasons in combination with a protest bid reason and then see how many of these were consistent with a rights based position. The hypothesis was then that individuals protest against CVM and bid nothing rather than take part in a process, which implicitly buys and sells improvements in what are seen as rights and duties. This approach was followed below and allows the results to be compared with the earlier work.

The survey allowed for bids by both time and money as shown in table 4. The impact of this approach was to reduce the zero bid category considered here beyond that of the monetarily defined. Remember, those who gave a positive WTP in time and/or money may be indicating that they would be prepared to make a trade-off (indifference) or that they are giving up a substantive part of their current living standard (lexicographic). The zero bidders as a sub-group of strong duty

holders were quite small in contrast to previous findings 3.4–7.5%.

Next the reasons for giving a zero bid were analysed. These were divided into accepted economic reasons for a zero bid, i.e., income constraint, no value, no value in this case. The remaining reasons were taken as indicating non-zero value. The outcome was to reduce the protest zeros which were consistent with a strong lexicographic preference as defined by the strong duty, to 1.7% for Curaçao and 4.8% for Jamaica. This compares with the 23.2% found for the UK. This difference was difficult to attribute merely to the countries involved because the tourist sample would then be expected to be substantially larger than that of the locals but was very similar in size. The problem that remains for CVM studies is that the motives behind bids and refusals to bid are often outside of the economic model and this is discussed further below.

Table 3. Personal Responsibility to Protect Life and Habitats in the Marine Park

	No Rights	No Duty in this Case	Remove Duty if Cost High	Attribute Duty if Cost Low	Strong Duty	Total *N*
Curaçao						
Locals	2	91	262	120	173	648
Tourists	8	77	185	75	135	480
Total *N*	10	168	447	195	308	1128
% of Sample	0.9	14.9	39.6	17.3	27.3	100
Jamaica						
Locals	10	64	328	74	88	564
Tourists	0	46	342	34	70	492
Total *N*	10	110	670	108	158	1056
% of Sample	0.9	10.4	63.3	10.2	14.9	100

Table 4. WTP of Individuals Holding a Strong Duty Position

	Zero Bid	Positive Bid Time	Positive Bid Money	Positive Bid Time & Money	Total *N*
Curaçao					
Locals	38	19	82	34	173
Tourists	46	16	41	32	135
Total *N*	84	35	123	66	308
% Population Sample	7.5	3.1	10.9	5.9	27.3
Jamaica					
Locals	10	8	39	31	88
Tourists	26	7	29	8	70
Total *N*	36	15	68	39	158
% Population Sample	3.4	1.4	6.4	3.7	14.9

4.4 Protecting Rights and the Desire for Alternative Institutional Arrangements

Investigating the way in which all strong duty holders expected their identified environmental rights could be protected within the Marine Parks revealed two main methods. In Jamaican 66.4% of strong duty respondents (10% of the total sample) and in Curaçao 48.3% of the strong duty respondents (13% of the total sample) wanted rights to be protected by either a legal approach or education, or a combination of the two (methods 1,4 and 7). Some of those holding a strong duty position felt the trust fund was also a good idea and would help in the protection of the rights they had attributed to the marine environment. Others gave responses combining more than one category. The miscellaneous category included a variety of actions to be taken by various bodies or unspecified groups, e.g., NGO initiatives, unspecified schemes, restriction of specific activities (e.g. harpooning, anchoring, creation of beaches, diving), allowing technology to prevent pollution, and economic development.

Those holding a strong duty position that protested in terms of a zero bid were in favour of legal and educational approaches to increase the quality of biodiversity in the Marine Parks. In Jamaica 50% of these individuals opted for a purely legal approach, while in Curaçao 53% wanted either a legal and/or an educational approach.

The overall picture can be viewed as a proportion of these individuals externalising the cost to other parties or organisations. Alternatively there may be a genuine failure to consider the cost of the proposed solution. The main category, which avoids externalising the cost and maintains a position consistent with a strong duty and lexicographic preference, was that of the 'lifestyle change'. Education may also cover a range of activities, which go beyond the classroom, and remain consistent with the ethical position.

5. DETERMINANTS AND MEANING OF THE WILLINGNESS TO PAY RESULTS

5.1 WTP Determinants for Curaçao

A bid curve analysis, using a semi-log linear form, for Curaçao showed determinants of WTP as a set of standard socio-economic variables, knowledge and the position taken towards rights (i.e. lexicographic preference). The socio-economic variables were sex, age and education. Income would be another standard variable expected to determine WTP, but was excluded here because it was correlated with age and education and therefore added little to the explanatory power. In addition the income variable only had 642 responses so that its inclusion with list-wise deletion of missing variables would severely reduce the number of observations. The inclusion of a dummy variable for tourists versus locals was strongly insignificant showing no difference. A set of dummies to test for the impact of language, because the survey was translated into Dutch and Papiamentu, were also found to be strongly insignificant. The final model and regression results are shown in table 5.

The knowledge and use variables proved significant determinants of WTP. Knowledge of marine biodiversity (KNOWMBD) was derived from a question where individual's used a ten-point scale to signify their prior knowledge of the concept after having had a description. Greater knowledge increased WTP. This was also true for the direct benefit variable which gave the number of benefits the individual derived from the Marine Park (BENUM), e.g. swimming, diving, site seeing, sun bathing.

A set of variables measuring different aspects of the ethical stance being taken by the respondent were included. First was the attitude of the individual towards rights. A seven-point scale was developed covering the attribution of a right to be protected from harm to marine animals, plants and ecosystems (RIGHTSEA). The idea was to create a scale on the basis of the consistent attribution of rights. Respondents who answered 'don't know' to any the three groups were treated as missing data and so no position on the scale was given to these respondents. Those attributing absolute rights to

Table 5. Multiple Regression Results for Curaçao

Variable		B	Sig T
SEX	Gender (Male=0, Female=1)	–0.71	0.0232
AGE	Age by category (level 1–10)	0.23	0.0026
EDUC	Level of educational attainment (scale 1–5)	0.70	0.0000
KNOWMBD	Knowledge of Marine Biodiversity (scale 1–10)	0.21	0.0003
BENUM	Number of benefit categories identified (0–5)	0.78	0.0000
RIGHTSEA	Marine animal, plant & ecosystem have rights (scale 0–6)	0.64	0.0000
NODUTY	No personal duty to protect marine life and habitats from harm in the Marine Park (0/1)	–1.16	0.0113
STRDUTY	Strong personal duty to protect marine life and habitats from harm in the Marine Park (0/1)	0.73	0.0378
PROBC	Difficulty with ethical questions (scale 1–10)	0.19	0.0261
PREFINFO	Preferences were changed or changed & informed by the survey (0/1)	2.72	0.0000
(Constant)		–10.77	0.0000
F		25.37	0.0000
R Square		0.21	
Adj. R Square		0.20	

all three aspects of the marine environment were ranked highest, and those denying rights in all three cases ranked lowest, with a graduating scale between these two extremes. As can be seen rights for the marine environment were positively related to WTP, which means these individuals held a position inconsistent with economic assumptions about their motives.

The role of ethical positions was confirmed by the significance of the dummy variables on the personal duty to protect the life and habitats of the Marine Park. The dummy variables represent those respondents taking the strong duty perspective (STRDUTY) and those rejecting any duty (NODUTY). As can be seen a strong personal duty regardless of the cost was positively correlated with WTP, while the rejection of this duty reduced WTP. Thus WTP for biodiversity improvement was partially related to the ethical concern people showed for marine animals, plants and ecosystems.

A variable on the difficulty found with ethical questions was included in the light of the results for Jamaica. This was also significant and positively correlated. These individuals cared less about marine biodiversity and also found little problem in stating their lack of belief in rights. In contrast those concerned about biodiversity improvement struggled with their precise ethical position and the extent to which duties were for them weak (tradable) or strong (lexical).

Thus, the overall results for Curaçao show a model of WTP being dependent upon standard socio-economic variables plus rights and duty based variables. The RIGHTSEA variable was a recognition at an aggregate level of rights in the marine environment. The STRDUTY and NODUTY variables were specific to the Marine Park itself and the extent to which individuals were prepared to prevent harm at the risk of a loss in terms of their own living standards.

In addition, a dummy variable was included to account for whether individuals felt their preferences about marine biodiversity preservation had been changed by the survey PREFINFO. This was found to be highly significant and positive.

5.2 WTP Determinants for Jamaica

A similar model was run for Jamaica including a set of variables covering socio-economic status, knowledge and the position taken towards rights. A dummy vari-

able for tourists versus locals was strongly significant and negatively correlated with tourists. The knowledge and use variables also again proved significant determinants of WTP. Greater knowledge of marine biodiversity increased WTP, as did the positive likelihood of future use of the Marine Park. In Jamaica the set of variables on ethical stance were less relevant. However the role of ethical positions was confirmed by the significance of the dummy variable rejecting any duty (NODUTY). This was also negatively correlated to WTP as was the case for Curaçao. The dummy variable PREFINFO was found to be highly significant and positive as in Curaçao. What was different here was the strong positive relationship of a second dummy representing the case of individuals whose preferences had remained unchanged but who felt they had been informed. Thus, the overall results for Jamaica were in line with those for Curaçao except in that the model lacked significant rights and strong duty variables. In addition, the model was weaker in terms of predictive power, although all the variables in the model were significant at the 99% level with the exception of gender.

5.3 Aggregation, Transfer and Use of WTP Results

The temptation amongst those concerned to show that coral reef biodiversity is valuable will be to take figures from table 2 and try to aggregate these or transfer them to other reefs. However, there are both practical and methodological problems with any such attempt. First the mean bids are underestimates because there are a significant number of protest bidders. Zero bid reasons were identified as those which were in accord with economic theory and those which were more problematic representing a protest which cannot be taken as reflecting zero value. The combined result of all the reasons falling under the second category was to bias downward WTP because many of the respondents were concerned about biodiversity and place a positive value upon it. In the survey sample this proved to be a substantial group with 32% and 27% of zero bids for Curaçao and Jamaica respectively reflecting non-zero values. This excludes those in the 'other' and 'refuse/unable to answer' categories who may also place a positive value on biodiversity improvement.

Second there was no analysis here of the sensitivity of the results to variations in population characteristics beyond susceptibility to outliers. This might be attempted via bid curve analysis making use of the derived coefficients. However, any aggregation would require population characteristics relating to the regression variables for both locals and tourists which in each case are unknown, e.g. what is the ethical position on rights of the Jamaican public or tourists to Curaçao?

Third the actual population for tourists is unknown and the sample of the island to which the results could be applicable is also unknown. In this latter respect there might be a distance decay function affecting willingness to pay or there may be no such impact. Fourth the specific circumstances and institutional arrangements posed in the survey must be remembered as these formed an integral part of what respondents were asked to value. Transferring any numbers to alternative scenarios or management options has unknown implications for the stated intention to pay. Fifth the treatment of the future benefits of the reef is poorly addressed by discounting as if these were merely financial flows and the choice of any discount rate makes implicit ethical judgements about future generations (Spash, 1993).

On the methodological side of the issue, the findings of the research show both local individuals and tourists were prepared to give a stated intention to pay for coral reef biodiversity improvements which was related to their ethical position on rights. This means the dollar value arising from the CVM survey is difficult to employ in any cost-benefit framework because it fails to represent the trade price expected by economic theory. Rather than merely taking the numbers from table 2 and trying to sum these over some population their meaning requires close attention. The monetary values being stated included expressions of multiple values some of which were unrelated to the specific environmental change in that they related to the moral concern to protect marine animals, plants and ecosystems. Pricing all aspects of the marine environment as another commodity will then

fail to reflect the rich range of values individuals associate with their environment and the meanings they associate with their bids. This has implications for the design of any policy attempting to protect coral reef biodiversity because support will be partially based upon the extent to which such ethical concerns are respected and addressed.

6. CONCLUSIONS

Although the CVM approach has been routinely used in assessing environmental benefits, no rigorous country-wide CVM analysis had previously been undertaken of a marine environmental resource such as coral reef quality, and few studies had taken account of the methodological issues raised by the possible existence of lexicographic preferences. The evidence given here shows the extent to which lexicographic preferences occur in relationship to both positive and zero bid CVM estimates for the improvement of coral reef biodiversity in Jamaica and Curaçao. The prevalence of positive bidders holding rights based positions raises concerns over the interpretation of the monetary values obtained and their use in cost-benefit analysis.

Those claiming a strong duty to protect aspects of the marine environment accounted for one third to one sixth of the sample. This group was identified after probing questions confronted the respondent with a hypothetical trade-off in terms of their current living standard. The result contrasts with those attributing general but absolute rights to aspects of the marine environment, two thirds or more of the sample.

Only a few percent of strong duty holders were found to be protest zero bidders i.e., when the data were analysed for zero bids being given for reasons of non-zero value (which also excludes those unable to pay, i.e. low income/unemployed). There was no apparent difference between the tourist and local sub-samples as might be expected if the result were due to the developing country context. The non-bid category was reduced by allowing for bids in terms of both time and money. The study took the case of an environmental improvement, which may have proven less controversial than if WTP had been asked for preventing an environmental deterioration. However, the process adopted here for confirming respondents adoption of a strong duty was also effective in reducing the proportion claiming absolute rights.

The finding of a low percentage of protests amongst zero bidders consistent with a strong duty position appears to conflict with that of earlier studies. However, rather than conflicting the result implies the context specific composition of preferences and that human management of some environmental entities may prove less controversial than others. In addition, the other results here imply rights are more generally important within the context of economic valuation of the environment than previously suggested and specifically amongst positive bidders.

A positive bid for an environmental improvement proves to be positively related to the belief in duties towards environmental entities. A positive bid can be consistent with a lexicographic position because any increase in the highly ranked good will increase welfare regardless of the loss of those goods ranked as inferior. A second improvement or a reversal of the improvement would both illicit a zero WTP because the individual has no income left (or no spare income under modified lexicographic preferences). Thus, positive bids for reasons of rights remain problematic. The rights based position and implied duty were found to significantly influence bids as shown by the bid curve analysis. This result was particularly strong for Curaçao.

The consistent results for the strong duty holders across the two countries shows they were in favour of alternative institutional approaches such as education, legal enforcement and to a lesser extent lifestyle changes. The implication for stated WTP is that in many cases those holding a strong duty position are prepared to pay for a different institutional framework (e.g. a judicial approach) if required to do so. This creates a practical problem for CVM as currently practised because, as part of the survey design, one institutional approach to the problem at hand is selected when framing the WTA/WTP question. In addition, there is the theoretical

problem that where respondents are prepared to pay for an institutional framework this becomes entwined with the resource value. One extension to the current research would be to experiment with alternative institutions and processes of valuation to see how WTP/WTA varies.

In terms of the design of CVM the study shows a methodology for classifying a range of different preferences some of which are inconsistent with economic theory. Caution has been expressed here concerning the interpretation of the monetary bids within any cost-benefit context and especially over the simplistic use of mean bid values. The results have been shown to be related to ethical concerns which appear to be commonly associated with aspects of the marine environment and which are incorrectly interpreted as trade prices or economic welfare measures.

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