IVM Institute for Environmental Studies

The economics of expanding the Marine Protected Areas of the Cayman Islands

The cultural and recreational value of the Marine Environment to the Cayman Islands' residents

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Contents

Abstract **5**
Acknowledgements **6**
1 Introduction **7**
2 Background **9**
2.1 The Cayman Islands' system of Marine Parks 9
2.2 Public support 12
2.3 The economic value and ecosystem-based management 13
3 Methodology **15**
3.1 Valuation methods 15
3.2 Contingent valuation 16
3.3 Choice Modelling 16
3.4 Anchoring/ordering effect 20
3.5 Questionnaire and sampling strategy 21
4 Results **23**
4.1 Sample description and distribution choice set versions 23
4.2 Background of the respondents 24
4.3 Recreation 25
4.4 Recreational fishing 27
4.5 Threats to the marine environment 28
4.6 Willingness to pay contingent valuation 30
4.7 Regression analysis contingent valuation 33
4.8 Willingness to pay choice experiment 35
4.9 WTP range contingent valuation and choice experiment 38
4.10 Anchoring/ordering effect 39
4.11 Statements 42
5 Discussion and conclusion **45**
5.1 Discussion 45
5.2 Conclusion 46
References **47**
Annex A Questionnaire **51**
Annex B Maps **64**
Annex C Threats to the marine environment **71**
Annex D Recreation **75**
Annex E Eating locally caught fish/lobster **78**
Annex F Choice experiment **79**
Annex G Variables in the regression **83**
Annex H List of species **85**
Annex I Comparing sister islands **86**

Abstract

Quantification of the benefits humans obtain from Marine Protected Areas (MPAs) supports decision-makers by elucidating the link between the functioning of MPAs and human welfare. By conducting a residential household survey among residents in the Cayman Islands, this study assesses people's willingness to pay for the marine environment from a perspective of cultural and recreational values. In this way the study offers a partial estimation of the total economic value of the marine environment of the Cayman Islands. Two valuation methods are applied: the contingent valuation and the choice modelling method.

Data from 384 household surveys shows that 63% of the respondents are willing to pay for additional management of the marine environment. The average amount that respondents are willing to pay per month for an improvement in a marine protection area ranges between is 12.69 CI$ and 16.55 CI$. The Cayman Islands has approximately 24,165 households, resulting in a range of the total yearly cultural and recreational value of the marine environment of between 3.7 million – 4.8 million CI$ for its residents.

The choice experiment shows that respondents especially value coral reefs and water quality as marine elements. Moreover, households who participate in fishing on average express a higher value for all attributes of marine environment covered in the experiment. The study also shows that residents from Cayman Brac value fish catch significantly more than the other sister islands and that no-take zones are less valued by older residents and people born on the Cayman Islands.

The conclusions from our study concerning public support for expansion of the MPA diverge the findings of an earlier study. While Richardson et al. (2013) concludes that levels of support range from 14% to 47% between the sister islands, our study measured much higher levels of public support ranging between 58% to 85%. Whilst Richardson et al. (2013) used public consultation, geared towards assessing people's opinions on the intended expansion, the statement within this study was part of a larger survey and a simplification of the proposed changes presented during the public consultation. However, besides the simplification, within this study people might have been primed by previous questions in the survey, which may have led to respondents realizing what trade-offs need to be made in marine conservation.

Finally, this research reveals the presence of an anchoring/ordering effect in the valuation process. Showing respondents the choice experiment first is associated with a higher fraction of the respondents being willing to pay in the contingent valuation, and to respondents being willing to pay more in the contingent valuation, compared to respondents that were shown the contingent valuation question first.

Acknowledgements

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1 Introduction

Marine Protected Areas (MPAs) are a frequently used tool in managing marine ecosystems, and their popularity has been on the rise. Commitments made by governments should have led to 10-30% of the waters being MPAs in 2012 (Halpern et al. 2010). Although these goals have not been met, the amount of MPAs has been increasing, leading to more than 6800 MPAs worldwide in 2010, which cover 2.86% of all Exclusive Economic Zones (Bennett and Dearden, 2013).

Also in research, MPAs have become an increasingly popular subject. Indeed, Caveen et al. (2013) suggest that it may be the scientists' support of MPAs that led them to become the principal management tool of promoting sustainable fisheries and preserving marine biodiversity. Whereas initially, the designation of MPAs served ecological goals (UNEP, 1992; Agardy, 1994; Alder, 1996; Mangel, 1998), the attention is shifting more and more towards ecosystem services: the benefits humans may obtain from marine ecosystems (Millennium Ecosystem Assessment, 2005; Potts et al., 2014; Roncin et al., 2008; Angulo-Valdés and Hatcher, 2010).

Angulo-Valdés and Hatcher (2010) have identified 99 benefits from MPAs, within nine categories. Examples are the expansion of non-consumptive recreational opportunities such as tourism, improved aesthetic values, the recovery of depleted populations of fish, spillover effects to be enjoyed by fisheries, and educational opportunities (Angulo-Valdés and Hatcher, 2010).

Potts et al. (2014) have studied the possible streams of ecosystem services that flow from MPAs. They argue that by identifying the ecosystem services flowing from marine ecosystems can show the importance and added value of MPAs. Taking stock of the benefits humans obtain from MPAs can contribute to decision-making processes by elucidating the link between the functioning of MPAs and human welfare (Agardy et al., 2003).

Although MPAs can provide multiple benefits, there are also costs involved (Bennett and Dearden, 2014; Agardy, 2011). It is therefore necessary to take into account all costs and benefits resulting from MPAs when making decisions about the management of the marine environment. Calculating a total economic value (TEV) of an ecosystem can provide decision makers with the information they need when balancing the costs and benefits of their (intended) policies (Costanza et al., 1997).

This study's focus is on the system of Marine Parks present in the Cayman Islands. The Cayman Islands' Department of Environment seeks to enhance their system of Marine Parks, and did a public consultation to see whether the residents of the Cayman Islands would support this enhancement. The public consultation showed that residents are supportive of the proposed changes to the Marine Parks system (Richardson et al., 2013). The public consultation was part of a Marine Parks Review, and this review indicated which ecosystem services could be enhanced or supported by the expansion of the MPAs. These services include sustainable fisheries, a maintained and enhanced tourism product, and storm barriers as well as island protection (Richardson et al., 2013). Not included in this list are cultural and recreational ecosystem services, which are discussed in this study.

Knowing how MPAs contribute to human welfare may increase support of conservation policies, by showing the relative importance of the different ecosystem services delivered by the marine ecosystem at hand. While the public consultation study that was conducted by the Department of Environment clearly indicated the level of support for enhancement of the MPA system, knowledge on the exact values of the marine environment is still lacking. The public consultation was directed towards gauging people's support of expansion of the MPAs, not towards assessing the value residents attach to the marine environment in terms of recreation and culture. This research seeks to fill that gap. It does so by providing an analysis of the cultural and recreational value of the marine environment to the residents of the Cayman Islands. The study uses data from

a household survey in which people were asked to indicate their willingness to pay for management of the marine environment. The methods used are contingent valuation (CV) and choice modelling (CM). The study shows how much residents of the Cayman Islands are willing to pay for nature conservation, including differences between people born on the Cayman Islands and people born elsewhere, as well as differences between fishermen and non-fishermen.

The setup of the study also allows testing for the presence of an anchoring/ordering effect. The study looks at what happens to the *level* of the payment chosen when changing the order of the contingent valuation and the choice experiment. In addition, following Frykblom and Shogren (2000), this study also looks at the *difference* in the payment levels caused by changing the order of the questions.

This report is structured as follows. Section 2 contains a description of the background of the study and the literature concerning the valuation of ecosystems. Section 3 presents the methodology and describes the setup of the survey. Section 4 shows the results and section 5 concludes.

2 Background

This section provides background information on the Cayman Islands and its Marine Parks system. The section also discusses the literature concerning ecosystem-based management and economic valuation of the environment.

2.1 The Cayman Islands' system of Marine Parks

The Cayman Islands are situated in the Caribbean. They consist of three islands: Grand Cayman, Cayman Brac and Little Cayman. The total population of the three islands is about 57,000 persons. Tourism is an important source of income in the Cayman Islands, accounting for 25.4% of GDP in 2013, and forecasted to rise by 5.3% in 2014 (WTTC, 2014). The other major contribution to GDP (42%) is the finance and insurance services industry (Moody's, 2013).

The Cayman Islands are well known for their outstanding diving opportunities. It is the marine life that attracts a lot of tourists. In an attempt to protect the marine life of the Cayman Islands, the government has established a system of Marine Parks in 1986. Within the Cayman Islands' system of Marine Parks several different categories have been identified, as shown in Table 1. Violation of the law is an offence carrying a maximum penalty of 500,000 CI$ fine and one year imprisonment. Enforcement officers ensure enforcement of these laws (DOE, 2014).

In December 2013, the National Conservation Law passed in the Legislative Assembly of the Cayman Islands. This law seeks to "protect and conserve endangered, threatened and endemic plants and their habitats as well as the variety of wildlife in the Cayman Islands" (The National Conservation Law, 2013, p.1). The law aims to combine the separate conservation laws that already exist, including the Marine Conservation Law. In conjunction with the development of the National Conservation Law, the Cayman Islands Department of Environment have been conducting a Marine Parks Review. This review has shown that despite the fact that these marine parks have proven their effect, the natural marine resources of the Cayman Islands are still shown to be in critical decline. Enhancement of the Marine Parks of the Cayman Islands is considered necessary to halt or even reverse these declines.

It is estimated that expanding the MPAs, so that they will cover 40-50% of the coastal shelf of the Cayman Islands, would be optimal. Doing so will make it possible to reach conservation goals and to achieve sustainable fisheries, conservation of biodiversity and ecosystem resilience when it comes to local and regional threats (Olynik et al., 2012; Richardson et al., 2013). MPAs are considered the best available tool because the required infrastructure is already in place (Richardson et al., 2013). In the face of the threats identified, and taking into account the considerations following from the Marine Parks Review, the Department of Environment proposes the following changes to the Marine Parks system of the Cayman Islands:

Table 1: Marine Park Regulations and Marine Conservation Laws.

Category	Regulations	Exceptions
Marine Park Zone	No take of any marine life, no anchoring - use of fixed moorings only. Special restrictions on use of Bloody Bay Marine Park (Little Cayman)	Line fishing from shore permitted, line fishing at depths >80ft permitted, taking fry and sprat with a fry or cast net is permitted. Anchoring in sand permitted, anchoring in designated Port Areas permitted
Designated Grouper Spawning Area	No fishing for Nassau Groupers 1 November through 31 March, no fish pots or spear fishing within one-mile radius of Designated Grouper Spawning Areas from 1 November through 31 March	
No Diving Zone	No SCUBA diving	
Environmental Zone	No taking of any marine life, alive or dead with no exceptions, no in-water activities, public may access only at speeds of 5 m.p.h. or less, no anchoring of any boat, line fishing, fish traps, nets, spear guns and strikers are totally prohibited	
Replenishment Zone	No taking of conch or lobster by any means. Spear guns, pole spear, fish traps and nets prohibited. NOTE: these zones include the outside edge of the reef to a depth of 20ft.	Line fishing and anchoring are permitted, but anchor, chain or line must not touch coral. Taking fry and sprat with a fry or cast net is permitted.
Wildlife Interaction Zone	No taking of marine life by any means, no selling of fish from boats, no removing of any marine life from the water. No anchoring in water shallower than 3ft or so that the boat/anchor is within 20ft of any reef structure. No feeding of any marine life with food of any kind or amount other than approved by Marine Conservation Board. No wearing any footwear in water shallower than 4ft.	Special conditions apply to commercial boats that must have a license issued by the Marine Conservation Board and clearly displayed on the boat to enter this area.
Animal Sanctuary/ RAMSAR site	No hunting, no collection of any species, no littering	
Prohibited Diving Zone	No SCUBA diving in this zone	Unless licensed to do so by the Marine Conservation Board.

Source: http://www.doe.ky/laws/marine-parks-brochure/

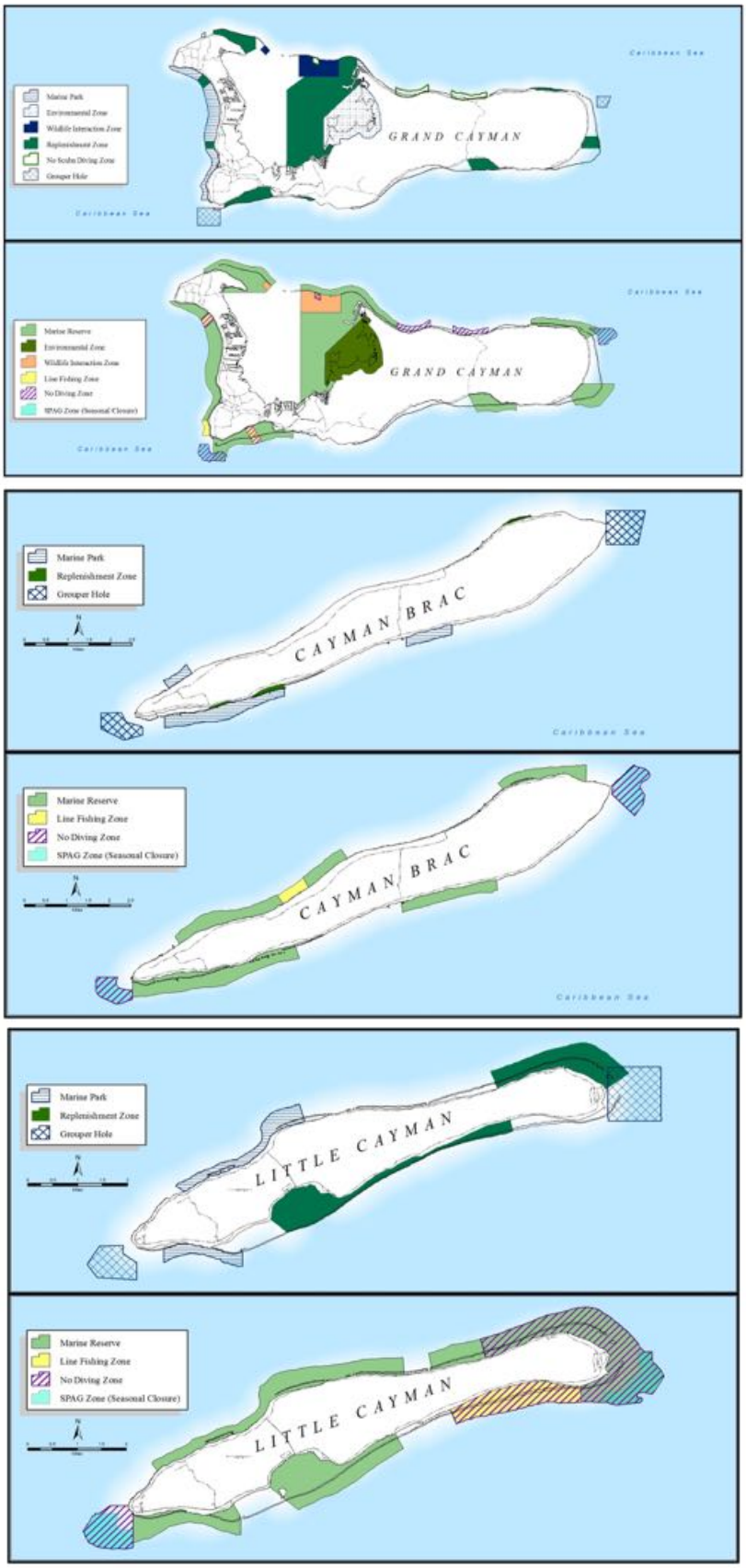


Figure 1: Proposed changes to the MPAs of Grand Cayman, Cayman Brac and Littlke Cayman (Richardson et al., 2013)

2.2 Public support

Along with the Marine Parks Review, the Department of Environment of the Cayman Islands conducted a public consultation, assessing to what extent residents support expansion of the MPAs. This study has shown that residents mostly use the marine environment for swimming, snorkelling, diving, recreational fishing and eating seafood. Participants were also asked what changes they would like to see in the Marine Parks. The outcomes are shown in Figure 2.

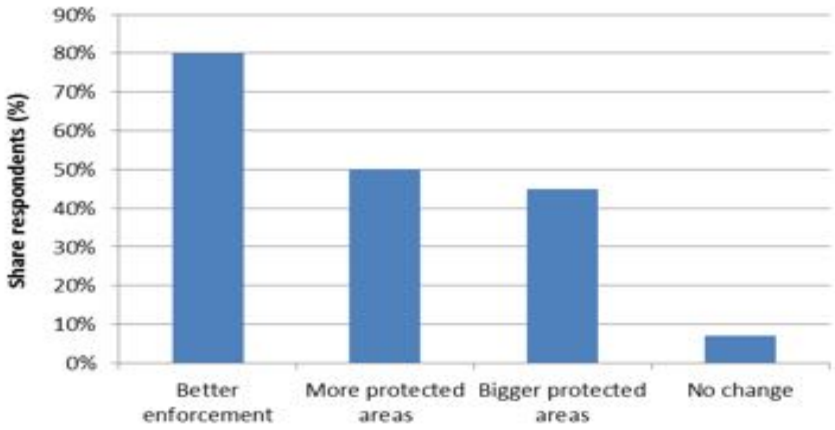


Figure 2: Preferred changes in the Marine Parks

Source: Richardson et al., 2013 (p. 28)

In the second part of the consultation, residents were asked if they agreed with the proposed changes to the Marine Parks (see Figure 1 for details of these proposed changes). Overall, 48.1% of the respondents supported all the suggested changes. 39.3% of the respondents said that they did not want any changes to the current system. 9.0% of the respondents said that they would be happier if their suggested alternations were made, and 3.6% said that they did not support the suggested changes unless their suggested alternations were made. The different islands show different levels of support for the proposed changes (see Figure 3).

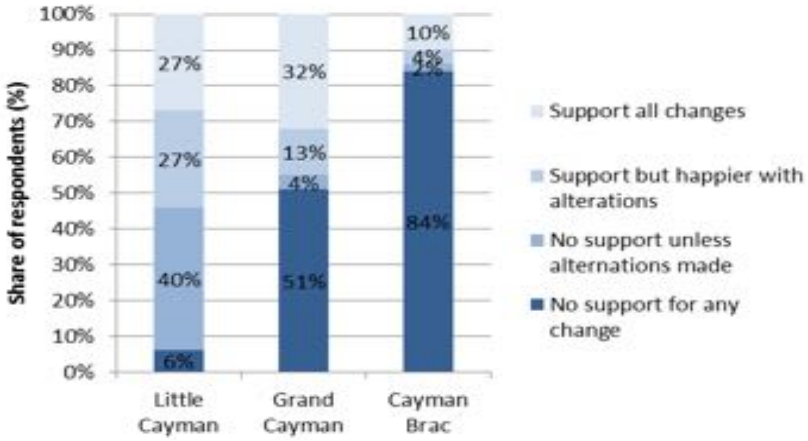


Figure 3: Level of support for changes on the three islands of the Cayman Islands

Source: Adapted from Richardson et al. (2013)

2.3 The economic value and ecosystem-based management

MPAs are the main tool used within the ecosystem-based management approach to governing marine ecosystems. The ecosystem-based approach should guarantee that ecological, social and economic considerations are combined when governing the use of natural resources (Angulo-Valdés and Hatcher, 2010). Ecosystem-based management is "an integrated approach to management that considers the entire ecosystem, including humans" (McLeod and Leslie, 2009, p.1). The Scientific Consensus Statement on Marine Ecosystem-Based Management, written in 2005, states as its first main concept that "key interactions among species within an ecosystem are essential to maintain if ecosystem services are to be delivered" (McLeod et al., 2005, p.3). Following this line of reasoning, ecosystem-based management seeks to ensure that ecosystems are able to perform their functions, in this way providing humans with their ecosystem services. Also, it seeks to balance the different services, provided by one ecosystem, by using the concept of sustainability: managing the ecosystem in such a way that social, economic and environmental aspects are taken into account. In this way, ecosystem-based management seeks to take a holistic approach. The Cayman Islands Department of Environment underwrites the concept of ecosystem-based management by stressing the advantages of a holistic approach to ecosystem conservation, namely broad species protection and habitat protection (Richardson et al., 2013).

Halpern et al. (2010) stress the opportunity for improved management when ecosystem-based management principles are applied more broadly to the management of MPAs. They argue that ecosystem-based management fits into MPAs perfectly, but that the focus of MPAs is too often on one single societal value (conservation) through regulating one single use of the ecosystem (fisheries), whereas marine ecosystems usually provide multiple ecosystem services.

Following the Millennium Ecosystem Assessment (2005), there are four categories of final ecosystem services: provisioning services, regulating services, cultural services and supporting services. By combining the separate values for each of the different services, one can arrive at a total socio-economic value of an ecosystem. In this way a total welfare effect of a certain policy (for example the expansion of a marine parks system) can be estimated. This approach of calculating a total economic value is not only worthwhile from a total welfare perspective; it can also help increase acceptance of a certain policy (Jentoft et al., 2007).

Whereas the findings of Richardson et al. (2013) did provide the Cayman Islands Department of Environment with information on the public support of the plans for expansion of the MPAs, their aim was not to arrive at a value for the marine environment. This study contributes to the findings of Richardson et al. (2013) by measuring the value of one of the ecosystem services of the marine environment of the Cayman Islands: the cultural and recreational value for residents.. This study is part of a broader research aimed at establishing the Total Economic Value of the marine ecosystem services of the Cayman Islands. Calculating the total value of the marine environment can help the Cayman Islands government in both maximizing welfare and increasing the effectiveness of governance. The outcomes of this broader research will assist the Department of Environment in making a cost-benefit analysis for the intended expansion of the MPAs.

Cultural services are described by the Millennium Ecosystem Assessment as the "the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences" (Millennium Ecosystem Assessment, 2005, p.10). As this definition is rather broad, Church et al. (2011, p.3) propose to define final cultural ecosystem services as "environmental settings, which provide the sites for human interactions with nature and others". The study looked at the most easily quantifiable services, such as the provision of health, recreation, heritage, education/ecological knowledge and religious goods. Their meta-analysis shows that people who spend time in parks at least once a month and people who spend time in their gardens every week express a higher life satisfaction than those who do not (Church et al., 2011).

Adding the values for the provisioning and regulating services from the marine environment to the outcomes of this study will yield a total economic value of the Cayman Islands marine environment. This can assist decision makers, as “in a complex world, to differentiate between better and worse alternatives, it is much easier to distinguish better from worse in one dimension” (Farrow et al., 2000, p.2)

3 Methodology

This section starts with discussing methods for the socio-economic valuation of the environment. Afterwards, it explains the methods that were used in the study and it describes the design of the survey.

3.1 Valuation methods

In order to find out what the value of nature to humans is, one needs to identify all the benefits people obtain from ecosystems. Because these benefits are difficult to gauge, Fisher et al. (2008) suggest combining the notion of ecosystem services with economic theory. The benefits people obtain from ecosystems can then be summarized in the total utility people receive from not only using these ecosystems (use values), but also from simply knowing ecosystems and their functions are there (non-use values). By aggregating all benefits people obtain from ecosystems, the value of an ecosystem can be derived. This knowledge can contribute to policy- and decision making processes, as it brings to front the tradeoffs that necessarily need to be made when managing ecosystems.

One of the ways in which people enjoy ecosystem services is by being in direct contact with the ecosystem. This way of interacting with the environment results in a direct use value. An example is the recreational value people attach to going to the beach. Going to the beach is a non-consumptive way of directly using the ecosystem. Harvesting food from an ecosystem is an example of a consumptive way of directly using the ecosystem. People can also indirectly use an ecosystem, for example when a coral reef is protecting them against flooding. Another category is the non-use values attached to the ecosystem, in which people do not use the environment, neither directly nor indirectly. Non-use values can be divided into the bequest value, which is the value attached to knowing that certain ecosystem goods and services will be there for future generations to enjoy, and existence value, the value placed on simply knowing an ecosystem and its services are there. The option value is the value people attach to having the possibility of using the ecosystem. This value stands somewhere in between use and non-use values: the ecosystem is currently unused, but indeed knowing that it can be used in the future is what defines its value. Figure 4 summarizes this framework.

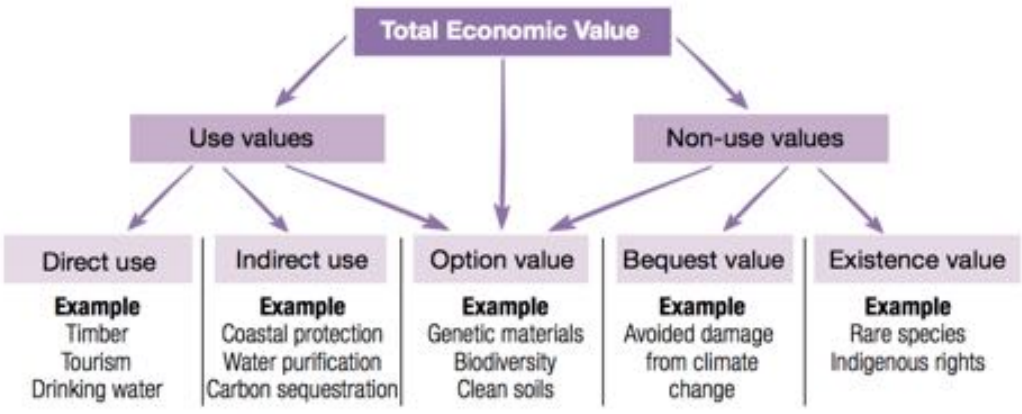


Figure 4: The use and non-use values framework. Source: Van Beukering et al. (2007)

There are a number of valuation methods available to gauge the value of ecosystem services. Direct use values can be measured in a more or less straightforward way when there are markets

on which the ecosystem goods and/or services are traded: one can have a look at the direct market prices to find out how much people are paying for the good or service (Van Beukering et al., 2007). When there is no market, and direct market prices therefore are not available, revealed preference methods can be used, in which the value people attach to an ecosystem good or service is derived from prices in complementary or surrogate markets. Revealed preference methods include (among others) the travel cost method, hedonic pricing, replacement cost and the damage cost avoided (Van Beukering et al. 2007).

The methods above are all not applicable to measuring the cultural and recreational value of an ecosystem. These values constitute a public good that is not sold on any market. Also, there are no complementary or surrogate markets available that can be used to derive the value of these ecosystem services. Market valuation techniques or revealed preference techniques can therefore not be applied: the only way to find out how people value these services is to directly ask them. Rather than looking at revealed preferences, this study has to look at stated preferences, which are expressed by people directly. Two stated preference methods are the contingent valuation method and choice modelling (Van Beukering et al., 2007).

3.2 Contingent valuation

When applying contingent valuation, the researcher asks the respondent directly what he/she would be willing to pay for a certain ecosystem service. The researcher can ask this in the form of a dichotomous choice: the respondent is asked whether he/she would be willing to pay a certain amount and the possible answers are yes or no. This question might be followed up by another dichotomous choice. Alternatively, the respondent can be asked an open question, in which he/she needs to come up with an amount him/herself (Van Beukering et al., 2007).

The contingent valuation method is used in this study by asking people directly (in an open ended question) how much they would be willing to pay for management of the marine environment of the Cayman Islands. The most important flaw of the contingent valuation method is the hypothetical nature of the question. This is necessarily the case with stated preference methods, because respondents are asked to imagine a certain situation and state their willingness to pay. Because of this flaw, this study combines the contingent valuation method with choice modelling to narrow down the randomness of their answers.

In this study, people were asked whether they were willing to pay for management of the marine environment of the Cayman Islands. People could answer yes or no to this question. After this dichotomous question, when saying yes, people were asked an open ended question: "*what is your maximum amount of monthly additional contribution you are willing to pay for better enforcement and expansion of Marine Protected Areas?*" People were asked to carefully take into account their ability and willingness to pay, given their current income level. Those who had difficulties deciding on the amount could receive help from an example payment card, providing the respondent with a list of suggestions.

3.3 Choice Modelling

Choice modelling has as an advantage over contingent valuation that the choices the respondents makes resemble real life trade offs more than the contingent valuation method does. Rather than stating a monetary amount directly, the respondent is asked to choose from a number of scenarios. His or her willingness to pay is then derived from the choices that are made, since every scenario has a payment vehicle, which should be taken into account by the respondent when making the choices. Apart from the payment vehicle, each scenario consists of a number of other attributes with different levels. Because the respondent needs to make a trade off between

these different attributes, choice modelling allows for making a ranking of aspects considered important by respondents (Van Beukering et al., 2007).

Choice modelling may be less prone to the hypothetical bias than the contingent valuation method is, but on the other hand, the scenarios respondents are presented with are not necessarily realistic. This may confuse respondents (Zwerina et al., 2010). Also, taking part in a choice experiment may demand a lot from respondents' capabilities. Furthermore, although some biases present in contingent valuation can be mitigated by using choice modelling as an alternative, choice experiments can also be subject to biases such as anchoring.

Apart from its disadvantages, choice modelling has some major advantages over contingent valuation. These advantages include the fact that choice modelling is more suitable to estimate values for attributes that combined constitute an environmental good, such as a nice scenery. Also, the problem of "yea-saying" is avoided when using choice experiments rather than contingent valuation, because people are not asked directly if they are willing to pay (Hanley et al., 1996).

Choice modelling is a combination between Lancaster's (1966) theory of value, the random utility theory and McFadden's (1986) formal description of choice. The theory of value states that people makes choices based on the utility they receive from consuming the good or service, not on the good or service itself (Lancaster, 1966). The utility function is formulated as follows (Hanley et al., 1998):

$$U_{in} = U(Z_{in}, S_{in}) \qquad (3.3.1)$$

In this function, for any individual n, utility is determined by the alternative chosen, i. This alternative will be chosen when the utility experienced by the individual is higher when choosing alternative i rather than any of the other options. Utility is assumed to be determined by the composition of the attributes of the choice made. Yet, it is not only the attributes that explain a respondent's choice, his/her personal characteristics (such as demographics) also play a role.

Following equation 2.7.1, utility can be re-written as (Hanley et al., 1996)

$$U_{in} = V(Z_{in}, S_{in}) + \varepsilon(Z_{in}, S_{in}) \qquad (3.3.2)$$

In which V is the deterministic, observable utility and ε is the random error term. And when i is defined as the option chosen, and j are all the other options, which are not chosen, the probability that the respondent will choose option i over all other options j, is (Hanley et al., 1996):

$$\text{Prob}\,(i \mid C) = \text{Prob}\,\{V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}, \text{all}\, j \in C\} \qquad (3.3.3)$$

In words: the probability that a respondent chooses alternative *i* over all other options in the choice set, denoted by *j*, is given by the probability that the utility obtained from choosing *i* is bigger than the utility obtained from choosing one of the alternatives *j*. Finally, the equation also shows that *j* is an element of the choice set.

In order to estimate this probability, it is necessary to make assumptions about the distribution of the variance of the error terms. Hanley et al. (1996) assume that the errors are Gumbel-distributed, meaning that they follow a minimum extreme distribution (Gumbel et al., 1953). Hanley et al. (1996) also assume that the errors are independently and identically distributed and arrive at the following equation, expressing the probability a respondent will choose option *i*:

$$\text{Prob}(i) = \frac{\exp^{\mu v_i}}{\Sigma_{j \in C} \exp^{\mu v_j}} \qquad (3.3.4)$$

Equation 3.4.4 states that the probability of a respondent choosing option *i* can be calculated by dividing the expected utility to the power of μ, which is a scale parameter reflecting the error variance and is usually 1, assuming constant error variance, times the value of *i*. This term is then divided by the sum of these expected utility values of *j*, all the other choices within the choice set.

The statistical programme Ngene was used to construct the most relevant choice cards. This resulted in an initial design of 10 different versions, with each version consisting of 6 choice cards. This amounts to a total of 60 different choice cards for the initial design. This design was used to conduct a pre-test, in which 20 respondents were asked to make their choices. Each version was therefore tested twice. The results were used to update the design, including two extra payment levels. The final design consisted of 12 versions, each version containing 6 choice cards. This amounts to a total of 72 different choice cards for the final design. The choice cards showed the respondents three scenarios that were different on six attributes. Each respondent was presented with one version, containing 6 different choice cards. In explaining the choice experiment to the respondent, the same example card was used for all respondents. The following descriptions were given to the respondents to explain the attributes:

1. **Payment** in CI$ is the contribution per year/month (both are shown) that would be contributed financially by all inhabitants of the Cayman Islands and would be used strictly for management of the marine environment of the islands.
2. **No take zones** represent the areas that restrict access for fishers to certain parts of the marine environment.
3. **Mangrove conversion** refers to how much of the currently existing mangroves will be converted into canals and real estate.
4. **Reef quality** is about the quality of the coral reef that is present in the sea, providing habitat for fish and in this way scenery for diving and snorkelling.
5. **Water clarity** is indicating whether the seawater is turbid or clear.
6. **Fish catch** refers to how much fish can be caught for recreational purposes in the seas surrounding the Cayman Islands.

Following this explanation the respondent was explained that he/she would get to see six choice cards that would be all different and independent of each other. The interviewers were instructed to ensure that respondents understood the "package deal" nature of the choices and the impossibility of combining different levels of attributes. Also, the respondents have been explained that there is no ideal choice and that trade-offs necessarily need to be made. The respondents were told that option A and B would always be different, and that these two options would always include a contribution paid by the residents of the Cayman Islands. There were also told that option C would be the same in each of the six choice cards, with no payment. After having made sure the respondent understood the example card, the interviewers continued with the choice experiment. Figure 5 shows an example of a choice card used in the choice experiment. A list of the levels of the attributes is shown in

Table 2.

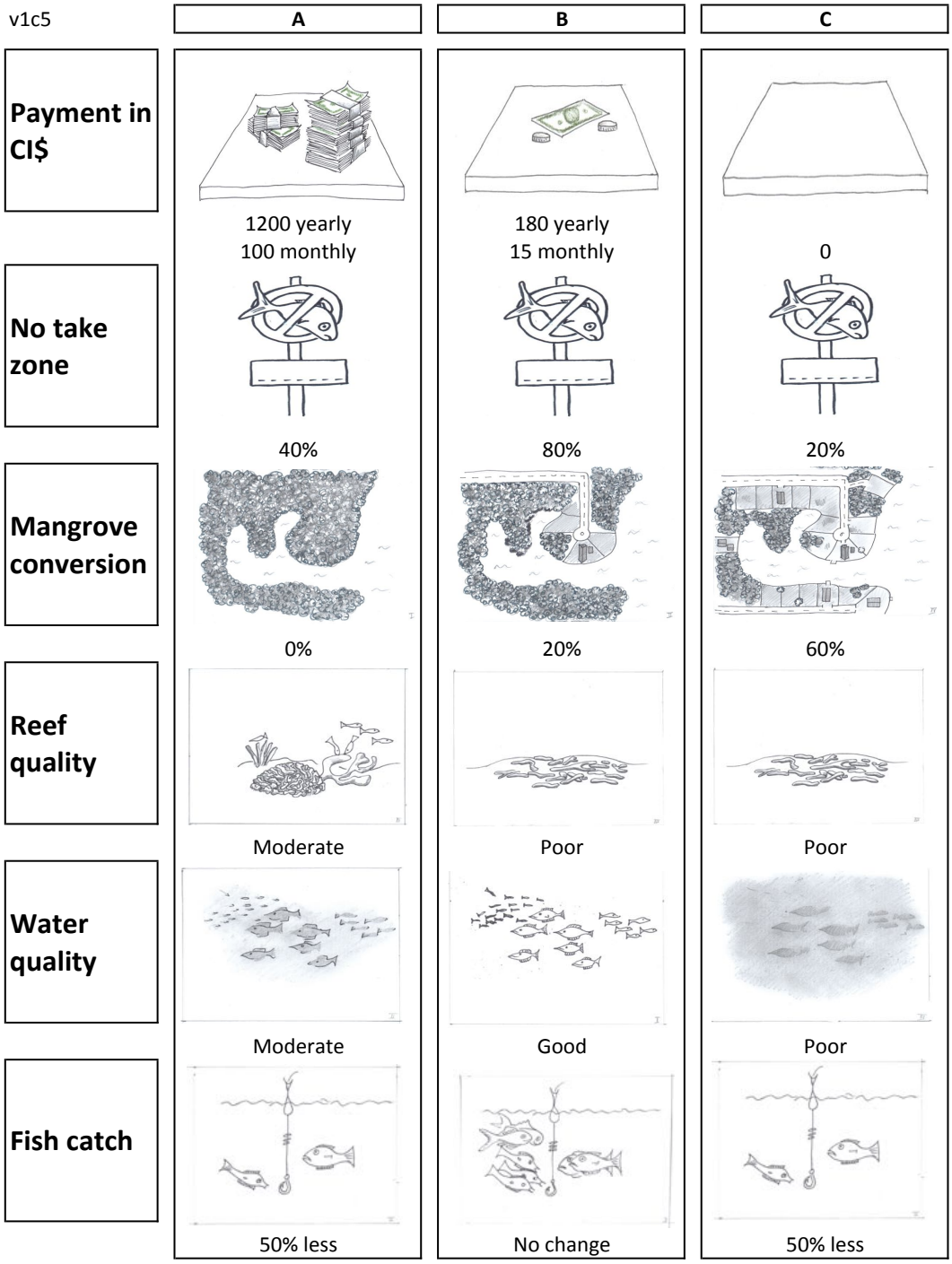


Figure 5: Example choice card

Table 2: Attributes and levels of the Choice experiment design

Level	Payment per month	No take zone	Mangrove conversion	Reef quality	Water quality	Fish Catch
Level 1	2 CI$	20%	0	Poor	Poor	50% less
Level 2	5 CI$	40%	20%	Moderate	Moderate	No change
Level 3	10 CI$	60%	40%	Good	Good	50% more
Level 4	15 CI$	80%	60%			
Level 5	20 CI$					
Level 6	25 CI$					
Level 7	35 CI$					
Level 8	100 CI$					
Status quo	0 CI$	20%	60%	Poor	Poor	50% less

3.4 Anchoring/ordering effect

People use heuristics and biases in their daily lives all the time. Heuristics, or rules of thumb, help people making decisions under uncertainty. Humans are per definition constrained in their abilities to make rational choices. This "bounded rationality" makes that people necessarily need to rely on heuristics in making choices, because they are unable to be truly rational (Simon, 1957).

Because taking part in the choice experiment is a complex and demanding task, people may use heuristics in making their choice. These heuristics can lead to biases and might affect the outcome of the experiment. An important critique on choice modelling, and stated preference surveys in general, is that the hypothetical and complex nature of the method can lead to biased outcomes (Ladenburg and Olsen, 2006; Hoyos, 2010; Kragt and Bennett, 2008).

This study aims to find out whether there is an anchoring/ordering effect present in respondents' answers to the choice experiment. The anchoring effect is one of the possible biases caused by people following heuristics and was first studied by Amos Tversky and Daniel Kahneman in their 1974 paper "Judgment under Uncertainty: Heuristics and Biases". People tend to use a certain starting point, which is the anchor, and adjust this value in such a way they think yields the final answer. Different starting points can lead to different outcomes (Tversky and Kahneman, 1974). In this way the anchoring effect could become a severe bias in decision-making. The anchoring effect can be influenced by the order of the questions, resulting in an ordering effect. This can be particularly problematic if simultaneous problems are answered sequentially (Halvorsen, 1996), which is the case in this study, where the same ecosystem services are valued sequentially, in two different orders.

Several authors have tested for an anchoring effect in choice experiments (Frykblom and Shogren, 2000; Kragt and Bennet, 2008; Kriström, 1993; Green et al., 1998; Ladenburg and Olsen, 2006). Most have combined the anchoring effect with the starting point bias, and have concentrated on possible effects caused by altering the levels of the payment vehicle in the choice

experiment. The results are mixed: Ladenburg and Olsen (2006) find a gender-dependent anchoring effect in which only women are prone to being affected by price levels, Green et al. (1998) find a strong general anchoring effect, whereas Frykblom and Shogren (2000) and Kriström do not find any significant evidence of the anchoring effect. Kragt and Bennett (2008) find ambiguous results.

This study uses the notion of anchoring as well, not to see whether changing the *levels* of the choice experiment causes an anchoring effect, but to see whether altering the *order* of the contingent valuation and the choice experiment significantly influences the answers giving by the respondents. In other words, this study aims to find out whether there is a bias present in people's decision-making on how they value their marine environment and whether this bias is caused by an ordering effect that leads people to use their previous answer as an anchor. It does so by using two different survey designs: one in which the contingent valuation takes place before the choice experiment, and on in which the choice experiment comes first. It might be the case that when respondents are asked to first come up with an amount themselves, the amount they have chosen in the first question influences their choices in the choice experiment. The study however, also tests whether the choice experiment influences the amount chosen in the contingent valuation. The research design allows doing so: there are two versions of the questionnaire. In version A, the contingent valuation question was asked before taking the choice experiment. In version B, the order was reversed: the choice experiment was conducted first, after which the interviewers continued with the contingent valuation question. Both versions were used an equal amount of times.

Should there be an anchoring effect, the outcomes of the two versions would be different. If an anchoring effect is present, the answers given during the choice experiment are expected to differ significantly between version A and version B of the questionnaire. Therefore, one of the explanatory variables in explaining the choices people made is the version of the questionnaire that has been used.

A second approach is used here, too, following Frykblom and Shogren (2000). They studied the effect of a discrete choice (in this case the choice experiment in which the respondent has three choices) on an open-ended question (the contingent valuation question in which the respondent comes up with a monthly payment himself). They did not find significant differences between the answers given to the open ended question and the discrete choice question, and consequently they did not find evidence for an anchoring effect. Following Frykblom and Shogren (2000), a similar approach is used here: in addition to changing the order of the questions, also differences between the stated willingness to pay in the contingent valuation context and the choice experiment are studied. Because the choice experiment model has the same random utility framework as the contingent valuation framework (Hanemann, 1984), it is possible to directly compare the outcomes of both methods.

3.5 Questionnaire and sampling strategy

Every household was approached with the same introduction and question: people were asked if they were willing to participate in a survey directed towards assessing the importance of the marine environment to them. Interviews took between 20 and 30 minutes. An example of the questionnaire can be found in Annex A. This questionnaire was developed in close collaboration with local stakeholders and is based on questionnaires that have been used in similar studies (Van Beukering et al., 2007; Laclé, 2013).

The questionnaire consists of 29 questions, divided into 8 sections such as general questions, environmental awareness and recreation, the contingent valuation question, the choice experiment, statements, and demographics.

In close collaboration with the Economics and Statistics Office (ESO) of the Cayman Islands, three residential household samples were constructed in order to cover Grand Cayman, Cayman Brac and Little Cayman. For Grand Cayman, a stratified random sample of 194 households was constructed. To take non-response into account, the sample was increased by 30%, leading to a total sample of 252 residential household addresses. The sample was stratified according to the different districts on the island. Table 3 shows the division.

Table 3: Division per district

District	No. of addresses	Goal
George Town	143	110
West Bay	52	40
Bodden Town	45	36
North Side	6	5
East End	6	5
Total	**252**	**196**

For Cayman Brac, a simple random sample of 155 households was constructed by the ESO. Taking into account non-response, the sample as a whole consisted 202 addresses. For Little Cayman, a simple random sample of 50 households was constructed, 40 of which were actually visited. No non-response has been experienced on Little Cayman. The samples not only consisted of addresses, but also of descriptions of the buildings, increasing convenience for the interviewers.

The household surveys have been conducted by a team of 7 interviewers, four of which were based on Grand Cayman and the other three being based on Cayman Brac. On Little Cayman, there has been no help of external interviewers. All 7 interviewers were experienced as they were working for the ESO, conducting the census and keeping track of consumer prices and other socio-economic parameters. The interviewers all took part in a training in which they were given directions for surveying. They received compensation for this training and for each completely filled in questionnaire. The interviewers were required to check in every week on their progress. Each interviewer was given their target amount of addresses (40 addresses per interviewer on Grand Cayman and 52 addresses per interviewer on Cayman Brac). In cases of non-response, they could ask for more addresses from the spare list. Non-response is estimated to have been approximately 15% for Grand Cayman and Cayman Brac, which can be considered very low. The fact that the interviewers were experienced and the respondents had seen them before during other surveys that were carried out by the ESO might have been of a positive influence on reducing non-response.

4 Results

4.1 Sample description and distribution choice set versions

The sample consists of 384 respondents, 146 (37.9%) of which were born on the Cayman Islands. The remaining 238 respondents (62.1%) were born elsewhere or declined to answer. Their places of origin are shown in Figure 6. Unfortunately it is not possible to make a comparison with the actual population of the Cayman Islands, since this data, as well as data on income, is not available at ESO.

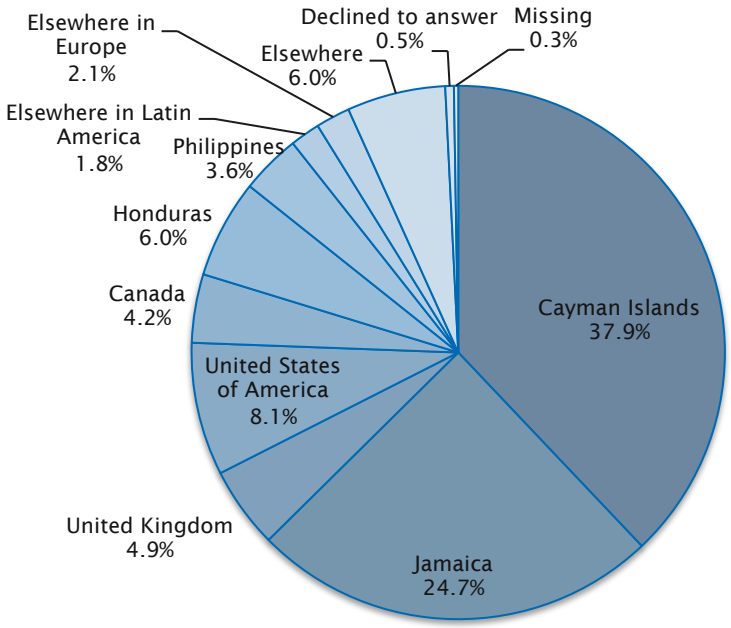


Figure 6: Country of origin

On Grand Cayman, 189 interviews have been conducted. This is 96.4% of the desired sample size of 196. On Cayman Brac, 155 interviews have been conducted. This is 99.4% of the desired sample size of 156. On Little Cayman, given the unique situation of only 120 inhabitants and due to time constraints, the approach was to conduct as many interviews as possible, leading to a sample of 40.

As described in Chapter 3, 12 different sets of choice cards have been employed. The aim in this survey was to use each version equally often, that is, 32 times. Therefore, the interviewers were instructed to carefully follow the instructions and to always check which version to use. This has led to the following distribution of versions (Figure 7). Figure 7 shows that most versions came close to their targets. The biggest differences between the desired and the actual amount of versions used are shown by versions 3 and 10 (desired = 32, actual = 28) and version 6 (actual = 36, desired = 32). These deviations from the desired division were caused by some misunderstandings of the interviewers, which were noticed in time so that some corrections could be made.

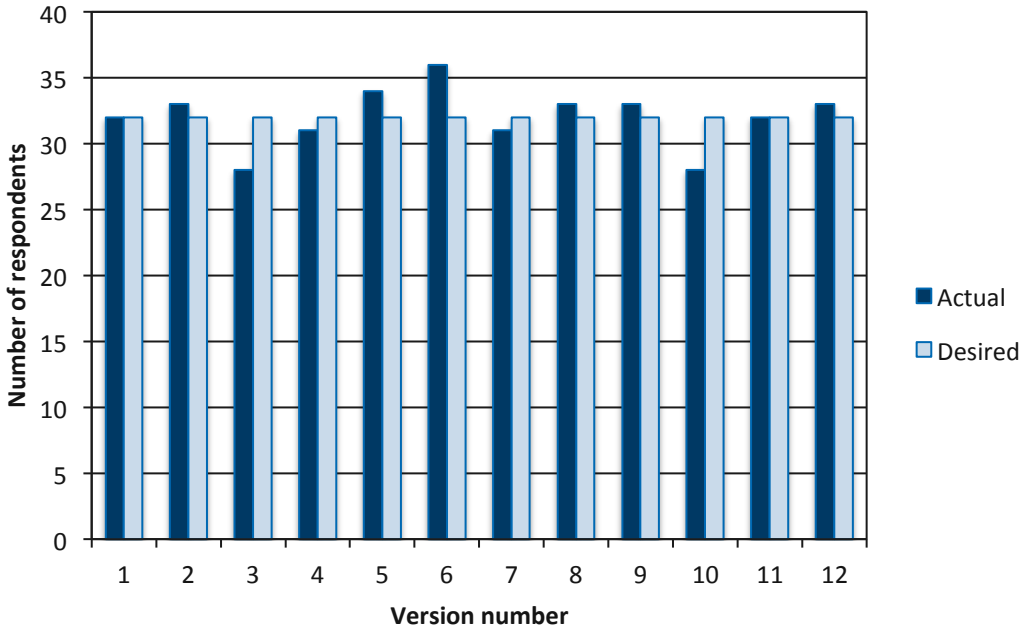


Figure 7: Distribution of versions

4.2 Background of the respondents

A Chi-square test is used to test for the goodness-of-fit of the sample in terms of age. Figure 8 summarizes the findings. The outcome of the Chi-square test is 27.924, $p < 0.05$. The null hypothesis, which says that there are no significant differences between the sample and the population, is rejected. The composition of the sample in terms of age is significantly different from the composition of the population. Figure 8 shows that young people are underrepresented and that older people are overrepresented.

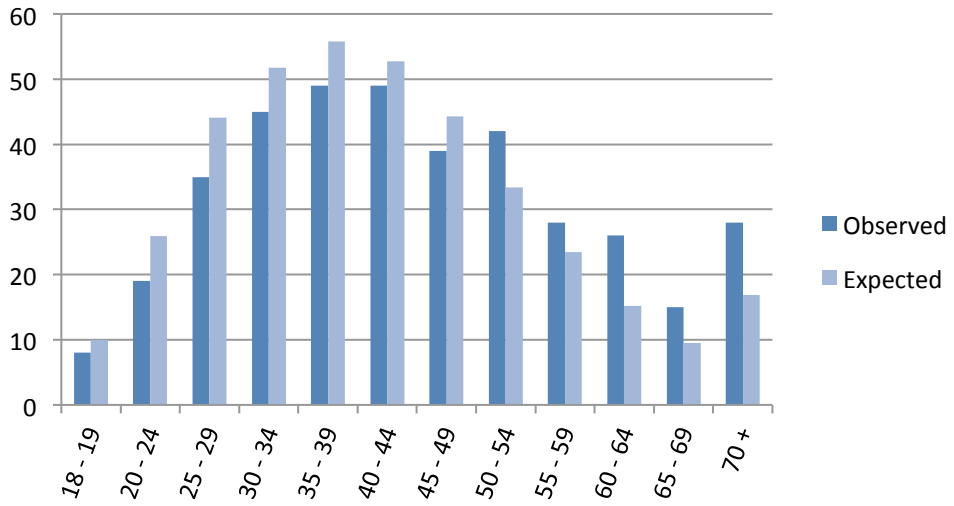


Figure 8: Age

The same test is performed to check the goodness of fit of the sample in terms of gender. The outcome of the Chi-square test is 1.935, p = .164. There are no significant differences in the amount of men and women in the sample compared to the population.

The respondents have also been asked to indicate their field of work. Their answers are compared to the ESO data again to assess the goodness of fit in terms of work field. Figure 9 summarizes the findings. The outcome of the Chi-square test is 69.638, p < .000. The null hypothesis, which says that there are no significant differences between the sample and the population in terms of work field, is rejected. The composition of the sample is significantly different from the composition of the population. Figure 9 shows that wholesale and retail, construction, and activities of households as employers are underrepresented. Financial services and professional, scientific and technical activities are approximately the same, and general public administration activities and other work fields are overrepresented.

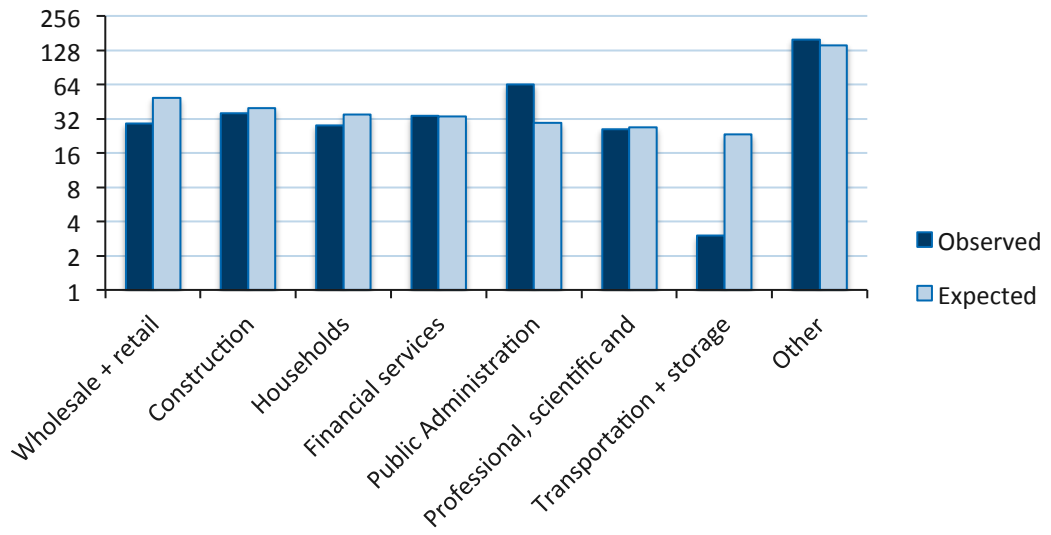


Figure 9: Work field

4.3 Recreation

In this section, respondents are asked how often they participate in certain activities in nature. These activities are: fishing, going to the beach, boating/sailing/kayaking, swimming/wading, diving and snorkelling. On average, people on the Cayman Islands say that snorkelling, boating/sailing/kayaking and fishing are done once a year, going to the beach and swimming/wading once a month, and they never dive.

Annex D shows a cross-tabulation of the recreational activities and their frequencies sorted by place of birth (on the Cayman Islands or elsewhere) and island (Grand Cayman, Cayman Brac and Little Cayman). Figure 10 shows the differences in recreation between respondents that were born on the Cayman Islands and those that were not. The bars show the weighted average of the number of times per year respondents take part in each activity. In general, people born outside the Cayman Islands go to the beach more often, and go swimming and diving more often. Those that were born on the Cayman Islands go fishing and snorkelling more often.

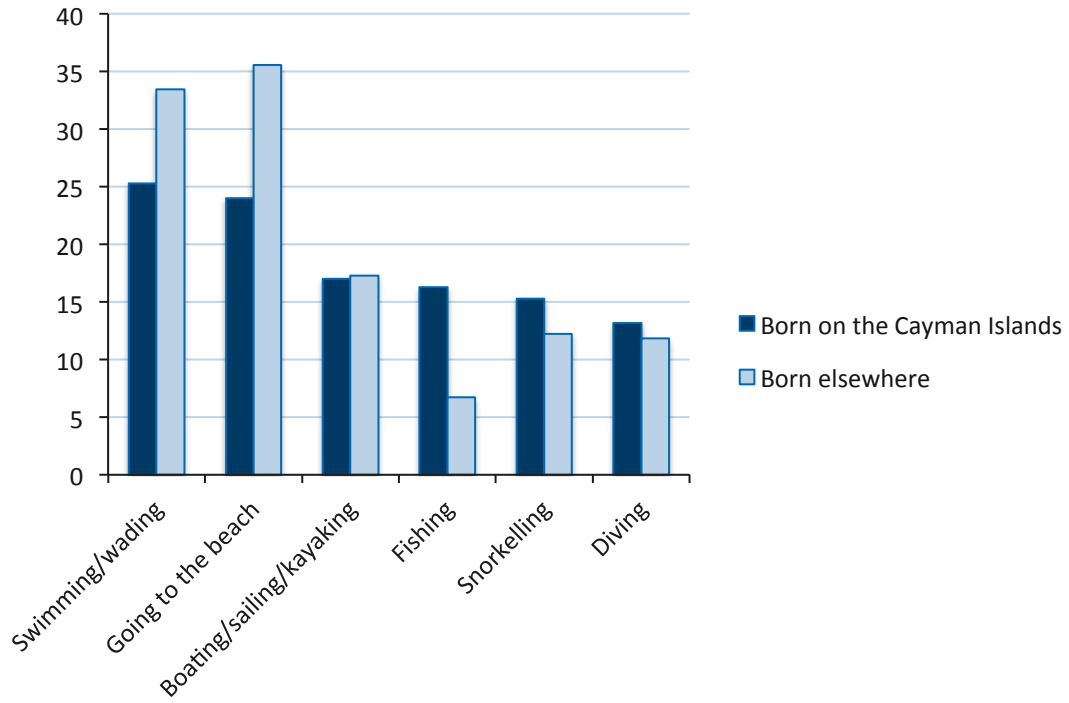


Figure 10: Recreational activities (weighted average per year)

For each of the recreational activities, a t-test is performed to see whether the differences between those who were born on the Cayman Islands and those who were not are significant. The outcomes are summarized in Table 4. This table shows that there are significant differences between the mean frequency of people born on the Cayman Islands and people born elsewhere with respect to fishing, going to the beach, and diving.

Table 4: Recreation in nature

	Born on Cayman Islands	*Born elsewhere*	*t-value*	*Sig.*
Going to the beach	2.77	3.1	2.321	.021**
Swimming/wading	2.7	2.8	1.037	.300
Fishing	2.3	1.7	-4.933	.000***
Boating/sailing/kayaking	2.0	2.0	-.243	.808
Snorkelling	2.0	1.9	-1.105	.270
Diving	1.4	1.5	1.791	.074*
N	145	238		

** stands for significance at the 10% level, **stands for significant at the 5% level, *** stands for significant at the 1% level*

The difference in terms of fishing between people born on the Cayman Islands and people born elsewhere is significant at the 1% level: $t = -4.933$, $p < .000$. The table shows that people born on the Cayman Islands on average go fishing more often than people that were born elsewhere: once

a year to once a month versus never to once a year. The difference between people born on the Cayman Islands and people born elsewhere in terms of going to the beach is significant at the 5% level: $t = 2.321$, $p < .05$. The table shows that people born outside the Cayman Islands on average go to the beach more often than people who were born on the Cayman Islands: once a month versus between once a year and once a month.

The difference between people born on the Cayman Islands and people born elsewhere in terms of diving is significant at the 10% level: $t = 1.791$, $p < .10$. The table shows that people born outside the Cayman Islands on average go diving more often than people who were born on the Cayman Islands, but the difference is very small: both groups go diving somewhere between never and once a year, but people born outside the Cayman Islands go diving slightly more often (a bit closer to once a year).When asked how often respondents go diving, 81 respondents or 21.1% of the whole sample go diving at least once a year (see Table 5 and Figure 11 . The t-test in Table 5 shows that people born outside the Cayman Islands go diving significantly more often than people born on the Cayman Islands ($t = 2.464$, $p < .05$).

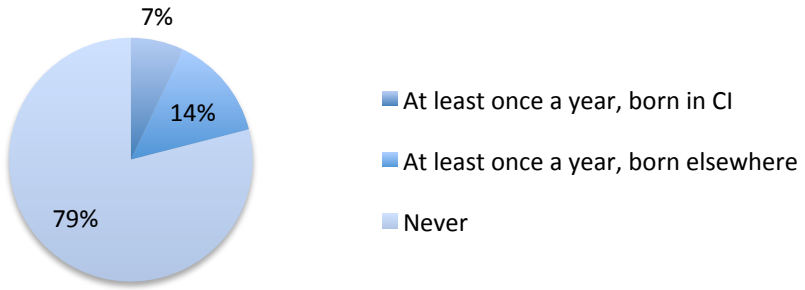


Figure 11: Frequency of diving whole sample

Table 5: Respondents diving at least once a year

	Born on Cayman Islands	*Born elsewhere*	*t-value*	*Sig.*
Diving	2.82	3.40	2.464	.016**
N	28	53	1.037	.300

**stands for significant at the 5% level

In addition to recreational activities in nature, respondents are also asked how often they eat locally caught fish or lobster. On average, people in the Cayman Islands eat locally caught fish or lobster once a week. Annex E shows cross-tabulations for the amount of times people on the Cayman Islands eat locally caught fish or lobster. Annex E1 shows a cross-tabulation divided per island. Annex E2 shows a cross-tabulation divided per place of birth (Cayman Islands or elsewhere).

4.4 Recreational fishing

Every respondent is asked whether someone in the household goes fishing. Overall, when looking at the sample as a whole, 33.9% of the Cayman Islands' households have member that

goes fishing (see Table 6). The table shows fishing activity per island and per place of birth. A t-test is used to see whether the differences between people born on the Cayman Islands and people born elsewhere are significant. There is a significant difference between people born on the Cayman Islands and people born elsewhere in terms of whether the respondents or other people in their households go fishing: people born on the Cayman Islands live in a household with fishermen significantly more often than people born elsewhere (t = 3.910, Sig. = .000).

Table 6: Fishing in household per island and place of birth

	Count	Percent
Grand Cayman	48	25.4%
Cayman Brac	61	39.4%
Little Cayman	21	52.5%
Overall	130	33.9%
Born in CI	67	46.2%
Born elsewhere	63	26.5%

Respondents have also been asked to indicate how important some possible motivations to go fishing were to them. For each of the reasons, Figure 12 shows the average score, with scores running from 1 (not important) to 5 (very important). Almost all respondents indicated the reason "I enjoy fishing/I find it relaxing" as a very important reason to go fishing.

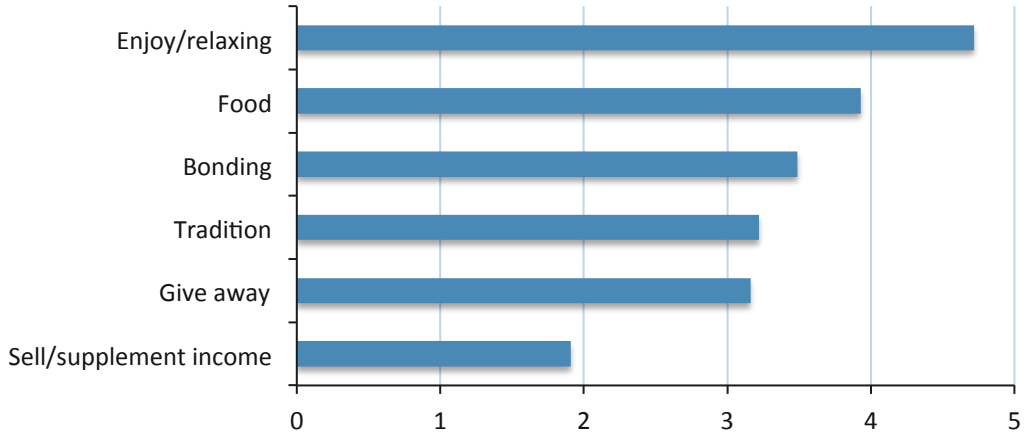


Figure 12: Reasons to go fishing

4.5 Threats to the marine environment

Respondents were asked to indicate how important they find several potential threats to the marine environment. People could indicate the importance of each threat on a scale from 1 to 5, with 1 being not important and 5 being very important. Most threats were considered somewhat important, with solid waste and litter being considered very important, and diving, snorkelling

and boating considered neutral. A comment often heard from respondents is that they consider people that go diving as being well educated in terms of how not to damage the coral reef.

An ANOVA shows that there are significant differences between the three islands concerning respondents' thoughts on population increase as a potential threat to the marine environment ($F = 20.152$, $p < .000$). Table 7 shows that respondents on Grand Cayman and Little Cayman scored this threat significantly higher than respondents on Cayman Brac. This might be caused by the distinct characteristics of the islands: Grand Cayman, with a population of approximately 53,000 (ESO, 2010), is densely populated compared to the Sister Islands. Therefore, population increase might be perceived as a bigger threat on this island. Little Cayman on the other hand has a population of about 120 and therefore is another extreme: an often expressed concern is that the unique atmosphere of the island will be lost with significant population increase.

Table 7: ANOVA for "population increase" (Multiple comparisons: Games-Howel)

Island	Compared with	Mean difference	Sig.
Grand Cayman	Cayman Brac	.892	.000***
	Little Cayman	-.279	.254
Cayman Brac	Grand Cayman	-.892	.000***
	Little Cayman	-1.171	.000***
Little Cayman	Grand Cayman	.279	.254
	Cayman Brac	1.171	.000***

** stands for significant at the 10% level, **stands for significant at the 5% level, *** stands for significant at the 1% level*

An ANOVA shows significant differences as well between the three islands concerning respondent's thoughts on the impacts of fishing as a potential threat to the marine environment ($F = 18.723$, $p < .000$). See Table 8. Post-hoc test Hochberg is used (equal variances can be assumed, but group sizes are different) and this test shows that respondents on Cayman Brac score this threat significantly lower than respondents on Grand Cayman and Little Cayman. A Pearson correlation test shows no significant correlation between number of households that participate in fishing and the score given to "impacts of fishing" as a threat to the marine environment. One possible reason for Brac's lower score might be that respondents behave strategically in their answers. On the Brac some people rely heavily on fishing, in addition the Brac has a tight and small community, people might feel solidarity and that it would be better for them to present a positive picture to avoid further restrictions. Another possible reason might be that most fishermen from the Brac go to Little Cayman for fishing. Fishing puts a big pressure on fish populations in the Brac. In Little Cayman, because it has such a small human population, fishing pressures from the island itself do not play a big role.

Table 8: ANOVA for "impacts of fishing" (Multiple comparisons: Hochberg)

Island	**Compared with**	**Mean difference**	**Sig.**
Grand Cayman	Cayman Brac	.943	.000***
	Little Cayman	-.113	.963
Cayman Brac	Grand Cayman	-.943	.000***
	Little Cayman	-1.056	.000***
Little Cayman	Grand Cayman	.113	.963
	Cayman Brac	1.056	.000***

*** stands for significant at the 1% level

4.6 Willingness to pay contingent valuation

4.6.1 WTP in principle 'yes' or 'no'

The contingent valuation question, which led as follows: 'Are you in principle willing to pay for management of the marine environment of the Cayman Islands?' shows 37.1% of the total sample 62.3% of respondents replied "yes" and 37.1% replied "no". Table 9 shows the differences between the three islands and Table 10 between people born on the Cayman Islands and people born elsewhere.

Table 9: Willingness to pay by islands

Island	*Observed*	*Yes*	*No*
Grand Cayman	*Count*	*109*	*79*
	Percentage	*58.0%*	*42.0%*
Cayman Brac	*Count*	*97*	*58*
	Percentage	*62.6%*	*37.4%*
Little Cayman	*Count*	*34*	*6*
	Percentage	*85.0%*	*15.0%*
Total	*Count*	*240*	*143*
	Percentage	*62.7%*	*37.3%*

Table 10: Willingness to pay by origin

Place of birth	*Observed*	*Yes*	*No*
Born in CI	*Count*	*83*	*62*
	Percentage	*57.2%*	*42.8%*
Born elsewhere	*Count*	*157*	*81*
	Percentage	*66.0%*	*34.0%*

A one-way ANOVA is used to find out whether the differences concerning the respondents' willingness to pay between the three islands are significant. The test (see Table 11 shows significant differences in willingness to pay across the three islands: $F(2, 380) = 5.248$, $p < .05$. Levene's test of variances shows that variances are not equal: Levene statistic = 58.094, $p < .001$. Therefore, post-hoc test Games-Howell is used. This test shows significant differences between Grand Cayman and Little Cayman, and between Cayman Brac and Little Cayman, but no significant differences between Grand Cayman and Cayman Brac.

A t-test was performed to find out whether the differences between people born on the Cayman Islands and people born elsewhere are significant. The outcomes are shown in Table 11. There is a significant difference at the 10% level between respondents born on the Cayman Islands and respondents born elsewhere. People born outside the Cayman Islands are more often willing to pay (see also Table 9)

.Table 11: Willingness to pay according to place of birth (Multiple comparisons: Games-Howell)

Island	Compared with	Mean difference	Sig.
Grand Cayman	Cayman Brac	-0.46	.662
	Little Cayman	-2.70	.000***
Cayman Brac	Grand Cayman	0.046	.662
	Little Cayman	-2.224	.005**
Little Cayman	Grand Cayman	0.270	.000***
	Cayman Brac	0.224	.005**

The respondents were given several possible reasons for not being willing to pay. They have been asked to indicate their main reason. The outcomes are summarized in Figure 13. A one-way ANOVA was also conducted to examine whether there were statistically significant differences among residents from the three different islands in relation to their answers on the question why they were not willing to pay. The results do not show significant differences between the different islands with $F(2, 138) = .571$ and $p = .566$). The test shows that people from the different islands did not differ significantly in terms of their reasons not to be willing to pay for marine environment conservation.

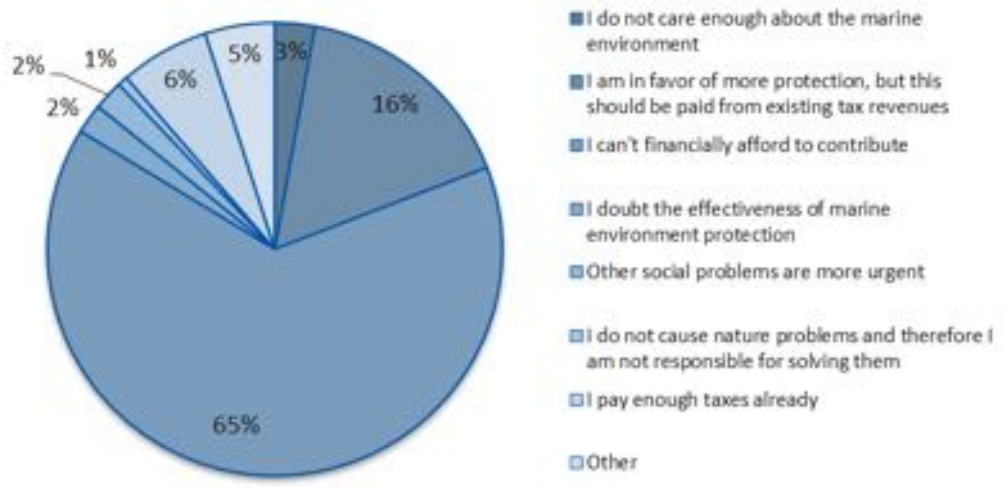


Figure 13: Reasons for not being willing to pay

4.6.2 Comparison with public consultation

When comparing these outcomes to the outcomes of the public consultation done by the Department of Environment of the Cayman Islands (Richardson et al., 2013), the results are not always the same. When combining the categories "I support all the suggested changes" and "I support the suggested changes, but would be happier if my suggested alternations were made" (which is also done by Richardson et al. (2013) to calculate overall support) and comparing these numbers with the percentage of people willing to pay, the outcomes are as follows (see Table 12). The levels of support for the suggested changes are much lower than the percentage of

people willing to pay in this study. The differences on Cayman Brac and Little Cayman are bigger than the difference on Grand Cayman. There are several possible explanations for these differences, which need more research before being able to really explain the discrepancies.

One of the possible reasons could be that respondents are willing to pay for management of the marine environment, but they would not so much like to see changes made to the current system. This creates a tension between the environmental objectives of the Marine Parks system, which can only be attained if the parks are enhanced, and the opinions of the public, which is prepared to contribute financially to managing the parks but only partially supports the expansion plans.

Table 12: Comparison of support and willingness to pay

Island	Share supportive according to Richardson et al. (2013)	Share expressing positive Willing to Pay in survey
Grand Cayman	47%	58.0%
Cayman Brac	14%	62.6%
Little Cayman	52%	85.0%

4.6.3 WTP amount contingent valuation

Of the respondents, 62,3% stated that they are willing to pay. The average monthly payment that these people are willing to contribute is 20.49 CI$. The median and the mode are both 10 CI$ per month. Again, a one-way ANOVA was conducted to examine whether there were statistically significant differences among residents from the different islands in relation to the amount that they are willing to pay every month for marine environment conservation. The dependent factor is the amount; the independent factor is the island on which the respondent lives.

The test shows significant differences in willingness to pay across the three islands: $F(2, 232) = 6.990$, $p < .001$. Levene's test of variances shows that variances are not equal: Levene statistic = 4.372, $p < .05$. Since group sizes are not equal either, post-hoc test Games-Howell is used. The post-hoc analysis, as presented in Table 13, shows that there is a significant difference in willingness to pay between Grand Cayman and Cayman Brac (the amount that people on Grand Cayman are willing to pay is significantly higher than on Cayman Brac), but not between Grand Cayman and Little Cayman. The test also shows significant differences between Cayman Brac and Little Cayman: the number of people that are willing to pay is significantly higher on Little Cayman.

A t-test is conducted to check if there are significant differences in the amount people are willing to pay across people born on the Cayman Islands and people born elsewhere. No significant differences were found.

Table 13: Amount of willingness to pay (Multiple comparisons: Games-Howell)

Island	Compared with	Mean difference	Sig.
Grand Cayman	Cayman Brac	9.344	.006**
	Little Cayman	-4.816	.596
Cayman Brac	Grand Cayman	-9.344	.006**
	Little Cayman	-14.159	.013**
Little Cayman	Grand Cayman	4.816	.596
	Cayman Brac	14.159	.013**

The same analysis is repeated, using the sample as a whole. Also people that indicated that they are not willing to pay are included in this analysis. Their amounts are set to 0. Including the respondents that are not willing to pay in the analysis gives the following results. **The average amount that respondents in the sample are willing to pay per month is 12.68 CI$.** The mean is 5 CI$ per month and the mode is 0. See Table 14.

Table 14: Willingness to pay overall

	Yes	No
Count	240	143
Percentage	62.5%	37.2%
Mean	**Median**	**Mode**
12.68	5.00	0

As shown in Table 15, the ANOVA analysis again shows significant differences between the amounts that respondents from the different islands are willing to pay: $F(2, 374) = 9.535$, $p < .001$. Levene's test of variances shows that variances are unequal (Levene statistic = 8.681, $p < .001$). Because the group sizes are also different, post-hoc test Games-Howell is used. The post-hoc analysis shows that there are significant differences between all three islands.

A t-test is used to check if there are significant differences in the number people are willing to pay across people born on the Cayman Islands and people born elsewhere. The test concludes that people born outside the Cayman Islands are willing to pay significantly (at the 10% level) more than people born in the Cayman Islands.

Table 15: ANOVA willingness to pay (Multiple comparisons: Games-Howell)

Island	Compared with	Mean difference	Sig.
Grand Cayman	Cayman Brac	4.514	.072*
	Little Cayman	-10.786	.042**
Cayman Brac	Grand Cayman	-4.514	.072*
	Little Cayman	-15.300	.002**
Little Cayman	Grand Cayman	10.786	.042*
	Cayman Brac	15.300	.002**

4.7 Regression analysis contingent valuation

Regression analysis is used to find out whether the following factors (independent variables) influence willingness to pay (dependent variable). *Income* is measured in 20 possible categories. *Environmental awareness* is measured on a scale from 1-13 (see Annex G1 for calculation). *Fishing* is measured in a dummy variable (yes or no). *Cultural and recreational score* is measured on a scale from 7-41 (see Annex G2 for calculation). *Age* is measured as a continuous variable. *Children* is measured in a dummy variable (1 = yes, 0 = no). *Education* is measured in 8 categories. *Gender* is measured as a dummy variable (1 = male, 0 female). *Place of birth* is measured as a dummy variable (1 = in the Cayman Islands, 0 = elsewhere).

A linear regression is made using the sample as a whole. The dependent variable is the amount that respondents have indicated to be willing to pay in the contingent valuation section. A

backward regression method is used, omitting those variables that are insignificant step by step. The results are as follows (see Table 16). The explanatory power of this model is not very high: the adjusted R Square is .145.

The excluded variables did not provide any statistical significant improvement of the model and are therefore not included in the final model. The table shows that the only significant variables are environmental awareness, income and gender. All three significant variables show a positive relation with the amount respondents were willing to pay.

Since the regression shows that income, environmental awareness and gender are significant in explaining the willingness to pay. Extra analysis is conducted to see how these variables differ per island, which might shed light to the differences in the level of WTP between the islands.

From Table 16 is concluded that residents from Cayman Brac are willing to pay a significantly lower amount than the other two sister islands. According to the analysis on income, a difference in income is found only between Cayman Brac and Grand Cayman, but not between Caymand Brac and Little Cayman respondents (see Annex I). Therefore income does not explain why Cayman Brac residents are willing to pay a level significantly lower than both sister islands. Additionally, environmental awareness is higher in Little Cayman than on the other two islands (see Annex I), which might explain the higher portion of residents in principle WTP in Little Cayman (see Table 9), but does not explain why Cayman Brac residents are willing to pay significantly less than Little Cayman as well as Grand Cayman. As for gender no significant differences are found between the three islands (see Annex I). The analysis on income, environmental awareness and gender does not explain why Cayman Brac residents are willing to pay significantly less than the other two islands, other factors play a role herein.

Table 16: Regression analysis WTP (contingent valuation)

Parameter	***Coefficients – Unstandardized***	***Coefficients – Standardized***	***t***	***Sig.***
Constant	-11.868		-2.923	.004**
Awareness	2.426	.247	4.691	.000***
Income	.001	.237	4.510	.000***
Gender	4.356	.102	1.994	.047*
Excluded				
Recreational and cultural score	.004		.066	.947
Place of birth	-0.045		-.873	.384
Children	-.035		-.669	.504
Education	.064		1.108	.269
Age	-.059		-1.145	.253
Fishing in household	-.062		-1.198	.232
Adjusted R Square	.145			

**** stands for significant at the 1% level, **stands for significant at the 5% level, * stands for significant at the 10% level.*

4.8 Willingness to pay choice experiment

The utility of the environmental protection options (Alternatives A and B) is expressed as a function of the attributes shown in options A and B, and the utility of the opt-out option (Alternative C) is modeled using a constant parameter. Formally, the indirect utility functions of the alternatives can be represented by the equation below.

$$U_{environmental\ protection} = \beta_1 \times no\ take\ zone + \beta_2 \times moderate\ reef\ quality + \beta_3 \times good\ reef\ quality + \beta_4 \times moderate\ water\ quality + \beta_5 \times good\ water\ quality + \beta_6 \times fish\ catch + \beta_7 \times mangrove\ conversion + \beta_8 \times tax$$

$$U_{opt\ out} = \alpha_1 \times constant.$$

A description of these variables and their coding is given in Annex F1. As is common, the attributes with qualitative levels (reef quality and water quality) are included in the model as dummy variables. Dummy variables of the levels of moderate and good quality of these attributes are included in equation 4.9.1, while the dummy variables of the poor quality levels are excluded. In other words, the coefficients of the included dummy variables capture the utility differences of keeping quality at moderate or good levels compared with the utility of a poor quality (the excluded baseline level).

Table 17 shows the results of a standard logit model. The coefficients of the attributes are highly statistically significant (at the 1%), meaning that they differ from zero, except for the coefficient of the attribute no take zone.[1] All coefficients have the expected sign. In particular, the utility of environmental protection is positively related with reef and water quality as well as with fish catch, and negatively related with mangrove conversion and the tax. Moreover, the utility of good reef quality is higher than moderate reef quality, while differences in utility between moderate and good water quality are very small. Moderate and good levels of both of these attributes have a higher utility than poor levels.

Next, more advanced models are estimated to test and relax some of the assumptions that underlie the standard logit model. A panel error correction logit model is estimated. While the standard logit model assumes that the error terms of the model are independent, the panel model accounts for possible dependence between errors for each individual. In other words, the panel model accounts for the fact that each respondent answered 6 choice cards, meaning that not every observation in the data is independent as the standard model assumes. Moreover, an error correction component was included by adding a normally distributed zero mean error correction component which allows for different variances of the environmental protection alternatives and the opt-out option (Scarpa et al., 2007). The standard deviation of this error component appears to be statistically significant, which implies a considerably larger variance of the utility specifications of the environmental protection alternatives than of the opt-out. This is in line with others who find that the variance of utility of hypothetical alternatives is larger than the opt-out, which has been called the 'status quo' effect in choice experiments (Hess and Rose, 2009; Hu et al., 2009; Botzen and van den Bergh, 2012; Botzen et al., 2013).

[1] It has been examined whether dummy variables of the separate levels of the no take zone attribute have a significant influence on choices; these variables are also insignificant and do not significantly improve model fit.

The last column in Table 17 shows the results of this final attributes-only model. This model provided a better fit of the data than the standard logit model, as is reflected by a lower AIC and higher pseudo-R^2. Overall the pseudo-R^2 vale of 0.30 reflects a reasonably good fit for this type of models (Train, 2003). The main results are similar to the findings of the standard logit model in Table 17. In addition, the standard deviation of the error correction component is highly statistical significant. In other words, the variance of the error terms of the choice alternatives A and B is significantly larger than the error associated with the opt out, and capturing this in the model improves its fit.[2]

Table 17: Attributes only model results estimated by a standard logit model (left) and an error correction panel logit model (right)

Variable	Standard logit Coefficient	Error correction panel logit Coefficient
no take zone	-0.0008	-0.0007
moderate reef quality	0.2574***	0.3573***
good reef quality	0.4877***	0.6682***
moderate water quality	0.3628***	0.4365***
good water quality	0.3754***	0.3818***
fish catch	0.0022***	0.0033***
mangrove conversion	-0.0056***	-0.0063***
tax	-0.0044***	-0.00689***
constant	-0.3162**	-4.2551***
Number of observations	2103	2034
McFadden R^2	0.19	0.30
AIC	2.1182	1.5450
Log likelihood	-2218	-1560

*Notes: *** stands for significance at the 1% level. The number of observations is lower in the error correction model, because observations from respondents who did not answer all choice cards have to be excluded in order to be able to estimate respondent-specific error terms that reflect the panel structure of the data.*

[2] Moreover, random distributions of the parameters of the attributes were added to the model, resulting in a panel error correction mixed logit model. These random distributions can detect the presence of significant heterogeneity of preferences between respondents. Following common practice, uniform distributions were specified for coefficient of dummy variables and normal distributions were specified for the continuous variables mangrove conversion, no take zone, and fish catch (e.g. Train, 2003). The parameters of the latter two variables appear to have significant standard deviations, while no significant preference heterogeneity exists (at the 5% significance level) for the coefficients of the other variables (results are not shown here). However such an attributes only model using a panel error correction mixed logit model that models preference heterogeneity for the attributes no take zone and fish catch does not significantly improve model fit compared with the panel error correction model in Table 19, which is why the simpler error correction model is reported here.

A variety of models have been estimated to examine how preferences for the attributes differ with respect to various socio-economic and other characteristics of the respondents as well as the Islands where the interviews took place. This is done by including interactions of these variables with the attributes, and testing whether such interactions are statistically. Table 17 shows the results of a panel error correction model with only significant interactions, meaning that variables with insignificant interactions terms (see Annex F2) were excluded from this model[3]. Annex F3 defines these variables for which interactions turned out significant. It should be noted that different socio-economic characteristics may be (in)significant in the choice experiment model than in the contingent valuation model. These models and their underlying choice patterns are difficult to compare, because they entail different decision making processes: i.e. proving a maximum WTP value for marine protected areas in the contingent valuation question and indicating preferences for a bundle of environmental goods with varying characteristics in the choice experiment.

Several additional insights result from the complete model shown in Table 18 compared with the attributes only model results in Table 17. While the coefficient of the no take zone is insignificant in the attributes only model (Table 17), it is significant in the complete model that controls for the negative interactions of place of birth and age with this attribute (Table 18). These results imply that residents born in Cayman Islands have a negative preference for larger no take zones, while this negative effect is less severe for residents born elsewhere. The negative interaction with age means that older people place a lower value on larger no takes zones.

The results for improvements in reef and water quality of the complete model are similar to the attributes only model since no significant interactions with these attributes can be observed.

Table 18: Complete model results estimated by a panel error correction mixed logit model that includes significant interactions with the attributes and respondent characteristics

Variable	Coefficient
no take zone	0.0169***
no take zone × born on the Cayman Islands	-0.0145***
no take zone × age	-0.0003***
moderate reef quality	0.3754***
good reef quality	0.7107***
moderate water quality	0.4715***
good water quality	0.3938***
fish catch	0.0007
fish catch × Cayman Brac	0.0070***
mangrove conversion	-0.0077***

[3] It has been examined whether the coefficient of the tax depends on income and/or whether this coefficient differs in the questionnaire version where the contingent valuation (CV) question was placed before the choice experiment (Version A) compared with the version where the CV question appeared after the experiment. Both of these interactions variables with the tax variables are insignificant. Moreover, we tested for whether the following variables have an influence on preferences for the attributes, which turned out to be having insignificant effects: education level, gender, number of children in a household, and whether the interview took place on the Island.

mangrove conversion × Little Cayman	0.0081*
tax	-0.0105***
tax × fishing	0.0089***
Constant	3.0805*
Constant × environmental awareness	-0.9542***
standard deviation of the error component	6.7325***
Number of observations	*2022*
McFadden R^2	*0.32*
AIC	*1.5150*
Log likelihood	*-1516*

*Notes: ***,**,* stands for significance at the 1%, 5%, and 10% level.*

It is examined for all attributes whether preferences differ between the three Islands of the Cayman. A statistically significant difference is found for the fish catch attribute, which is significantly higher for interviews taken on Cayman Brac. Including this significant interaction implies that the overall fish catch attribute (for the main Cayman Island and Little Cayman) becomes insignificant (Table 18), while this was significant in the attributes only model (Table 17). This suggests that positive WTP for improved fish catch mostly apply to Cayman Brac and not to the other islands. Moreover, a significant and positive interaction is found for the attribute mangrove conversion and interviews taken on Little Cayman. Overall significant negative preferences exist for mangrove conversion, while this effect is slightly positive (but close to zero) for Little Cayman.

A positive significant coefficient is observed for an interaction variable with the tax level and whether people fish. This implies that people that fish have overall a higher WTP level for all environmental attributes. Preferences for specific environmental attributes do not differ significantly between people who do, or do not, fish.

4.9 WTP range contingent valuation and choice experiment

The panel error correction logit model is used to calculate willingness-to-pay (WTP) values since this model provides the best fit of the data. The results of the initial analysis are suspected to suffer from a hypothetical bias, which causes WTP estimates that are unrealistically high. Therefore, an additional analysis is used to calculate WTP estimates (please see Annex F4 for details on WTP calculation).

The average amount that households in the sample are willing to pay per month for an improvement in a marine protection area ranges between 12.68 CI$ (CV) and 16.55 CI$ (CE). The Cayman Islands has approximately 24,165 households (ESO, 2012), which leads to a range of **the Total Yearly Cultural and Recreational Value of the Marine Environment of 3.7 million – 4.8 million for its residents**. Within Table 19 one can see the average WTP per month per household for a marine protection area improvement and the relative importance between attributes expressed by the respondents when choosing between different scenarios.

What is prominent is that reef quality and water quality as well as mangrove conversion are on average valued substantially more than the other attributes (no take zone and fish catch)[4]. The nuance lies, as explained in the chapter 4.8 on other factors, such as being born on Cayman, being a fisherman, age and differences between islands.

Table 19: Average WTP per household per month range between CV and CE

Attribute	WTP per household per month CV	WTP per household per month CE
no take zone (80% no take zone)	-$0.52	-$0.67
good reef quality	$6.16	$8.04
good water quality	$3.52	$4.59
fish catch	$0.03	$0.04
Mangrove conversion (60% not converted)	$3.49	$4.55
Total	$12.68	$16.55

4.10 Anchoring/ordering effect

In answering the contingent valuation question, 62.7% of the respondents answered that they are willing to pay for management of the marine environment (see Table 20). In answering the choice experiment, 76.8% of the respondents chose a choice card that included a payment at least once. Of those respondents that said "no" in the contingent valuation question, 46.9% still chose at least one choice card including a payment in the choice experiment.

Table 20: Willingness to pay

	Contingent valuation	Choice experiment
Yes	62.7%	76.8%
No	37.3%	23.2%

A t-test was performed to see whether changing the order of the questions influences the percentage of people willing to pay. Table 21 shows that respondents presented with version B were significantly more often willing to pay in the contingent valuation question. Having seen the more comprehensive choice experiment first, including implications of certain payments, might influence the respondent in determining the amount in the contingent valuation question. In answering the choice experiment, no significant differences were found between variant A and B.

[4] Since attribute 'mangrove conversion' does not ecologically lead to an improvement in marine park management it is excluded from the calculation of the average WTP per month per household for an improvement in marine park management (please see Annex F4 for more detailed explanation).

Table 21: Percentage of people willing to pay, per version

	% willing to pay - Version A	% willing to pay - Version B	t-value	Sig.
Willingness to pay contingent valuation	58.3%	67.0%	-1.759	.079*
Willingness to pay choice experiment	75.1%	78.5%	-.789	.431

Note: * stands for significant at the 10% level

When looking at the amounts that respondents said they would be willing to pay, the following differences were observed. In answering the contingent valuation question, those respondents that were presented with the questionnaire of variant A expressed a lower willingness to pay than the respondents presented with variant B. This difference is significant at the 10% level: $t = -1.752$, $p < .10$ (see Table 22). These outcomes show that having the choice experiment first possibly increases the amount that people are willing to pay in the contingent valuation question. This can be seen as an anchoring/ordering effect of the choice experiment on the contingent valuation question. The t-test does not show significant differences in the amount people are willing to pay in the choice experiment. People answering version A did not show a significantly lower or higher willingness to pay than people answering version B.

Table 22: Mean willingness to pay (amount) and t-test

		Mean	t	Sig.
Contingent valuation	*Variant A*	10.84	-1.752	.081*
	Variant B	14.51		
	Mean difference	-3.673		
		Mean	**t**	**Sig.**
Choice experiment	*Variant A*	16.87	.431	.667
	Variant B	16.22		
	Mean difference	.647		

The results following from the choice experiment, as discussed earlier, show no evidence of the presence of an anchoring effect in the outcomes of the choice experiment. There is no significant influence of the version used (A or B) on the amount of the willingness to pay respondents express in the choice experiment.

Following Frykblom and Shogren (2000), the presence of the anchoring effect is also tested in a way different from the method used in Section 4.9. For each respondent, the average willingness to pay following from the choice experiment was calculated. In order to do so, the corresponding monthly payment for every choice card of every version was added to each choice made by the respondent. Afterwards, the average for each respondent could be calculated. This average was compared with the amount people stated they would be willing to pay when asked the contingent valuation question. For each respondent, the difference between these two values was calculated as follows:

$$WTP_{Difference} = WTP_{Contingent\ Valuation} - WTP_{Choice\ Experiment}$$

The new variable $WTP_{Difference}$ was used to see whether these differences between the two questions were bigger for one of the versions. Variant A is the variant in which the contingent valuation question was asked first, variant B is the variant in which the choice experiment took place first. If there would be an anchoring effect of the contingent valuation question, one would expect to see a bigger difference between both values in variant A than in variant B. Vice versa, if the choice experiment would have an anchoring effect on the contingent valuation question, there would be a bigger difference between both values in variant B than in variant A. To sum up, this method looks at the *difference* in amounts rather than the *level* people are willing to pay.

A t-test was conducted to see if the average difference between the willingness to pay expressed in the contingent valuation question and the willingness to pay expressed in the choice experiment is significantly different between version A and version B. The outcomes are summarized in Table 23. The t-test shows that there is a significant (at the 10% level) difference in between $WTP_{Contingent\ valuation}$ and $WTP_{Choice\ experiment}$ between variant A and variant B. Those respondents that were presented with variant A, in which the contingent valuation question was posed before the choice experiment, show a significant bigger difference between the two willingness to pay measures than people that were presented with variant B (choice experiment first, contingent valuation question afterwards). The mean difference between the two WTP measures is 6.16 CI$ for the "variant A-group" and 1.83 CI$ for the "variant B-group". And since Table 22 shows that there are no significant differences in the amount people are willing to pay in the choice experiment, it must be the case that in variant A, the amount that people are willing to pay in the contingent valuation is significantly lower than in variant B. It seems like there is an anchoring effect of the choice experiment on the contingent valuation question: having seen the more comprehensive choice experiment first not only leads to a higher percentage of the respondents willing to pay in the contingent valuation (Table 21), it also leads to respondent willing to pay *more* in the contingent valuation (Table 22).

Showing respondents the choice experiment first is associated with a higher fraction of the respondents being willing to pay in the contingent valuation, and to respondents being willing to pay more in the contingent valuation, compared to respondents that were shown the contingent valuation question first.

Table 23: difference in $WTP_{Difference}$

	Mean	t-value	Sig.
Variant A	-6.1563	-1.824	.069*
Variant B	-1.8329		
Mean difference	-4.32340		

* stands for significant at the 10% level

Next, "variant" is included in the regression analysis to find out whether the effect still remains present when correcting for other factors, such as income and age. The outcomes are shown in Table 24. The dependent variable is $WTP_{Difference}$: the difference between the values expressed in the contingent valuation question and the values expressed in the choice experiment. The explanatory variables are the same variables used in section 4.8, adding the version of the questionnaire as an extra explanatory variable. A backward regression method is used, omitting those variables that are insignificant step by step. The explanatory power of this model is not very high: the adjusted R Square is .072.

The excluded variables did not provide any statistical significant improvement of the model and are therefore not included in the final model. The table shows that the only significant variables are environmental awareness, income and variant. All three significant variables show a positive relation with the amount respondents were willing to pay. This means that the variant indeed

plays a role in determining the difference in WTP between the contingent valuation question and the choice experiment. Shifting between version A and B (0 and 1 in the dummy variable) leads to an increase in the difference between both values. The t-test has already shown that this difference in bigger in version A than in version B.

Table 24: Regression analysis for $WTP_{Difference}$

Parameter	Coefficients Unstandardized	Coefficients Standardized	t-value	Sig.
Constant	-25.070		-5.175	.000***
Awareness	1.942	.176	3.203	.001**
Income	.001	.164	2.997	.003**
Variant	5.455	.114	2.137	.033**
Excluded				
Fishing in household	-.005		-.101	.972
Education	-.013		-.209	.792
Recreational and cultural score	-.003		-.054	.809
Age	.018		.342	.984
Place of birth	-.032		-.592	.985
Children	.028		.529	.985
Gender	.081		1.516	.980
Adjusted R2	*.072*			

*Notes: ***,**,* stands for significance at the 1%, 5%, and 10% level.*

4.11 Statements

At the end of the survey, respondents were presented with 9 statements about managing the marine environment of the Cayman Islands. This section analyses the responses. For every statement, respondents were asked to indicate to what extent they agreed with the statement. Options run from 1 (completely disagree) to 5 (completely agree). Annex I shows a cross-tabulation of the scores per statement across the three islands. The following statements are fully agreed with by most of the respondents:

1. 'A healthy marine environment is crucial for my family and me' – 76.3% of the respondents completely agreed with this statement.
2. 'I want future generations to enjoy a healthy marine environment at least as much as I do' – 85.1% of the respondents completely agreed with this statement.
3. 'The marine environment of the Cayman Islands should be managed actively' – 71.8% of the respondents agreed completely with this statement.

The vast amounts of tourists visiting the Cayman Islands each year (1,375,872 by cruise and 345,387 by air in 2013 (Cayman Islands Government, 2014)) put a burden on the environment in terms of litter, energy consumption (Richardson et al., 2013). Therefore, statement no. 7 ("the total amount of visitors allowed on the Cayman Islands should be restricted") was included in the

questionnaire. This statement serves to see what respondents' attitudes are towards the influences of tourism on the marine environment. It might be that respondents regard these influences as detrimental to their own cultural and recreational appreciation of the marine environment. The statement provoked a lot of reactions. The responses to this statement are mixed and are therefore shown in more detail in. The figure shows that on Little Cayman, much more respondents completely agreed with this statement than on the other two islands. Also, on Little Cayman, the number of respondents completely disagreeing with the statement was much lower than the number of respondents from the other two islands.

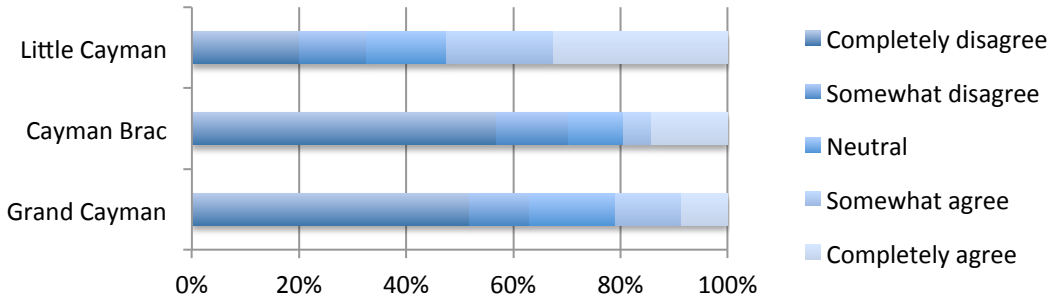


Figure 14: Restriction on visitors per island

A one-way ANOVA was used to see whether the differences between the islands are significant. The outcomes are shown in Table 25. This table shows that there are significant differences between the three islands ($F = 12.927$, $p < .000$). Post-hoc test Hochberg is used, because variances can assumed to be equal and group sizes are different. Respondents on Little Cayman agreed significantly more with this statement than respondents on Grand Cayman and Cayman Brac. There are no significant differences between Grand Cayman and Cayman Brac. This difference may be caused by the difference in current capacity on the islands: Little Cayman has only 85 bedrooms available for tourists and residents value the small community and less developed island (Cayman Islands National Tourism Management Plan, 2009).

Table 25: ANOVA for "restrictions on visitors" - Multiple comparisons: Hochberg

Island	Compared with	Mean difference	Sig.
Grand Cayman	Cayman Brac	.080	.940
	Little Cayman	-1.181	.000***
Cayman Brac	Grand Cayman	-.080	.940
	Little Cayman	-1.260	.000***
Little Cayman	Grand Cayman	1.181	.000***
	Cayman Brac	1.260	.000***

*Notes: ***,**,* stands for significance at the 1%, 5%, and 10% level.*

The statements section also included two statements about the expansion of the MPAs of the Cayman Islands:

1. I support the expansion of the Marine Protected Areas of the Cayman Islands
2. I support the expansion of the Marine Protected Areas of the Cayman Islands up to at least 40-50% of the coastal shelf

The second statement reflects the proposed changes made by the Department of Environment. Table 26 shows the percentage of people agreeing (those who somewhat agreed and those who completely agreed) with the second statement and compares these percentages with the outcomes of the public consultation done by the Department of Environment (Richardson et al., 2013). The table shows that a larger fraction of the respondents agreed with the expansion of the Marine Parks system in this study compared to the public consultation. Especially the scores on Cayman Brac are very far from each other. Again, there are several possible reasons for this discrepancy. Whereas the public consultation was completely geared towards assessing people's opinions on the intended expansion, the statement in this study was part of a larger survey. People might have been primed by the previous questions, and may have started to realize what trade-offs need to be made in marine conservation. Also, the statement used in this study is a simplification of the proposed changes presented during the public consultation. Whereas the statement in this study is only referring to expansion of the MPAs, the public consultation study offered respondents a much more comprehensive overview of the proposed changes, including, apart from the expansion, stricter regulations in some places.

The difference in scores on Cayman Brac might be caused by the fact that during the public consultation, there was an active action group that was campaigning against changes to the system of Marine Parks (Richardson et al., 2013).

Table 26: People agreeing with proposed changes

Island	% supportive (Richardson et al., 2013)	% agreeing with statement number 2 on 40-50% expansion
Grand Cayman	47%	58.0%
Cayman Brac	14%	62.6%
Little Cayman	52%	85.0%

5 Discussion and conclusion

In this section, the results are discussed. Also, conclusions are drawn and suggestions for further research are made.

5.1 Discussion

The careful design of the study allowed for testing of anchoring or ordering effects. Although the choice experiment did not reveal a significant sensitivity of the version of the questionnaire on the willingness to pay, there are indications that in the contingent valuation question such influences do play a role. Furthermore, when looking at the differences between payments, the analysis has shown that in version A the difference between the contingent valuation and the choice experiment is significantly higher than in version B. This effect remains present when correcting for other factors in a regression. Changing the order of the questions influences the difference between the payments made in the contingent valuation and the payment made in the choice experiment. Showing respondents the choice experiment first is associated with a higher fraction of the respondents being willing to pay in the contingent valuation, and to respondents being willing to pay more in the contingent valuation, compared to respondents that were shown the contingent valuation question first.

Choice modelling is a method that is especially useful in determining people's relative preferences. The willingness to pay values resulting from the choice experiment are rather high. Due to extrapolation of the values given in the choice experiment, the analysis arrives at maximum amounts that are beyond the levels shown in the attributes. The usefulness of these CE values is that they show us important information regarding the relative preferences of the respondents. However, it is essential to combine these values with the quite possibly more realistic outcomes of the direct contingent valuation question regarding the WTP. Despite the fact that these values do not perform as well as the choice experiment in terms of reflecting real life choice making between different factors, they usually are lower and thus might be more realistic than the values derived from the choice experiment.

Similar to choice experiments, the contingent valuation method seems to suffer from various biases such as the hypothetical bias. Yet, the literature shows disagreement as to whether the answers respondents give to contingent valuation questions are actually that hypothetical. For example, Hoehn and Randall (1987), as well as Hanemann (1994) stress that if people are under the impression that their responses will have an influence on policy (which was definitely the case in the Cayman Islands, where respondents were well aware of the fact that their answers could affect decision making), they take this into account when answering the question. On the one hand, one can see this as a disadvantage, leading to strategic answers by the respondents. On the other hand, this influence might also lead to more realistic answers, because when people think they really have to pay, they will not come up with amounts they cannot afford. When people do not believe they really have to pay, strategic answers may lead to values that are unrealistically high: for example when people want to express how important they think the subject is. The added value can be found in combining the two: using the contingent valuation for realistic levels of willingness to pay, and combining this with the knowledge about relative preferences of the various components of that value, obtained in the choice experiment.

5.2 Conclusion

The contingent valuation has shown that 63% of the respondents is willing to pay for management of the marine environment. The average amount that respondents are willing to pay per month for an improvement in a marine protection area according to the contingent valuation is almost 12.69 CI$ and according to the choice experiment 16.55 CI$. The Cayman Islands has approximately 24,165 households, resulting in a range of the total yearly cultural and recreational value of the marine environment of between 3.7 million – 4.8 million CI$ for its residents.

Combining the WTP values with the relative importance of each of the attributes found in the choice experiment yields information for decision makers, for example in determining how to allocate a budget. The analysis in this study has shown that people who fish, or have someone in their households who fishes, are willing to pay more for marine environment conservation than people who do not. Furthermore, the choice experiment has shown that reef quality and water quality are valued substantially more than the other attributes (no take zone and fish catch). Decision makers can make use of this knowledge, because it shows what exactly people value in the marine environment and how much they value these elements.

The choice experiment further shows the differences in WTP for the no take zone between born on the Cayman Islands and residents born elsewhere. Residents born in the Cayman Islands have a negative WTP for no take zone whilst residents born elsewhere have a positive WTP. This means that no take zones are more accepted by residents born elsewhere. Additionally it was found that older people place a lower value on larger no take zones and thus are more apprehensive of this protection approach. Even though no take zones are a main component of MPAs for the protection of the other attributes that people value, declaring areas as no-take zones remains the biggest challenge for policy makers. The results indicate that compensation will have to be provided for fishermen to give up fishing areas.

There is also difference in values between the sister islands. Residents from Cayman Brac have a relatively higher value for fish catch than the other sister islands. This especially holds for fishing families. It was also observed that mangrove conversion is less of an issue for residents on Little Cayman than on the other sister islands.

This study has also found levels of support for expansion of the MPAs different from the levels found by Richardson et al. (2013). As discussed, there are several possible reasons for this difference, including the fact that respondents are primed differently in both studies and the fact that the public consultation offered respondents a more comprehensive explanation of the plans. In general, the public consultation by Richardson et al. (2013) yielded levels of support ranging from 14% to 47% between the sister islands, whereas this study found that 58% to 85% of the respondents agree with the statement: “I support the expansion of the Marine Protected Areas of the Cayman Islands up to at least 40-50% of the coastal shelf”.

In summary, this study provides important information on the cultural and recreational value of the marine environment of the Cayman Islands. The overall economic analysis of the costs and benefits of MPA expansion in the Cayman Islands is not complete yet. After all, the cultural and recreational value is only one element of the larger Total Economic Value of the Cayman Islands’ marine environment. Further research should therefore try to measure the additional values such as commercial fisheries and non-use values. Ultimately, estimating the Total Economic Value of the marine environment will assist decision makers in raising awareness and showing and deciding on trade-offs. Moreover, such all-encompassing value will also enable decision makers to conduct a complete benefit-cost analysis for the expansion of the Marine Protected Areas of the Cayman Islands.

References

Agardy T., Bridgewater P., Crosby M.P., Day J., Dayton P.K., Kenchington R., et al. (2003). Dangerous targets? Unresolved issues and ideological clashes around marine protected areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 13: pp. 353–67.

Agardy, M. (1994) Advances in marine conservation: the role of marine protected areas. *Trends in Ecology & Evolution*, 1994, Vol. 9 (7): pp.267-270.

Alder, J. (1996). Have tropical marine protected areas worked? An initial analysis of their success. *Coastal Management* Vol.24 (2): pp. 97-114.

Amos Tversky and Daniel Kahneman (1974). Judgment under Uncertainty: Heuristics and Biases. *Science* Vol.185, No. 4157, pp. 1124-1131.

Angulo-Valdés, Jorge A., and Bruce G. Hatcher (2010). A new typology of benefits derived from marine protected areas. *Marine Policy* 34, pp. 635-644.

Benjamin S. Halpern, Sarah E. Lester, Karen L. McLeod and Steven D. Gaines (2010). Placing marine protected areas onto the ecosystem-based management seascape. *Proceedings of the National Academy of Sciences of the United States of America* Vol. 107, No. 43, pp. 18312-18317

Bennett, Nathan James, and Philip Dearden (2014). Why local people do not support conservation: Community perceptions of marine protected area livelihood impacts, governance and management in Thailand. *Marine Policy* 44: pp. 107-116.

Botzen, W.J.W. and van den Bergh, J.C.J.M. (2012). Monetary valuation of insurance against flood risk under climate change. *International Economic Review* 53(3): 1005-1025.

Botzen, W.J.W., de Boer, J. and Terpstra, T. (2013). Framing of risk and preferences for annual and multi-year flood insurance. *Journal of Economic Psychology* 39: 357-375.

Cayman Islands Department of Environment (DOE) (2014). Marine Park Regulations and Marine Conservation Laws.

Church A., Burgess, J. Ravenscroft, N. (2011). Cultural Services (Chapter 16). Technical Report, Cambridge: UK National Ecosystem Assessment.

Convention on Biological Diversity (UNEP, 1992)

Costanza, R. ; Ralph D'arge ; Rudolf De Groot ; Stephen Farber ; Monica Grasso ; Bruce Hannon ; Karin Limburg ; Shahid Naeem ; Robert V. O'neill ; Jose Paruelo ; Robert G. Raskin ; Paul Sutton ; Marjan Van Den Belt (1997) The value of the world's ecosystem services and natural capital. *Nature* Vol.387: pp.253-260

ESO (2012). 'Compendium of Statistics 2012'. The Economics and Statistics Office of the Government of The Cayman Islands

Fisher, B. & Turner, R.K. (2008). Integrating ecosystem services and economic theory. *Ecological Applications* 18: pp. 2050–2067.

Frykblom, P., and Jason F. Shogren (2000). An Experimental Testing of Anchoring Effects in Discrete Choice Questions. *Environmental and Resource Economics* 16: pp. 329-341.

Green, D., K. Jacowitz, D. Kahneman and D. McFadden (1998). Referendum Contingent Valuation, Anchoring, and Willingness to Pay for Public Goods. *Resource and Energy Economics* 20: pp. 85– 116.

Gumbel, E. J., J. Arthur Greenwood and David Durand (1953). The Circular Normal Distribution: Theory and Tables. *Journal of the American Statistical Association* Vol. 48, No. 261: pp. 131-152

Hanemann, Michael W. (1994). Valuing the Environment through Contingent Valuation. *Journal of Economic Perspectives* 8(4): pp. 19-43.

Hess, S. and Rose, J.M. (2009). Should reference alternatives in pivot design SC surveys be treated differently? *Environmental and Resource Economics* 42: 297-317.

Hoehn, John P. and Alan Randall (1987). A satisfactory benefit cost indicator from contingent valuation. *Journal of Environmental Economics and Management* Vol. 14, Issue 3: pp. 226-247.

Hu, W., Cox. K.B.K. and Pan, M. (2009). Economic values of Dolphin excursions in Hawaii: A stated choice analysis. *Marine Resource Economics* 24: 61-76.

Jentoft, Svein, Thijs C. van Son and Maiken Bjørkan (2007). Marine Protected Areas: A Governance System Analysis. *Human Ecology* 35: pp. 611–622

Kragt, Marit & Jeff Bennett (2008). Designing Choice Experiments to Test for Anchoring and Framing Effects. Environmental Economics Research Hub Research Reports No.10, Environmental Economics Research Hub, Crawford School of Public Policy, Australian National University.

Kriströ̈m, B. (1993). Comparing Continuous and Discrete Contingent Valuation Questions. *Environmental and Resource Economics* 3: pp. 63–71.

Laclé, F.A. (2013). Recreational and cultural value of Bonaire's nature to its inhabitants. Master thesis. Amsterdam: VU University.

Ladenburg, J., & Olsen, S. B. (2006). Starting point anchoring effects in choice experiments. Copenhagen: Center for Skov, Landskab og Planlægning/Københavns Universitet.

Lancaster, Kelvin J. (1966). A new approach to consumer theory. *The Journal of Political Economy* Vol. 74 No. 2: pp.132-157.

Mangel (1998). No-take areas for sustainability of harvested species and a conservation invariant for marine reserves. *Ecology Letters* Vol.1(2): pp.87-90

McFadden (1986). The Choice Theory Approach to Market Research. *Marketing Science* Vol. 5, No.4: pp. 175-297

McLeod, K. L., J. Lubchenco, S. R. Palumbi, and A. A. Rosenberg (2005) Scientific consensus statement on marine ecosystem-based management. The Communication Partnership for Science and the Sea (COMPASS). Signed by 221 academic scientists and policy experts with relevant expertise. Available from http://www.compassonline.org/sites/all/files/document_files/EBM_Consensus_Statement_v12.pdf (retrieved June 9, 2014).

McLeod, Karen, and Heather Leslie (ed.) (2009). *Ecosystem-Based Management for the Oceans*. Washington, DC, USA/London, UK: Island Press, 2009

Millennium Ecosystem Assesment. (2005). *Millennium Ecosystem Assessment: Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.

Moody's (2013). Credit Analysis: Government of the Cayman Islands. New York: Moody's Investor Service.

Olynik, J., Richardson, L., Schill, S. (2012). *Marine Ecological Gap Analysis Methodology for the Darwin Initiative to enhance an established marine protected area system in the Cayman Islands*. Report prepared by The Cayman Islands Department of Environment, Bangor University and The Nature Conservancy

Potts, T.; Burdon, D.; Jackson, E.; Atkins, J.; Saunders, J.; Hastings, E.; Langmead, O. (2014). Do marine protected areas deliver flows of ecosystem services to support human welfare? *Marine Policy* Vol.44: pp.139-148

Richardson, L., J. Bothwell, G. Ebanks-Petrie, T. Austin, C. McCoy, J. Olynik, J. Byrne, S. Schill and J. Turner (2013). *Darwin Initiative Marine Parks Review: Public Consultation Summary.* Report prepared by the Cayman Islands Department of Environment and Bangor University for the Darwin Initiative project 18-016, 100 pp.

Roncin N, Alban F, Charbonnel E, Crec'hriou R, De la Cruz Modino R, Culioli J- M, et al. (2008). Uses of ecosystem services provided by MPAs: how much do they impact the local economy? A southern Europe perspective. *Journal for Nature Conservation* 16: pp.256–70.

Scarpa, R., Willis, K.G. and Acutt, M. (2007). Valuing externalities from water supply: Status quo, choice complexity and individual random effects in panel kernel logit analysis of choice experiments. *Journal of Environmental Planning and Management* 50: 449-466.

Scott Farrow, R., Carol B. Goldburg, Mitchell J. Small (2000). Economic valuation of the environment: a special issue. *Environmental Science and Technology* Vol. 34, No. 8.

Simon, Herbert (1957). *A Behavioral Model of Rational Choice. Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting*. New York: Wiley.

TEEB (2010). *The Economics of Ecosystems and Biodiversity Ecological and Economic Foundations.* Edited by Pushpam Kumar. Earthscan, London and Washington

The Cayman Islands National Tourism Management Plan (2009). London: The Tourism Company.

The National Conservation Law of the Cayman Islands (2013-12) [24].

Train, K.E. (2003). *Discrete Choice Models with Simulation*. Cambridge University Press, Cambridge.

Van Beukering, P. H., W. Longland, Cesar, H.; Sablan, J.; Shjegstad, S.; Beardmore, B.; Liu, Y.; Omega-Garces, G. (2007). The Economic Value of Guam's Coral Reefs. Laboratory Technical Report, University of Guam.

WTTC (2014). Travel and Tourism: Economic Impact Cayman Islands 2014. London: World Travel and Tourism Council

Zwerina, K., Huber, J., & Kuhfeld, W.F. (2010). A general method for constructing efficiënt choice designs. SAS Technical Document MR-2010. Available from http://support.sas.com/techsup/technote/mr2010e.pdf (retrieved on June 19, 2014).

Annex A Questionnaire

RECREATIONAL AND CULTURAL VALUE OF THE MARINE ENVIRONMENT TO RESIDENTS OF GRAND CAYMAN

I. Name Interviewer:		***V. Interview ID no.:***
II. Date of interview:		
III. Location:	*District:*	
IV. Start time/end time of interview	*Start time:*	*End time:*

HELLO MY NAME IS..... AND I AM HELPING THE VU UNIVERSITY AMSTERDAM WITH THEIR RESEARCH CALLED "THE CULTURAL AND RECREATIONAL VALUE OF THE MARINE ENVIRONMENT OF THE CAYMAN ISLANDS". WE ARE DOING A SURVEY TO SEE HOW IMPORTANT MARINE LIFE IS TO THE PEOPLE OF THE CAYMAN ISLANDS. WITH MARINE LIFE WE MEAN CORAL REEFS, FISH AND OTHER LIVING CREATURES IN THE OCEAN. WE WOULD LIKE TO HEAR YOUR OPINION ABOUT THIS. **EVERYTHING THAT YOU TELL US WILL BE KEPT STRICTLY CONFIDENTIAL**. THE INTERVIEW WILL TAKE ABOUT THIRTY MINUTES. WOULD YOU BE WILLING TO PARTICIPATE?

I. General Questions

1. Were you born on the Cayman Islands?

1] Yes	□ (GO TO QUESTION 4)
2] No	□

2. If not, where are you from?

1] Jamaica	□	6] Philippines	□
2] United Kingdom	□	7] Elsewhere in Latin America	□
3] United States of America	□	8] Elsewhere in Europe	□
4] Canada	□	9] Elsewhere, specify:	□
5] Honduras	□	10] Declined to answer	□

3. For how many years have you been living on the Cayman Islands? _____ years

4. How many people live in your household?

1] Number of adults		2] Number of children under 18	

II. Environmental awareness

5. To what extent do you consider yourself environmentally aware?

1] Not at all	☐	4] More than average	☐
2] Less than average	☐	5] Very much	☐
3] Average	☐		

6. Did you do any of the following activities in the past year?

	1] Yes	2] No
1] Seek environmental information (*on internet, TV, newspaper, radio etc.*)	☐	☐
2] Attend public meetings held by the Department of Environment	☐	☐
3] Avoid littering	☐	☐
4] Buy locally grown fruit and vegetables	☐	☐
5] Purchase environmentally friendly products (*reusable bags etc.*)	☐	☐
6] Donate money to an environmental cause (*e.g. a nature conservancy organization*) IF YES, SPECIFY: ..... CI$ IN LAST YEAR	☐	☐
7] Do any voluntary environmental work (*e.g. clean up beach/nature*) IF YES, SPECIFY: .....HOURS IN THE LAST YEAR	☐	☐
8] Other environmentally friendly activities, please specify: …	☐	☐

7. How important do you consider the following potential threats facing the marine environment of the Cayman Islands? (*1 being not important at all and 5 being very important*)

	Not Important	Not very Important	Neutral	Somewhat Important	Very Important	Don't Know
1] Population increase	1	2	3	4	5	0
2] Invasive fish (*e.g. the Red Lionfish*)	1	2	3	4	5	0
3] Impacts of fishing	1	2	3	4	5	0
4] Coastal development of beaches	1	2	3	4	5	0
5] Coastal development of mangroves	1	2	3	4	5	0
6] Impacts of diving, snorkelling and boating	1	2	3	4	5	0
7] Climate change	1	2	3	4	5	0
8] Solid waste and litter	1	2	3	4	5	0
9] Sewage	1	2	3	4	5	0
10] Diseases of coral	1	2	3	4	5	0
11] Other, specify:	1	2	3	4	5	0

III. Recreation

8. How often do you participate in each of the following activities in nature?

	1] Never	2] Once a year	3] Once a month	4] Once a week	5] More than once a week
1] Fishing	□	□	□	□	□
2] Going to the beach	□	□	□	□	□
3] Boating/sailing/ kayaking	□	□	□	□	□
4] Swimming/wading	□	□	□	□	□
5] Diving	□	□	□	□	□
6] Snorkelling	□	□	□	□	□

9. How often do you eat locally caught fish or lobster?

1] Never	2] Once a month	3] Once a week	4] More than once a week	5] Every day
□	□	□	□	□

10. In your view, what specific species in the marine environment of the Cayman Islands should receive extra protection? Please name 3 species (if applicable)

_____

_____

_____

IV. Recreational Fishing in your household

11. Do you or someone else in your household currently fish (for recreational purposes)?

1] Yes CONTINUE WITH QUESTION 12	☐
2] No CONTINUE WITH QUESTION 14	☐

[**Important Note** – fishing can include any method of harvesting marine food from the sea; hook and line, spearing, netting, gathering lobster, etc.]

12. How many people currently fish for recreational purposes in your household? Number: _____

13. What motivates members of your household to go fishing?

	Not important	Not very important	Neutral	Somewhat important	Very important
1] I enjoy fishing / I find it relaxing	1	2	3	4	5
2] I catch for food	1	2	3	4	5
3] To give catch to my family and friends	1	2	3	4	5
4] I catch fish to sell it / supplement income	1	2	3	4	5
5] For tradition: my family has always fished	1	2	3	4	5
6] Fishing strengthens the bond with my friends and family	1	2	3	4	5
7] Other, specify…	1	2	3	4	5

V Contingent valuation

The natural marine resources of the Cayman Islands are in critical decline. An appropriately configured system of Marine Parks is the best tool available for actively managing the natural resources of the Cayman Islands. Nature protection is a costly matter and, therefore, additional financial resources may be needed.

14. Are you in principle willing to pay for management of the marine environment of the Cayman Islands?

1] Yes, CONTINUE WITH QUESTION 16	☐
2] No, CONTINUE WITH QUESTION 15	☐

1] I do not care enough about the marine environment	
2] I am in favour of more protection, but this should be paid from existing tax reven	
3] I can't financially afford to contribute	
4] I doubt the effectiveness of marine environment protection	
5] Other social problems are more urgent	
6] I do not cause nature problems and therefore I am not responsible for solving the	
7] I pay enough taxes already	
8] Other, specify…	

15. What is the main reason why you are **not willing to pay** for management of the marine environment of the Cayman Islands? [AFTER THIS QUESTION, GO TO QUESTION 18]

16. What is your maximum amount of monthly additional contribution you are willing to pay for better enforcement and expansion of Marine Protected Areas? In making a choice, carefully take into account whether you actually can and are willing to pay this amount given your current income level.

CI$ 0	CI$ 2	CI$ 4	CI$ 8	CI$ 15	CI$ 30	CI$ 65	CI$ 120
CI$ 1.25	CI$ 2.50	CI$ 5	CI$ 10	CI$ 20	CI$ 40	CI$ 80	More than CI$ 120
CI$ 1.50	CI$ 3	CI$ 6	CI$ 13	CI$ 25	CI$ 50	CI$ 100	Don't know

You can fill an amount from the table below or any other amount in this box: CI$……. per month

17. Indicate on a scale between 1 to 10 how certain you are about your choice of the amount: 1 means "*not certain at all*" and 10 "*fully certain*"

18. Which of following factors influenced the choice of the amount of your willingness to pay for the marine environment of the Cayman Islands? Please, use a scale between 1 (no influence) to 5 (major influence) to indicate the extent.

	No influence		***<->***	***Major influence***		Don't know
	1	2	3	4	5	
1] Nature degradation is unavoidable anyway						
2] I do not think it is feasible to effectively enforce the Marine Protected Areas						
3] I do not feel that the government is taking into account opinions of Caymanians in designing Marine Protected Areas						
4] Other, specify…						

VI CHOICE EXPERIMENT

REFER TO THE INTERVIEW PROTOCOL

IMPORTANT: FILL VERSION NUMBER____

[REMIND THE RESPONDENT THAT THIS IS AN ANONYMOUS QUESTIONNAIRE AND THAT THIS EXPIREMENT IS HYPOTHETICAL AND THAT THEY SHOULD CHOOSE THE SCENARIOS REGARDLESS OF WHO IS MANAGING THE FUNDS]

SHOW THE EXAMPLE CHOICE CARD HERE

The following questions ask you to make a choice between three scenarios for the future state of the marine environment of Grand Cayman. The scenarios are described in terms of the following aspects:

1. The contribution per year/month that would be contributed financially by **all inhabitants of the Cayman Islands** and would be used strictly for management of the marine environment of the islands
2. No take zones that restrict access for fishers to certain parts of the marine environment.
3. Mangrove conversion refers to how much of the currently existing mangroves will be converted into canals and real estate
4. Reef quality is about the quality of the coral reef that is present in the sea, providing habitat for fish and in this way scenery for diving and snorkelling.
5. Water clarity is indicating whether the seawater is turbid or clear.
6. Fish catch refers to how much fish can be caught for recreational purposes in the seas surrounding the Cayman Islands.

You will be asked to make a choice **six times**. In each question, the options on offer will be different. Try to imagine in which situation you would prefer to be, taking into account the payment, and then choose that option. [SHOW ON THE EXAMPLE CHOICE CARD THAT THE ITEMS FOR ONE SCENARIO BELONG TOGETHER AND INDICATE THAT HE/SHE SHOULD CHOOSE ONE OF THE THREE SCENARIOS]. Be aware that none of the choices has a clear-cut best scenario and that you will need to make trade-offs between the different aspects. There are no wrong answers - we are only interested in your opinion!

Please look at the 3 options shown in the example card. To make a choice between the 3 options you should look at all of the items that shape the option (reef quality, fish catch, contribution per year, etc.).

- In **Option A** there are no takes zones in 40% of the coastal shelf. There is no conversion of mangroves into canals and real estate. The reef quality is good and the water quality is poor. There is no change in fish catch for recreational purposes compared to the current situation. You pay 420 CI$ per year.

- In **Option B** there are no takes zones in 40% of the coastal shelf. There is no conversion of mangroves into canals and real estate. The reef quality is moderate and the water quality is poor. There is no change in fish catch for recreational purposes compared to the current situation. You pay 240 CI$ per year.

- In **Option C** there are no takes zones in 20% of the coastal shelf. 60% of the mangroves are being converted into canals and real estate. The reef quality is poor and the water quality is poor. The fish catch for recreational purposes will be 50% less compared to the current situation. You do not have to pay an additional contribution. This option will remain the same in all 6 choice questions that you will be asked.

Options A and B are different in each question. Please note that none of the options will be perfect from your point of view and that some decisions may be difficult. Every card represents a new choice and has nothing to do with the previous choice.

[FOR THE FIRST CHOICE CARD TRY NOT TO HELP THE RESPONDENT TOO MUCH, UNLESS HE REALLY DOESN'T UNDERSTAND. JUST BRIEFLY POINT OUT THE DIFFERENCES BETWEEN THE OPTIONS IF NECESSARY BUT TRY TO GIVE A BALANCED PRESENTATION. DO NOT LET YOUR VALUES AND PREFERENCES INFLUENCE THE RESPONDENT'S CHOICE!! AFTER ALL CHOICES ARE MADE, ASK THE RESPONDENT THE FOLLOW UP QUESTIONS. IF THE RESPONDENT REFUSES TO MAKE A CHOICE, TRY TO FIND OUT WHY.]

19. Record the respondent's answers to each choice question and the certainty of the choice in the table below. (*Check only one box per row).*

Choice Set	1. **Option A**	2. **Option B**	3. **Option C**	**Declined to answer**
Choice Card 1				
Choice Card 2				
Choice Card 3				
Choice Card 4				
Choice Card 5				
Choice Card 6				

20. Please indicate on a scale from 1 to 10 how certain you are about the choices you just made.

Uncertain ↔ Certain									
1	2	3	4	5	6	7	8	9	10

[ONLY ASK THE FOLLOWING QUESTION IF THE RESPONDENT HAS CHOSEN OPTION C EACH TIME OR DECLINED TO ANSWER, OTHERWISE SKIP TO QUESTION 21]

21. You have chosen the option C in each card or declined to answer. Can you explain why? (*Check only one)*

1] I am not responsible for the damage to the marine environment	☐	6] Don't need another contribution no matter what it is used for	☐
2] I am not confident that the money will be used as specified	☐	7] I couldn't understand the questions/ Too hard to make the choices	☐
3] I do not believe there are serious threats to the marine environment	☐	8] The choices weren't relevant to me / Didn't describe what matters to me	☐
4] The issues are more complex than these questions suggest	☐	9] Other, specify…	☐
5] I cannot afford it /The costs were too high	☐	10] Don't know/refused	☐

22. In making your choices, how important were the following attributes to you? (*1 being not important and 5 being very important*)

	Not important	Not very important	Neutral	Somewhat important	Very important
1] Yearly contribution	1	2	3	4	5
2] No take zones	1	2	3	4	5
3] Mangrove conversion	1	2	3	4	5
4] Reef quality	1	2	3	4	5
5] Water quality	1	2	3	4	5
6] Fish catch	1	2	3	4	5

VII. Statements

23. Indicate whether you agree or disagree with the following statements (*1 disagree & 5 agree*)

Statement	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
1] A healthy marine environment is crucial for my family and me.	1	2	3	4	5
2] I am willing to accept restrictions on fishing if that helps to protect marine life of the Cayman Islands	1	2	3	4	5
3] The tourism sector on the Cayman Islands is dependent on better enforcement of the Marine	1	2	3	4	5
4] The Cayman Islands should be the front-runners of marine conservation in the Caribbean.	1	2	3	4	5
5] I want future generations to enjoy a healthy marine environment at least as much as I do.	1	2	3	4	5
6] The marine environment of the Cayman Islands should be managed actively.	1	2	3	4	5
7] The total amount of visitors allowed on the Cayman Islands should be restricted.	1	2	3	4	5
8] I support the expansion of the Marine Protected Areas of the Cayman Islands	1	2	3	4	5
9] I support expansion of the Marine Protected Areas of the Cayman Islands up to at least 40-50% of coastal shelf	1	2	3	4	5

VIII. Demographics

[REMINDER: FOLLOWING QUESTIONS ARE FOR STATISTICAL PURPOSES ONLY]

24. Gender:

1] Male	☐	2] Female	☐

25. How old are you?

1] 18-19	☐	7] 45-49	☐
2] 20-24	☐	8] 50-54	☐
3] 25-29	☐	9] 55-59	☐
4] 30-34	☐	10] 60-64	☐
5] 35-39	☐	11] 65-69	☐
6] 40-44	☐	12] 70+	☐

26. In which field are you employed?

1] Wholesale and Retail	☐	5] General Public Administration Activities	☐
2] Construction	☐	6] Professional, Scientific and Technical Activities	☐
3] Activities of households as employers	☐	7] Transportation and Storage	☐
4] Financial Services	☐	8] Other, please specify:	☐

27. What is the highest level of education that you have completed?

1] None	☐	5] Vocational training	☐
2] Primary school	☐	6] College / Bachelor's degree	☐
3] Secondary school	☐	7] University / Master's degree or other post-graduate	☐
4] High school	☐	8] Declined to answer	☐

28. What is the gross income earned in your household **before taxes or other deductions** in CI $ last month?
(*Refer to income card and remind the respondent that you are not aware of the meaning of the income categories due to the random lettering)*

29. If you have any other comments, please leave them in the box below.

IF THE RESPONDENT WANTS TO LEAVE HIS OR HER PERSONAL INFORMATION IN ORDER TO RECEIVE INFORMATION OF THE REPORT, ASK HIM OR HER TO DO SO NOW AND RECORD IT.

Name (optional): _____

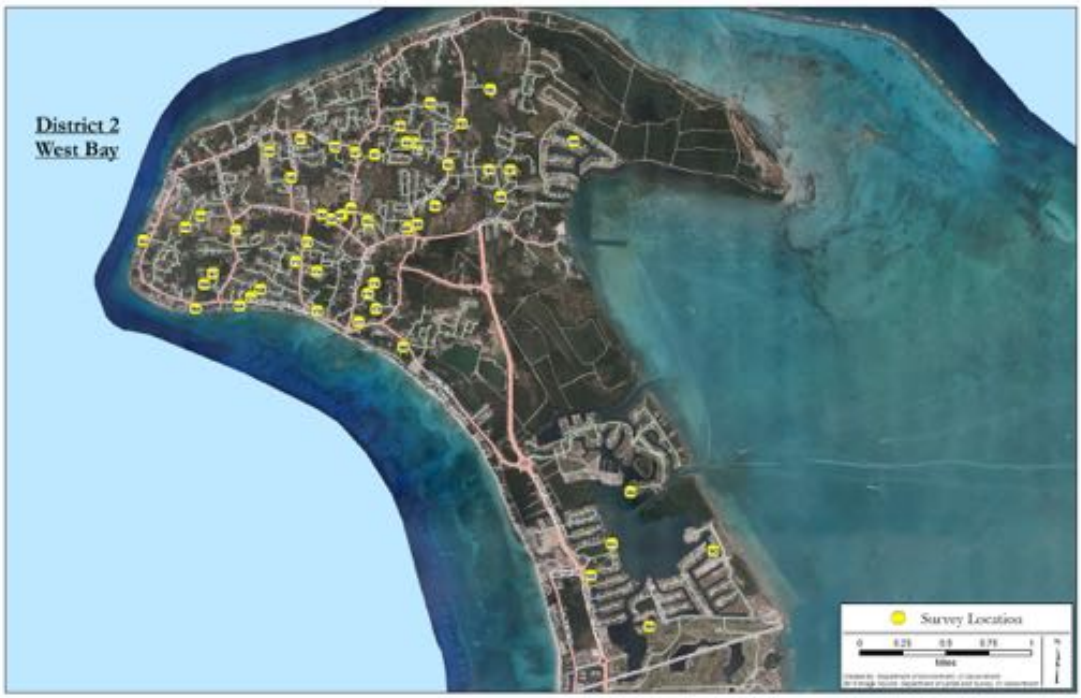
Phone (optional): _____

E-mail (optional) _____

THIS IS THE END OF THE QUESTIONNAIRE; THANK THE RESPONDENT FOR HIS/HER TIME AND PATIENCE!!!

Annex B Maps

B.1 Maps of Grand Cayman




District 3
Bodden Town
Survey Location


District 5
East End
Survey Location


District 4
North Side
Survey Location

B.2 Maps of Cayman Brac

B.3 Maps of Little Cayman


District 7
Little Cayman Map 4
Marleen's Sites
Little Cayman
Marleen's Sample Site

Annex C Threats to the marine environment

C.1 Cross-tabulation of threats according to place of birth

Threat/importance	Not important	Not very important	Neutral	Somewhat important	Very important	Don't know
Population increase						
Born in CI	10.3%	5.5%	16.6%	16.6%	48.3%	2.8%
Born elsewhere	9.2%	6.7%	13.0%	26.8%	38.9%	5.4%
Overall	9.6%	6.2%	14.3%	22.9%	42.4%	4.4%
Invasive fish						
Born in CI	4.2%	0.0%	3.5%	10.4%	78.5%	3.5%
Born elsewhere	2.5%	0.8%	5.4%	10.9%	71.5%	8.8%
Overall	3.1%	0.5%	4.7%	10.7%	74.2%	6.8%
Impacts fishing						
Born in CI	14.5%	7.6%	22.1%	13.1%	40.7%	2.1%
Born elsewhere	8.4%	3.8%	17.6%	20.5%	41.8%	7.9%
Overall	10.7%	5.2%	19.3%	17.7%	41.4%	5.7%
Development beaches						
Born in CI	11.0%	8.3%	15.2%	18.6%	45.5%	11.4%
Born elsewhere	7.9%	4.6%	10.0%	18.4%	53.1%	5.9%
Overall	9.1%	6.0%	12.0%	18.5%	50.3%	4.2%
Development mangroves						
Born in CI	13.8%	5.5%	13.1%	13.1%	52.4%	2.1%
Born elsewhere	5.4%	3.8%	9.6%	10.9%	62.3%	7.9%
Overall	8.6%	4.4%	10.9%	11.7%	58.6%	5.7%
Diving, snorkelling, boating						
Born in CI	26.4%	9.7%	20.1%	20.1%	20.8%	2.8%
Born elsewhere	18.1%	10.5%	19.0%	20.7%	24.9%	6.8%

Overall	21.3%	10.2%	19.4%	20.5	23.4%	5.2%
Climate change						
Born in CI	11.0%	6.9%	12.4%	13.1%	48.3%	8.3%
Born elsewhere	7.6%	4.2%	12.2%	13.0%	53.4%	9.7%
Overall	8.9%	5.2%	12.3%	13.1%	51.4%	9.1%
Solid waste, litter						
Born in CI	5.5%	1.4%	7.6%	5.5%	80.0%	0.0%
Born elsewhere	1.7%	1.3%	3.8%	12.1%	79.9%	1.3%
Overall	3.1%	1.3%	5.2%	9.6%	79.9%	0.8%
Sewage						
Born in CI	8.3%	3.4%	10.3%	8.3%	69.0%	0.7%
Born elsewhere	2.5%	2.5%	7.5%	11.7%	71.1%	4.6%
Overall	4.7%	2.9%	8.6%	10.4%	70.3%	3.1%
Coral disease						
Born in CI	6.2%	1.4%	15.2%	9.0%	55.9%	12.4%
Born elsewhere	2.9%	1.3%	9.6%	11.7%	54.8%	19.7%
Overall	4.2%	1.3%	11.7%	10.7%	55.2%	16.9%

C.2 Cross-tabulation of threats according to island

Threat/importance	**Not important**	**Not very important**	**Neutral**	**Somewhat important**	**Very important**	**Don't know**
Population increase						
Grand Cayman	5.3%	5.3%	10.1%	25.4%	51.3%	3.7%
Cayman Brac	16.8%	16.8%	19.4%	18.1%	29.0%	6.5%
Little Cayman	2.5%	2.5%	15.0%	30.0%	52.5%	0.0%
Overall	9.6%	9.6%	14.3%	22.9%	42.4	4.4%
Invasive fish						
Grand Cayman	2.6%	1.1%	4.8%	12.7%	67.7%	11.1%
Cayman Brac	3.9%	0.0%	4.5%	9.1%	79.2%	3.2%

Little Cayman	2.5%	0.0%	5.0%	7.5%	85.0%	0.0%
Overall	3.1%	0.5%	4.7%	10.7%	74.2%	6.8%
Impacts fishing						
Grand Cayman	5.8%	3.2%	11.6%	18.5%	54.5%	6.3%
Cayman Brac	18.1%	7.7%	31.0%	14.2%	23.2%	5.8%
Little Cayman	5.0%	5.0%	10.0%	27.5%	50.0%	2.5%
Overall	10.7%	5.2%	19.3%	17.7%	41.4%	5.7%
Development beaches						
Grand Cayman	5.8%	2.1%	8.5%	21.2%	56.1%	6.3%
Cayman Brac	15.5%	10.3%	16.8%	15.5%	39.4%	2.6%
Little Cayman	0.0%	7.5%	10.0%	17.5%	65.0%	0.0%
Overall	23.8%	6.0%	12.0%	18.5%	50.3%	4.2%
Development mangroves						
Grand Cayman	4.8%	0.5%	8.5%	9.0%	69.3%	7.9%
Cayman Brac	15.5%	9.7%	14.8%	14.8%	40.6%	4.5%
Little Cayman	0.0%	2.5%	7.5%	12.5%	77.5%	0.0%
Overall	8.6%	4.4%	10.9%	11.7%	58.6%	5.7%
Diving, snorkelling, boating						
Grand Cayman	10.2%	9.1%	17.2%	23.7%	32.3%	7.5%
Cayman Brac	38.7%	11.0%	19.4%	14.2%	13.5%	3.2%
Little Cayman	5.0%	12.5%	30.0%	30.0%	20.0%	2.5%
Overall	56.5%	10.2%	19.4%	20.5%	23.4%	5.2%
Climate change						
Grand Cayman	3.2%	2.1%	9.0%	12.2%	63.3%	10.1%
Cayman Brac	17.4%	10.3%	14.2%	12.9%	36.1%	9.0%
Little Cayman	2.5%	0.0%	20.0%	17.5%	55.0%	5.0%
Overall	8.9%	5.2%	12.3%	13.1%	51.4%	9.1%
Solid waste, litter						

Grand Cayman	2.6%	0.0%	5.3%	11.1%	80.4%	0.5%
Cayman Brac	4.5%	2.6%	6.5%	7.7%	77.4%	1.3%
Little Cayman	0.0%	2.5%	0.0%	10.0%	87.5%	0.0%
Overall	3.1%	1.3%	5.2%	9.6%	79.9%	0.8%
Sewage						
Grand Cayman	1.6%	1.6%	6.3%	10.6%	76.7%	3.2%
Cayman Brac	9.7%	3.2%	11.0%	8.4%	65.2%	2.6%
Little Cayman	0.0%	7.5%	10.0%	17.5%	60.0%	5.0%
Overall	4.7%	2.9%	8.6%	10.4%	70.3%	3.1%
Coral disease						
Grand Cayman	2.1%	1.1%	14.8%	10.6%	54.0%	17.5%
Cayman Brac	7.7%	1.9%	9.7%	9.0%	54.8%	16.8%
Little Cayman	0.0%	0.0%	5.0%	17.5%	62.5%	15.0%
Overall	4.2%	1.35	11.7%	10.7%	55.2%	16.9%

Annex D Recreation

D.1 Cross-tabulation of recreational activities according to island

	Recreation				
Activity/ frequency	**Never**	**Once a year**	**Once a month**	**Once a week**	**More than once a week**
Fishing					
Grand Cayman	55.9%	24.5%	13.8%	4.3%	1.6%
Cayman Brac	48.4%	17.4%	20.0%	12.3%	1.9%
Little Cayman	15.0%	37.5%	20.0%	22.5%	5.0%
Overall	48.6%	23.0%	17.0%	9.4%	2.1%
Going to the beach					
Grand Cayman	6.3%	34.4%	36.5%	15.3%	7.4%
Cayman Brac	22.6%	16.1%	29.7%	20.0%	11.6%
Little Cayman	2.5%	5.0%	15.0%	40.0%	37.5%
Overall	12.5%	24.0%	31.5%	19.8%	12.2%
Boating/ sailing/ kayaking					
Grand Cayman	55.9%	21.8%	12.8%	5.9%	3.7%
Cayman Brac	57.4%	13.5%	12.9%	11.0%	5.2%
Little Cayman	7.5%	17.5%	30.0%	15.0%	30.0%
Overall	51.4%	18.0%	14.6%	8.9%	7.0%
Swimming/ wading					
Grand Cayman	18.2%	27.3%	28.3%	19.8%	6.4%
Cayman Brac	34.8%	6.5%	25.2%	23.9%	9.7%
Little Cayman	7.5%	5.0%	22.5%	37.5%	27.5%
Overall	23.8%	16.5%	26.4%	23.3%	9.9%
Diving					
Grand Cayman	83.6%	9.0%	4.8%	2.1%	0.5%
Cayman Brac	83.2%	5.8%	6.5%	1.9%	2.6%

Little Cayman	40.0%	10.0%	2.5%	22.5%	25.0%
Overall	78.9%	7.8%	5.2%	4.2%	3.9%
Snorkelling					
Grand Cayman	64.6%	13.8%	11.6%	7.4%	2.6%
Cayman Brac	58.1%	5.8%	18.7%	14.2%	3.2%
Little Cayman	12.5%	20.0%	35.0%	25.0%	7.5%
Overall	56.5%	11.2%	16.9%	12.0%	3.4%

D.2 Cross-tabulation of recreational activities according to place of birth

	Recreation				
Activity/ frequency	**Never**	**Once a year**	**Once a month**	**Once a week**	**More than once a week**
Fishing					
Born in CI	34.5%	24.1%	22.1%	15.9%	3.4%
Born elsewhere	57.1%	22.3%	13.9%	5.5%	1.3%
Overall	48.6%	23.0%	17.0%	9.4%	2.1%
Going to the beach					
Born in CI	15.2%	24.8%	33.8%	20.0%	6.2%
Born elsewhere	10.9%	23.4%	10.1%	19.7%	15.9%
Overall	12.5%	24.0%	31.5%	19.8%	12.2%
Boating/ sailing/ kayaking					
Born in CI	51.7%	15.9%	15.2%	11.0%	6.2%
Born elsewhere	51.3%	19.3%	14.3%	7.6%	7.6%
Overall	51.4%	18.0%	14.6%	8.9%	7.0%
Swimming/ wading					
Born in CI	23.6%	19.4%	26.4%	24.3%	6.2%

Born elsewhere	23.9%	14.7%	26.5%	22.7%	12.2%
Overall	23.8%	16.5%	26.4%	23.3%	9.9%
Diving					
Born in CI	80.7%	8.3%	6.9%	3.4%	0.7%
Born elsewhere	77.8%	7.5%	4.2%	4.6%	5.9%
Overall	78.9%	7.8%	5.2%	4.2%	3.9%
Snorkelling					
Born in CI	53.8%	10.3%	18.6%	13.1%	4.1%
Born elsewhere	58.2%	11.7%	15.9%	11.3%	2.9%
Overall	56.5%	11.2%	16.9%	12.0%	3.4%

Annex E Eating locally caught fish/lobster

E.1 Cross-tabulation of eating locally caught fish/lobster per island

Eating locally caught fish or lobster

Frequency	Never	Once a month	Once a week	More than once a week	Every day
Grand Cayman	8.5%	43.9%	25.9%	19.6%	2.1%
Cayman Brac	3.9%	28.6%	37.7%	29.2%	0.6%
Little Cayman	7.5%	47.5%	25.0%	17.5%	2.5%
Overall	6.5%	38.1%	30.5%	23.2%	1.6%

E.2 Cross-tabulation of eating locally caught fish/lobster per place of birth

Eating locally caught fish or lobster

Frequency	Never	Once a month	Once a week	More than once a week	Every day
Born in CI	3.4%	35.9%	35.9%	23.4%	1.4%
Born elsewhere	8.4%	39.5%	27.3%	23.1%	1.7%
Overall	6.5%	38.1%	30.5%	23.2%	1.6%

Annex F Choice experiment

F.1 Coding of the variables

Variable	Description
no take zone	Continuous variable, % of the coastal shelf with restricted access for fishers
moderate reef quality	Dummy variable, 1= moderate reef quality, 0=otherwise
good reef quality	Dummy variable, 1= high reef quality, 0=otherwise
moderate water quality	Dummy variable, 1= moderate water quality, 0=otherwise
good water quality	Dummy variable, 1= high water quality, 0=otherwise
fish catch	Continuous variable % of fish that can be caught compared with the current situation
mangrove conversion	Continuous variable % of converted mangroves
tax	Continuous variable, tax per year in $

F.2 Insignificant variables

Variable	Description
contingent valuation effect	Dummy variable, 1=questionnaire version in which the contingent valuation question was included before the choice experiment, 0=questionnaire version in which the contingent valuation question was included after the choice experiment
cultural and recreational score	Continuous variable, see appendix G2
high income [a]	Dummy variable, 1=respondent income is above average (>$4000 net income per month), 0=otherwise
female	Dummy variable, 1=respondent is female, 0=male
children	Continuous variable of the number of children of the respondent
university education	Dummy variable, 1=highest completed education level is a university degree, 0=otherwise

Notes: [a] Similar results are obtained using a continuous variable of income, and a dummy variable representing respondents with a low income (<1,000).

F.3 Significant variables

Variable	**Description**
resident	Dummy variable, 1=respondent is a resident from the Cayman Islands, 0=otherwise
Cayman Brac	Dummy variable, 1= interview took place on the island Cayman Brac, 0=otherwise
Little Cayman	Dummy variable, 1=interview took place on the island Little Cayman, 0=otherwise
age	Continuous variable of age of the respondent in years
fishing	Dummy variable, 1=someone in the household is involved in fishing, 0=otherwise
environmental awareness	Continuous variable, see appendix G1

F.4 WTP calculation

The panel error correction logit model is used to calculate willingness-to-pay (WTP) values since this model provides the best fit of the data. These were computed by taking the ratio of the coefficient of the attribute and the (negative) of the coefficient of price. Table F.4.1 shows the maximum WTP values of respondents for the attribute levels of the attributes only model. It

should be noted that the WTP for the no take zone is statistically insignificantly different from 0 in the attributes only model.

Table F.4.1 Willingness-to-pay (WTP) values per attribute based on the attributes only model (WTP monthly per household)

Variable	Maximum WTP
no take zone	$-0.10 per % of restricted area
moderate reef quality	$51.86
good reef quality	$96.98
moderate water quality	$63.35
good water quality	$55.41
fish catch	$0.48 per % of higher catch
mangrove conversion	$-0.91 per % of converted mangroves

Table F.4.2 shows the maximum WTP values of respondents for the attribute levels based on the complete model. This allows us to distinguish WTP values for fishers and non-fishers, as well as the size of the differences in WTP for the no take zone between born on the Cayman Islands and born elsewhere. Another distinction that is made is for catch between Cayman Brac and the other islands, and for mangrove conversion between Little Cayman and the other islands. There is through this analysis no concrete explanation as to why Little Cayman has a slightly negative relationship with mangrove conversion, in this case meaning that residents do not mind mangrove conversion or did not pay to much attention to this attribute. It might be the case that mangrove conversion has not been an issue on Little Cayman, whilst the reef and water quality are highly valued.

Table F.4.2 Willingness-to-pay (WTP) values per attribute based on the complete model (WTP monthly per household)

Variable	Maximum WTP non-fishers	Maximum WTP fishers
no take zone for born elsewhere	$0.36	$2.34
no take zone for born on the Cayman Islands	$-1.03	$-6.73
moderate reef quality	$35.75	$234.63
good reef quality	$67.69	$444.19
moderate water quality	$44.05	$228.62
good water quality	$44.90	$294.69
fish catch	$0.07	$0.44
fish catch Cayman Brac	$0.73	$4.81
mangrove conversion	$-0.73	$-4.81
mangrove conversion Little Cayman	$0.04	$0.25

Additional analysis

The results of the initial analysis using the attributes only model are suspected to suffer from a hypothetical bias, which causes WTP estimates that are unrealistically high. Therefore, a different methodology is used to calculate WTP estimates.

The coefficients calculated for each attribute with the attributes only model are still valid, which means that the relative WTP for different attributes in the CE can be used. To estimate the total WTP for nature conservation the payment vehicle is used: the average WTP of the CE is calculated based on the different levels of the payment vehicle that were chosen by the respondents. This average is assumed to represent the maximum WTP for nature conservation per respondent. Based on the relative WTP for the scenario that includes the highest attribute levels, the average WTP is divided. Because the relative WTP for different attribute levels is still valid, the absolute WTP for the highest level of each attribute is determined. In order to present a low and a high range of the WTP per month, the same coefficients are used to calculate the relative difference between willingness-to-pay per attribute with the average CV WTP results (please see 4.6.3 for WTP amount contingent valuation). Both the results of the average willingness-to-pay per household per month by the CV and CE results are presented in table F.4.3.

Table F.4.3 WTP per household per month for an improvement in marine park management

Attribute	Coefficient	**WTP per household per month CV**	**WTP per household per month CE**
no take zone (80% no take zone)	-0.0007	-$0.52	-$0.67
good reef quality	0.6682	$6.16	$8.04
good water quality	0.3818	$3.52	$4.59
fish catch	0.0033	$0.03	$0.04
Mangrove conversion (60% not converted)	0.0063	$3.49	$4.55
Total		$12.68	$16.55

The effect on utility of attribute ‘mangrove conversion’ by observing its coefficient, is negative, meaning on average respondents do not desire mangrove conversion and are willing to accept a certain compensation for the loss of this natural asset (see Tables F.4.1 and F.4.2). Since attribute ‘mangrove conversion’ does not ecologically lead to an improvement in marine park management, its coefficient is made positive (originally a negative coefficient), which enables to observe how much respondents are willing to pay to conserve the mangrove presented as converted within the choice experiment.

Annex G Variables in the regression

G.1 Calculation of environmental awareness score

The following questions are used to calculate the environmental awareness score:

- To what extent do you consider yourself environmentally aware?
    - Not at all (score 1)
    - Less than average (score 2)
    - Average (score 3)
    - More than average (score 4)
    - Very much (score 5)
- Did you do any of the following activities in the past year? Answer options are yes or no, with yes yielding a score of 1 and no yielding a score of 0.
    - Seek environmental information
    - Attend public meetings held by the department of environment
    - Avoid littering
    - Buy locally grown fruit and vegetables
    - Purchase environmentally friendly products
    - Donate money to an environmental cause
    - Do any voluntary environmental work
    - Other environmentally friendly activities

G.2 Calculation of the cultural and recreational score

The following question is used to calculate this score: how often do you participate in the following activities in nature? *Never* yields 1 point, *once a year* yields 2 points, *once a month* yields 3 points, *once a week* yields 4 points, *more than once a week* yields 5 points.

Annex H List of species

Species in the marine environment of the Cayman Islands that respondents think should receive extra protection (including the number of times mentioned):

Turtle	108
Conch	98
Lobster	81
(Nassau) grouper	70
Whelk	28
Coral	24
Stingray	23
(Red) snapper	23
Fish	18
Shark	15
Parrotfish	13
Dolphin	9
Mangrove	7
Jack	5
Starfish	4
Turbot	3
Tuna	3
Squirrel	3
Mackerel	3
Old wife	2
Barracuda	2
Squab	1
Shellfish	1
Mahi Mahi	1
Crab	1

Annex I Comparing sister islands

Regression shows that income environmental awareness and gender are significant in explaining the willingness to pay.

Comparing income on the different islands:

There is a significant difference in income between Grand Cayman and Cayman Brac, but not between Grand Cayman and Little Cayman. Also, there is no significant difference in income between Little Cayman and Cayman Brac.

Explanation of output: Levene shows that variances are not equal. Therefore, we are looking at Games-Howell for the post hoc tests. Island 1 = Grand Cayman, island 2 = Cayman Brac, island 3 = Little Cayman

Test of Homogeneity of Variances

Income

Levene Statistic	df1	df2	Sig.
16,902	2	344	**,000**

ANOVA

Income

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	312566407,023	2	156283203,511	13,359	**,000**
Within Groups	4024399010,845	344	11698834,334		
Total	4336965417,867	346			

Multiple Comparisons

Dependent Variable: Income

	(I) Island	(J) Island	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	1	2	2008,934*	389,337	,000	1092,47	2925,40
		3	757,862	622,163	,443	-706,65	2222,37
	2	1	-2008,934*	389,337	,000	-2925,40	-1092,47
		3	-1251,072	629,973	,117	-2733,97	231,82
	3	1	-757,862	622,163	,443	-2222,37	706,65
		2	1251,072	629,973	,117	-231,82	2733,97
Hochberg	1	2	2008,934*	389,337	,000	1074,91	2942,96
		3	757,862	622,163	,532	-734,72	2250,44
	2	1	-2008,934*	389,337	,000	-2942,96	-1074,91
		3	-1251,072	629,973	,137	-2762,39	260,25
	3	1	-757,862	622,163	,532	-2250,44	734,72
		2	1251,072	629,973	,137	-260,25	2762,39
Games-Howell	**1**	**2**	**2008,934***	**373,360**	**,000**	1129,22	2888,65
		3	**757,862**	**697,823**	**,527**	-922,93	2438,65
	2	**1**	**-2008,934***	**373,360**	**,000**	-2888,65	-1129,22
		3	**-1251,072**	**659,136**	**,151**	-2849,41	347,26
	3	**1**	**-757,862**	**697,823**	**,527**	-2438,65	922,93
		2	**1251,072**	**659,136**	**,151**	-347,26	2849,41

*. The mean difference is significant at the 0.05 level.

Comparing environmental awareness across the three islands:

The environmental awareness is significantly higher on Little Cayman than on Grand Cayman and on Cayman Brac. There is no significant difference between Grand Cayman and Cayman Brac.

Variances are equal; therefore Hochberg's post hoc test is used.

Test of Homogeneity of Variances

Awareness

Levene Statistic	df1	df2	Sig.
1,083	2	381	,339

ANOVA

Awareness

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	100,564	2	50,282	11,676	,000
Within Groups	1640,769	381	4,306		
Total	1741,333	383			

Comparing gender across the islands:

There are no significant differences in gender between the three islands.

Variances are equal: therefore Hochberg's test is used.

Test of Homogeneity of Variances

Gender

Levene Statistic	df1	df2	Sig.
,326	2	376	,722

ANOVA

Gender

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,045	2	,023	,091	,913
Within Groups	93,986	376	,250		
Total	94,032	378			

Statements

	Completely disagree	Somewhat disagree	Neutral	Somewhat agree	Completely agree
Marine crucial					
Grand Cayman	1.1%	1.6%	9.0%	12.2%	76.2%
Cayman Brac	0.0%	0.0%	7.1%	14.8%	78.1%
Little Cayman	2.5%	7.5%	7.5%	12.5%	70.0%
Overall	0,8%	1.6%	8.1%	13.3%	76.3%
Accept restrictions					
Grand Cayman	3.2%	2.1%	13.3%	12.8%	68.6%
Cayman Brac	7.7%	7.1%	12.3%	16.8%	56.1%
Little Cayman	2.5%	0.0%	2.5%	20.0%	75.0%
Overall	5.0%	3.9%	11.7%	15.1%	64.2%
Tourism dependent on MPA					
Grand Cayman	4.8%	3.2%	13.8%	20.7%	57.4%
Cayman Brac	7.7%	4.5%	27.7%	16.8%	43.2%
Little Cayman	2.5%	0.0%	5.0%	35.0%	57.5%
Overall	5.7%	3.4%	18.5%	20.6%	51.7%
Front-runners					
Grand Cayman	2.1%	0.5%	25.9%	17.5%	54.0%
Cayman Brac	7.7%	8.4%	27.7%	11.0%	45.2%
Little Cayman	2.5%	2.5%	10.0%	25.0%	60.0%
Overall	4.4%	3.9%	25.0%	15.6%	51.0%
Future generations					
Grand Cayman	0.5%	0.0%	4.3%	10.7%	84.5%
Cayman Brac	0.0%	0,0%	3.9%	12.3%	83.9%
Little Cayman	2.5%	0.0%	0.0%	5.0%	92.5%
Overall	0.5%	0.0%	3.7%	10.7%	85.1%

Active management					
Grand Cayman	0.5%	1.1%	9.0%	12.2%	77.1%
Cayman Brac	2.6%	3.2%	20.6%	11.6%	61.9%
Little Cayman	2.5%	0.0%	2.5%	10.0%	85.0%
Overall	1.6%	1.8%	13.1%	11.7%	71.8%
Restrictions visitors					
Grand Cayman	51.9%	11.2%	16.0%	12.3%	8.6%
Cayman Brac	56.8%	13.5%	10.3%	5.2%	14.2%
Little Cayman	20.0%	12.5%	15.0%	20.0%	32.5%
Overall	50.5%	12.3%	13.6%	10.2%	13.4%
Support expansion					
Grand Cayman	9.0%	4.8%	18.5%	21.7%	46.0%
Cayman Brac	20.0%	6.5%	21.9%	14.2%	37.4%
Little Cayman	2.5%	0.0%	17.5%	15.0%	65.0%
Overall	12.8%	4.9%	19.8%	18.0%	44.5%
Support expansion 40-50%					
Grand Cayman	8.5%	4.8%	29.6%	18.0%	39.2%
Cayman Brac	21.9%	3.9%	25.2%	16.1%	32.9%
Little Cayman	2.5%	2.5%	15.0%	22.5%	57.5%
Overall	13.3%	4.2%	26.3%	17.7%	38.5%