

Chapter 6

Lexicographic Preferences and the Contingent Valuation of Coral Reef Biodiversity in Curaçao and Jamaica

Clive L Spash

Department of Land Economy, University of Cambridge, Cambridge, United Kingdom

Jasper D van der Werff ten Bosch

Resource Analysis, Delft, The Netherlands

Susie Westmacott

Resource Analysis, Delft, The Netherlands

Jack Ruitenbeek

H.J. Ruitenbeek Resource Consulting Limited, Gabriola, BC, Canada

The contingent valuation method (CVM) is a stated preference method that directly surveys individuals to obtain their preferences rather than analyzing their actual behavior as revealed in the market place. In contrast to other methods for cost-benefit analysis (CBA), CVM has received considerable and increasing attention in the literature. The main advantage attracting this attention is the ability of CVM to estimate option, existence and bequest values in addition to direct use values.¹ The travel cost method, production function analysis, and hedonic pricing are all restricted to assessing only the direct use values of the environment (Hanley and Spash 1993).

There are several stages involved in conducting a CVM study—designing and pre-testing the survey, carrying out the main survey, estimating willingness-to-pay (WTP) and/or willingness-to-accept (WTA), bid curve analysis, data aggregation, and final assessment. In making decisions at each stage of the studies' design and conduct, economists impose their implicit value judgments as to what seems appropriate. While the art of survey design may make CVM more controversial, similar judgments are required in the application of any CBA method. What CVM adds is the ability to probe motives and attitudes.

Issues in Survey Design

Practical CVM survey design must be carefully conducted with awareness of the need to make the trade-off being described both realistic and easy for the general public to understand. This is often a careful balancing act between depth and comprehensibility. Thus, for example, the lengthy technical discussions of ecologists about coral reef degradation have to be simplified to a set of stylised facts. In addition, the length of the survey must be controlled to achieve an administration time that maintains the average interviewee's attention.

The Design Process

The design of a CVM study includes the way information is presented to individuals, the order in which it is presented, the question format, and the amount and type of information presented. There is a wide body of evidence to suggest that survey design can affect responses. 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, the analyst must take several decisions, including a

reason for the payment, how funds will be raised (i.e., the bid vehicle), and the arrangements for and regularity of payments. For example, Rowe *et al.* (1980) found that WTP to preserve landscape quality was higher when an income tax increase was suggested than when entry fees were used. The technique for bid elicitation may be an open-ended question (with or without a bidding card), a dichotomous choice, or a bidding game. Also, information on physical changes will need to be summarized and the method of their description chosen (e.g., text, graphics, maps).

Due to the sensitivity of responses to the information supplied, the pre-testing of the survey has become of increasing importance. This can be conducted via a small sample test run to see if respondents have problems and special sections can be included to pick out the occurrence of difficulties. A focus group is another method now in use for pre-testing. Generally, the pre-test will enable the identification of problems with regard to the framing of the decision problem, as well as divergence between encoding and decoding of information.

The conduct of the main survey can use several variations. The in-house interview is now most favored in developed country surveys, although the expense of this approach often means surveys are completed in the street, by telephone interviewing, or by mail. In the Caribbean, 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 centers and on the beach) in addition to the developed country preference for in-house interviewing. While random samples are recommended, in practice a truly random sample is difficult to obtain. This is especially true in developing countries where large sections of the population may lack telephones or have no postal address. Again, sampling tourists can pose problems in terms of predefining and selecting a random sample. Even in developed countries, the sample is often based on a quota as it is less expensive (although a random element may be included, such as the random walk method).² The sample is also often weighted in terms of the local or regional population, whichever is seen as politically more important to the decision and likely to have strong direct economic connections to the outcome.

Responses to the survey may include "protest bids", and these are often omitted from the mean WTP or WTA calculation without adequate reason. 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 that they feel should be protected at all costs. Respondents may refuse to state a WTP or WTA 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 and Hanley 1995). Another potential problem is the outlier who bids a very large amount and so has a strong influence on the mean. This should only be regarded as a problem when the bid is unlikely to occur because the individual lacks the income to pay (under WTP) or would actually accept a much lower amount (under WTA). In this case, the respondent would be acting strategically, thus creating a bias.

Analysis of the bid curve is used to test construct validity (i.e., that the socio-economic variables have the expected signs and the regression is statistically significant). Other relationships can also be investigated at this stage. In general, bid curve analysis has tended to be of academic rather than policy interest. However, this analysis can provide useful insights into the behavior of respondents and the determinants of their bids. In this chapter, such analysis is used to investigate the importance of ethical positioning.

Final reflection upon the CVM study can include convergent validity and success of repeatability where there exist other similar studies. The overall success of the exercise will also become apparent as the results are being analyzed (e.g., a high number of protest bids). There are several specific problems that are recognized as possible causes of bias, some of which have been mentioned (e.g., strategic bias, design bias). More problematic are the impacts of the information, as this is, by necessity, restricted but can have serious influence upon the resulting bids and the problem of embedding as raised by Kahneman and Knetsch (1992).

Information Provision

In a hypothetical market, respondents combine information provided to them regarding the good to be valued and how the market will work with information they already hold on that good. Either the hypothetical market or commodity-specific information given to them in the survey may influence their responses. This phenomenon implies that WTP and WTA values are endogenous to the valuation process. Thus, bids to preserve different animal species may vary significantly according to the information provided by researchers (Samples *et al.* 1986). Ajzen *et al.* (1996) concluded from experimental research that the nature of the information provided in CVM surveys can

profoundly affect WTP estimates and that subtle contextual cues can seriously bias these estimates under conditions where the good is of low personal relevance. However, Randall (1986) has argued that CVM answers should vary under different information sets, otherwise the technique would be insensitive to significant changes in commodity framing.

Indeed, the effects of information may be inappropriately labelled as bias, depending on the way in which WTP or WTA is changed. Information that improves the knowledge of an individual concerning the characteristics of a good can be regarded as informing a consumption decision. Information that alters the preferences is more problematic in the neo-classical framework and could be regarded as creating a bias. For example, Baron and Maxwell (1996) show that individuals' WTP can be biased by information on the cost of provision of public goods and suggest eliminating information from which costs could be inferred from CVM surveys so that respondents can focus more easily on benefits alone. While such redesign may avoid some types of bias, a more general issue, which remains, is how far individual preferences can be regarded as exogenous to the valuation process and, especially so, when goods are unfamiliar and/or never traded in a market.

Part-Whole Bias and Embedding

This problem arises when the component parts of an individual's valuation are evaluated separately and, when summed, found to exceed the valuation placed upon the whole. CVM studies have found part-whole bias, also termed embedding, and this has been attributed by some to valuation of the moral satisfaction from contributing to a worthy cause ("warm glow") rather than the good itself (Kahneman and Knetsch 1992). The counter reaction has been that CVM surveys finding embedding are flawed in some way that creates the part-whole bias and that this can be corrected by careful survey design (Carson and Mitchell 1993, 1995; Hanemann 1994). However, Bateman *et al.* (1997) have provided experimental evidence for the existence of part-whole bias for private goods outside of the CVM context. They therefore suggest that the problem lies with economic preference theory rather than the CVM approach.

Hypothetical Market Error

Valuations in a hypothetical market could make responses differ systematically from actual payments in actual markets. Random over and under statement would be a

non-systematic error term and, therefore, would not represent a hypothetical bias (Mitchell and Carson 1989). In general, CVM studies avoid actual trade-offs, unless they are specifically testing for a hypothetical bias, and so the evidence on the impact of this bias is limited. A CVM study will be different from actual markets because there is no debate over the value of goods, no sequential learning from a series of purchasing decisions, and no enforcement of actual purchases. Thus, the extent to which hypothetical market bias occurs will be dependent upon how realistic the trade-off described is felt to be by respondents. Also relevant is whether the design has considered the type of incentives that might unintentionally be given to respondents.

WTP versus WTA

WTA formats can generate more protest bids and outliers than WTP. Protest bids may occur because people are unwilling, on ethical grounds, to accept monetary compensation for the loss of an environmental asset (an implied loss of property rights). Outliers may be due to a rejection of the notion of compensation resulting in a large request for compensation based upon rejection of the implied trade-off, rather than an amount intended to represent their welfare loss.

Willig (1976) showed that these two welfare measures would be close if the ratio of consumer surplus to income was sufficiently small and if the income elasticity of demand for the good in question was sufficiently low. Where these conditions failed to hold, precise limits on the difference between the two measures could be calculated. While some criticized the applicability of Willig's findings to environmental benefits (Bockstael and McConnell 1980), others extended Willig's theorem to the quantity changes more commonly encountered in environmental valuation (Randall and Stoll 1980).

However, stated WTP has been found to be significantly lower than stated WTA (e.g., Hammack and Brown 1974; Rowe *et al.* 1980). In addition, experimental work has also found that WTA exceeded WTP (Gregory 1986; Knetsch and Sinden 1984). Several reasons have been given as to why WTA may be greater than WTP. First, actual WTA is greater than actual WTP when loss aversion occurs. Individuals value a given reduction in entitlements more highly than an equivalent increase in entitlements (Knetsch 1989). Second, income constrains WTP bids, unless limitless borrowing is possible, whereas WTA bids are unconstrained, making bounded trade-offs hard to enforce. Third, the availability of substitutes provides theoretical evidence for a difference. If private goods

are poor substitutes for public goods, then WTA can be greater than WTP (Hanemann 1991). A public good with few private goods as substitutes will be valued differently because under WTP the loss of public good is prevented, while under WTA the private goods are meant to provide compensation and the public good is lost. Fourth, risk-averse consumers find they have only one chance to value the good under the typical CVM and will tend to overstate WTA and understate WTP. They do so due to uncertainty concerning the value of the good and in order to avoid a potential loss (Hoehn and Randall 1987).

On practical grounds, the status quo reference position is preferable in terms of the property rights structure. If an alternative is imposed by the blanket imposition of WTP formats in all CVM surveys, the result can be to create an unrealistic trade-off, hypothetical market bias and protest bids. Thus, rather than follow a generic prescription to always use WTP formats as a conservative estimate of values, the property rights prevalent in a given situation should be used as guidance. This reinforces the theoretical argument for using WTA to measure a loss and WTP for a gain (Knetsch 1994).

Dichotomous Choice versus Open-Ended Formats

The dichotomous choice format has been recommended because those supporting the approach regard a one-off yes or no decision as closer to a free market. This is debatable in itself with the yes or no decision being closer to a political referendum. There should be some concern for the rejection of such an approach in countries where prices are often discussed and argued about rather than given as fixed. Also, to bind the range of choices when conducting dichotomous choice, an open-ended CVM is required as a first step. This means that those advocating dichotomous choice must defend the open-ended CVM. Neither format is clearly superior on *a priori* grounds. However, the dichotomous choice format does suffer problems in practice. The “yea-saying” problem may be evidence of an anchoring bias and has raised questions as to the usefulness of the format. Desvouges *et al.* (1993) found dichotomous choice exceeded the open-ended format and had greater variability. The results are sensitive to the choice of bids by the analyst, and the choice of functional form for mean estimation adds to variability in results.

The NOAA Panel: A Comment on Generalized Guidelines

As the use of CVM has increased, so has the debate between supporters and detractors. Sagoff (1996) has

critically attacked CVM and, in particular, what he terms the “Wyoming experiment” of the late 1970s and early 1980s. He sees the technique as economist venturing into the political realm, which he regards as totally separate. Applications to Kakadu National Park in Australia and the assessment of damages arising from the Exxon Valdez oil spill in Alaska created public controversy. In the Exxon case, one result was the suggestion that a specific set of guidelines for conducting a CVM should be followed.

A panel of experts was convened by the National Oceanic and Atmospheric Administration (NOAA) to fight pressure from Exxon coming via the Bush administration. The panel, which included Kenneth Arrow (Exxon consultant) and Robert Solow (State of Alaska consultant), gave qualified support for CVM. They produced guidelines which suggest there is one correct approach to conducting a “good” CVM study (i.e., methodologically similar to Cummings *et al.* 1986). Blind adoption of the NOAA guidelines has become a defense of the validity of specific work, although this ignores the variation in case study circumstances, such as whether property rights prescribe a WTP or WTA approach. In addition, merely quoting the use of NOAA guidelines seems inadequate defense and some regard for independent testing of the validity and applicability of both these guidelines and CVM results is required.

The extent to which CVM can be generalized is easily overstated. According to Cummings *et al.* (1986), CVM works best in only a limited range of circumstances. The most important rules are that respondents understand and be familiar with the commodity to be valued; that respondents have prior valuation and choice experience with respect to the commodity; that uncertainty about the operation of the hypothetical market is low; and that WTP is used in preference to WTA. However, the quantitative results of violating these conditions remain largely unspecified.

The NOAA panel guidelines include the use of WTP; in-house interviews on a random sample; full information on the resource change (including information on substitutes) and checks for understanding; closed-ended referendum formats (dichotomous choice); reinforcing budget restrictions; and careful pre-testing. They have also recommended reducing any resulting valuation, which raises questions over the derivation and credibility of this particular set of rules. In this regard, those using the guidelines should remember that the NOAA panel was politically appointed to adjudicate over the use of CVM in the USA as a result of the Exxon Valdez accident. The procedure for deriving the guidelines, with a Nobel laureate from each of the opposing camps on the panel, would

be interesting to discover, along with the underlying justification for some of these rules.

A more general problem is the extent to which any one set of rules can dictate CVM research. The NOAA guidelines have not resolved the debate around CVM because they assume a technical solution regardless of the problem at hand. The rules try to impose a set behavioral model upon individuals (economic rationality) and reject divergent behavior (e.g., see the discussion of part-whole bias in Bateman *et al.* 1997). However, there can be general guidelines as to good practice rather than set formats for an idealised CVM survey that is universally applicable. Regard to bias problems, appropriate testing and conduct of the survey, and learning from past experience are obvious steps to adopt.

Designing the CVM for the Coral Reef Case Studies

Two separate CVM surveys were designed—one survey for Jamaica and one for Curaçao. 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. The Jamaican survey was designed and tested first and this informed the Curaçao survey, but feedback on the Curaçao experience was also possible before either of the final surveys. This resulted in some simplification of the information presented and the development of show-cards that could be used in either country.

Developing the Information Pack

The term “information pack” is used to summarize reference to all the descriptive materials included in a CVM survey to convey information about the environmental changes. Maps were sought to show the islands, the reefs by quality, mangroves, endangered or rare species, and main source points of pollution. This was to inform respondents as to the current areas of interest in terms of marine biodiversity, the threats to biodiversity, and the context for the proposed project. In addition, the area covered by the case study needed to be described along with some detail on what it would be protecting.

The final surveys included colour maps, descriptions to be read aloud by the interviewer, and show-cards for the interviewee to study. For each survey area, two maps were used. One showed the whole island and explained the location of the proposed project (i.e., the park) and identified other coral and marine resources (i.e., reefs,

seagrass beds and mangroves), and, for Curaçao, the location of the endangered sea turtle. The second map detailed the use zones proposed within the parks themselves (e.g., recreation, fishing, multiple use, and shipping).

Institutional and Environmental Setting in Jamaica

For Montego Bay, Jamaica, background information was gained from available documents which allowed a characterisation of both the environmental quality and the institutional setting. The aim was to find a realistic scenario in which to describe a reason why the general public might need to pay for biodiversity improvement. The choice of an institutional setting was interconnected with the environmental problem that would be selected. There appeared to be several anthropogenic causes of reef damage that could be used in a CVM approach:

1. *Overfishing.* A policy would need to be presented which gave an institutional setting under which overfishing would be reduced. This would need to be combined with knowledge of the system of regulation to assess whether a realistic reason for asking the general public to contribute to such a scheme was feasible. Problems with this approach were the institutional setting, fishing being related to use values creating confusion when separating non-use values, and the difficulty of blaming one cause for marine biodiversity losses.
2. *Mining the reef.* This is an extreme scenario where the entire reef is lost. The difficulty was that the total value, rather than marginal quality change, in the reef in its present state would be estimated. The problems were the hypothetical nature (i.e., the creation of a problem which did not exist), the high probability of protests, and the failure to relate to the current institutional setting. In addition, WTA compensation as the appropriate measure of welfare loss would add another aspect of experimentation to the study.
3. *Waste treatment plant.* The need to improve water quality was the focus here. Problems arose in that many individuals were probably not connected to sewage systems and so would have no obvious payment mechanism. These individuals might resent paying for others' externalities. The institutional setting in terms of who pays and who benefits from wastewater treatment would have needed clarification. In addition, the extent to which the issue would be connected to coral reefs rather than human health was unclear and separating out the effects could be difficult.
4. *Trust fund for restoration.* This was realistic and could be given an institutional setting within the Montego Bay Marine Park. A range of management options for restoration could be outlined and their expected consequences described. Thus, the CVM survey would

outline expected biodiversity benefits related to Park provision. No one issue was needed as a cause to be blamed for reef decline; rather, a range of causes could be identified. There were no obvious problems with this option. 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 a non-government organization (NGO) was seen as most trustworthy to manage such funds. Similar funds in existence in Jamaica (e.g., Portland Environment Protection Association) implied this would be unproblematic.

The Montego Bay Marine Park (MBMP), which had already formed a point of interest in reef management, immediately had the advantages of an actual institution with a record of marine ecosystem management and provided a realistic context within which a WTP scenario could be developed.

Institutional and Environmental Setting in Curaçao

The best options raised for Curaçao were either: i) a trust fund to protect marine biodiversity to be used for the establishment and maintenance of a marine park along the south coast; or, ii) the improvement of the existing underwater park. The present underwater park, at the eastern end of the island, was deemed to be more substantive on paper than in fact. The site borders private property, effectively restricting access. Dive operators in the vicinity and the ecological institute (Carmabi/Stinapa) are the main users of the area. The limits on site access and the proximity of private property raised the following issues:

- The site might be seen as private property rather than a public good;
- Familiarity would be low;
- Use would be restricted, which would limit the survey more to indirect benefits; and,
- The possibilities for biodiversity improvement appeared limited.

At the time this project was being established (early 1997), a plan for a marine park along the whole south coast of Curaçao was developed by the agency responsible for the management of national parks (Stinapa). Thus, the best option was to base the CVM survey on this new plan. A major advantage was adopting an actual project proposal with an expected range of biodiversity improvements.

Information on the current state of Curaçao reef systems was gathered. There are very few mangrove areas and these are mainly surrounding inland lagoons. The main endangered or rare species identified were sea turtles, which have nesting grounds in one area of the islands.

The main sources of pollution were industrial, primarily around the Willemstad refinery and the town itself. The main threat of physical damage was through the construction of artificial beaches. In terms of development, new tourist and population centers in the west and east were seen as potential threats.

Describing Marine Biodiversity

Biodiversity is a difficult concept to explain quickly and simply. Previous experience has shown the very term is often poorly understood by the general public and even among sub-groups with high education levels (Spash and Hanley 1995). However, people are quite often familiar with the ideas that lie behind the concept and these need to be brought out before any WTP questioning. The survey downplayed academic wording while portraying the same information.

Defining and Describing the Coral Quality Change

A major concern in designing the CVM survey was the characterisation of the environmental change and its cause and 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. Experts advised on the characterisation of the problem for the survey. On this basis, the Jamaican pre-test tried to explain the concept of coral reef abundance. Coral reef abundance was felt to be the best approximation to a measure of coral reef species diversity and health. The description of coral reef degradation and improvement in the WTP preamble and question was in terms of percentages from a maximum (100%). The general public was able to comprehend the idea of percentage changes from a hypothetical maximum without going into the detailed scientific reasoning. The aim was, therefore, limited to describing the environmental trade-off and the benefits from the proposed project.

The Benefit 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. As explained above, environmental quality within the proposed parks was characterized to give a background picture.

In order to achieve a stated improvement in marine biodiversity, a set of management actions needs to be

described. This requires some knowledge of the powers and jurisdictions of institutions so that management options attributed to the manager of the trust fund are realistic. For example, such things as tourist development projects and designation and enforcement of shipping lanes may be regarded as outside park management's jurisdiction.

The reduction of the nutrient and sediment loading onto the reef was seen as the main problem. This could be achieved through sewage treatment and industrial pollution control. However, a marine park is more likely to be involved in monitoring to determine whether such standards are being met and the occurrence of physical damage (e.g., due to anchors from fishing and diving boats). In these cases, the park is unlikely to be actually installing or running mitigating measures. However, the enforcement of the measures and provision of data and information to ensure the measures are enforced could be within park jurisdiction. The management options selected as examples for the survey were, in the end, found to be common to both the South Coast Marine Park in Curaçao and the Montego Bay Marine Park in Jamaica. These were:

- Planting mangroves and coastal plants to reduce impacts from run-off;
- Establishing monitoring of water quality, fish, plant life and mangroves;
- Establishing mooring buoys for fishers;
- Enforcing and patrolling use zones; and,
- Enforcing fishing regulations.

Several other possible management strategies were dropped as being outside of the jurisdiction of the parks:

- Treatment of sewage;
- New drainage systems for storm waters;
- Encouraging proper disposal of chemicals, garbage and other waste to improve water quality;
- Promoting higher industrial effluent treatment; and,
- Limiting inshore dumping by ships.

The current state of the reef system to be included in the park must be given and the expected improvements detailed. Knowledge of the existing situation can be used as the "business as usual" scenario and predictions made about the quality of the environment at some point in the future. This is then compared to the situation at that time with environmental measures in place.

In terms of environmental changes, the "business as usual" scenario is given by the current policy. The CVM survey could use the characterisation of reef quality to imply either stability of the reef system or, more realistically, degradation by a given percentage over a given

period of years. The parks would then be described in terms of a "policy on" situation where degradation is avoided or coral abundance is increased. Thus, the management aim could be to either improve reef biodiversity or prevent biodiversity reductions and reef deterioration that would otherwise occur. In the survey, a mixed approach was felt to be most realistic. That is, the current situation of the coral reefs was estimated to be one of deterioration, but in both countries institutions had been identified which were working on reef maintenance. This allowed the current situation to be described as one in which the reef would deteriorate without any action, but that some action was already ongoing. This ongoing management would then allow the reef quality to be maintained at present levels, which had been characterized as degraded. The proposed project for which individuals would be asked to pay would increase the coral abundance from this level. The two scenarios were both for a 25% improvement.

Survey Sections and Questions

The layout for the CVM survey used here has been developed over several years. The design makes use of individual sections to separate a group of issues. In this instance, five main sections were included:

1. *Framing and background information.* The public policy context is described in terms of related issues that are of concern. That is, by a series of questions, the interviewees are made aware of a range of issues among which the environment is but one. They are asked to think about and reflect upon their own priorities. This also helps reinforce the concept of society having limited resources and there being a set of possible public policy issues requiring attention. The idea of framing is to place the problem of coral reef degradation within a broader context. Thus, the questions move from a very general level, with no mention of the environment, to environmental issues and the specific case study sites. Failure to frame the issues may be regarded as promoting one specific issue without any context and has been cited as a cause of embedding problems. Besides being concerned with framing the issue, this first section also gathers background information on the interviewees' knowledge of the site and provides information. The site information is given via maps and a short description. This aims to give all respondents a basic level of knowledge about the area and places it within a geographical context. Such information also acts as another framing device by showing other areas of coral reef and environmental habitat that may be regarded as substitutes. Background information on the interviewees' knowledge and use of the area is also gathered at this

stage. By the end, the context has been set and the interviewee has had to think about the coral reef case study area, their knowledge of the site, the benefits they gain from the coral reef, and their knowledge of biodiversity and, in particular, marine biodiversity.

2. *WTP into the trust fund.* The information forming the background to the WTP question has been described above. The scenario is to improve coral reef biodiversity by 25% given a set of management strategies to be adopted by a marine park. The park will have a trust fund set up explicitly for the purpose. Payment could have been on several bases, but a per annum payment for five years was felt to be reasonably realistic. Beyond five years, people are unlikely to regard actual payment as likely. The main alternative would have been to request a one-time payment and then try to estimate the time period or interest rate over which this might represent a discounted present value. This introduces unnecessary complications and, therefore, the per annum five-year payment mechanism was employed. The bid question was open-ended. Following the bid question, respondents were asked to explain the reason for their response. Tourists claiming no spare income had been noted to be an unusual group in the pre-test for Jamaica and interviewers were directed to probe these respondents. Probing was also requested in the case of those making extremely high bids. A coding table was developed for the zero bidders from the pre-tests. A separate question explores the embedding problem. The approach was to ask respondents whether they would increase their bid if a greater reef area were to be included in the project. Respondents should be prepared to do so unless they place no value on other reef systems. If they state that their bid was to cover all reefs, then a case of embedding has occurred. Subsequent questions probe indirect use values. Respondents are reminded of the uses they make of the area and the expected direct benefits of the project for them. Once the respondents are thinking of the uses they are asked to imagine leaving the island never to return. They are then asked whether this would lead to a reduction in their WTP and, if so, by what percentage. In the pre-test, a few respondents actually increased their bid despite being told their circumstances would be the same. In the final survey, the interviewer was requested to probe such respondents for their reasoning. Next, payment by volunteering hours was requested. This allows the unemployed and those on a low income to contribute to the project. In developing economies, payment by hours may be seen as more practical for many. The respondents were asked to make a commitment over five years, the same period as for the WTP question. The final question in this section was on the impact of information on the individual's preferences. The concern here was to see if the survey was informing the respondent, forming their preferences on coral reef degradation, or both.

3. *Rights and responsibilities.* This section had four questions. The first question splits the sample by the degree to which they attribute the right to be free from harm to five categories of potentially morally considerable groups. The five groups were: i) other humans now living; ii) future generations; iii) marine animals; iv) marine plants; and, v) marine ecosystems. Rights were attributed using a three-point scale with each point being associated with a position. The three positions can be summarized as: i) rights apply absolutely; ii) rights depend upon the circumstances; and, iii) no rights apply. Respondents could also answer "don't know". Those who responded by attributing a right under any category were then probed regarding their readiness to make trade-offs that might occur by the claimed attribution of a right. Thus, within the context of the park, the respondent was asked to agree or disagree with a personal responsibility to prevent harm regardless of the cost. They were then further probed to consider their answer. Those claiming such a responsibility were asked to reconsider if the cost was their current standard of living. Those rejecting the responsibility were asked to reconsider if their current standard of living was maintained. The final question asked how the individual thought the rights they had identified for the park should be protected.
4. *Socio-economics.* The collection of socio-economic data allows population statistics to be calculated and aids bid curve analysis. A set of standard questions was included to cover gender, age, education, and income. In addition, occupation was requested as a check on income and a few experimental variables added, namely dietary preference and religion.
5. *Interviewer response.* The interviewer was asked to give some feedback. The first question was whether others had been listening while the survey was conducted as this can lead to respondents saying what they think others want to hear and being reticent about their own beliefs. Next, the interviewer was asked to rank the difficulty the respondent had in answering each section. Finally, they were requested to note any specific questions that were found to create a problem for the respondent.

Pre-test Results and Survey Redesign

The survey was designed to derive estimates of non-use biodiversity values and test for the importance of a refusal to make trade-offs of money for environmental quality (i.e., the occurrence of lexicographic preferences). The survey for Curaçao was adapted from the Jamaican case study. This survey was pre-tested and updated prior to the survey being applied in Curaçao. Although the survey had already been pre-tested in Jamaica, the redesign

and new cultural and geographic context meant a pre-test was also recommended for the Curaçao case study. Thus, survey pre-tests were conducted in both Jamaica and Curaçao.

The pre-test survey is a crucial stage in the development of a CVM survey and requires sampling the population from which the main test sample will be drawn. Typically, a pre-test is performed on 100 to 150 people with qualitative feedback being the central aim, rather than attempting to gain quantitative results. The aim of pre-testing is to identify any areas where the survey may be misinterpreted, where questions produce unexpected results, and, more generally, to identify areas requiring improvement. For example, misinterpretation can occur due to the use of excessively technical language in the description of environmental quality changes and probing a sample of the general public can make the analyst aware of divergence from the common use of language.

Both the interviewer and interviewee are important sources of feedback during the pre-test. Where survey design requires optional sections, the interviewers must be able to understand the sequencing of questions they are to relay. The CVM surveys used here required the design of questions to probe sub-samples and, therefore, were reasonably complicated and care was taken to redesign the format in light of interviewer comments. The pre-test was also a learning experience for the survey coordinators who were responsible for training the interviewers. This allowed the coordinators to revise the method of training and improve on the selection procedure for interviewers. In countries where market research companies, who are practiced in such matters, are unavailable, selection and training of the domestic coordinators takes on specific importance.

The results of the pre-test were used to make several improvements prior to the implementation of the main survey. Among the lessons for survey coordinators, which as mentioned above may be particularly relevant in the context of developing countries, are the following:

- Use older, more mature individuals able to understand the local language and probe the respondent when necessary;
- Increase the level of in-depth individual training of the interviewers;
- Increase the intensity and quantity of feedback given to the interviewers after surveys have been completed;
- Carry out the surveying over a longer period of time to allow quality control after a batch of surveys have been completed;
- Keep a close record of what each interviewer has received and done; and,

- Feedback the survey quota results to the interviewers to keep them informed.

In Curaçao, the survey required re-translation in selected areas. Changes were also made to the original translation in order to maintain direct comparability across different language versions. The administrators in each country selected and trained a set of interviewers (i.e., conducted sessions on familiarisation with the survey and an assessment of the interviewer as a competent but neutral purveyor of the survey information and questions). In addition, close quality control was undertaken to ensure at least 1,000 completed surveys were collected. The outcome was 1,152 surveys in Curaçao and 1,058 in Jamaica.

Detailed results of the main surveys for Jamaica and Curaçao (i.e., population sample statistics and data results for specific sections of the questionnaires) can be found in Spash *et al.* (1998). The remainder of this chapter will be concerned with the analysis of the WTP data and lexicographic preferences.

Lexicographic Preferences and WTP

One major difficulty with using CVM in the context of coral reef biodiversity is related to the existence of “lexicographic preferences”. Stated simply, lexicographic preferences exist where decision-makers are unwilling to accept any trade-offs for the loss of a good or service. The literature demonstrates that, where such preferences are prevalent, CVM techniques are methodologically flawed. The first step of an applied CVM procedure should, therefore, be to determine the potential extent of such preferences. Recent work suggests that lexicographic preferences for biodiversity are exceedingly widespread in developed countries and that, moreover, the actual “definition” or “understanding” of biodiversity differs significantly among respondents. Under such conditions, the use of CVM techniques is questionable. Thus, this research tries to address the question of how to adapt CVM and test for refusal to make trade-offs in the context of coral reef valuation, taking account of possible lexicographic preferences.

Monetary valuation of the environment requires the definition of commodities in a way fundamentally identical to marketed goods and services. That is, when an environmental improvement occurs, an individual must give up some consumption of other commodities to maintain a constant utility level. This gives an individual’s WTP amount, which can then be summed across all affected individuals to obtain an aggregate WTP figure. Similarly, the minimum

quantity of other commodities demanded to accept a reduction in environmental quality is the WTA compensation. In this case, expenditure on other goods must be increased to compensate for the reduction in environmental quality, so maintaining the individual's initial level of welfare. Whether the other commodities are regarded in terms of a single numerate (i.e., money) or remain as a diverse set of goods and services is inconsequential.

The essential message of the normal indifference curve is that individuals are able to swap one bundle for another and can do so for a set of bundles without affecting their welfare level. As mentioned, a problem arises if, for example, an individual believes that aspects of the environment have to be protected without regard to the cost in terms of other commodities. That individual will refuse all money or commodity trade-offs that decrease what is regarded as an environmental commodity in the neo-classical framework. In theory, WTP to prevent the loss would be all the available commodities the individual could command (i.e., their income) and WTA compensation would be infinite. The respondent believes the aspect of the environment in question should remain at or above its current level in terms of either quantity or quality.

Such preferences mean that utility functions, including environmental aspects that are to be protected at all cost, are undefined for an individual (since the axiom of continuity is violated) and that indifference curves collapse to single points (denying the principle of gross substitution). These preferences are termed lexicographic by neo-classical economics because they give absolute priority to one commodity over all others and, therefore, imply a strict ordering as in a lexicon. The position described is, however, best regarded as extreme because its implications for the individual are total sacrifice for the environmental aspect to be protected (e.g., coral reef biodiversity). Economists have tended to regard the denial of continuity and violation of gross substitution as of little relevance because lexicographic preferences are unrealistic and unlikely to occur (Malinvaud 1972, p.20).

The extreme lexicographic position does indeed seem likely to be uncommon because of this overriding ranking of a good above even the individual's own life. The modified lexicographic position might be drawn-up in terms of first attaining a minimum standard of living prior to being prepared to defend the environment. Following Pigou (1920, p.759) this minimum might include, but not be restricted to, a defined quantity and quality of housing, medical care, education, food, leisure, sanitation and safety at work. Sen (1988), appealing back to notions of Adam Smith, goes further and defines functionings (the various living conditions we can achieve) and capabilities (our

ability to achieve them) as essential parts of living standards rather than commodities. Such a living standard might be relatively materialistic in societies where being a functional member of society is defined in such terms (e.g., requiring ownership of a car and a television). As Sen (1988, p.17) states: "The same capability of being able to appear in public without shame has variable demands on commodities and wealth, depending on the nature of the society in which one lives". In this formulation, the concept of lexicographic preferences becomes more readily acceptable, but the definition for empirical purposes becomes far more difficult because the minimum living standard is expected to differ among social groupings.

Rights and Lexicographic Preferences

Lexicographic preferences are signified by a discontinuity in the preference function giving a single point, or bundle of goods, as the indifference set in goods space. The aim of the surveys reported here was first to identify the occurrence of such preferences and then see how far these might be indicative of a refusal to make trade-offs. This was achieved by direct questions on ethical beliefs that signify behavior incompatible with a continuous preference function, follow-up questions and consistency checks. The approach to dealing with lexicographic preferences taken here was based upon previous work (Spash 1993b, 1997, 1998c; Spash and Hanley 1995). The general approach to lexicographic preferences is reviewed next in light of the few key studies previously conducted.

The dominant economic theory of decision-making requires a fundamental philosophical assumption—namely, that individuals believe the net utility from the consequences of an action determines whether that action is right or wrong. Cost-benefit analysis and its tools, such as CVM, assume that individuals are able and willing to consider trade-offs in relation to the quantity and/or quality of public goods. Debates in environmental ethics have raised the issue of individuals refusing to make these judgments and so raised serious problems for the application of economic efficiency arguments (Sagoff 1988; Spash 1993a, 1994). One aspect of refusal can be a basis of belief in inviolable rights so that actions are intrinsically of value or deontological.

Neo-classical economists reject the notion of deontology because there is an assumed rationality attributed to the ability to make trade-offs, whatever the commodity, as long as enough compensation is offered in return. This can be summarized by the old colloquialism that everybody has his or her price. However, some individuals

may treat certain aspects of the environment differently from the manner suggested by this theoretical framework. If an individual believes that aspects of the environment, such as wildlife, have an absolute right to be protected, then that individual will refuse all money trade-offs that degrade what is regarded as an environmental commodity in the neo-classical framework. Thus, the prevalence of the deontological position seems likely to be high among those who claim absolute rights to life for humans and other animals, future generations, trees or ecosystems. In contingent valuation, evidence exists in developed countries to suggest individuals express lexicographic preferences for wildlife (Stevens *et al.* 1991) and these relate to rights for animals, plants and ecosystems (Spash and Hanley 1995).

The Coral Reef Survey Results

Previous work on lexicographic preferences has relied upon a statement of belief in a position without consistency checks or developing a series of probing questions. In the current study, the survey instrument was designed to accommodate the presence of lexicographic preferences and to probe those claiming such a position more fully. This approach allows for the adjustment of a CVM survey instrument to detect the presence and extent of such preferences in the surveyed population, and also allows for the inclusion of variables reflecting those preferences for use in bid curve analysis. The methodology used had not been previously tested in a developing country context. Thus, among the results, the comparison between the tourist and local sub-samples is of interest as a reflection of the relationship between contexts and preferences and, in turn, their relationship to stated WTP.

The method used in the surveys takes a rights-based ethical position as signifying an ethical stance compatible with the lexicographic preference hypothesis. In the survey, 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. These general attributions of rights were then probed further in the context of the marine park in question because a general discontent with trade-offs may disappear upon the specification of circumstances. Beyond this, 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.

More specifically, respondents were initially asked to use the following categories in attributing or denying rights: an absolute right to be protected from harm applies to this case; a right applies that depends upon the circumstances and may, therefore, be withdrawn under certain conditions; or, no such rights to protection from harm applies to this case. The case where they had to decide which of these categories applied were: i) other humans now living; ii) future human generations; iii) marine animals; iv) marine plants; and, v) marine ecosystems. Respondents could answer that they just did not know, but only 0.2% in Jamaica and 2.1% in Curaçao found this necessary. Table 6.1 shows that almost all the sample are prepared to attribute rights to the first of these categories and that, for Curaçao, this declines moving from i) to v), while, for Jamaica, no decline occurs. More than just attributing rights, the respondents in the majority of cases are attributing an absolute right to protection from harm. Marine animals, plants and ecosystems are attributed these absolute rights by approximately 60% of the Curaçao sample and over 80% of the Jamaican sample.

People may fail to consider whether they are actually prepared to defend this position by making choices in their daily lives. Also, in over 60% of the cases, other people were listening while the interview was being conducted, which might stimulate a social norm. In order to address this issue, those who attributed a right to any of the five categories above were then asked a set of follow-up questions.

The 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 question in order to give the rights-based position a context linked to the WTP questions. The respondents who had attributed any rights to one of the five categories were therefore initially 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 is equivalent to reflecting that a duty for an individual would result from enforcing a right. The result was approximately 79% of the Jamaican and 68% of the Curaçao respondents answered affirmatively.

Next, respondents were channeled into two separate questions. Those affirming that they have 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, was also asked to reconsider

Table 6.1. Rights to protection from harm (% of total survey sample of 1,152 for Curaçao and 1,058 for Jamaica).

	<i>Absolute right applies</i>		<i>Right applies depending upon the circumstances</i>		<i>No right applies</i>		<i>Don't know</i>	
	Curaçao	Jamaica	Curaçao	Jamaica	Curaçao	Jamaica	Curaçao	Jamaica
Other humans now living	84	82	9	16	5	2	2	0
Future human generations	81	82	12	15	4	2	3	1
Marine animals	57	82	32	13	5	2	6	3
Marine plants	58	85	29	9	5	3	8	3
Marine ecosystems	60	84	25	10	4	3	11	3

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 be unaffected. The outcome of these questions is to enable the sample to be split into four categories (in addition to those denying any rights to any of the five categories described earlier):

1. Those who attribute rights and accept a strong personal responsibility to protect marine life and habitats from harm even when their standard of living is threatened;
2. Those who attribute rights and accept a personal responsibility to protect marine life and habitats from harm only if their own current standard of living is unaffected;
3. Those who withdraw rights and any personal responsibility to avoid harm to marine life and habitats when

the cost of doing so is in terms of their current standard of living; and,

4. Those who reject rights and any personal responsibility to protect marine life and habitats from harm regardless of whether their own current standard of living is unaffected.

The results for the two countries are shown for locals and tourists in Table 6.2. The two middle categories, 2 and 3 above, show a willingness to make trade-offs that is consistent with a modified lexicographic position (i.e., once a basic standard of living is obtained, a stronger ethical position for other species is adopted). A readiness to consider the trade-off circumstances and the subjectivity of the relevant standard of living means that individuals in these categories may be regarded as acting as utilitarians and weighing-up the trade-offs. The situation

Table 6.2. Personal responsibility to protect life and habitats in the marine park.

	<i>No rights in this case</i>	<i>No duty</i>	<i>Remove duty if cost high</i>	<i>Attribute duty if cost low</i>	<i>Strong duty</i>	<i>Total</i>
Curaçao						
Number of locals	2	91	262	120	173	648
Number of tourists	8	77	185	75	135	480
Total number	10	168	447	195	308	1128
Total (% of sample)	0.9	14.9	39.6	17.3	27.3	100 ^a
Jamaica						
Number of locals	10	64	328	74	88	564
Number of tourists	0	46	342	34	70	492
Total number	10	110	670	108	158	1056
Total (% of sample)	0.9	10.4	63.3	10.2	14.9	100 ^a

^aRow may not add to 100% due to rounding errors.

for Jamaica shows a dramatic reduction in those attributing absolute or strong rights from 79% down to 14%. Similarly, although slightly less dramatic, for Curaçao the reduction is from 68% to 28%. Despite this large reduction, there is still a sizeable hardcore of individuals taking a position consistent with strong lexicographic preferences. This leaves the question open as to how these individuals expect to protect the rights they hold so strongly and how they would avoid having to make a trade-off decision, for example, where material goods are equated to the discharge of the moral duty being described. In order to try and address these issues, another set of follow-up questions was asked.

How to Protect Rights?

Those protesting in terms of a zero bid and a strong duty position are in favor of legal and educational approaches to increasing 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.

As mentioned earlier, both zero and positive bid strong duty holders are potentially signifying lexicographic prefer-

ences. The way in which this entire group, which is prepared to protect the marine environment at personal cost, believes the rights they have identified are to be protected is shown in Table 6.3. The biggest grouping of responses falls upon two methods for protecting the rights identified within the marine park. In Jamaica, 66.4% and, in Curaçao, 48.3% of respondents wanted rights to be protected by either a legal approach or education, or a combination of the two. 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 includes a variety of actions to be taken by various bodies or unspecified groups (e.g., NGO initiatives), unspecified schemes, and restriction of specific activities (e.g., harpooning, anchoring, creation of beaches, diving, allowing technology to prevent pollution, economic development).

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

Table 6.3. How to protect a strong duty position (code method of protection: 1=legal enforcement, regulation and policing; 2=international community funded initiatives; 3=lifestyle and fundamental behavioral changes; 4=education, formal and informal (e.g., media); 5=user fees; 6=government responsibility and tax funded initiatives; 7=combined education and legal approach; 8=combined various approaches; 9=other miscellaneous approaches; 10=don't know).

	<i>Method of protection by code total</i>										Total
	1	2	3	4	5	6	7	8	9	10	
Curaçao											
Number of locals	51	2	12	30	17	14	8	12	8	19	173
Number of tourists	28	6	7	28	8	10	4	16	5	23	135
Total number	79	8	19	58	25	24	12	28	13	42	308
Total (% of sub-sample)	25.6	2.6	6.2	18.8	8.1	7.8	3.9	9.0	4.2	13.6	100 ^a
Jamaica											
Number of locals	42	2	5	18	1	2	6	5	1	6	88
Number of tourists	20	1	5	15	1	4	4	2	10	8	70
Total number	62	3	10	33	2	6	10	7	11	14	158
Total (% of sub-sample)	39.2	1.9	6.3	20.9	1.3	3.8	6.3	4.4	7.0	8.9	100 ^a

^aRow may not add to 100% due to rounding errors.

classroom and remain consistent with the ethical position. However, given the limited extent of allowance for open-ended responses on the subject possible in the current survey, little more can be read into this.

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, of course, creates a practical problem for a CVM survey that, as part of the design, selects one institutional approach to the problem at hand. In addition, there is the theoretical problem that, where respondents are prepared to pay for an institutional framework, this fails to be a reflection of the resource value, but is rather a contribution to a social construct. An extension to the current research would be to experiment with alternative institutions to see how WTP or WTA varies.

Internal Consistency of Responses

The characterisation of the change in biodiversity as an improvement also has implications for the trade-off. That is, the expectation of a lexicographic preference is that individuals will bid all their spare income in such a situation for even a small improvement. In fact, individuals may reject the institution that imposes such a condition upon them. This behavior has the advantage for the individual of avoiding acceptance of an institution, which may lead to a potential irreversibility. That is, if the improvement were reversed and the WTP bid had been made, the individual would now have no spare income to give a positive WTP and would then be classified as a zero bidder. The approach taken by Spash and Hanley (1995) was to identify zero bids for non-zero value reasons, identify protest bids and see how many of these were consistent with a lexicographic preference. 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 is followed below and allows the results to be compared with the earlier work.

However, a qualification is necessary. We note that a positive bid by a believer in strong duties can still be consistent with a lexicographic preference. Such individuals are rejecting neo-classical choice theory but are acting in a way consistent with the expectations of mainstream economic theory by giving a WTP amount. If the less extreme modified lexicographic preference position is adopted, positive bids are expected to be the amount above a minimum standard of living. An additional complication is then that while the position seems more reasonable

because it is less extreme, that lack of extremity means it is also difficult to identify. That is, positive bids may be given that reduce income to a subjective minimum living standard but this minimum is unknown. One way we try to address the positive bid issue is by using scaling and dummy variables in the bid curve analysis reported later.

First, consider the zero bids, which are taken as a rejection of a trade-off. The only data that is of interest with regard to the lexicographic position is taken to be that defined by the strong duty category. Note that this assumption may be questioned for a modified lexicographic model where a minimum living standard is defended first and, if threatened, takes priority. Positive and zero bids can split this category. The survey allowed for bids by both time and money as shown in Table 6.4. That is, the project gave the scope for including voluntary work to improve marine biodiversity and this was seen as an important alternative in a developing country context where many may be on a low wage or in a non-monetary economy. The impact of this approach is to reduce the zero bid category considered here beyond that of the monetarily defined. Remember, those who show 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 are quite small in contrast to previous findings of 3.4% to 7.5%.

Next, the reasons for giving a zero bid are analyzed. These are divided into accepted economic reasons for a zero bid (i.e., income constraint or no value). The remaining reasons, shown in Table 6.5, are taken as indicating non-zero value. The outcome is to reduce the protest zeros, which are consistent with a strong lexicographic preference as defined by the strong duty, to 1.7% for Curaçao and 4.8% for Jamaica.

Bid Curve Analysis

Analysis of the determinants of WTP is particularly relevant to the purposes of the coral reef valuation project. The variables, which are hypothesised to determine variations in WTP, can be specified and studied via econometric analysis. In this section, bid curves are reported for the two case studies. The approach used in this section relies on a "tobit" analysis of the sample. Although many bid curve analyses rely on ordinary least squares (OLS) procedures, such techniques may be flawed when applied to data sets such as those generated by our surveys. The procedure is detailed in standard texts on limited dependent variables (e.g., Maddala 1983) and has been applied

Table 6.4. WTP of individuals holding a strong duty position.

	<i>Zero bid</i>	<i>Positive bid time</i>	<i>Positive bid money</i>	<i>Positive bid time and money</i>	<i>Total</i>
Curaçao					
Number of locals	38	19	82	34	173
Number of tourists	46	16	41	32	135
Total number	84	35	123	66	308
Total (% of sample)	7.5	3.1	10.9	5.9	27.3
Jamaica					
Number of locals	10	8	39	31	88
Number of tourists	26	7	29	8	70
Total number	36	15	68	39	158
Total (% of sample)	3.4	1.4	6.4	3.7	14.9

Table 6.5. Identifying reasons for non-zero bids by strong duty respondents.

<i>Zero bidders by reason</i>	<i>Curaçao</i>	<i>Jamaica</i>
Zero Economic Value Reason		
Low income or unemployed	20	13
Reef improvement unimportant	5	0
Non-resident	25	5
Total (% of sub-sample)	59	50
Non-Zero Value Reason		
Paying incorrect solution	6	1
Improvement will occur anyway	2	0
Mistrust marine park institution	3	2
Government is responsible	21	3
Could not place a money value	0	3
Other	2	6
Refused to answer or don't know	0	3
Total (% of sub-sample)	41	50
Total number	84	36

within the context of environmental economic household and individual choice decision models (e.g., Ruitenbeek 1996). A maximum likelihood estimation (MLE) procedure sets up a likelihood function and through iteration provides an efficient solution to the tobit specification. The procedures are analyzed based on the significance of individual explanatory variables (through t-statistics) and, when comparing models, through a likelihood ratio test based on a chi-square distribution. All tests of significance are reported at a 95% level of confidence.

WTP Determinants for Curaçao

A range of variables was available from the survey and those considered most important are shown in Table 6.6. A bid curve analysis, using a semi-log linear form, for Curaçao shows determinants of WTP as a set of standard socio-economic variables, knowledge and the position taken towards rights (i.e., a lexicographic type preference).³ The socio-economic variables are gender, age and education. Income would be another standard variable expected to determine WTP, but is excluded here.

Table 6.6. Variable definitions and basic statistics for Curaçao.

<i>Variable</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>	<i>Valid number</i>	<i>Label</i>
TL	0.43	0	1	1152	Tourist (1) or local (0)
LANGDUTC	0.36	0	1	1145	Language Dutch
LANGENG	0.18	0	1	1145	Language English
LANGPAP	0.46	0	1	1145	Language Papiamentu
BENUM	1.41	0	5	1151	Number of benefit categories
VISITF	0.88	0	1	1152	Visit site in future
KNOWMBD	4.68	1	10	1152	Knowledge of marine biodiversity
PREFINFO	0.37	0	1	1152	Preference change and information effects
HARMMA	1.45	1	3	1078	Anti-rights to marine animals
HARMMP	1.43	1	3	1060	Anti-rights to marine plants
HARMME	1.38	1	3	1022	Anti-rights for marine ecosystems
RIGHTSEA	4.84	0	6	988	Marine animal/plant/ecosystem rights
NODUTY	0.16	0	1	1128	No rights/duty to marine environment
STRDUTY	0.27	0	1	1128	Strong duty
SEX	0.50	0	1	1152	Gender (male=0; female=1)
AGE	4.24	1	10	1151	Age by category (1=low; 10=high)
EDUC	2.86	1	5	1139	Level of educational attainment
INCOME	3.25	1	10	642	Level of gross income (coded)
WTPALL	49.16	0	2000	971	WTP (NAF)
LNWTP3	1.88	0	7.6	971	Natural log of (WTPALL+1)
PROBC	2.39	1	10	1149	Ease/difficulty with Section C of survey

This is because income is correlated with age and education and, therefore, little is added to the explanatory power of the equation if both sets of variables are included. In addition, the income variable only had 642 responses so that its inclusion would severely reduce the number of degrees of freedom in the estimation. Even the responses gained for income were suspected to be suffering from under-reporting, which is especially problematic when others are listening to the interview. The inclusion of a dummy variable for tourists versus locals was strongly insignificant, showing no difference. A set of dummies were also tried to test for the impact of language because the survey was translated into Dutch and Papiamentu, but these were also found to be strongly insignificant by the t-test. The final model results are shown in Table 6.7.⁴

The knowledge and use variables proved significant determinants of WTP. Knowledge of marine biodiversity (KNOWMBD) was derived from a survey question where individuals used a 10 point scale to signify their prior knowledge of the concept after having had a description. Greater knowledge increases WTP. This is also true for the use related variable, giving the number of benefits

the individual derives from the marine park (BENUM; e.g., swimming, diving, site seeing, sunbathing).

A set of variables was also included to measure the ethical stance being taken by the respondent. First is the attitude of the individual towards rights. A seven point scale was developed from the questions of the survey 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 of 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 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 are positively related to WTP, which means these individuals could be misconstrued as making an implicit trade-off of their rights position and this was implied earlier by the development of the “strong duty” category. Here, the data on personal duties is also incorporated in the equation.

Table 6.7. Preferred tobit model for Curaçao. The dependent variable is LNWTP3. Model has 463 limit observations (zero) and 508 non-limit observations. The predicted probability of $y > \text{limit}$ given average x_i is 0.5868. The observed frequency of $y > \text{limit}$ is 0.5232. At mean values of x_i , $E(y)=1.5657$.

<i>Variable</i>	<i>Normalised coefficient</i>	<i>Standard error</i>	<i>Asymptotic t-ratio</i>
SEX	-0.17322	0.073843	-2.3459
AGE	0.054646	0.018042	3.0288
EDUC	0.18416	0.039794	4.6278
KNOWMBD	0.051143	0.013414	3.8126
BENUM	0.18653	0.039808	4.6857
RIGHTSEA	0.15628	0.024749	6.3143
NODUTY	-0.31661	0.11346	-2.7904
STRDUTY	0.16615	0.080436	2.0656
PROBC	0.041131	0.019463	2.1133
PREFINFO	0.60101	0.074180	8.1020
CONSTANT	-2.0385	0.21111	-9.6561
LNWTP3	0.33092	0.011671	

The role of ethical positions is 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, is positively correlated with WTP, while the rejection of this duty reduces WTP. This shows that WTP for biodiversity improvement is partially related to the ethical concern people show for marine animals, plants and ecosystems. Also, a variable on the difficulty found with these sets of survey questions was included in light of the results for Jamaica. This is also significant and positively correlated, which can be seen as supporting the no duty position in that these individuals care less about marine biodiversity and also find little problem in stating their lack of belief in rights. In contrast, those concerned about biodiversity improvement struggle with their precise ethical position and the extent to which duties are 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 is a recognition at an aggregate level of rights in the marine environment. The STRDUTY and NODUTY variables are specific to the marine park itself and the extent to which individuals are prepared to prevent harm at the risk of a loss in their own living standards.

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

WTP Determinants for Jamaica

A similar semi-log linear form of model was developed for Jamaica with a set of socio-economic variables, knowledge and the position taken towards rights (i.e., a lexicographic type preference). The range of variables considered most important, along with some descriptive statistics, are shown in Table 6.8. The socio-economic variables, in this case, are gender and income. Income replaces the age and education variables of the Curaçao model. Income data for Jamaica was far more complete with 839 observations. This time, the inclusion of a dummy variable for tourists versus locals was strongly significant and negatively correlated with tourists. The final model results are shown in Table 6.9.

The knowledge and use variables again proved significant determinants of WTP. Knowledge of marine biodiversity (KNOWMBD) was found to be similar to that concerning reef degradation (KNOWCD) in terms of the equation and, in this case, the latter was used. This is derived from a survey question where individuals used a ten point scale to signify their prior knowledge of the causes of coral reef degradation after having had them

Table 6.8. Variable definitions and basic statistics for Jamaica.

<i>Variable</i>	<i>Mean</i>	<i>Min</i>	<i>Max</i>	<i>Valid number</i>	<i>Label</i>
TL	0.47	0	1	1058	Tourist (1) or local (0)
ENVIROAT	1.53	0	23	1058	Number of environmental concerns
VISITC	0.47	0	1	1058	Ever visited marine park
VISITF	0.88	0	7	1056	Visit site in future
KNOWCD	4.67	1	10	1058	Knowledge of coral degradation
KNOWMBD	3.29	1	10	1056	Knowledge of marine biodiversity
PREFINFO	0.19	0	1	1058	Preferences changed and informed
INFO	0.74	0	1	1058	Informed only
RIGHTSEA	5.51	0	6	1028	Marine animal/plant/ecosystem rights
NODUTY	0.11	0	1	1056	No duty to marine life/habitats
STRDUTY	0.15	0	1	1056	Strong duty marine life/habitats
SEX	0.56	0	1	1056	Gender (male=0; female=1)
AGE	3.63	1	10	1058	Age by category (1=low; 10=high)
EDUC	3.04	1	5	1058	Level of educational attainment
INCOME	3.47	1	10	839	Level of gross income (coded)
PROBC	1.83	1	10	1058	Difficulty with Section C of survey
WTPALLX	26.24	0	2866	833	WTP (US\$)
LNWTP3	1.54	0	7.96	833	Natural log of WTPALLX

Table 6.9. Preferred tobit model for Jamaica. The dependent variable is LNWTP3. Model has 317 limit observations (zero) and 516 non-limit observations. The predicted probability of $y > \text{limit}$ given average x_i is 0.6544. The observed frequency of $y > \text{limit}$ is 0.6194. At mean values of x_i , $E(y)=1.4304$.

<i>Variable</i>	<i>Normalised coefficient</i>	<i>Standard error</i>	<i>Asymptotic t-ratio</i>
TL	-0.19667	0.083661	-2.3508
ENVIROAT	0.053173	0.024215	2.1959
INCOME	0.061696	0.015320	4.0273
NODUTY	-0.48570	0.13237	-3.6693
VISITC	-0.22942	0.076518	-2.9982
VISITF	0.47212	0.12543	3.7641
KNOWCD	0.038592	0.012067	3.1980
PREFINFO	0.36412	0.18868	1.9298
INFO	0.49011	0.17434	2.8112
PROBC	0.085788	0.028718	2.9872
CONSTANT	-0.81805	0.23137	-3.5356
LNWTP3	0.43953	0.014998	

described. As with KNOWMBD, greater knowledge increases WTP. This is also true for the positive likelihood of future use of the marine park (VISITF). Also, the relationship between WTP and having visited the park in the past is negative (VISITC). This result is not uncommon for such surveys in that it implies that, once an initial curiosity is satisfied, an individual's utility from subsequent visits will tend to drop off (this is consistent with decreasing marginal utility in individual preference functions).

In Jamaica, the set of variables on ethical stance were less relevant. However, some role for ethical positions is confirmed by the significance of the dummy variable rejecting any duty (NODUTY). This is also negatively correlated to WTP as was the case for Curaçao. The contrast with the results for Curaçao in terms of the role of ethical variables led to the inclusion of survey difficulty variables, and this showed a strong positive correlation with WTP. However, as this was then included in the Curaçao model and a similar result occurred, this alone seems unable to explain the difference in results.

Finally, PREFINFO is a dummy variable for whether individuals felt their preferences about marine biodiver-

sity preservation had been changed by the survey. This 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 are in line with those for Curaçao, except in that the model lacks significant rights and strong duty variables.

Prediction of WTP

The expected WTP will depend on the location of the individual, their individual socio-economic characteristics, and their attitudes towards rights. Simulations using the preferred models were conducted to estimate WTP and the probability that they would return a non-zero bid. Results are shown in Table 6.10.

First, we note that at the sample means, WTP in Curaçao is about US\$2.08, while in Jamaica it is US\$3.24. This difference is readily explained through the differences in the mix of tourists and locals in the sample. Tourists generally had the same WTP in Curaçao and Jamaica—

Table 6.10. Predicted WTP for Curaçao and Jamaica as a function of individual characteristics. Local and tourist statistics taken at population means. For strong duty simulation (Curaçao): RIGHTSEA=6; NODUTY=0; STRDUTY=1. For no duty simulation (Curaçao): RIGHTSEA=0; NODUTY=1; STRDUTY=0. In Jamaica, the simulation turns on and off the NODUTY variable.

	<i>Probability of non-zero bid (%)</i>	<i>Expected WTP (US\$)</i>
Curaçao		
Sample means—all	58.33	2.08
Sample means—typical local	56.18	1.85
Sample means—typical tourist	61.15	2.46
Locals with strong moral duties/rights	69.08	4.05
Locals with no moral duties/rights	17.82	0.19
Tourists with strong moral duties/rights	74.18	5.82
Tourists with no moral duties/rights	22.01	0.26
Jamaica		
Sample means—all	65.77	3.24
Sample means—typical local	68.49	3.75
Sample means—typical tourist	62.51	2.73
Locals with moral duties/rights	70.72	4.26
Locals with no moral duties/rights	52.37	1.66
Tourists with moral duties/rights	64.22	2.98
Tourists with no moral duties/rights	45.17	1.17

US\$2.46 and US\$2.73 respectively. Jamaicans, on the other hand, were willing to pay almost double their counterparts in Curaçao.

The importance of perceptions relating to rights and duties, however, is again seen in the WTP results. The tobit model simulations were conducted with the duty and right variables tuned to their highest and lowest possible combinations. The Curaçao set permitted a more extreme case because of the three variables, while the Jamaica is a “softer” comparison. The results show that people with some duty and rights perceptions are willing to pay approximately two to three times as much as those who have no such attachments; people with very strong perceptions will pay at least an order of magnitude more. Interestingly, in the Curaçao case, those with absolutely no moral attachment are expected to pay virtually nothing.

Conclusions

The goal of this study was to undertake a contingent valuation analysis of coral reef quality for amenity, biodiversity, and other values in Montego Bay, Jamaica, and reef areas along the south coast of Curaçao. Coral reef conservation benefits were to be valued in monetary terms with a view to identifying various economic and demographic characteristics of this valuation and its determinants (e.g., education, gender, and knowledge of biodiversity, local versus tourist). Although CVM is well developed and routinely used in assessing environmental benefits, two broad areas of innovation were part of the current study in the context of coral reefs. First, a rigorous developing country CVM analysis was undertaken of an environmental resource that had previously been neglected (i.e., coral reef quality); most developing country CVM studies having focused on other issues, such as water quality, or on specific urban locations. Second, and more significantly from a research perspective, the recent CVM literature had identified the existence of lexicographic preferences as one of a number of outstanding methodological questions associated with biodiversity valuation that required further analysis. The research addressed itself directly to this issue.

The lexicographic preference can be consistent with a positive or zero WTP. The expectation of protest responses associated with zero bids for reasons of non-zero value has been studied in a developed country context and has shown that around one fifth of respondents reject trade-offs when asked to pay to prevent environmental deterioration. A similar approach was adopted here in that the consistency of claiming a strong duty to protect

the environment was contrasted with stated WTP in terms of a zero bid for reasons of non-zero value. In this case, WTP was for an environmental improvement.

Zero bid reasons were identified as those which are in accord with economic theory and those which are 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 is to bias downward WTP because many of the respondents are 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.

Those claiming a strong duty accounted for one third to one sixth of the sample, as shown in Table 6.11. When the data were analyzed for zero bids, in terms of time and money being given for reasons of non-zero value (which also excludes those unable to pay—the low income earners and the unemployed), the sub-sample falls to a few percent. There was no apparent difference between the tourist and local sub-samples as might be expected if the result was due to the developing country context. Another explanation may be that, because the study took the case of an environmental improvement, less controversy arose than if a WTP were asked for preventing an environmental deterioration (i.e., the low percentage of protests among zero bidders consistent with a strong duty). However, as Table 6.11 shows, the process adopted here for confirming respondents’ adoption of a strong duty was also effective in reducing the proportion claiming absolute rights. Respondents claiming a strong duty to protect the environment were 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, being two thirds or more of the sample.

While the finding of only a few percent of respondents in the protest-zero-lexicographic position does conflict with that of earlier studies, some caution should be taken in generalising the result. As mentioned, a positive bid for an environmental improvement 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 elicit a zero WTP because the individual has no income left (or no spare income under modified lexicographic

Table 6.11. Type and consistency of rights and duties for zero bidders.

	Curaçao		Jamaica		Total
	Locals	Tourists	Locals	Tourists	
Sample size	656	496	565	493	2210
Absolute marine rights (number)	322	251	385	441	1399
Absolute marine rights (% of sample)	58.9	56.9	71.8	89.6	63.3
Strong duty (number)	173	135	88	70	466
Strong duty (% of sample)	26.4	27.2	15.6	15.0	21.1
Strong duty and zero bid for reason of non-zero value (number)	20	14	6	12	52
Strong duty and zero bid for reason of non-zero value (% of sample)	3.0	2.8	1.0	2.4	2.4

preferences). This raises the interesting possibility that those refusing to bid more for the improvement of other reefs that were classified as showing part-whole bias (see Spash *et al.* 1998) may have lexicographic preferences. In addition, the rights-based position and implied duty does seem to influence bids as shown by the bid curve analysis. This result is very strong for Curaçao, but more limited for Jamaica. This Jamaican result led to consideration of the difficulty respondents may have had in answering the survey. In both countries, the levels of difficulty respondents were observed to have in answering the rights and duties section of the survey has a significant and positive influence on WTP. As this was an unexpected finding, explanations are purely speculative. However, one possibility is that people who dismiss rights and duties for the environment can answer quickly without problems and are also likely to give a low WTP bid. Those who are more concerned, with a higher WTP, struggle when confronted by the idea that they make trade-offs but, when pressed to do so, conform but still regard the language of rights as a more appropriate description of their actual position. Placing a set of right questions prior to the WTP question may, therefore, result in the respondents finding the bid section problematic rather than the ethics section.

In terms of the design of CVM, the study shows a methodology for classifying lexicographic type preferences. The second stage is then to develop checks for consistency in terms of WTP, and this was only partially achieved here because of the concentration on zero bidders and relative neglect of positive bidders in the analysis. However, the consistent results for the strong duty holders across the two countries shows they are in favor of alternative institutional approaches such as education,

legal enforcement and, to a lesser extent, lifestyle changes. This poses a problem for CVM as currently practiced because it places the problem in a specific institutional setting when framing the WTP or WTA question and fails to allow for such alternatives.

Endnotes

- ¹ Option value arises when there is uncertainty about the continued supply of a good or service and an individual is prepared to pay to keep a future option open for use of the good or service. Bequest value refers to the welfare from endowing future generations with goods and services. Existence value is more controversial and varies in definition in the literature, but essentially tries to capture the welfare related to knowing something exists; this welfare is independent of any use which might be made either directly or indirectly (i.e., by future generations).
- ² A quota sample is conducted so as to take into account specified population characteristics such as the ratio of male to female respondents, age distribution, and income distribution.
- ³ Note in the table that to prevent estimation biases and provide a basis for conducting the tobit runs, the dependent variable is specified as LNWTP3, which is the natural logarithm of the WTP plus one. The addition of 1NAF introduces a bias of about +0.1% in the estimates but provides a truncation point on all of the relevant data (i.e., LNWTP=0 if and only if WTPALL=0).
- ⁴ Unlike OLS estimates, the estimators in this table cannot be used directly to derive a WTP through simple multiplication. Actual estimation of the WTP requires transformation of this function and application of density function for any given set of characteristics. This is most readily done in a simulation environment, dealt with later in this section.