IVM Institute for Environmental Studies

Recreational and cultural value of Bonaire's nature to its inhabitants

Final report

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Summary

The global environment is in a relatively bad state and there is growing awareness of its importance to human wellbeing. This study aims to shed light on a corner of this importance. Although a corner its affects to human wellbeing is great. What if the entities one culturally identifies with should begin to deteriorate or very plausibly disappear? In the spirit of learning and providing innovation to current environmental policy practices, it is the objective of this study to determine the recreational and cultural value that the marine and terrestrial environment of Bonaire provides to its residents. The later in order to improve decision making on conservation efforts on the island by internalizing externalities in policies that affect the environment and its ecosystems. This was done through use of the environmental economics technique of choice modelling, which consists of a choice experiment as well as a supporting structured survey. Choice modelling determines the WTP (willingness to pay) to conserve nature. The results of this study suggest a yearly WTP by all households on Bonaire to improve the overall natural environments state from poor to moderate to be approximately $2,9 million USD and from poor to high as much as $3,9 million USD. However from the supporting background questions it was also concluded that a widely employed PES system (Payment for Ecosystem Services) would not succeed without learning taking place. There should be dialogue on the one hand and on accountability (locals or tourists?) and on the other hand on the need for environmental management itself. In addition to this the most important perceived threats were found to be waste (solid and liquid) and coastal development. To sum up the study shed light on the tension that exists between tourism which residents economically depend on and the effect expanding tourism has on the nature of Bonaire. An important conclusion is that restriction of coastal and inland development is supported by locals as well as better waste management and goat management. Policy makers should take this document into account since it expresses the concerns and desires of the local population as regards to policies affecting the environment.

1 Introduction

The introduction will elaborate on five main aspects of the study. The first part of the introduction is dedicated to the aim of the study, describing the research question. Section 1.2 describes the framework project in which this study forms part of. Subsequently 1.3 describes the study site giving background information relevant to comprehend the context of the study. Section 1.4 specifies the scope of the study, an insight is given into the ecosystems being valued, the services they provide to humans as well as the threats they are facing. To conclude the introduction chapter, section 1.5 is dedicated to explaining the relevance of this specific study both in academic as well as managerial terms

Human beings rely upon the environment more than they are aware of. It easy to take for granted what we do not have to rely upon directly to live our lives, but our lives cannot be fulfilling without those millions of connections we make indirectly with the environment and the resources it provides us with. To make this clear is the fact that we do not have to grow our own food as we used too we receive it indirectly but conveniently within the supermarket in our neighbourhoods, we are not all farmers but we all depend upon farmers. That human beings are taking the environment for granted is no news, we have polluted our airs, we are overfishing our oceans, we have caused damage to our soils, all of which we ultimately rely upon. But all is not grey there is room for learning and that is what the scientific field of study of ecosystem services is all about. Ecosystem services is about valuing the benefits that we as humans receive from the natural ecosystems in our environment and thereby creating awareness of our interconnectedness (Millennium Ecosystem Assessment, 2005). This study finds itself imbedded within a larger ecosystem valuation study which aims to present the island of Bonaire with a comprehensive view of the importance and value of its ecosystems.

The main pillar of the economy of Bonaire is tourism, mainly diving tourism and cruise tourism. On average about 80.000 people visit Bonaire annually whilst the island population itself is approximately 15.000 people. Thereby Bonaire is heavily dependent upon its ecosystem services which provide the island with tourists. Besides the provisioning of ecosystem services to industries such as tourism, nature also forms an integral part for human wellbeing by providing the opportunity for recreation and cultural identification.

The natural environment and its aesthetic and landscape diversity provides opportunities for recreational activities, from more active activities such as hiking to more passive activities such as nature study and the relaxation related to the enjoyment of scenery. From a cultural perspective the natural environment has always shaped the human culture in which it finds itself, it serves as inspiration for folklore, paintings, dance etc. The natural environment is also deeply interlinked with heritage-values, giving people a sense of place as they identify themselves with the landscape and ecosystems found in it (de Groot, Wilson & Boumans, 2002). Bonaire is no exception, according to the Cultural Policy Plan of 2010 its culture IS nature. Bonaire's flag signals to the natural environment, blue for the sea, yellow for the kibracha plant and a compass to signal the fishing culture, so too does the national anthem and cultural festivities related to the harvest season (Cultural policy plan Bonaire, 2010). However most human beings are not consciously aware of these cultural and recreational services and their value are not readily investigated in academia (de Groot, Wilson & Boumans, 2002).

The main purpose of economic valuation studies is to put a comprehensive indicator – monetary unit – on the value of ecosystem services and thereby communicate its value

in a comprehensive manner to all relevant stakeholders. It makes it possible to calculate, to a certain extent, human welfare loss due to ecosystem degradation and making it possible to include the value of nature when making economic policy decisions. The focus of this study is on the values of *Local recreation* and *Cultural services.* The following research question is posed.

What is the recreational and cultural economic value of Bonaire's marine and terrestrial ecosystems to its inhabitants?

This study forms part of a larger study – "What is Bonaire's nature worth?" – which aims to produce a comprehensive assessment of the socio-economic importance of ecosystem services on Bonaire. It will contribute to the overall The Economics of Ecosystems and Biodiversity (TEEB) study that is currently conducted for the Dutch Caribbean on behalf of the Netherlands Ministry of Economic Affairs, Agriculture and Innovation. The rationale behind this socio-economic valuation study is that small island economies in the Dutch Antilles depend heavily on their marine and terrestrial ecosystem services for their main industries such as tourism and fisheries (Wolfs, 2011). Even though Bonaire has a reputation of being a leader is sustainable tourism and its marine park management is often quoted as an example for others it still experiences different pressures, for example coastal development and different types of pollution which fall within the broader spectrum of policy domains and not just the environmental policy area. It is readily impossible to fragment the environment from other policy areas such as infrastructure and industries, in Bonaire's case especially tourism. For example would it be beneficial to have more cruise-ships visit Bonaire or will this be in detriment to the marine environment in the long term?

In order to better understand the socio-economic impacts of changes in ecosystems this study provides insight into the composition of the Total Economic Value (TEV) of these ecosystem services. The identified ecosystem services within this projects framework are: Tourism, Fisheries, Local recreation, Cultural services, Amenity services, Coastal protection, Climate regulation, Water services, Non-use values, Research and education, Pharmaceutical potential, Air quality and Genetic resources.

Bonaire history and facts

Bonaire forms part of the chain of the Leeward Antilles islands in the Caribbean. These islands are located along the south-eastern fringe of the Caribbean Sea, just north of the Venezuelan coast of the South American mainland. Bonaire's economy is mainly based on tourism due to its pristine marine environment which makes it a popular destination for recreational diving and snorkelling. Its coral reef ecosystem is important to the islands economy and a sustainable use of the natural asset is in the islands interest. The weather is pretty precious as it is 28-30°C in the daytime and around 27°C at night. As most Caribbean islands Bonaire has a colonial past. It has been a colony for of Spain, The Netherlands and England. Bonaire is since 2010 a special Dutch municipality, formerly it belonged to the Netherlands Antilles. Due to the colonial past the dialect spoken on the island – Papiamentu - is a mix a different languages; Spanish, Dutch, African dialects, English and Portuguese. About 70% of the population of the island speaks Papiamentu (Central Bureau of Statistics of the Netherlands Antilles [CBS], 2003). The rest are mainly Dutch, Spanish and English speaking immigrants. Currently Bonaire counts 15.849 residents according to the department of Civil Affairs.

Bonaire currently has two protected natural areas, which are the Bonaire National Marine Park (BNMP) set up in 1979 and the Washington Slagbaai National Park (WSNP)

set up in 1969. The national marine protected area includes two Ramsar sites – Lac and Klein Bonaire[1]. In addition to this the Washington Slagbaai national park includes two ramsar sites- Saliña Slagbaai and Saliña Goto. Both protected areas are managed by STINAPA, a non-profit organization with the mission to protect the islands natural, cultural and historical resources, through ecological sustainable use, for present and future generations (STINAPA, 2011). Additionally there is a fourth protected area under the Ramsar convention which is the Pekelmeer, it is exclusively managed by the salt company in the southern point of the island.

As mentioned earlier, the aim of this study is to find the recreational and cultural economic value of Bonaire's marine and terrestrial ecosystems to its inhabitants. Thus the first limitation of this study is that although ecosystem services can have different groups of beneficiaries the recreational value of this study is limited to the inhabitants of Bonaire. Secondly since it is monetary value that is being investigated only household members who provide income, and preferably head of households, can participate in this study and thus the population under 18 is left out of the scope of this study.

Thirdly it is important to elaborate upon the scope of the ecosystems being valued. This study aims to find the recreational and cultural value of both the marine and the terrestrial ecosystems on Bonaire. The relation between the ecosystems, the ecosystem service, and present threats of the ecosystems being valued within the scope of this study is presented in Table 1.1[2]. Thus this includes all marine and terrestrial ecosystems and is not spatially limited to currently protected areas. One specific ecosystem that may possibly have cultural and recreational value and has been left out of the scope of this study is the open ocean, the reason for this being that marine ecosystem management on the island is very much limited to the fringing reefs surrounding the island to a depth of 60 meters (STINAPA, 2011). Due to the bathymetry of Bonaire migratory oceanic species such as pelagic fishes (e.g. Wahoo, Tuna, Dorado) are found very close inshore, however it is not possible to manage these migratory species optimally without international co-operation. This study does provide insight into the relative participation of recreational fishing in the open ocean and of pelagic fish but does not value the recreational and cultural value provided by the open ocean through its economic valuation method.

Additionally it is not in the scope of this study to provide advice as to the level of sustainability of residential recreation in the differing ecosystems. The management of ecosystems must adhere to differing groups of beneficiaries when ecosystem services are mutually exclusive (Brander, Ghermandi, Kuik, Markandya, Nunes, Schaafsma & Wagtendonk, 2010). For example recreational service and cultural service are mutually exclusive, since pressure from recreation (local and tourism) can have adverse effects on ecosystems which are of cultural value (local).

[1] Ramsar sites are a product of the Ramsar Convention which is an intergovernmental treaty that commits its member countries to maintain the ecological character of their wetlands and to plan for sustainable use of all the wetlands in their territories (Ramsar, 2011).

[2] The list of threats within table 1 is not exhaustive.

Table 1.1 Ecosystems and the ecosystem service being valued and their corresponding threats (Meesters, Slijkerman, de Graaf & Debrot, 2010; Stinapa, 2005, 2006; Nature policy plan [evaluation], 2010; Natural resources commission [annual report], 2010)

Ecosystems	Ecosystem Services	Threats to ecosystem
Marine ecosystems:		
Coral reefs	Recreation (e.g. snorkelling, diving) & Cultural (heritage-value)	Boat groundings, Divers, Over-fishing, Oil and contaminants, Invasive species (e.g. Lionfish), Climate change
Sea grasses	Recreation (e.g. snorkelling, diving) & Cultural (heritage-value)	Agricultural run-off, Sedimentation & Eutrophication (caused by Sewage discharge & Land erosion) Land erosion (caused by deforestation, goats), Marine litter
Mangroves	Recreation (e.g. kayaking) & Cultural (cultural landscape ,heritage-value)	Tourism pressure, Recreation, Marine litter, Climate change
Coastal vegetation	Cultural (cultural landscape ,heritage-value)	Coastal and inland development
Beach areas	Recreation (e.g. relaxing, wading, swimming) & Cultural (cultural landscape, heritage-value, cultural activities)	Littering, Sand-mining, Recreation (trampling by wind-surfers)
Terrestrial ecosystems:		
Lime-stone terrace	Recreation (e.g. rock climbing, cycling, bird watching) & Cultural (cultural landscape)	Coastal and inland development, Coral-mining
Caves	Recreation & Cultural (cultural landscape, Indian scriptures)	Coastal and inland development, Deforestation
Dry forest	Recreation (e.g. walking, hiking, cycling) & Cultural (cultural landscape, medicinal plants, heritage-value)	Coastal and inland development, Deforestation, Poaching of parrots, Free-roaming goats, Land-use change, Littering
Kunuku's (farm land)	Recreation (e.g. camping, farming, hunting) & Cultural (cultural landscape, cultural activities)	Coastal and inland development, Deforestation, Unsustainable use of land
Saliñas (hypersaline lakes)	Recreation (bird watching) & Cultural (cultural landscape, heritage-value)	Coastal and inland development, Tourism pressure

2 Methodology

This chapter is focused on the methodology behind this study. First it is important to understand the theoretical background of the techniques used, especially the main theories which form the backbone of this study. Subsequently in section 2.2 a comprehensive explanation is provided into the method being used for valuation within this study which is choice modelling. Section 2.3 explains the design of the Bonaire choice experiment. In section 2.4 the process taken for the development of the survey is thoroughly presented. Finally section 2.5 defines the sampling and data collection method used.

2.1 Theoretical background

This studies theoretical background lies in environmental economics. Economics can be said to be the study of human housekeeping; mainly the way humans as a society produce, allocate and consume goods and services (Perman, Ma, McGilvray & Common, 2003). Environmental economics took off in the 1970's when the first investigations into the optimal and efficient depletion of natural resources where conducted. At the heart of environmental economics is the concept of market failure which basically leads to inefficient allocation of resources. Market failure can arise due to externalities, institutional failures, imperfect information and public goods[3]. Many ecosystem services are (quasi) public goods, and thereby they do not have a market price and use-levels are difficult to regulate (Mitchell Carson, 1989; TEEB, 2010). A public good is both non-rivalry and non-excludable to other consumers meaning that there are no specific property rights assigned to it. The theory states that since there are no clear property rights this leads to the "tragedy of the commons" since everyone can make use of the same resource without taking into account its finite element or the point of sustainability if it were a renewable resource.

In the case of this specific study the recreational and cultural services provided by nature on Bonaire are public and quasi-public goods. For example residents of Bonaire have to pay a fee to enter the Washington Slagbaai National Park meaning it is excludible (if one cannot pay the price) but non-rivalry (one person's consumption does not interfere with another person's consumption) making it a quasi public good.

Environmental economists use welfare economics to identify these market failures and recommend policies to correct these in order for economies to perform efficiently in relation to services provided by the environment to the economy (Perman, Ma, McGilvray & Common, 2003). In order to find efficiency the "values" of these non-marketed goods and services must be derived. Values are either positive or negative depending on whether welfare is increased or decreased. The theory of environmental valuation techniques rests upon the consumer behaviour theory under which preferences can be represented by utility functions. Utility is a measure in which the relative satisfaction of a good or service is expressed. In welfare economics social welfare is the aggregation of individual utilities.

This basically translates to there being a point where the marginal benefit of conservation exceeds the marginal cost or vice versa (see Figure 2.1). The marginal benefits tend to increase as ecosystem services become scarcer, and marginal costs

[3] For more information on market failures and environmental policy see Baumol and Oates 1988.

tend to decrease as human activities move away from the areas providing these environmental services (Balmford, Fisher, Green, Naidoo, Strassburg, Tuner & Rodrigues, 2011). Thus values of ecosystem services must be derived in order to make the cost and benefits of conservation visible to stakeholders. This study forms part of a larger framework project whose aim is to do just that- environmental valuation- a Total Economic Valuation (TEV) of Bonaire's ecosystems.

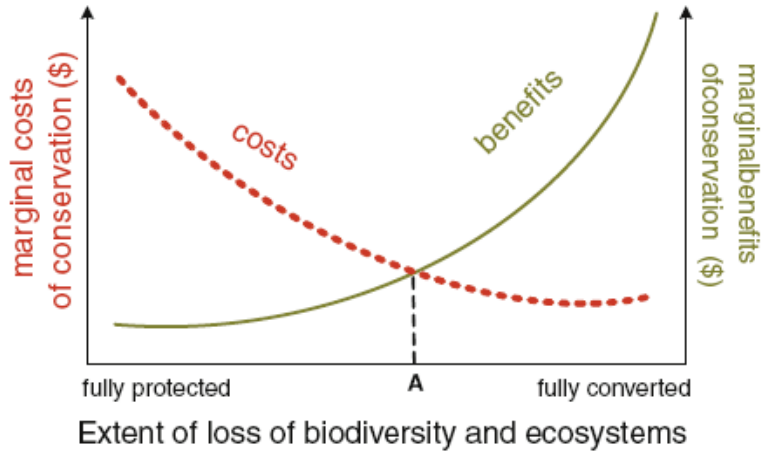

Figure 2.1 Conceptual representation of changes in the marginal benefit and costs of conservation as biodiversity and/or ecosystems are lost. To the right of intersection "A" marginal benefits exceed marginal costs which translate to conservation making economic sense. (Figure adapted from Balmford et. al, 2011)

Value in this environmental economics context can be divided into use-value and non-use value, the summation of resulting in Total Economic Value (TEV) (see Figure 2.2). Use-value can once more be divided into direct (e.g. timber used as fuel, harvesting of food crops) and indirect use-values (e.g. coastal protection, carbon sequestration) (van Beukering, Brander, Tompkins & McKenzie 2007). Non-use values refer to the value that people derive from ecosystem benefits independent of any present or future use that people might make of those benefits. The latter can be further subdivided into bequest, option and existence values (van Beukering *et al*. 2007). Environmental economics exhibits different techniques for economic valuation of environmental services. The valuation method chosen for this case study is choice modelling which is a discrete choice random utility analysis.

However it is important to note that the environmental economics approach automatically takes an anthropocentric view on the value of ecosystems. Something will have value only if it provides a service to humans. This is in contrast to the belief that ecosystems and biodiversity have an intrinsic value in itself which justifies their conservation. Economic value is only one dimension of the overall value of nature (Balmford *et al*., 2011) and in order to integrate dimensions that cannot be expressed in monetary terms (e.g. intrinsic value, freedom of choice, human rights) other analyses in addition to economic valuation are needed (e.g. livelihoods assessment, vulnerability assessment, capabilities to make choice assessments) (TEEB, 2010)

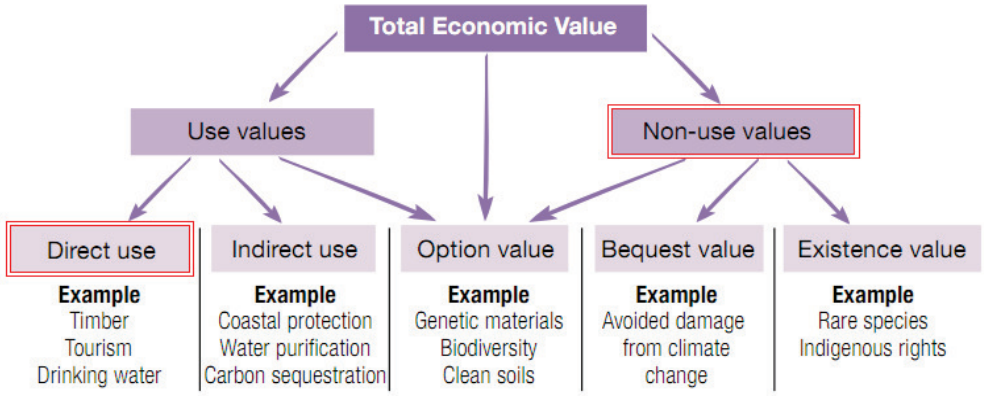

Figure 2.2 Framework of a Total Economic Valuation (TEV) study. Red highlighted sections represent the area of contribution of this study (Figure adapted from van Beukering et al. 2007)

The contribution of this study to the whole TEV framework corresponds to the sections direct use and non-use values within the TEV framework (see figure 3: red highlighted areas). A further elaboration of this is provided:

- *Direct use values* can be both *consumptive* and *non-consumptive*. *Consumptive* are for example the use of culturally significant medicinal plants or recreationally caught fish. *Non-consumptive* or *non-extractive uses* include, for example, the enjoyment of recreational and cultural activities that do not require harvesting of products but still involve the direct presence of the people appreciating it.
- As for the non-use values, all refer exclusively to cultural value except for option value which refers to recreational value as well[4]. Bequest value refers to benefits from ensuring that certain goods and services will be preserved for future generations. For example many Bonaireans might be concerned with future damages from global warming that would affect culturally significant natural areas and would be willing to pay to reduce them, despite the fact that the vast majority of the damages are not expected in the near future. Existence value reflects benefits from simply knowing that a certain good or service exists. For example there might be many Bonaireans who do not snorkel nor dive but still have value for the existence of coral reefs and their diversity within Bonairean waters due to heritage-values (cultural identification). Option value arises from uncertainty about the future demand for or supply of the good. For example, Bonaireans may be willing to pay for preserving biodiversity or genetic material to ensure the option of having related services in the future, such as the use of medicinal plants which have a cultural significance or the opportunity to go recreational fishing. It should be noted that option value is generally treated differently from other non-use values in current literature since it expresses a future use and thus explaining the direct line to use value within Figure 2.2.

[4] Non-use value of Bonaire's ecosystems is described to a certain degree since this study's spatial limit is to the inhabitants of Bonaire. Tourists as well as larger spatial scales (global) may exhibit non-use values as well which are not valued within this study.

2.2 Choice modelling

Recreational and cultural services provided by nature on Bonaire are public/quasi-public goods. Thereby non-market valuation techniques must be employed to examine the economic effects of changes in environmental quality and thus the provisioning of these ecosystem services. Choice modelling (CM) is a recent innovation in stated preference methods. Stated preference methods are used for the elicitation of values that are not reflected in any observable behaviour. Choice modelling was first applied to environmental management problems by Adamowicz, Louviere and Williams (1994), although it was applied in other fields (e.g. marketing, transport economics) since the 1980's. CM is a suitable approach to determine the willingness to pay or accept (WTP/WTA) and the utility derived from having an environmental service, either it be use or non-use value, and it performs better than other valuation methods (Boxall, Adamowicz, Swait, Williams & Louviere, 1996; Adamowicz, Boxall, Williams & Louviere, 1998; Hanley, Wright & Adamowicz, 1998; Tuan & Navrud, 2007)

CM is an extension of the Contingent Valuation (CV) method. The main difference between the two is that CV is a *direct* stated preference method whilst CM is an *indirect* stated preference method (Tuan & Navrud, 2007). With CV respondents are asked directly for values for an ecosystem service. CM asks respondents to select between a set of alternative scenarios including different attributes, and through having a payment vehicle (e.g. tax) as one of these attributes the values attached to each attribute can be indirectly derived. The approach is based on the notion that attributes of an environmental good can be used to understand the general trade-offs which an individual is willing to make.

The main theories that CM is based on is Lancaster's characteristics theory of value and the random utility theory (Hanley, Wright & Adamowicz, 1998). Lancaster's characteristics theory of value implies that consumer behaviour is stipulated by the characteristics (e.g. stories, distance to city, gated community etc.) goods contain rather than the goods (e.g. house A or house B) themselves (Lancaster, 1966). Random utility theory implies that utilities should be treated as random variables to reflect that the observer lacks information on the goods characteristics and alternatives as well as not possessing complete information on respondents (Manski 1977; Caussade, Ortuzar, Rizzi, & Hensher, 2005). CM illuminates the preferences (random utility theory) people have for environmental qualities (Lancaster's characteristics theory of value). The later through its experimental design of providing multiple choice tasks that allow the revelation of the environmental factors influencing choice.

There are additional advantages of CM compared to CV. CM allows estimation of the welfare gain from more than one attribute and thus a wider range of environmental quality changes (Hanley, Wright & Adamowicz, 1998). This multi-attribute-based approach makes it possible to observe the trade-offs that individuals are willing to make between attributes. Through having a repeated sampling approach (multiple choice tasks) CM avoids "yea-saying", allows for internal consistency tests (Hanley, Wright & Adamowicz, 1998), and alleviates some issues with information efficiency that affect CV (Boxall *et al.*, 1996). Additionally CM also circumvents the embedding problem encountered with CV since the scope of the attributes is built into the choice experiment (Hanley, Wright & Adamowicz, 1998). However there are aspects of the use of CM that may create difficulties, namely the experimental design, the survey design and survey implementation (Adamowicz & Deshazo, 2006), these will be explained further in the sections on *Design* and *Analysis* below.

Design

CM indirectly measures the Willingness To Pay (WTP) for conservation of respondents through the use of a controlled Choice Experiment (CE) that help reveal the factors influencing choice. The concept of choice is very important since economics is concerned with the derivation of values through behavioural actions and thus has a choice dimension to it (Boxall *et al*., 1996). The design of the choice task is constructed in a manner which can yield the effects of individual attributes on choice and thus requires the use of a statistical design model (further explained in section analysis). Respondents are asked to choose between scenarios with bundles of environmental services, which are described in terms of their attributes and the levels that these take. The levels represent the environmental quality change. Each scenario is a combination of the same attributes with different levels. One of these attributes is a payment vehicle (e.g. tax, addition to utilities bill, environmental fee etc.) which allows one to yield an estimation of the underlying utility for each individual attribute (Hanley, Wright & Adamowicz 1998). Respondents choice between the scenarios reflect the trade-offs they are willing to make between the attributes.

Designing a choice experiment requires careful definition of the attributes and its corresponding levels such that these are relevant to policy questions as well as significant elements of the choice process underlying the environmental quality change (Hanley, Wright & Adamowicz, 1998; Boxall *et al*., 1996; Carson *et al*., 1994). In other words the choice experiment must not lack in sufficient realism and credibility since its objective is to simulate real choice situations. The experimental design of a choice experiment also assumes that attributes as well as scenarios are independent of each other, if there is attribute causality within a choice experiment this can simplify the decision making process for the respondent and lead to lower value estimates (Blamey, Bennett, Louviere, Morrison & Rolfe, 2002). Additionally the level of complexity and cognitive burden that respondents face during the choice experiment must be taken into account. The most important design dimensions influencing choice consistency being the number of attributes and the number of scenario's presented in a choice set (Caussade, Ortuzar, Rizzi & Hensher, 2005).

One disadvantage of the CM is that the experimental design – attributes being independent – may be at odds with ecological realities. This is difficult when approaching ecosystem services and the attributes are chosen in a way that there is as minimal overlap as possible (Zwerina, Huber & Kuhfeld, 2010). Additionally a value of an environmental good or service may be more than the sum of its attributes (Hanley, Wright & Adamowicz, 1998). The choice experiment is combined with a survey including background questions in order to extrapolate possible explanations respondent characteristics as predictors - for the choices made.

Analysis

As mentioned the design of a CE requires the use of a statistical design model. For the analysis of a CE it is the multinomial logit model (MNL) that is predominantly used. The main point of analyzing the CE data is to determine which attributes predominantly influence the choices and trade-offs made by the respondent and thereby the utility derived per attribute and the thereby WTP to move from one level of an attribute to another level (representing environmental quality change). As mentioned the theory upon which CM is based on is both Lancaster's characteristics theory of value and the random utility theory. Lancaster's theory is incorporated by virtue of the fact that the environmental service is described using different attributes. These attributes are described as follows in the statistical design (Carson *et al*. 1994):

$$X_k = (k = 1,2, \dots K)$$

$$X_{kl} = (l = 1,2, \dots L)$$

The environmental service or good may potentially have a number (K) of attributes (X) and each attribute potentially has a number of levels (L)

The MNL which is used for the analysis of the CE is in accordance with the random utility theory. Utility of a respondent is explained by the following utility function:

$$U_{in} = V(X_{1l}, X_{2l}, \dots X_{kl}) + \varepsilon_{in}$$

A respondent(n)'s utility (U) derived from choosing a scenario (i) consists of a deterministic and in principle observable component $V(\bullet)$ and a random and unobservable component ε_{in}. The random and unobservable component represents the idiosyncrasy of respondent (n) that is unobservable to the observer. The observable component $V(\bullet)$ consists of the attributes and its corresponding levels presented in scenario (i). The observable component $V(\bullet)$ can be further explained with the following equation:

$$V_{in} = ASC + \beta_{1l}X_{1l} + \beta_{2l}X_{2l} + \cdots + \beta_{kl}X_{kl}$$

ASC is an abbreviation for the alternative specific constant which is an alternative (scenario) whose attributes and their corresponding levels are held constant from choice set to choice set. ASC is a dummy variable which equals zero when the ASC is chosen. The ASC allows for non-participation as well as for non-observable attributes to influence choice (Blamey, Gordon & Chapman, 1999; Hanley, Wright & Adamowicz, 1998; Carson *et al.*, 1994). β_{kl} is a coefficient representing the utility derived from attribute X_{kl} (with (l) being the attribute level) within scenario (i). These utilities are derived through fitting the observed data to the statistical design plan and thereby making calculation of WTP possible.

Selection of one scenario over another implies that the utility (U_i) associated to that scenario is greater than the utility of the other(U_j). If for respondent $(n)$the probability of choosing scenario (i) is equal or greater than the utility derived from all other scenario's within a choice set the following equation applies:

$$Prob(i|I) = P(V_{in} + \varepsilon_{in} \geq V_{jn} + \varepsilon_{jn}; \forall j \in I)$$

I represents all the scenarios the respondent faces within the choice set. The usual assumption made is that the random error terms (ε) are Gumbel-distributed, it could also be type 1 extreme value distributed (McFadden, 1974). Given the utility function and the distributional assumption of the random error terms as Gumbel-distributed, the probability expression of the Multinomial Logit Model (MNL) is given by:

$$Prob(i) = \frac{exp^{\mu v_i}}{\sum_{j \in I} exp^{\mu v_j}}$$

Thus the probability of choosing scenario (i) is expressed by the equation above with (μ) representing the scale parameter which is usually assumed to be 1 implying a constant error variance (Hanley, Wright & Adamowicz, 1998).

There are still issues concerning the CM method. The research on discrete choice models is still in its infancy and deals with issues such as preference heterogeneity, model uncertainties, the design of stated preference choice sets and the design of the supporting survey (Adamowicz & Deshazo, 2006; Louviere, 2006; Hoyos, 2010). Using discrete choice models in the field of environmental valuation is complex and requires interdisciplinary collaboration (e.g. economic theory, econometric analysis and psychology) to solve the different issue points (Hoyos, 2010).

2.3 Designing choice experiment

Attributes and corresponding levels

As mentioned in the design section above it is important that the attributes and levels chosen be policy-relevant and that ultimately the choice task represent a realistic choice situation. For the choice experiment on Bonaire six attributes were decided upon for representing both the marine environment ecosystems and the terrestrial environment ecosystems. Thus the environmental services being valued within this choice experiment is of a very broad nature. It was decided to include the terrestrial environment after a 3 day workshop on "Economic Valuation of Ecosystems" (which formed part of the Bonaire TEEB study) held on the island involving stakeholders from different sectors on the island. In this workshop it became apparent that the decision makers on the island and stakeholders were interested to know the value of the terrestrial ecosystems from a recreational and cultural perspective since there already exists much emphasis and knowledge on the marine environment. The complexity of the choice task must be taken into account and thus a trade-off must have been made between quantity and quality. To portray all ecosystems an infinite number of attributes could have been chosen (quantity) but the choice task must be comprehensive for the respondents (quality). Besides the attributes being partly developed through consultations with different stakeholders, they were also partly adapted from previous studies (Van Beukering 2006, 2007, 2009; Verbrugge 2010). The corresponding levels were also partly adapted from the same previous studies but also developed through interviews conducted with locals as well as an organized focus group discussion. The focus group discussion was conducted with 6 local individuals representing the multi-cultural background of Bonaire. Table 2 depicts an overview of the attributes and their corresponding levels.

Table 2.1 Overview of attributes and corresponding levels

Attribute	Level 1	Level 2	Level 3	Level 4
Reef quality	Poor	Moderate	High	
Terrestrial quality	Poor	Moderate	High	
Fish catch per trip	20% lower catch	No change	20% higher catch	
Roaming goats	Grazing	No Grazing		
Public beach access	20% less access	10% less access	No change	
Fee	No payment	$5	$10	$20

Reef quality: describes reef health and thereby the biodiversity found within the coral reef ecosystem. The coral reef ecosystem and the sea-grass and mangrove ecosystems are interconnected ecosystems. For example, mangroves are nurseries for juvenile species and support fish and invertebrate biomass and biodiversity on coral reefs, increasing resources available for extractive use in recreational fisheries and non-extractive use in diving or simply non-use values. In order to keep choice task simple for respondents a qualitative measure unit was used for the levels; poor, moderate and high.

Terrestrial quality: describes the overall health of all terrestrial ecosystems on the island (e.g. saliñas, caves, dry-forest, lime-stone terrace etc.) and thereby the bio-diversity found within these ecosystems. In order to keep choice task simple for respondents a qualitative measure unit was used for the levels; poor, moderate and high.

Fish catch per trip: describes the change in catch per trip from present catch levels. In order to keep choice task simple for respondents a qualitative measure unit was used for the levels; 20% less catch, no change, 20% more catch.

Roaming goats: describes a change in the amount of grazing by goats in the terrestrial environment. Through consultations with stakeholders it became apparent that grazing by goats is causing degradation of the terrestrial environment, but that there was a love-hate relationship with the goats since people are accustomed to seeing free-roaming goats. From a policy perspective it was important to find out on which side the balance is heavier, and for this reason an intermediate level for this attribute was not designed. Through having two levels the explicit opinion of the public could be derived. The attribute levels were qualitative; grazing, no grazing.

Public beach access: describes a change in the amount of beaches (rubble and sand) available to the local community. Due to economic development more and more private homes as well as hotels have been built along the coast of Bonaire, taking away coastal vegetation and making beaches private, and it was important to find the value of the local community to have access to recreational and cultural services provided by the degree of public access to beach. The attribute's level is described in qualitative terms; 20% less access, 10% less access, no change.

Fee: describes the change in monthly household income as a payment for the environmental situation depicted in the scenario. The fee is not tied to who will administer and collect the funds. This attribute is described in quantitative terms; No payment ($0), $5, $10, $20.

Design of Choice SETS

The design of the choice sets for the choice experiment was developed using the Sawtooth software program. Sawtooth program uses CBC (Choice-Based Conjoint) analysis for conducting discrete choice modelling research. It is up to the observer to input attributes and their corresponding levels as well as supporting pictograms and explanatory text into the software which then generates the most optimal experimental design. Experimental design refers to the most optimal number of attributes, their corresponding number of levels, number of scenarios, composition of the choice sets and required sample size. The experimental design resulted in thirty-six choice sets. These choice sets were then broken down into six versions of the choice experiment with six choice sets presented to each respondent. Within a choice set the respondent had to choose between three scenarios with one of the scenarios staying constant throughout the experiment. The constant scenario is called "Expected future without extra management" or the opt-out option because the respondent opts for no payments. Within the opt-out option the level for all attributes are set at level 1 from table 2. Each respondent was also presented with a warm-up choice set called the common card, identical for all six versions of choice sets, which the interviewer used to explain the choice experiment. The latter avoids issues with learning-effects[5]. The common card is presented in figure 4. The pictograms were developed as a support for the decision making process and they were tested for comprehension throughout the focus group discussion and the pilot survey.

[5] If a learning effect is present in the choice sets it would mean that preferences are not stable from choice set to choice set, thus biasing results (Hoyos, 2010). The purpose of the common card was to minimize a possible learning effect by giving respondents the opportunity to engage in learning about their own preferences before engaging in the actual CE.

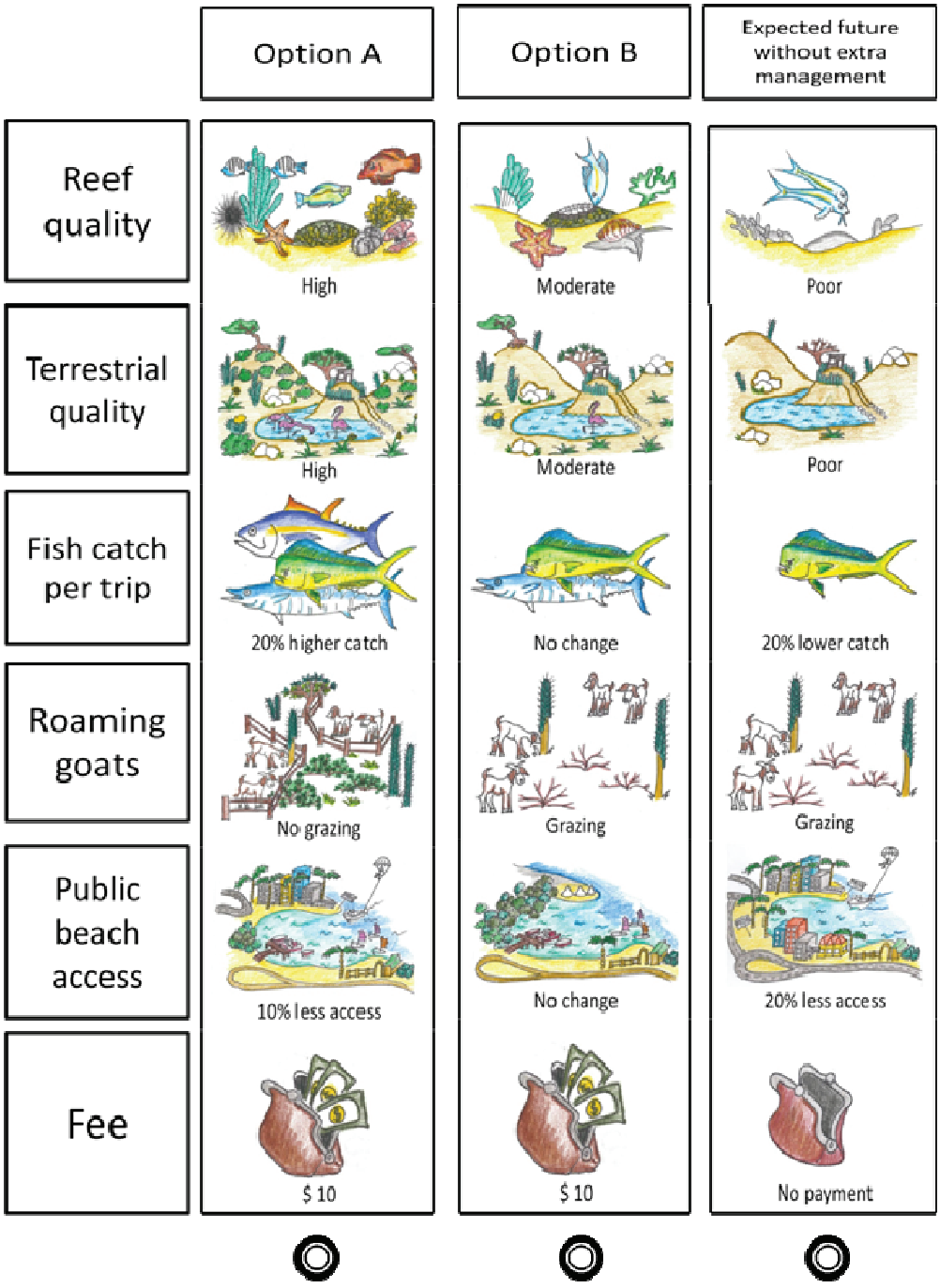

Figure 2.3 The common card used for explaining the choice experiment. The respondent is asked to make a choice between the three scenarios; "Option A", "Option B" or "Expected future without extra management".

2.4 Development of the survey

The choice experiment is combined with a an additional survey which includes background questions in order to extrapolate possible explanations (respondent characteristics as predictors) for the choices made by respondents within the choice experiment. The survey used was adapted from previous studies (Van Beukering, 2006, 2007, 2009; Verbrugge, 2010). Due to Bonaire being a multicultural island it was important to make the survey available in three different languages. These were Papiamentu, Dutch and English. Additionally it was important that the background questions could provide insight for local stakeholders in different fields, mainly natural resource management and policy. A first draft of a structured survey was created and discussed with local stakeholders to assure the right questions are being asked.

Subsequently the survey went into the pre-testing phase where a pilot survey was conducted. Due to time and limited resources available for this study the pilot-survey was limited to 3 participants. The 3 participants were simultaneously 3 of the interviewers conducting the household survey. The purpose of them participating in the pilot survey was for them to simultaneously receive a pre-training of conducting the household survey. After the pilot survey any problems encountered were addressed, e.g. the comprehensibility of the questions. Additionally the pilot survey served as an indication of the time frame needed to conduct the household survey. Ultimately the household survey comprised of seven sections and 41 questions in total (see appendix A for the composition of the survey and appendix B for the complete survey).

2.5 Sampling and data collection

The choice experiment and additional survey were administered to a sample of random selected households provided by the Bonaire government's department of Civil Affairs specifically for this study[6]. Based on a 2009 Social Cohesion report produced by different governmental departments (Ruimtelijke Ontwikkelingsplan Bonaire [ROB], 2009) a division of 12 neighbourhoods and their corresponding residential densities was used to calculate the target (n) number of households to be interviewed within each neighbourhood (see Table 2.2). In order to draw statistically sound conclusions the target sample size (n) was set at 400 households[7]. Due to the fact that household members may refuse to participate or it may result to be a vacant house, for each neighbourhood the number of addresses provided was more than the target (n). Unfortunately this study did not document the number of non-response cases.

[6] Due to time limit of the study and not receiving the database from the department of Civil Affairs at the start of the sampling period, the sampling started with another sampling strategy. Within each neighbourhood random street-names were selected and subsequently randomly assigned as even or an uneven house number to be interviewed. This sampling strategy lasted for 4 days from a total of 6 weeks and 2 day period of sampling.

[7] The 2009 Social Cohesion report presents the results of a working group within the framework of ROB (Ruimtelijk Ontwikkelingsplan Bonaire) which is the Spatial Development Plan for Bonaire published in 2010. The working group comprised of different organizations on the island but mainly the following governmental departments; -of Economic and Labour Affairs (DEZA), -of Social Affairs (SASO) and –of Urban and Physical Planning (DROB).

Table 2.2 Division of Bonaire by neighbourhoods and the corresponding target (n) sample

	Bonaire neighbourhoods	Target (n) based on ROB (2009)
1	Amboina	20
2	Antrejol (inl. Mexico)	91
3	Belnem (inl. Lima)	14
4	Hato	13
5	Lagun (inl.Guatemala)	2
6	Nikiboko (inl. Sabana)	76
7	Noord Salinja	26
8	Playa	55
9	Republiek/Santa Barbara	21
10	Rincon	47
11	Sabadeco	4
12	Tera Kora	31
	TOTAL	**400**

A total of 8 interviewers were employed to conduct the household survey. All interviewers received compensation for a training as well as for each correctly conducted and filled in household survey. Most of the interviewers already had experience with large scale household surveys. All interviewers are originally from Bonaire except for two which were from Aruba. This was important since all interviewers had to be able to speak all three languages the survey was provided in (Papiamentu, Dutch and English) as well as Spanish[8]. Additionally this minimizes the possible effects of cultural differences respondents may have with the interviewers. All interviewers received a training session in order to achieve consistency in interviewing among the interviewers which corresponds with the reliability of the results. Throughout the sampling period the progress of interviewers was documented; interviewers had specific targets set for each week in order to make sure the target sample size would be reached. The sampling period was approximately 6 weeks and in the first three weeks the quality of work delivered was intensely monitored. In addition all interviewers received a "Survey package" which was a set of documents and tools (e.g. pens, paper clips etc.) to take to each interview. It included a map where they could store the documents and tools (see appendix C-J for the survey package). Appendix C includes extra information on the training session.

[8] The Spanish speaking population can easily understand Papiamentu since Papiamentu is very similar to Spanish. It was important that interviewers could communicate in Spanish since it is the second most spoken language in households on the island Bonaire at 11,4%. 72% of households speak Papiamentu. (CBS, 2003)

3 Analysis and results

The purpose of this study is to determine the recreational and cultural value that the marine and terrestrial environment of Bonaire provides to the residents by determining their WTP (willingness to pay) for the conservation of nature and additionally to find out the motives behind the level of WTP. In this study mostly descriptive statistics was used. Other statistical tests were used for the choice experiment, determining correlations between different variables, and in the analyses of the representativeness of the sample.

The raw data provided by the interviewers is merged into one database using Microsoft Office Excel 2007. This program was also used for the creation of tables and graphs. The dataset is cleaned in Excel 2007 and imported into SPSS version 16.0 for analyses. The choice experiment, designed in Sawtooth, is analysed using statistical software program Limdep.

The first section in this chapter describes the size of the final sample and its spatial distribution and evaluates the socio-demographic representativeness, the second and third section describe the findings regarding recreation and environmental awareness, section four will discuss differences in recreational participation depending on country of origin, section five will discuss three questions related to cultural values, section six represents results on environmental awareness, section seven will explain correlations found between preparedness to pay with respondent characteristics and finally section eight will elaborate on findings of the choice experiment on willingness to pay.

3.1 Sample description

The total number of respondents is 387. The aim of this study was to reach 400 respondents. The reason for not reaching this goal is mainly due to the fact that one interviewee did not follow the protocol correctly ultimately leading to a removal of a number of the surveys carried out by this interviewee.

In order to be able to conduct an analysis on the WTP through the choice experiment, the distribution of the six versions of choice sets throughout the sample must be equal. Figure 3.1 represents the dissimilarity in the aimed distribution of the choice sets and the sample distribution of the choice sets. Versions 1, 2 and 3 were slightly over-represented and versions 4, 5 and 6 are slightly underrepresented. A reason why the last versions where slightly underrepresented could possibly be because all interviewees had all six versions of choice sets (each containing six choice sets) in their possession, meaning that if one lost track of the last version of choice sets used, one invariably goes back to the first versions, explaining correspondingly the slight overrepresentation of the first three versions. The dissimilarity is not of a magnitude that would have disturbed the conduction of the analysis.

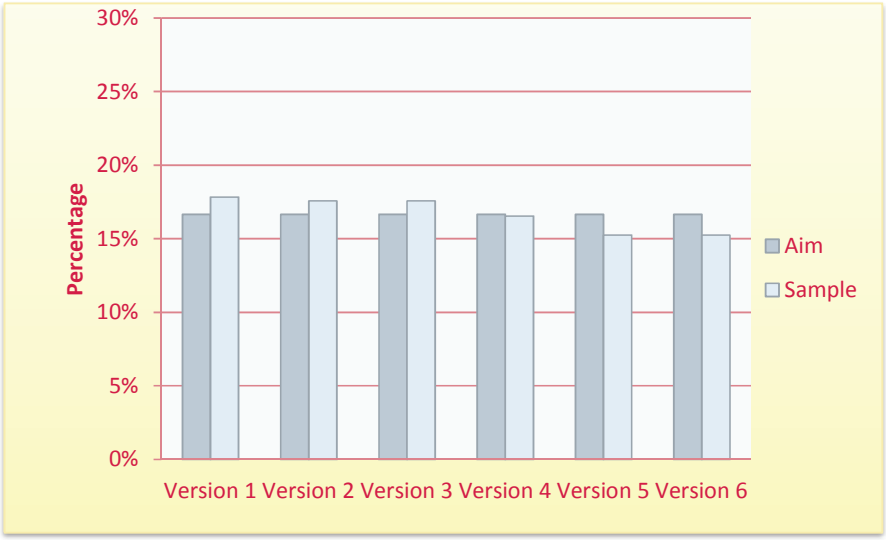

Figure 3.1 Distribution of choice sets used on Bonaire

The distribution of the sample over the islands neighbourhoods is important for representativeness of the results. As a reference point to compare the distribution of the sample, the most recent socio-economic data was used, which is the 2009 ROB Social Cohesion report (ROB, 2009).

From Figure 3.2can be seen that the distribution over neighbourhoods of the sample does not fit perfectly compared to ROB (2009). Especially Antrejol is overrepresented and Nikiboko and Playa are underrepresented. However the distribution of the sample is unlikely to have an impact on the quality of the results of this study.

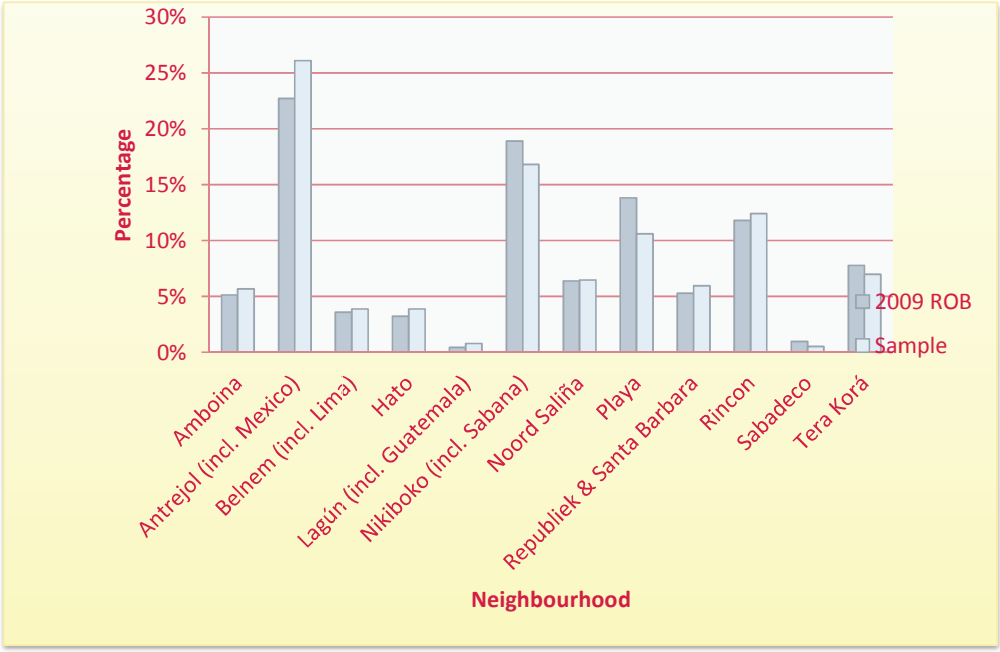

Figure 3.2 Distribution of sample over neighbourhoods on Bonaire

3.2 Socio-demographic representativeness

Representativeness was investigated by comparing socio-demographic profiles of the sample participants with the most recent information on the socio-demographic profile of the population of Bonaire. Ultimately four socio-demographic variables could be fairly compared; *Age*, *Gender*, *Education* and *Country of Origin*. The Statistical Yearbook 2010 of the Netherlands Antilles published by the Central Bureau of Statistics (CBS, 2010) was used as a reference point for comparison of most of the socio-demographic variables except for *Country of Origin*. In order to see if the sample is significantly different from the reference point the Wilcoxon Matched-Pair Signed-Rank test was used. The Wilcoxon Matched-Pair Signed-Rank test examines a set of differences by looking at the median of two samples and if it finds the difference of the medians to be zero then it finds the two samples to be perfectly similar. The hypothesis leads as follows:

$$H_0: Sample = Reference\ point\ sample$$
$$H_1: Sample \neq Reference\ point\ sample$$

$$H_0\ is\ rejected\ if\ p - value < \propto = 0.05$$

Ultimately only one socio-demographic variable was found to be representative in comparison to the reference points used; *Education*. One reason for this is that the reference points are not completely comparable to the sample for differing reasons. Secondly in the sampling period it was not possible to keep track of the proportions of the socio-demographic variables due to a lack of resources of this study. An additional disadvantage to finding the representativeness of the sample was that it deemed not possible to compare the distribution of household income of the population as this information could not be found[9]. Each socio-demographic variable is described below.

Age

A Wilcoxon test was conducted to evaluate whether the sample age distribution showed a significant difference from the reference point (CBS, 2010). The results indicated a significant difference, $p < .05$. H0 is rejected: the sample is not considered as representative of the age distribution of the population of Bonaire based on this reference point (CBS, 2010). From Figure 3.3 can be seen that the lower age categories are underrepresented and the higher age categories are overrepresented in the sample. One reason why this is the case is because the reference point used (CBS, 2010) is not completely comparable to the sample. The reference point (CBS, 2010) accounts the age distribution of the whole population of Bonaire, whilst the sample focuses only on breadwinners[10]. The second possible explanation is that the studies focus was to interview head of households as much as possible. Around eighty-two percent (82%) of the head households in Bonaire are 35 years and older according to

[9] The most recent data found was from a 2001 Census. Given the time span of 10 years it deems not reasonable to compare the sample to the 2001 Census data. From LBS (2008) it could be seen that from 2006 to 2008 alone the lowest household income equivalent group experienced a change of 10% reduction in size proportionate to the population. Income equivalent signifies adjustment of household income for the number of household members.

[10] Breadwinners includes employed population but also citizens on welfare and pensioners. The reference point (CBS, 2010) includes individuals whom were not the focus of this study such as students and homemakers.

the 2001 Census (CBS, 2003), explaining the samples heaviness in the older age categories[11].

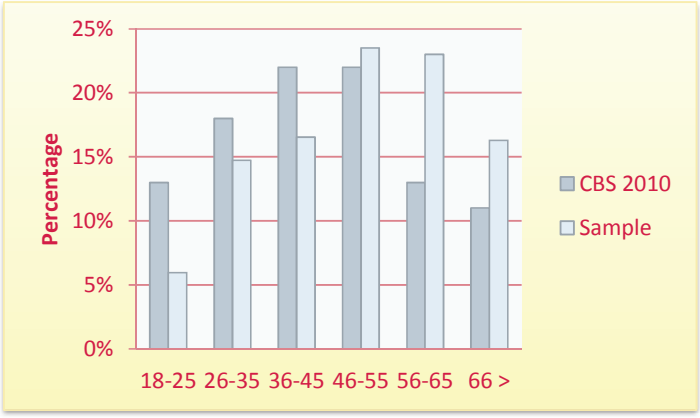

Figure 3.3 Age distribution of sample compared to CBS (2010)

Gender

A Wilcoxon test was conducted to evaluate whether the sample gender distribution showed a significant difference from the reference point (CBS, 2010). The results indicated a significant difference, $p < .05$. H0 is rejected: the sample is not considered as representative of the gender distribution of the population of Bonaire based on this reference point (CBS, 2010). From Figure 3.4 can be seen that females are over-represented in the sample. The reference point differs from the sample as it comprises the whole population and not only breadwinners which is the focus of this study, although this is not believed to influence the representativeness results found through use of this reference point.

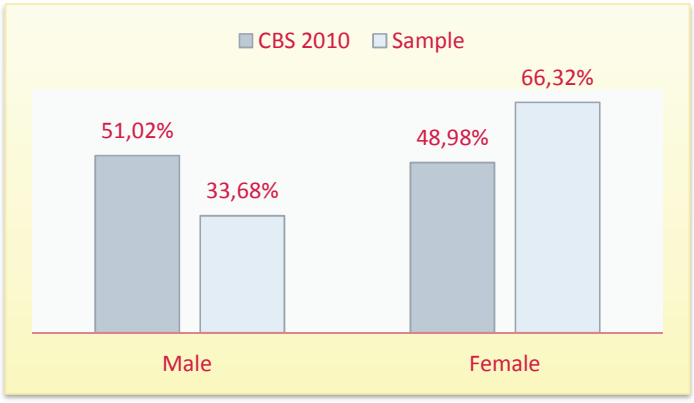

Figure 3.4 Gender distribution compared to CBS (2010)

[11] In this studies sample sixty-six percent (66%) of the time the respondent was the head of the household, twenty-three percent (23%) the respondent was the partner of the head of the household, and eleven percent (11%) of the time the respondent was not the head of the household nor the partner but was also a breadwinner within the household.

Education

A Wilcoxon test was conducted to evaluate whether the sample education distribution showed a significant difference from the reference point (CBS, 2010). The results indicated no significant difference, $p > .05$. H0 is not rejected: the sample is considered as representative of the education distribution of the population of Bonaire based on this reference point (CBS, 2010)(see Figure 3.5). The reference point data is based on a Labour Force Survey and represents the education level of the employed population of Bonaire in year 2008[12]. This means that the reference point is not completely comparable to the sample since individuals on welfare and pensioners are excluded from the reference point.

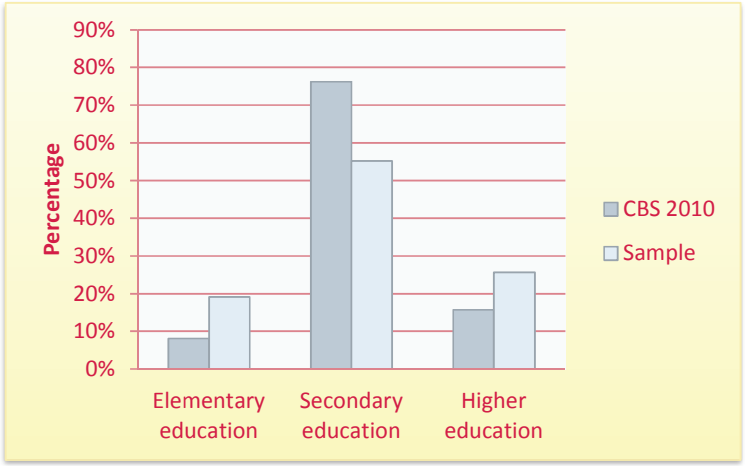

Figure 3.5 Education level distribution compared to CBS 2010

Country of origin

A Wilcoxon test was conducted to evaluate whether the sample gender distribution showed a significant difference from the reference point (Department of Civil Affairs, 2011). The results indicated a significant difference, $p > .05$. H0 is rejected: the sample is considered as not representative of the country of origin distribution of the population of Bonaire based on this reference point (Department of Civil Affairs, 2011). The reference point used was provided for this study by the department of Civil Affairs, it comprises the registry by country of origin (birth) of the whole population of Bonaire in 2010. The reference point differs from the sample as it comprises the whole population and not only breadwinners which is the focus of this study.

[12] The Labour Force Survey (LFS) is a sample survey conducted every two years by the Central Bureau of Statistics.

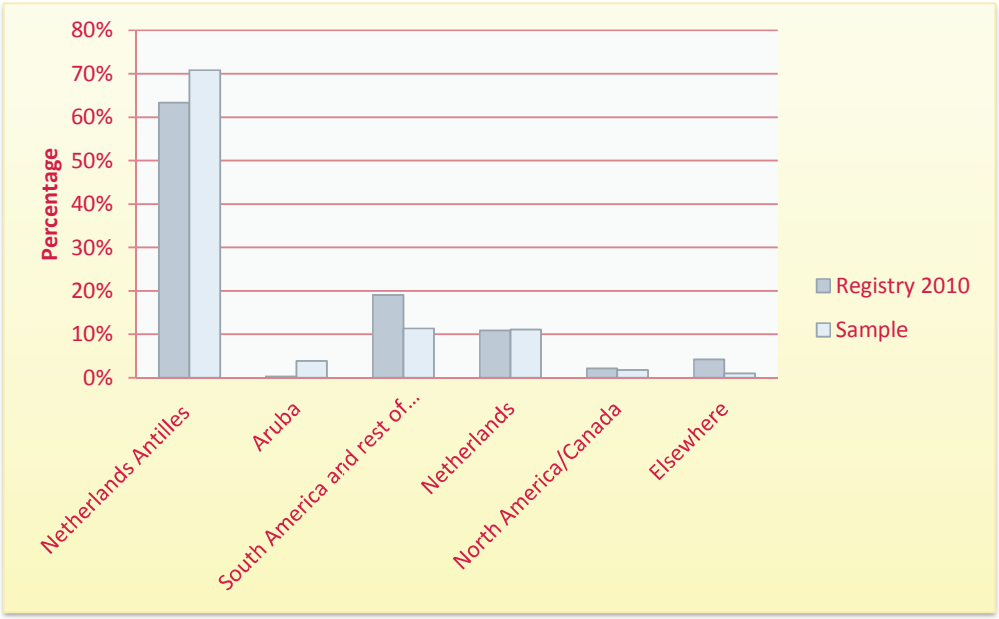

Figure 3.6 Country of origin distribution in comparison to registry in 2010

3.3 Marine environment recreation

For the household survey several recreational activities of the marine environment were investigated. From Table 3.1 one can see a summary of the different types of activities and their relative participation frequency's of the inhabitants of Bonaire. The most popular activities in chronological order are "Swimming", "Wading" and "Relaxing"[13].

Table 3.1: Overview of recreational activity by form of recreation and frequency

	Never	1-6 times a year	7-12 times a year	More than once a month	More than once a week
Beach-picnic/ Camping	44%	38%	5%	11%	2%
Relaxing	29%	27%	7%	23%	13%
Wading	37%	21%	7%	18%	16%
Swimming	26%	20%	6%	31%	17%
Windsurf	97%	1%	1%	1%	0%
Other board sports	99%	1%			
Kayaking	95%	4%	0%	1%	0%
Snorkelling	79%	7%	2%	7%	5%
Scuba diving	95%	2%	0%	2%	1%
Recreational fishing	71%	15%	2%	8%	4%

[13] Popularity is based on average participation rate of each activity. This was calculated by assigning a weighting system to the Likert scale, for example score 1 (never) was awarded 0 points. (1=0, 2=4, 3=10, 4=18,5=75). The weighting system purpose is to express participation to average number of days per year.

The survey also provided the ability to express favourite locations for these pass times. The top three favourite locations for marine environment related recreation by residents are Playa Palu di Mangel, otherwise known as Donkey Beach and Te Amo Beach, Sorobon Beach, and Chachacha/Playa Pàriba. For some of these activities there were no clear favourite places and was also expressed as "all around Bonaire" being important, namely Scuba diving and Recreational fishing.

This paper will elaborate further on the types of activities that require direct contact with the marine ecosystems and its cultural and recreational services. These are "Swimming", "Snorkelling", "Scuba diving", and "Recreational fishing".

Swimming

Swimming ability of the population was studied to find out to what extent the population is able to make use of these services through swimming. Van Beukering (2006) has found that swimming ability significantly influences a person's prepared-ness to pay for the conservation of nature. In the household survey the swimming ability was tested through one question asking the respondent about their comfort-ability level in the water. In the Bonaire sample, 53% express that they are comfortable in deep water for a short or long time, revealing a high level of swimming skills (see Figure 3.7). Another 47% of the population either do not swim (23%) or swim only a little due to feeling uncomfortable in deep water (24%). Swimming is the most popular recreational activity in the marine environment. The relative frequency of swimming by the inhabitants of Bonaire can be seen in table 5. 26% express that they never go swimming, which corresponds rather well with the 23% which cannot swim (see graph 4). 20% swim sometimes; between 1 to 6 times a year, 6% swim frequently; between 7 to 12 times per year, a whopping 31% swim often; more than once a month, and 17% swim very often; more than once a week.

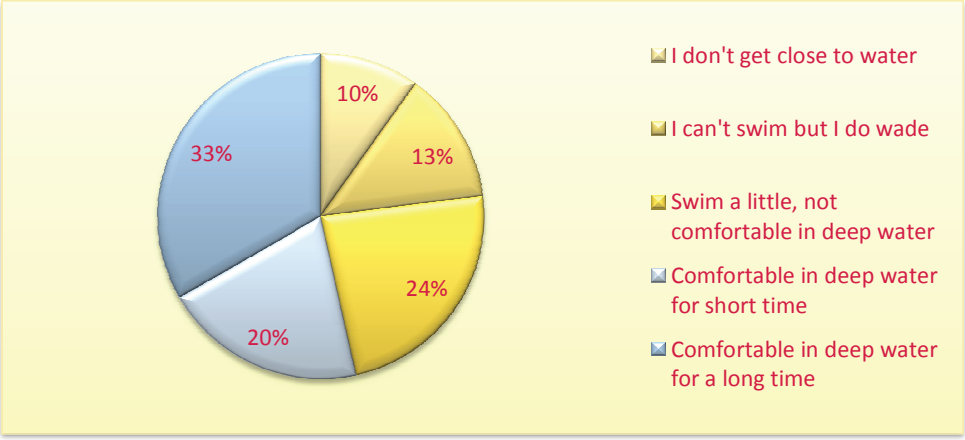

Figure 3.7 Swimming ability of inhabitants of Bonaire

Snorkelling and scuba diving

Snorkelling and scuba diving are both activities that require a more direct contact with marine ecosystems. In the household survey a separate section was included on snorkelling and scuba diving for the respondents that actively participate in these activities. From the Bonaire sample respondents 21% actively snorkel and only 5%

actively scuba dive (Table 3.1). Of course scuba dive takes more effort and resources to participate in, which partly might explain the low involvement. From the group that actively snorkels 56% do this often; more than once a month or more than once a week. For the scuba dive group this is 65%.

As for household participation approximately 82% of households do not participate in snorkelling nor diving activities. Around 17% of households participate in snorkelling and 7% in diving, and of this approximately 30% participate in both. Households that participate in diving almost always participate in snorkelling as well.

In absolute numbers more snorkel trips have been made than diving trips. Of the active snorkel group most have made 0-20 snorkel trips in their entire participation period. As for the active diving group, most have made 0-20 trips or they are more active around 101-300 trips. In Figure 3.8 one can see the most popular diving sites for inhabitants on the island, mainly Klein Bonaire, Karpata, Angel City, Bachelor's Beach, and Hilma Hooker. Popularity corresponds to the ones with the largest number of visits.

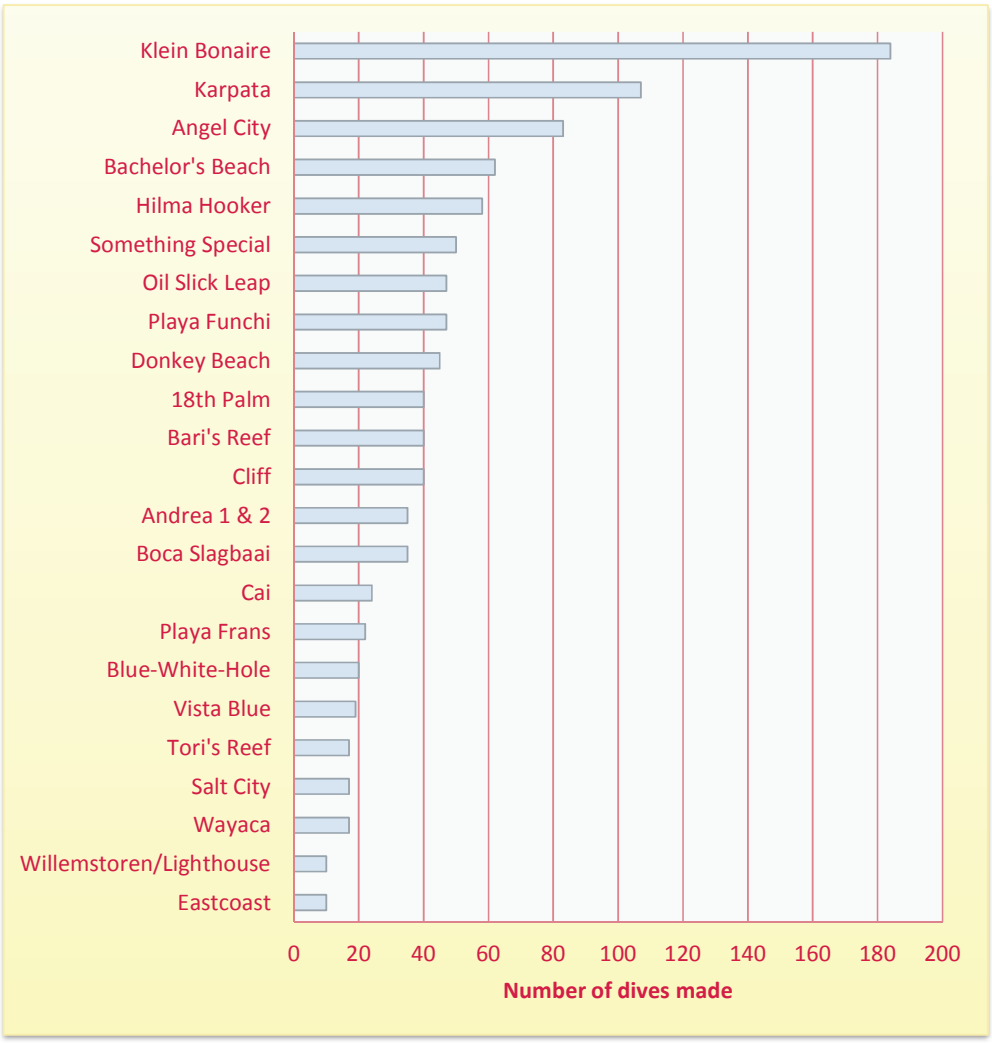

Figure 3.8 Dive sites and their corresponding number of visits

Recreational fishing

The relative percentage of households that participate in recreational fishing is 33%, in absolute numbers this is 126 households, one third of the sample. Mostly the participating households go fishing about 1 to 2 times per month. Whether one expresses the yield in kg or number of fish makes a difference. Different factors play a role, e.g. fish species, maturity etc. In order to get more insight into the catch respondents had the opportunity to express their yield from fishing in two different terms; average number of fish and/or average kg of fish. From Figure 3.9 one can see that mostly an average of 1 to 5 fishes were caught per trip and an average of 1 to 2 kg of fish were caught per trip.

The average catch composition is comprised of 63% shallow reef fish (0-30 meters) like the Barracuda (*Piku - Papiamentu name*), Bonefish (*Warashi*) or the Tarpon (*Sabalo*), 23% deep reef fish (30-60 meters) like the Yellow-tail Snapper (*Gristelchi piedra*), King Mackerel(*Konovis*) or the Bar Jack (*Yag*) and 10% deep sea fish like the Marlin (*Balua*), Wahoo (*Mulatu*), Mahi Mahi, or the Tuna (*Buni*). Invertebrates like lobster were given their own category and comprised on average 2% of the catch composition, as did the category bait fish (see graph 10). The respondents were also asked if they mostly go shore or boat fishing, 80% go mostly shore fishing.

Different reasons to go fishing exist and a question was included to investigate these reasons. Respondents could express more than one reason, thus one is not exclusive from another. Most respondents go fishing because they consider the enjoyment of fishing a great motivator, at the rear of this reason a lot of respondents consider fishing for food an important motivator (see Figure 3.10). The third most popular reason was that fishing represents an opportunity for bonding with family as well as friends. Additionally respondents had the opportunity to express another reason which was not part of the choices. One respondent took this opportunity to share the following reason; "To help with the current salary that you have". This might partly be a reason for indication of food as a reason, a "free" resource is used to create a buffer for their income. As this was not explicitly given as a choice it cannot be said what the frequency of this specific reason is.

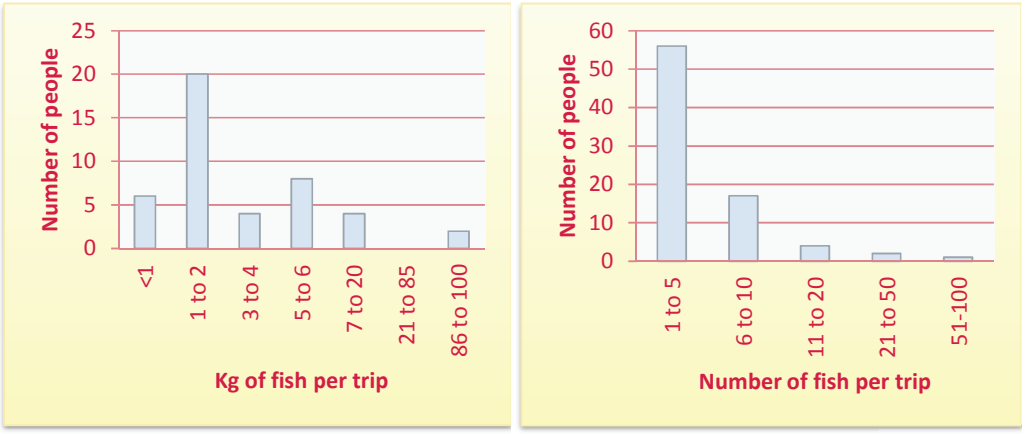

Figure 3.9 The average number of fish caught per trip and the kg of fish caught on average per trip

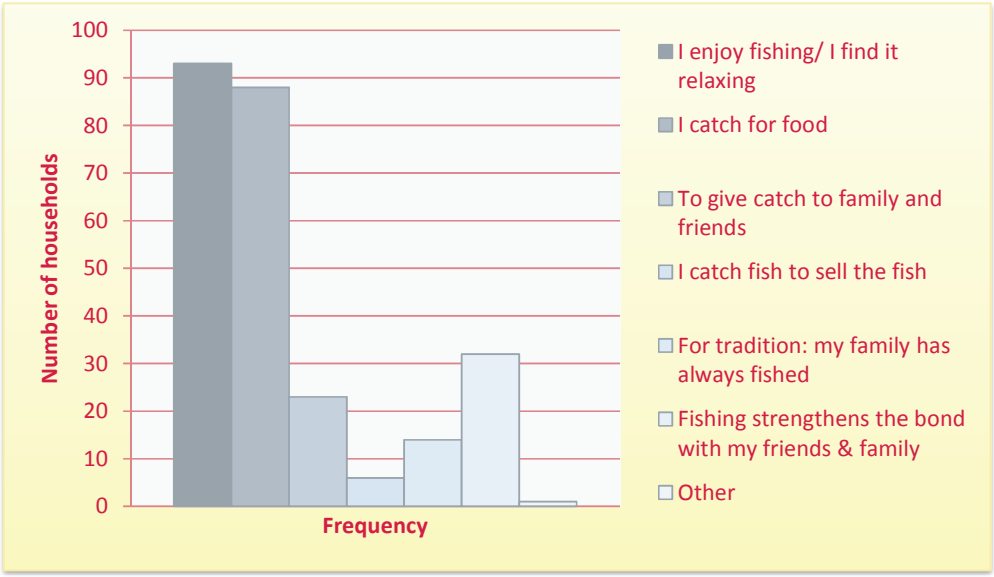

Figure 3.10 Motivations behind inhabitants of Bonaire's fishing activities

3.4 Terrestrial environment recreation

After the workshop organized on Bonaire involving stakeholders it became apparent to involve the terrestrial environment into the household survey. From Table 3.2 one can see a summary of the different types of recreational activities and their relative participation frequency's of the inhabitants of Bonaire.

Table 3.2 Overview of terrestrial recreational activity by form of recreation and frequency in percentages

	Never	1-6 times a year	7-12 times a year	More than once a month	More than once a week
BBQ/Camping	66%	21%	2%	9%	2%
Walking	35%	20%	5%	15%	25%
Hiking	80%	9%	2%	6%	3%
Cycling	81%	5%	1%	5%	8%
Hunting	94%	2%	1%	3%	0%

The most popular activities by magnitude of total participation in number of days per year are "Walking", "Cycling" and "BBQ/Camping"14. Especially hunting is practiced by a small minority on the island, which is to be expected on Bonaire. There are also some clear indications of favourite places to practice these recreational activities, namely at Kunuku's , Washington Slagbaai, Rincon, Lagoen and Seru Largu. Walking

[14] See footnote 11 on page 37 for the calculation on popularity.

and Cycling is mostly practiced within their own neighbourhoods. Kunuku's are situated all over the island.

Respondents had an opportunity to express another terrestrial recreational activity not given as an option in the survey. Three respondents took this opportunity to express gardening in their neighbourhood or their Kunuku's as a recreational activity in the terrestrial environment.

3.5 Local versus non-local recreation

It is interesting to see if there is a significant difference in the recreational participation score of residents born on Bonaire, which form the largest group of the population, and residents born elsewhere. The Recreation Score was comprised by weighting the participation level of each respondent to each activity and aggregating these scores for both the marine and the terrestrial recreational activities. Thus each activity was given equal weight and only the participation level was weighted. To investigate this correlation the two-tailed bi-variate Pearson-Correlation coefficient between the Recreation Score variable and the respondent characteristics variables, Local vs. Non-local, was generated. Local in this context means a person born on Bonaire. Local vs. Non-local is significantly correlated with Recreation Score at with Pearson correlation coefficient, , -0.245. The negative correlation coefficient signifies that if a person is born on Bonaire he/she participates significantly less in recreational activities than an inhabitant which was born elsewhere (see Figure 3.11 and Figure 3.12). However one must note that the Pearson correlation does not signify cause and effect (a third factor may be of influence). Additionally the range -0.3 to +0.3 signifies little or no association (Nieuwenhuis, 2008). We can say that 0.06% (0.2452) of the variation in Recreation Score is explained by Local vs. Non-local. More than not Non-locals have a higher average choice within the provided Likert-scale (1=never, 5=more than once a week), but especially three activities stand out "Snorkelling", "Relaxing", "Swimming", all within the marine environment.

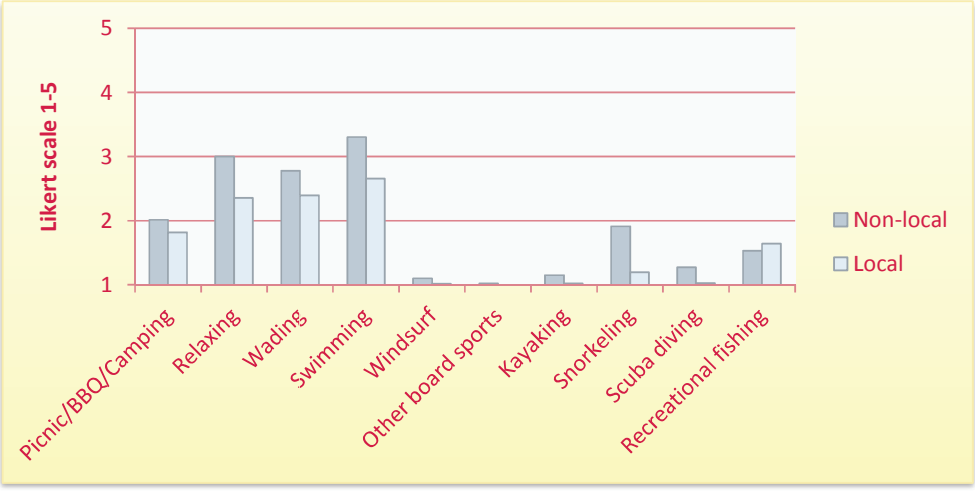

Figure 3.11 Local vs. Non-local marine recreation

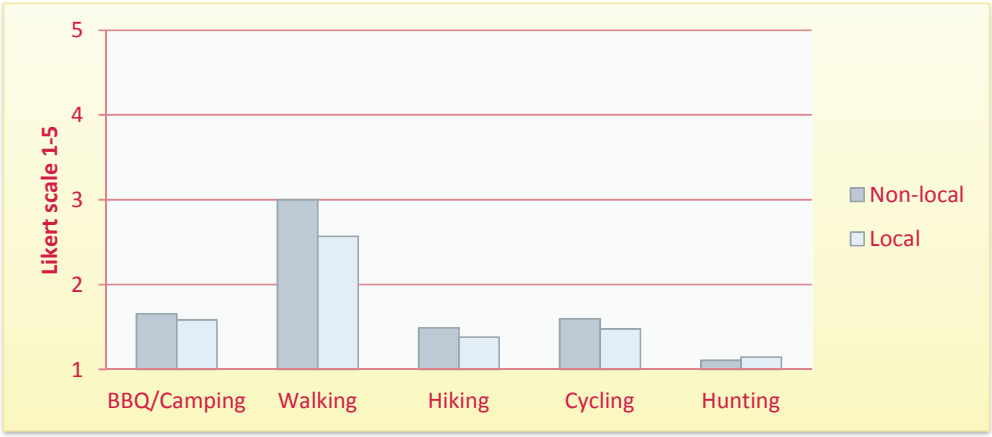

Figure 3.12 Local vs. Non-local terrestrial recreation

3.6 Three extra questions on cultural value

The household survey involved three extra questions related to the use of ecosystems as a source of cultural value. The first question was on the use of plants as medicine as an alternative to modern medicine or prescription drugs. Around 67% of respondents make use of medicinal plants. In Figure 3.13one can see the variation in frequency of use and type of plant. Besides the three plants that were given as options the opportunity to mention others was given. This opportunity was used in plentiful by respondents; in total 119 other observations of plants were documented. In total 29 other types of medicinal plants were given. The most popular ones being "Lamoengras", "Mampurito", "Yerba Seru", "Noni", "Flaira", "Yerba Buena", "Basora pretu" and "Stropi calbas". A distinction of indigenous and non-indigenous plants was not made, nor was the dynamic of plants which can be considered plagues or an ecosystem disservice (e.g. neem tree). Rather the focus was on the cultural aspect of generations using plants as medicine and to what extent it was still in play in current times.

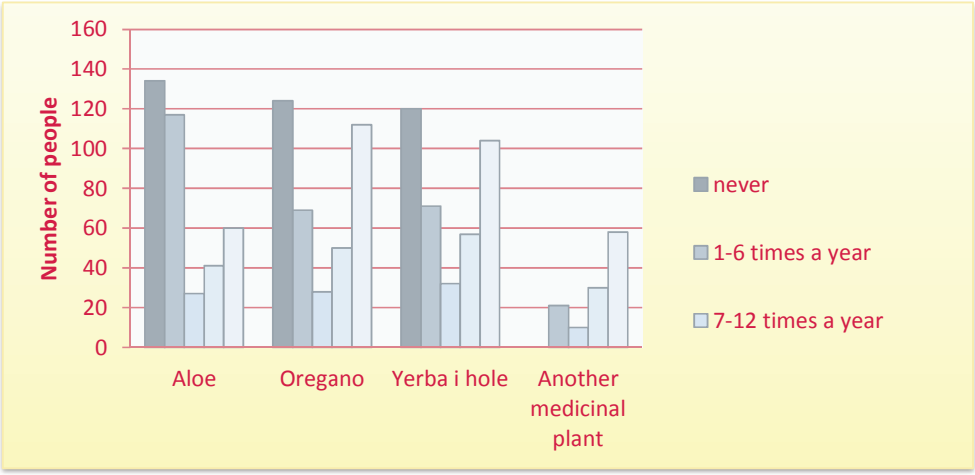

Figure 3.13 Frequency of use of different medicinal plants by residents of Bonaire

The second question was focused on finding out the perception of traditional and historical places within the terrestrial and the marine environment of Bonaire and thus carrying a heritage-value. The question posed was as follows: "Are the following traditional and historical locations in nature important for you? If yes, how often do you visit these locations?" Four options were given and their frequencies can be seen in Figure 3.14. It is apparent that visiting these historical or traditional places occurs mostly 1 to 6 times a year. This occurs mostly when friends and family are visiting from abroad.

The most popular other places mentioned are Washington Slagbaai as a whole as well as Playa Frans and Karpata individually. Besides this there was mention of caves, woods, rivers, as well as bays situated all over the island. For example the Trai montanja caves, Boca Onima (bay), Rooi Lamoenchi (river), and Mondi Bolivia (woods).

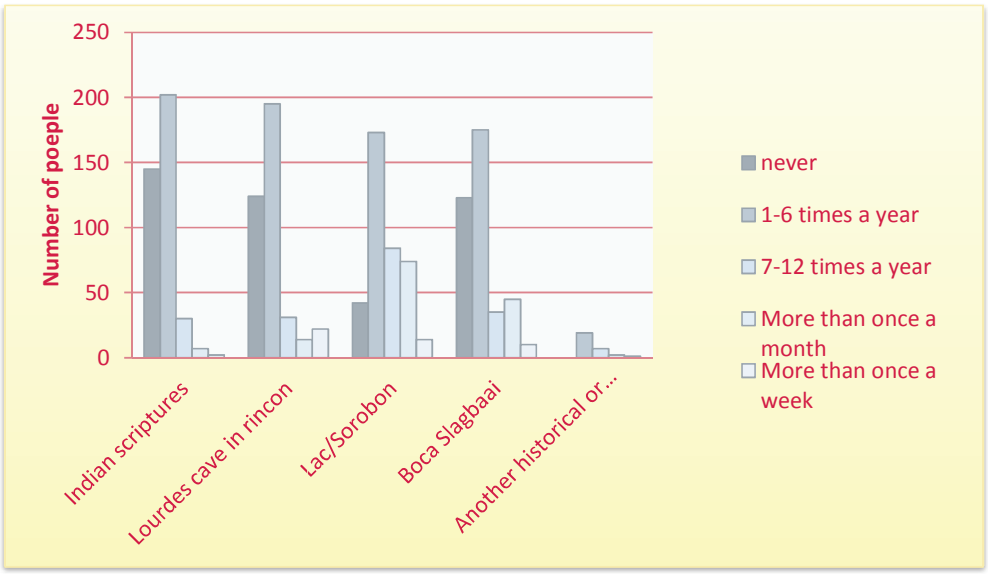

Figure 3.14 Frequency of visits to traditional/historical nature related locations on Bonaire

Third question related to culture was on the dietary importance of local fish. Only a small percentage indicated that they never eat locally caught fish. In Figure 3.15 the relative percentage of eating locally caught fish is represented.

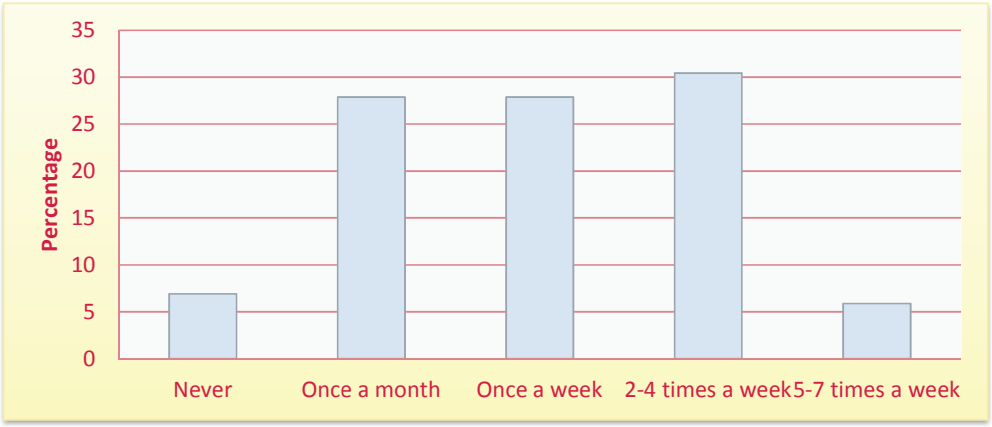

Figure 3.15 Relative frequency of eating locally caught fish

3.7 Environmental awareness

The household survey contained one section dedicated to evaluating the level of environmental awareness of a respondent. This section contained 5 questions touching upon different aspects of environmental awareness. An environmental score was calculated through looking at the actions a respondent undertakes to improve the environment and the perception of threats as well as perception on management options was assessed. In addition to this the perception of violations of environmental laws was evaluated.

Environmental score

The environmental score was calculated by aggregating the total number of times that a respondent stated to have participated in one of the 11 environmental activities that improve the environment within a span of one year. The 11 environmental activities ranged from participation in environmental events, proper waste disposal, donations, transport choice, altogether activities that require a conscious choice regarding the environment. The environmental score thus captures the environmental awareness of the respondent. The lowest possible score is 0 and the highest possible score is 11.

From Figure 3.16 one can see that the distribution of the environmental score on Bonaire is bell-shaped, indicating a normal distribution. The residents of Bonaire score on average around 4 on the environmental awareness score scale (0-11). The participation rate of the residents where highest for the following environmental activities “Not littering, and encourage others not to litter” (91% participation rate), “Purchase environmentally friendly products” (81%), and “Seek environmental information” (60%). As an example of an environmentally friendly product the use of a grocery bag was mentioned within the survey, however since most supermarkets on the island have cut back on handing out carrier bags and sell reusable grocery bag, the extent of this being a conscious choice by the respondent might be limited. Nonetheless the reason for this move was made clear to costumers through advertisements and awareness campaigns.

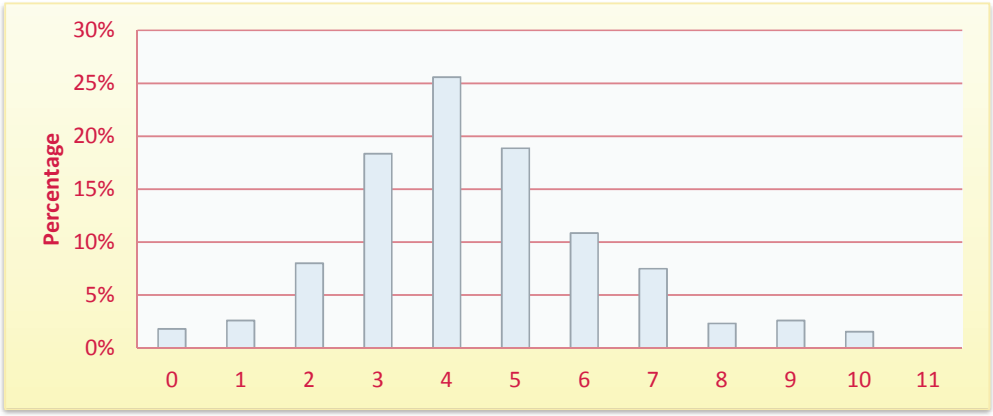

Figure 3.16 Environmental score distribution of Bonaire

The lowest participation rates are attributed to the following activities "Donate time" (9%), "Participate in beach clean-up" (15%), "Donate money"(20%), "Attend environmental event" (23%). Respondents had the ability to give an open comment approximating the end of the survey and some of these comments might explain to some extent the low participation rate of residents in environmental events carried out throughout a span of a year. Respondents took the opportunity to express that they are not made aware of these events enough and in the bigger spectrum there seems to be a feeling present expressing lack of information provision to the public within the domain of nature protection as well as Bonaire culture preservation (see Table 3.3 for the expressions provided by respondents).

Table 3.3 Expressions by respondents regarding lack of information

Quotes
"I think there should be more information made public on the status of nature"
"They should give more information about the events for the environment"
"Bonaire's culture has to be made more visible, such as sculptures and art and in the education"
"STINAPA should give out more information, and I find it sad for local fisherman that they can't fish at their liberty anymore"
"Which conch is the government is protecting? There are three kinds of conch at Lac"

Perceived threats to nature

In order to address the perception of threats facing Bonaire's nature in the eye of residents' two questions were inserted. First an open question to name the three top threats facing the marine and then the terrestrial environment off the top of their heads. Afterwards the respondent was asked to rank the importance level of twelve different environmental threats with a Likert scale of 5 categories starting from being not important at all to being very important.

Table 3.4 displays the top-3 environmental threats perceived by residents off the top of their heads for on the one hand the marine and on the other the terrestrial environment. Within the marine environment waste in sea refers to solid waste (mainly beer

bottles, plastic bags, old car batteries, tires, and fishing gear etc.) which can be debris washed up from other countries or by localized littering. Boats refer mainly to the pollution of motor oils, but also to turbulence created by the motors and bad anchoring (use of bricks). Divers are also seen as a threat by inhabitants, mainly the thought that there may possibly be too much diving activity which in turn can cause stress to the ecosystem. Divers are also seen as a threat because of the practice of night diving, use of wetsuit sprays and taking of pictures. In the terrestrial environment littering refers to solid waste dumped into woods (mainly old cars, car batteries, plastics, glass bottles, domestic waste, garden waste and building material). Oil and contaminants mainly refer to motor oil, paint, kitchen oil and the use of acid to stop plant and tree growth around houses. Lastly the clear-cutting of woods is seen as a threat, this is closely related to population rise and economic development[15].

Table 3.4 Top-3 perceived threats by open question

Marine environment	Terrestrial environment
#1 Waste in sea	#1 Littering
#2 Boats	#2 Oil and contaminants
#3 Divers	#3 Clear-cutting woods

For the second part of this section a ranking was made of twelve different threats, respondents did not see the list of these twelve threats when asked the former open question. The respondents were asked to rate the importance of each threat on a Likert scale with 1 being not important at all and 5 being very important. Weights were assigned to these scores in order to convert the rating to a score between 0 and 1o. Score 1 was rewarded 0 points, 2 was rewarded 3 points, 3 was rewarded 5 points, 4 was rewarded 7 points and 5 was rewarded 10 points. This weighting system is adapted from previous studies (Van Beukering, 2009).

The residents of Bonaire ranked the threats between 3.9 and 8.4, with the highest one being solid waste (see Figure 3.17). By solid waste is understood for example plastics and glass bottles, this corresponds well with the answers given in the open question where solid waste is the number one perceived threat in both the marine and the terrestrial environment. It is interesting to see that “Cruise ships for tourists” were seen as the second highest threat at a score of 7.2. The examples of problems that can occur with cruise ship tourism were represented by the following examples; anchoring, waste, oil and grounding. Beyond the problems that might occur with the cruise ships, cruise ship tourism brings an amount of pressure on the island since it is a large group of people coming to visit the same natural areas (mainly Sorobon/Lac). Third highest threat at a score of 7 is “Coastal development and runoff”. One perfect example of this is the port of call area in Playa/Kralendijk which is the area most developed and with the lowest reef resilience level (International Union for Conservation of Nature [IUCN], 2011). Additionally coastal development is seen as a threat to the aesthetic appeal of the island for the locals, as mentioned in the open question on perceived threats “too many high buildings are being built”, “urbanization and tall buildings” and “buildings for tourists that are not known in Bonaire”. Another interesting find is that sewage from homes and/or boats is seen as a threat. Bonaire currently does not have an optimal sewage system but investments are being made to improve this.

[15] The grouping of these threats is based on the “perceived” threats by inhabitants and thus is based on subjective judgements.

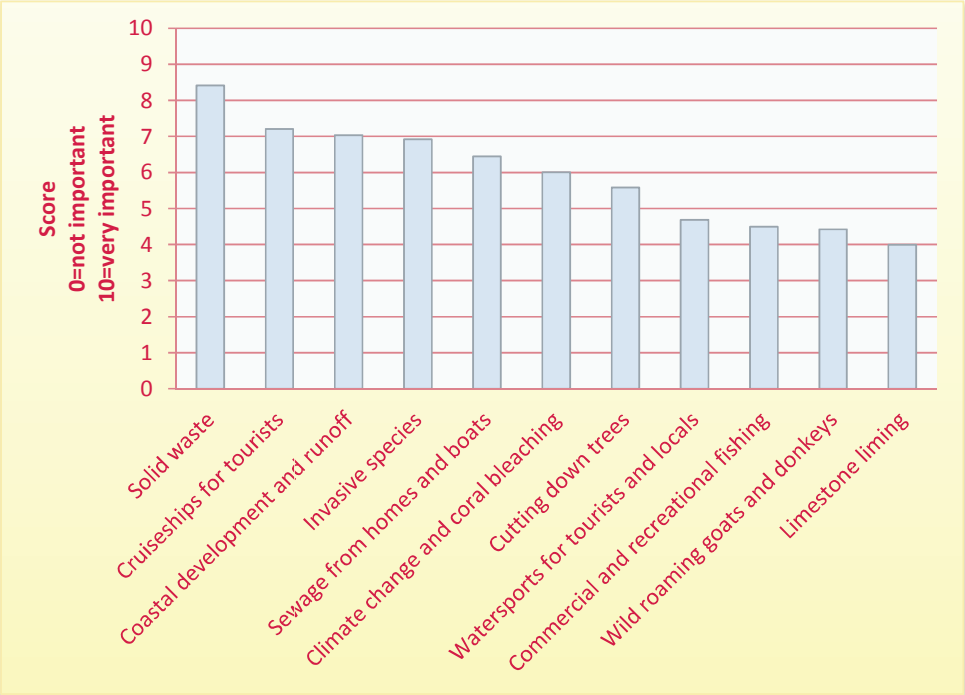

Figure 3.17 Perceived importance of threats to nature

It is interesting to note that although pouring oil on soil as well as other hazardous chemicals is seen as a top threat to the terrestrial environment, the participation rate for proper disposal of hazardous chemicals such as oil and paint that should not be poured down the drain is 57% of respondents. These activities are harmful to the soil as well as the fact that these chemicals reach the sea and affect the coral reefs (Meesters *et al.*, 2010).

Thus there is room for improving waste management by creating a more convenient and user friendly ways for proper waste disposal. Within an open comments section approximating the end of the survey respondents took the opportunity to express their concerns in regards to waste management on the island (see Table 3.5). Of course these expressions in no way encompass the broad and complex reasons for the status of waste management at the moment, it is simply the purpose of this survey to voice the concerns and thoughts of the public and thereby giving a reason and weight to improve the system to its optimal capacity.

Table 3.5 Expressions of respondents regarding waste management

Quotes
"Selibon should make dumping of waste free also during the week"
"There is a need for an improved sewage system and solid waste must be burned"
"There needs to be given a fine for dumping of trash in woods"
"The sewage system (beerput) must be fixed"

Violations to environmental laws

A question was inserted in order to get an insight in the amount and frequency that environmental laws are violated. The respondent was insured their anonymity and confidentiality before the question was asked. The respondents were asked to state if they had heard or seen six different violations of Bonaire environmental laws in the last year and if so how often. However a straightforward analysis of the frequency cannot be done through the design of the question. The focus is on the relative occurrence of violations *compared to other* violations instead of the frequency of occurrence. Relative occurrence was calculated by first scoring the frequencies of the six violations, the violation with the highest score was made the baseline. The violation that was most common on Bonaire was the "illegal dumping of trash in woods", which was documented on average 12 times per year per respondent. In comparison to the illegal dumping of trash in woods, the relative occurrence of the littering of beaches, the sea and mangroves, is almost matching (see Figure 3.18). Littering in general was seen as a threat in the perceived threats section and corresponding to that it is also the most documented violation of environmental law on the island.

Other than the violations mentioned by the survey respondent had to opportunity to express another violation not mentioned. One of the violations mentioned was the illegal poaching of parrots which is a major issue since the Yellow-shouldered Amazon parrot of Bonaire is critically endangered. Other violations mentioned was clear-cutting woods and mining.

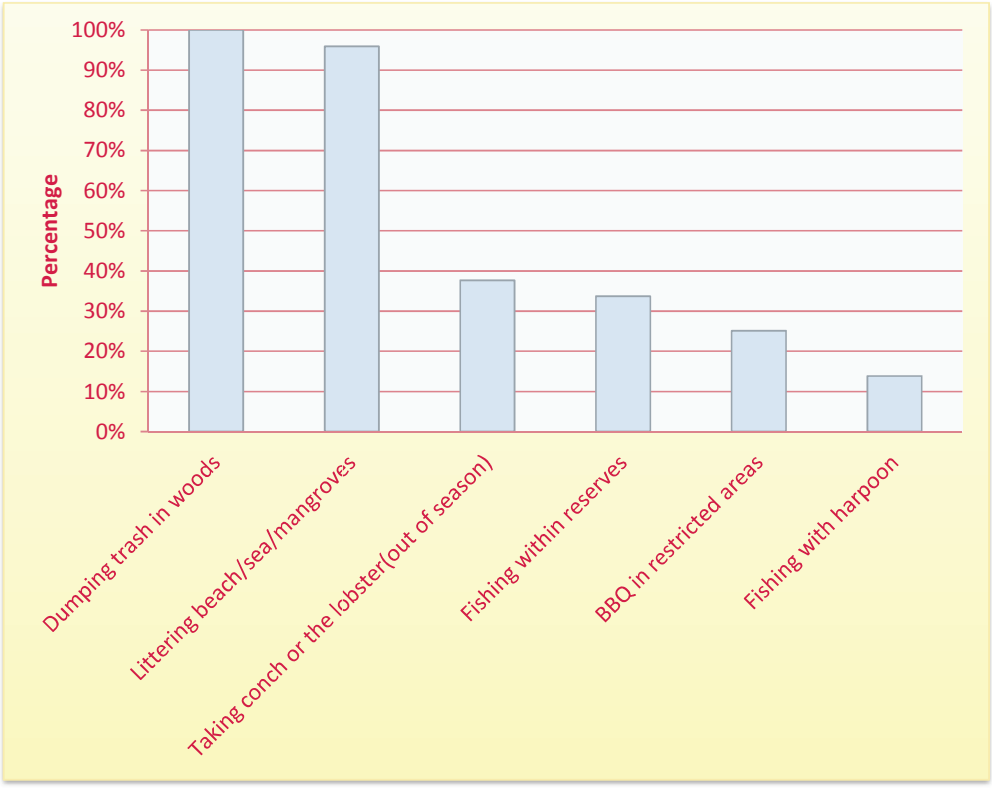

Figure 3.18 Relative occurrence per violation per island (baseline: Dumping trash in woods)

Management options

Nine different management strategies were presented to respondents in order to assess the amount of support they would assign to them. In order to calculate the relative support a score was calculated for each management option. The score was calculated by subtracting the amount of people opposed to the management strategy by the amount of people in favour of the management strategy. The management option with the most support was to improve solid waste management, which had 343 respondents in favour and 26 respondents opposed to it, giving it a score of 343-26; 317. This management option is set as the standard to which the other management options are compared to due to it being the most widely accepted by respondents.

From Figure 3.19 it can be concluded that there is support for the restriction of coastal and inland development, which was seen as the third highest threat Bonaire's nature . Additionally it is the opinion of the public that existing rules are not enforced optimally on the island. Interesting is to note that the sterilization of free-roaming donkeys is supported by many residents, this might be due to the fact that donkey's have increasingly caused car accidents on the island. The prohibition of sewage effluent also gains support by the residents, however it is important to note that this management option had a high frequency of "Don't know" answers, as well as the highest standard deviation (0.81). This might be the case for different reasons; it could be that the wording of the management option in the survey might not have been understood by all respondents, or it could be that there is a lack of information about the sewage system on the island and its effects and thereby creating very different opinions leading to a high standard deviation. The two management options with the lowest support are installing additional closures (e.g. the conch) and expanding FPA's (fisheries protected areas). Expanding FPA's also sports a high standard deviation, which is to be expected since it is a controversial topic on the island. Many residents believe that the resources from nature should not be owned by anyone and should be in principle free for all residents whereas others believe that it should be managed in order for it to keep a level of resilience and quality. However it is apparent that more restrictions in the area of fishing are generally not welcomed by the residents.

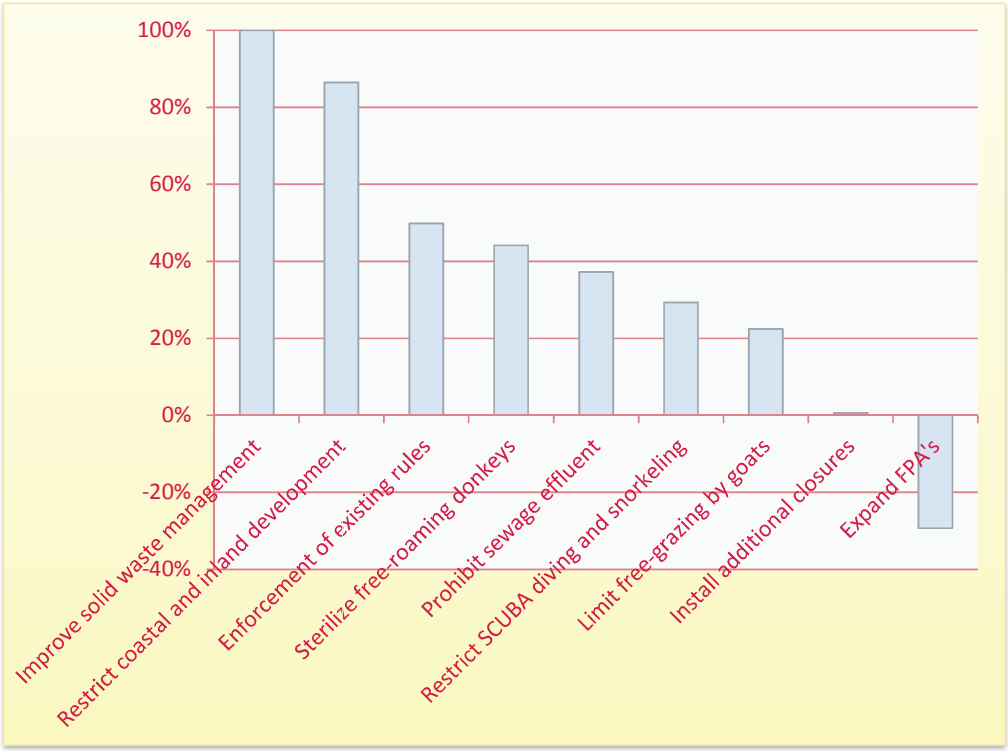

Figure 3.19 Relative support for different management options

3.8 Correlations with WTP-Preparedness

Preceding the choice-experiment respondent where asked if they were in principle willing to pay an environmental fee for the improvement of Bonaire's natural environment. The question lead as follows: *Are you in principle willing to pay an environmental fee, which would contribute to improving Bonaire's marine & land environment, and would be managed by a Non-Profit organization?* In total 64% of respondents replied that they were in principle willing to pay. It is interesting to see which respondent characteristics may influence this choice. To investigate this correlation the two-tailed bi-variate Pearson-Correlation coefficient between the WTP-preparedness variable and some respondent characteristics variables were generated. From table 10 can be seen that the variables *Income*, *Education*, *Environmental Score*, *Local vs. Non-local*, as well as *Recreation-Marine* are all significantly correlated with WTP-preparedness. All are significant at except for Income and which is significant at . Four of these correlations are positive, namely *Income*, *Education*, *Environmental Score* and *Recreation-Marine.* Expressing thereby that as the variables *Income*, *Education*, *Environmental Score* and *Recreation-Marine* rise so too does the WTP-Preparedness. People become more inclined to answer "Yes" rather than "No". Most of these results were to be expected as this was also the case in previous studies, what was rather prominent was that only recreation related to the marine environment had an influence on WTP-preparedness and the terrestrial environment did not. A possible explanation for this might be that marine environment recreation experiences much more focus to its development since it is closely linked to tourism, thereby there are less opportunities for terrestrial recreation than there are for marine recreation. The current opportunities for participation in marine environment

recreation might lead to a higher awareness of the environment than participating in terrestrial recreation and thereby a higher inclination on WTP-preparedness. Additionally public information sharing on the status of the terrestrial environment is lower than on the marine environment.

Table 3.6 Overview of correlations with WTP-preparedness

Variable:	Income	Education	Environmental score	Local vs. non-local	Recreation-marine
Pearson correlation	0.12*	0.16**	0.22*	-0.23**	0.14**
P-value Sig (2-tailed)	0.034	0.002	0.000	0.000	0.007

Note: *= significant at 0.05 level, **=significant at 0.01 level

Local vs. non-local is meant to project the difference between residents born on Bonaire and residents born elsewhere. The negative correlation signifies that being born in Bonaire gives a higher chance of not being in principle willing to pay for the improvement of Bonaire's environment. It was checked if this was the case when the Netherlands Antilles would be compared as a whole with other countries, but this was not significant, nor was grouping the ABC islands (Aruba, Bonaire and Curacao). A possible reason for this might be the case is because of the more recent change in socio-economic dynamics on the island. Since October 2010 the Netherlands Antilles dissolved and Bonaire became a special municipality of the Netherlands. Since the referendum the residents have expressed their discontent with the direction of the new government through manifestations on the island. This sentiment was expressed to the research team during interviews; the public was especially discontent with new implemented laws which in their perception have negatively affected middle and lower income households. Another reason for this might be that monetary valuation of nature may be at odds with inter-generational cultural norms on Bonaire. This aspect has been observed in interviews with local stakeholders where the general opinion leads as "nobody can ever own nature", perhaps this reflects an intrinsic value that is not compatible with the anthropocentric view on ecosystem services.

3.9 Choice experiment and Willingness to pay

In the choice experiment, the respondents were asked to make a choice between three different scenarios in a choice set, scenarios A, B and C, all depicting different levels of attributes. Scenario C was the same on each of the choice sets. It represented the expected future scenario without extra management and without extra payment.

Opting out

If a respondent repeatedly chose for option C and by doing so "opted out" of paying an environmental fee with every choice, they were asked to state why they were not willing to pay. The number of respondents that opted out was 26, which corresponds to 7% of all respondents. From Figure 3.20 can be seen the key reasons for opting out and the percentage of respondents stating them as most important. The most frequently stated reasons for opting out (19% of the people that opted out) was the lack of confidence that the money will be used well and not being able to afford the stated environmental fees. Additionally 15% state that they are not responsible for

environmental damage and thus opted out for this reason. Subsequently 12 % state that the issues are more complex than the CE suggests. A substantial part of the respondents that opted out gave a reason not specified by the available choices (19%). The reasons specified can be seen in Table 3.7.

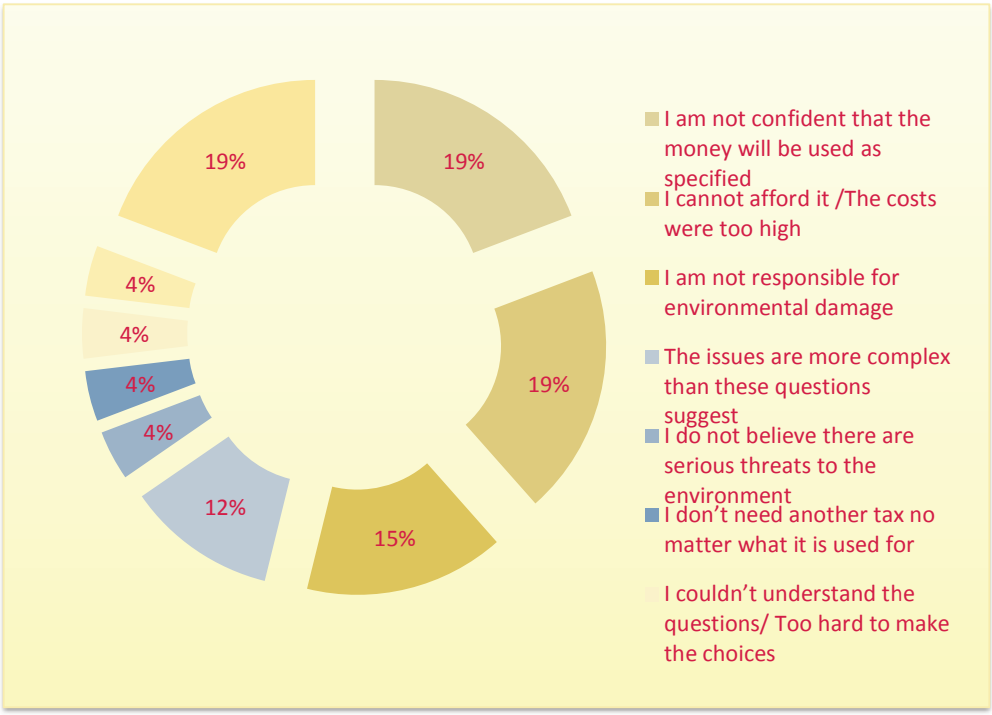

Figure 3.20 Key reasons for opting-out

Table 3.7: Reasons specified for opting-out when "Other" was chosen

Quotes
"Everything is going bad, I do not see any change happening"
"There is already a channel of money from the NL directed to the environment"
"The government must take care of this by using taxes paid by tourists"
"The items push a person to a desired answer"
"I don't think it's necessary to "fix" nature, if just everyone would cooperate"

Attributes

Figure 3.21 shows how the respondents rated the importance of the different attributes for making a trade-off in the choice experiment. The scores are generated by calculating a weighted average for each attribute. The respondents were asked to choose a score on a Likert scale, between "not important at all" and "very important". The weights vary from 0 points for "not important at all" and 10 points for "very important". In the table it can be seen that the four attributes that score the highest

are "Terrestrial quality" (average score: 7.4) and "Fish catch per trip" (average score: 7.2), followed by "Public access to beaches" (average score: 7.1), "Reef quality" (average score: 7). It is apparent that the importance between the four highest scored attributes have a score very close to each other and there is no prevailing attribute. "Free roaming goats" scored on average 6.5 and "Environmental fee" scored on average 5.4 and is considered to be the least important attribute.

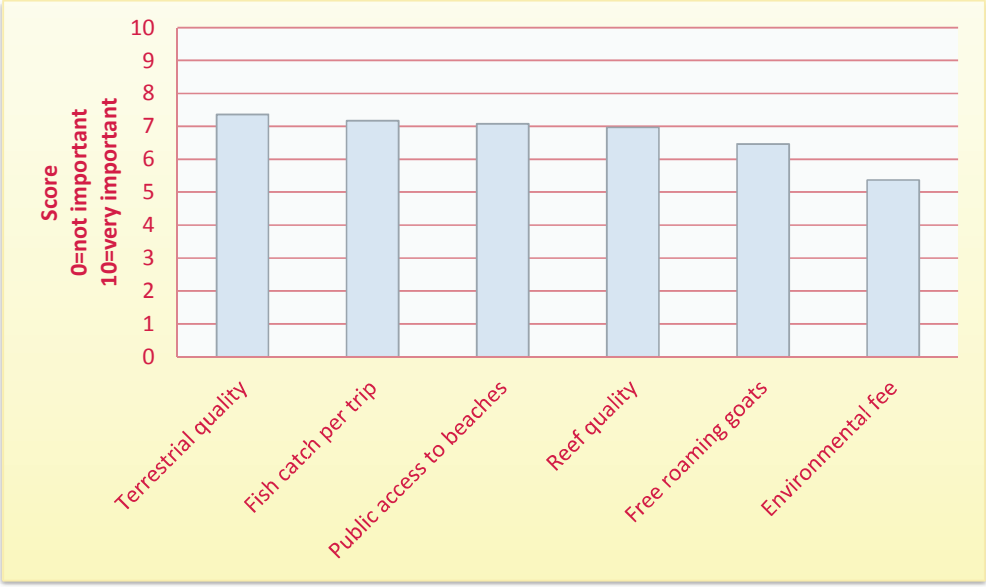

Figure 3.21 Rated importance of different choice-experiment attributes on average

Willingness to pay per attribute

From the responses that were given in the choice experiment, the respondent's willingness to pay can be determined. A multi-nominal logit regression model analysis of the choice data was conducted in order to identify the WTP per attribute. The attributes are all dummy coded except for the environmental fee attribute, which is coded as a continuous variable. The estimated coefficients on the attributes are all statistically significant at the 1% level ($p<0.01$), except for medium terrestrial quality, which is significant at the 5% level ($p<0.05$).

The estimated coefficients in table 7 represent the slope of the utility function, or the change in marginal utility per unit of change per unit change of each attribute. For example, the increase in reef quality from "poor" to "high" will increase utility by 0,704 and a decrease from "grazing" from free roaming goats to "no grazing" increases utility by 0,491. Table 3.8 shows that the attribute that yields the lowest increase in utility per increased unit is the environmental fee, although it does have a negative effect on the WTP.

Table 3.8 Regression results of willingness to pay with 95% confidence intervals

	Coefficient	SE	P	WTP(USD)	Upper CI	Lower CI
ASC	0.849	0.135	0.000	26.36	-39.49	-17.34
Reef quality moderate	0.524	0.071	0.000	16.27	-23.48	-11.32
Reef quality high	0.704	0.070	0.000	21.84	-29.78	-16.56
Terrestrial quality moderate	0.180	0.071	0.011	5.59	-11.24	-1.14
Terrestrial quality high	0.292	0.069	0.000	9.07	-15.27	-4.63
Fish catch: no change	0.199	0.075	0.008	6.18	-11.03	-1.81
Fish catch: 20% higher	0.473	0.074	0.000	14.67	-21.08	-10.16
No grazing	0.491	0.049	0.000	15.23	11.03	21.82
Beach access: 10% lower	0.261	0.076	0.001	8.10	-13.79	-3.48
Beach access: no change	0.310	0.075	0.000	9.61	-14.85	-5.24
Fee	-0.032	0.004	0.000			
N	2232					
R^2 Pseudo	0.0744					

Within Figure 3.22 one can see the average willingness to pay in USD per month per attribute. The attribute with the highest WTP for an improvement is reef quality. From Table 3.8 one can see that reef quality brings about the highest utility compared to the other attributes. Reef quality brings about more utility than the terrestrial quality, although no apparent difference in their rated importance was provided by respondents. One reason for this might be that residents depend more on the coral reefs for economic stability (tourism) than on the terrestrial terrain and thus brings about the highest utility if it were protected even though that from another perspective they may be considered equally important. Another perspective might be the value for the local recreational opportunities and other cultural connotations such as the cultural landscape of Bonaire for the locals. This would invariably mean that the WTP being measured relates not exclusively to recreation and cultural environmental service, but also to the opportunities provided by nature for tourism which correspond to income and prosperity of the country. This is not necessarily a deviation from the purpose of the study since tourism forms part of the social fabric of the island and the culture that has developed through it.

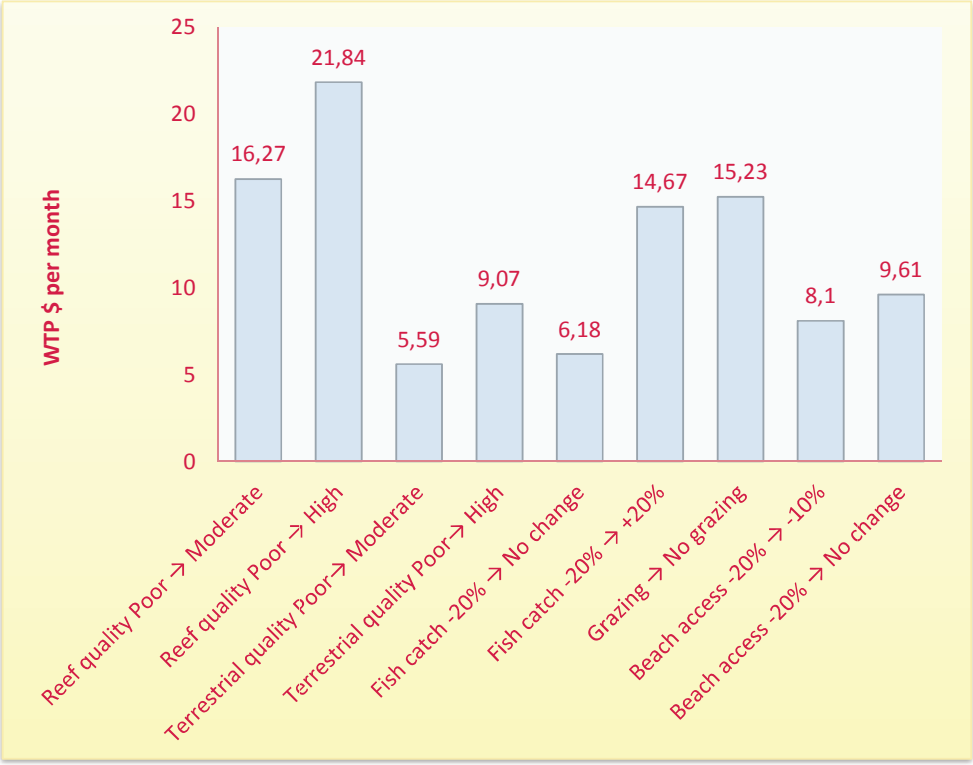

Figure 3.22 Average household WTP per month for an improvement of attribute state

The estimated coefficients are used to calculate mean household willingness to pay for each change implied by the attribute levels. The WTP amounts should be interpreted as the average WTP to move from the omitted category attribute level to the attribute level listed in the table. For example, mean household WTP to move from a situation with low reef quality (the omitted category) to a situation with medium reef quality is estimated to be USD 16.27. The Krinksky and Robb (1986) procedure is used to estimate 95% confidence intervals for each WTP estimate. Upper and lower CI represent the confidence interval for the WTP measure.

The alternative specific constant (ASC) estimated in the model represents the preference of respondents to avoid the "expected future without extra management" scenario and opt for one of the alternative management scenarios. It is a dummy variable that equals one when the "expected future without extra management" scenario was not chosen. This preference (26.36 USD) is over and above the differences between scenarios that are represented by the attributes, in other words there is a positive preference for additional environmental management on Bonaire.

What is also apparent is that attribute roaming goats resulted in the second highest WTP for an environmental improvement. From Table 3.8 one can see that a move from grazing to no grazing of roaming goats brings about the second highest utility compared to the other attributes. This is striking since free-roaming goats were not seen as a threat, and there was little support for the limitation of free grazing by goats. One possible explanation for this might be a lack of public information sharing about the effects of excessive grazing by goats on the terrestrial terrain, which was informed to respondents through the pictograms. The implied ranking of attributes is dependent upon the experimental design used, for example the pictograms used but

also the relative distances between the "good" and "bad" levels for each attribute (Hanley, Wright, Adamowickz, 1998). The attribute "Roaming goats" had only two levels - one good and one bad – this might be the reason for the high value assigned to it (15.23 USD to move from bad to good) since it was an "easy" decision to choose the best possible level since there was only one "good" level. From a policy perspective it was important to find out on which side the balance of the love-hate relationship with free roaming goats is heavier, through having two choices the explicit opinion of the public could be derived. This opinion is to protect the environment and introduce goat management schemes. Whilst "Terrestrial quality" measures the importance of conserving all terrestrial ecosystems the effects of grazing by goats "Roaming goats" measures the importance of conserving some terrestrial ecosystems. It is then remarkable that the variable "Roaming goats" has a higher WTP than "Terrestrial quality", as was explained earlier this is dependent on the experimental design used and may relate to a cause being depicted rather than an effect.

The third highest utility providing attribute is Fish Catch with a WTP of 14.67 USD to move from the worst scenario (a decrease of 20% from current levels) to the best scenario (an increase in current level with 20%) and thus an improvement from current levels. The WTP could be attributable to the direct-use-good fish catch but also to a non-use option value. The use-good fish catch WTP could be attributed by fishermen (more enjoyable fishing experience, selling fish, income buffer) but also by non-fishermen (traditional food source, altruism towards fishermen). Non-use option value is attributed by both fishermen and non-fishermen as the significance of maintaining the option of the use-good fish for future use. Fishermen here is everyone who participates in fishing activities; both recreational fishers and fisherman by profession. According to this survey 33% of households participate in fishing activities on the island, only 5% sell their catch and a proportion may use fishing as an income buffer (it was not possible to derive how much). However these motivations are not mutually exclusive from other motivations which can largely be classified as recreational and cultural.

The attribute Public Beach Access proved to have a WTP of 9.61 USD for a move from the worst scenario (a future loss of 20% from the current level) to the best scenario (no change from current levels). Coastal development was perceived as the third highest perceived threat on the island and a high support was given for the restriction of coastal and inland development. It is apparent that locals cherish the opportunity to make use of the beaches and believe in keeping their cultural landscape and enjoyment of scenery intact.

Integration of Bonaire WTP on a monthly and yearly basis

In order to express the WTP to improve Bonaire's marine and terrestrial environment as a whole an integration of the WTP measures is performed and then extrapolated to the total population of Bonaire. The monthly WTP per household to improve Bonaire's marine and terrestrial environment from poor to moderate is $ 51.37 USD and from poor to high yields a monthly WTP per household of $ 70.42 USD[16]. Department of Civil Affairs registers 4635 households on Bonaire, which leads to a total yearly WTP to improve the overall natural environments state from poor to moderate to approximately $2,9 million USD and from poor to high as much as $3,9 million USD.

[16] Since attribute "Roaming goats" does not have an intermediate level the same WTP amount expressed ($15.23) for the move from grazing to no grazing is used for both integration measures.

Do income and country of origin influence WTP levels?

In the interest of policy makers it was interesting to find out to what extent income and country of origin influence the WTP level. In order to investigate this a sub-sample of respondents were created to test if there were significant differences between the WTP levels of the different sub-samples. Both income and country of origin proved to have significant influence over WTP-levels. From Table 3.9 can be seen that residents with a High income are willing to pay on average $ 47.64 USD for a move away from the "expected future without extra management" scenario (ASC), whilst the average of the whole sample lies at $ 26.36 USD.

Table 3.9 Willingness to pay for sub-samples of respondents

	WTP All	High income	Bonaire	Antilles	Caribbean	Nether-lands	Latin America
ASC	26.36	47.64	20.85	18.02	23.50	151.97	65.69
Reef quality medium	16.27	33.93	12.87	11.08	14.44	93.45	40.76
Reef quality high	21.84	45.71	17.28	14.92	19.45	126.42	54.49
Terrestrial quality medium	5.59	13.92	4.41	3.82	4.89	31.92	13.97
Terrestrial quality high	9.07	19.24	7.18	6.20	8.07	52.70	22.66
Fish catch no change	6.18	12.67	4.82	4.15	5.30	33.94	15.50
Fish catch 20% higher	14.67	25.44	11.56	9.96	12.91	83.64	36.79
No grazing	15.23	27.13	12.05	10.37	13.53	87.65	37.99
Beach access 10% lower	8.10	16.05	6.38	5.46	7.12	45.35	20.20
Beach access no change	9.61	19.34	7.60	6.47	8.44	54.16	23.95

There are significant differences in the WTP-level of sub-samples of country of origin. Interesting is to see that Bonaire has a higher WTP-level ($20.85 USD) than the sub-sample Antilles ($18.02 USD), but still lower than all other country of origin sub-samples[17]. The difference between Bonaire and the Antilles may be attributable to some heritage-values assigned to Bonaire's ecosystems by the fact that one is born and has probably grown up on the island. It is safe to say that although significantly different the WTP-level of Bonaire, Antilles and Caribbean are close to each other. However the difference between these groups and the rest are considerably big (Netherlands $151.97 USD) (see Figure 3.23 for a more observable view of this con-cept). There could be cultural aspects at play, where for example the way a society

[17] Sub-samples North America and Rest of the world deemed insignificant and are thereby not included into the table. The insignificant results are probably due to a combination of a small sample size and high variation responses.

attends to risk, time horizons and the scenario's presented to them in the choice experiment influence the WTP-levels. Furthermore judgments on who is accountable for damages and other cultural norms might explain the big difference. Additionally it might be the case that the different sub-samples have significantly different income levels, this was not taken into account during the analysis.

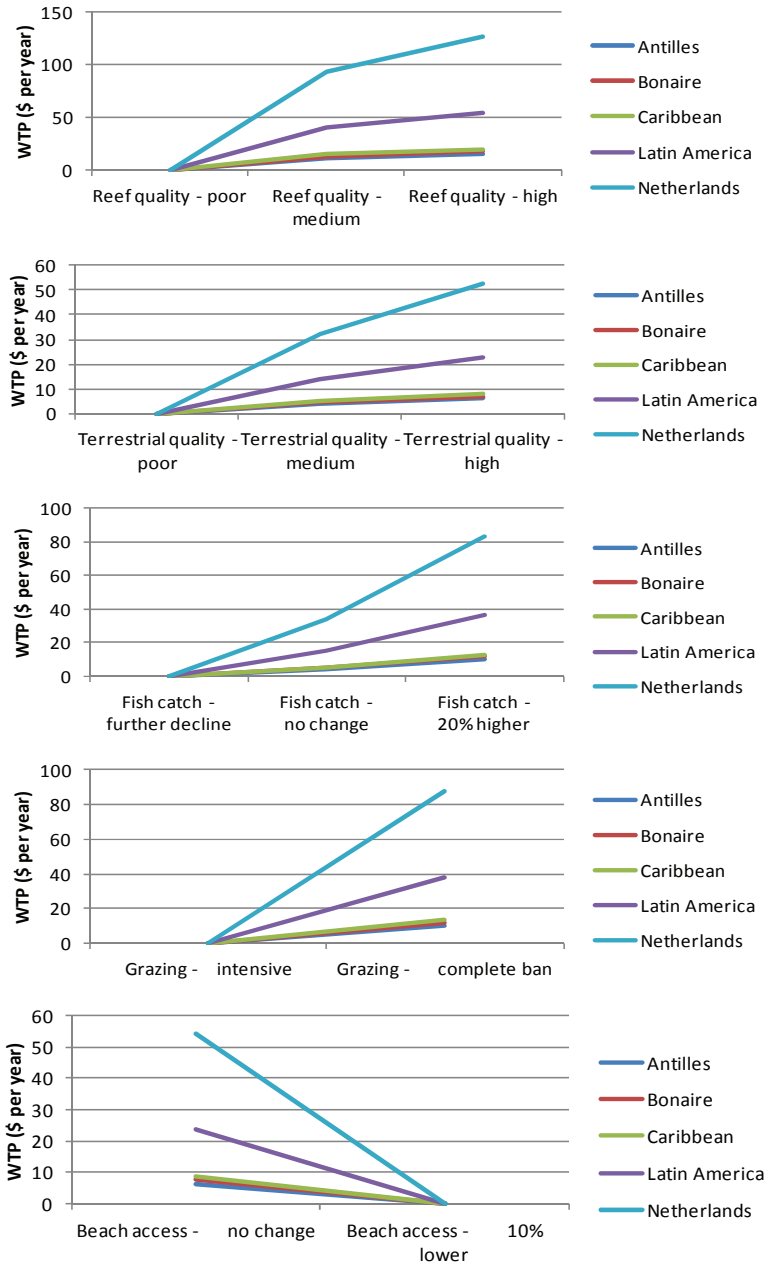

Figure 3.23 WTP in US $ for change in attribute level

4 Conclusion, limitations and recommendations

This chapter is dedicated to the conclusion of the analysis and results section, the limitation of this study that should be taken into account, and recommendations aimed at stakeholders on Bonaire.

4.1 Conclusion

This paper set out to answer the following research question: "***What is the recreational and cultural economic value of Bonaire's marine and terrestrial ecosystems to its inhabitant?***" To answer this question a choice experiment was set up with an additional structured survey. The survey inquired into the recreational activities related to nature on Bonaire. Household participation in snorkelling and/or diving which require a more direct contact with the coral reef environment is at 18 percent of all households on Bonaire. As for recreational fishing a staggering one third of all households participate in recreational fishing. The favourite locations seem to point at locations where conservation is presently aimed at such as Klein Bonaire as a favourite location for diving and Washington Slagbaai as a favourite location for terrestrial recreation. However there are other important areas mentioned for terrestrial environment recreation where presently there is not much focus on conservation such as Lagoen, Seru Largu, Rincon and Kunuku's in general. To take a closer look at the cultural value as a service provided by nature on the island three extra questions were asked where we could see that there are other important areas that play a traditional/historical role such as the *Trai montanja* caves, *Boca Onima* (bay), *Rooi Lamoenchi* (river), and *Mondi Bolivia* (woods), which are not the main target of conservation. There is also a cultural value attached to the use of medicinal plants as well as the use of fish as a traditional food. Only around 6% of respondent do not eat locally caught fish.

The additional survey also looked at the environmental score of respondents which was on average 4 from a scale from 0-11. The perceived threat by respondents largely focuses on waste management (sewage as well as solid waste). *Cruise-ships for tourists* as well as *Coastal development* were seen as important threats. The violations to environmental related laws identified by respondents largely focus again on waste; littering woods as well as beaches, sea, and mangroves. One important violation perceived is the poaching of parrots, unfortunately this was not provided as an option thus the relative frequency to the other violations is not known. Additionally there is clear support for the improvement of solid waste management and restrictions on coastal and inland development.

Through the choice experiment it became apparent that there is a positive preference for additional environmental management on Bonaire (ASC is higher than any utility gained by a change in the attributes). Through integration of the WTP amounts per attribute the results show that **a yearly WTP by all households on Bonaire to improve the overall natural environments state from poor to moderate to be approximately $2,9 million USD and from poor to high as much as $3,9 million USD**.

The order by rank of the attributes yielding the highest utility to the lowest is as follows; *Reef Quality*, *Roaming goats*, *Fish Catch*, *Public Beach Access* and *Terrestrial Quality*. All attributes are significant and affect utility of respondents meaning an improvement brings about higher utility levels for respondents. Although no apparent

importance was given to any attribute when asked directly the preference is clearly shown through the choice experiment where *Reef quality* yields more utility compared to *Terrestrial quality*. A possible reason for this being that Bonaire depends economically mainly on dive tourism and identification of a country with top pristine reefs. Additionally *Roaming goats* yielded the second highest utility even though it was not perceived as an important threat nor was their much support for goat management in the preliminary survey to the choice experiment. A lack in public information sharing on the effects of excessive grazing by roaming goats might explain this deviation in consistency. Another possible reason might be the experimental design used itself, the fact that two levels where used. Nonetheless it is clear that there is support for goat management given a negative effect on the terrestrial terrain. Additionally there is clear support for restrictions on coastal development as it affects public beach access which brings about utility for residents.

The WTP-preparedness is significantly correlated with *Income*, *Education level*, *Environmental score* (environmental awareness), *Recreation-Marine* (participation in marine related recreation) and *Local vs. Non-local* (rather one is born on Bonaire or not). For the first three mentioned the correlation was positive meaning a rise in WTP-preparedness goes hand in hand with a rise in *Income*, *Education level*, *Environmental score* and *Recreation-Marine.* Being born on Bonaire was negatively correlated to WTP-preparedness, a possible explanation for this might be the recent political and constitutional changes on the island or an intergenerational culture where paying for an environmental service is not in correspondence with cultural norms.

Additionally WTP-level itself was checked against *Income* and *Country of origin* where it became apparent that WTP-level in for respondents from the Caribbean region deemed low in comparison to other countries of origin. Reasoning for this might be related to cultural norms and the perception of risk and accountability.

4.2 Limitations

Since the environmental service being valued within this research through a choice experiment is very broad – recreation and cultural value of marine plus terrestrial environment- it can be said that many more attributes could have been evaluated. For example if it were only focused on the marine environment other attributes such as water clarity and coral diversity could have been evaluated and thus a deeper insight into the valuation of the marine environment and this vice versa with a separate CE for the terrestrial environment. The design of this CE provides the answer that the public does want a healthy coral reef, but not which aspects (e.g. water clarity, species diversity) are more or less important for managing the marine environment. Additionally a value judgment must be made as to what attributes to use to express values of specific ecosystem services.

Secondly this study experienced a change in direction once the research team arrived on the island. Through the workshop with local stakeholders it became apparent that a new choice experiment would be built with incorporation of terrestrial attributes. This was important in order to apply the results to real policy issues on the island. The change in direction did cause for complications as the study became time restricted. A thorough pilot survey could not have been carried out with the available time and resources. The pilot survey was carried out at one point in time with 3 respondents which were also the interviewers. A more thorough pilot could have improved the design of the questionnaire. Additionally it was a challenge to keep track of the socio-demographic characteristics of respondents since the researcher was also an

interviewer and there were no resources at that time to simultaneously enter collected surveys into a database. The training day for interviewers was also cut short to half a day training which was not enough for a good start, at the beginning many interviewers still had questions and had entered one of their first surveys incorrectly which deemed unnecessary if a bit more training would have been provided.

Thirdly this research did not document the number of non-responses and thereby the response rate is unknown. Fourthly choice experiments by definition of their methodology face issues as this research field is still in its infancy (See Hoyos 2010 for a full description of the status on CE). We as humans do not understand the complex links of ecological systems let alone their intricateness with the human society. And lastly results of this study depend on the honesty of respondents, although some of this is taken into account within the choice experiment, where respondents must repeatedly express a choice, within the additional survey there is not much way of checking for consistency issues.

4.3 Recommendations

Given the results and conclusions of this study certain prevalent issues can be highlighted and advice can be given to policy makers as well as other local stakeholders on the island of Bonaire. **The most prevalent being that residents on Bonaire have a general preference to move towards additional conservation of nature are WTP an amount for it**.

From the choice experiment it is apparent that once the effects of over-grazing by free-roaming goats is known there is a preference to manage them, and keeping goats within confinements such as kunuku's is not seen as a problem. The main problem here is that most kunukero's (farmers) do not have the resources to provide food for the livestock. As such projects for sustainable growing of food for the livestock in consideration with socio-economic impacts to farmers are readily given weight. Through public information engagement and stakeholder participations there will probably be much enthusiasm and understanding for changes in goat management and support for these kinds of initiatives.

Coastal development is seen as an important threat on the island and public beach access is affected by it, especially the building of private homes along the coast. Pressure areas for development such as *Sorobon/Lac* should be kept as it is for residents as it is seen as one of the most important areas for beach recreation by the residents.

In general reef quality and terrestrial quality improvements both raise utility of Bonaire residents. Thus conservation in general is supported by residents**. It is also apparent which types of management options are sensitive, especially limiting or restriction of fishing areas as well as fishing methods.** For these issues it is rather important to engage in public awareness raising. From the survey it can be concluded that more public information sharing about the status of nature and the effects of certain stress causers is appreciated by the residents.

As for perceived threats on the island waste management is a major issue in the eyes of residents. Especially littering of nature, dumping trash in woods, littering beaches and other natural areas is seen as a big issue on the island where improvements are supported. As a frame of reference all the perceived threats should be taken into account since they are important areas of focus for the residents of Bonaire which are represented by their policy makers.

Even though Bonaireans are in favour of conservation they are not even on the brink of accepting a widely employed PES system (Payment for Ecosystem Services). This does not translate into not having a value for nature, which is apparent through the choice experiment result, but rather signals to the cultural norms and the current turbulent political times. This in respect does not mean that a PES system can never be introduced and succeed on Bonaire, rather this means that learning must take place before any widely uniform PES system can be introduced for all residents. Especially to understand that accountability does not only lie with tourists but also locals and that the environment needs management given the level of influence we as humans have.

And last but not least a critical struggle is observed between tourism and environmental and cultural heritage conservation. Bonaireans take pride in the pristine reefs and fresh air both of which are threatened by infrastructure development and rising numbers of tourists leading to road congestions. Policy makers should keep this particular struggle in mind especially given Bonaire's goal of sustainable tourism. Quite possibly number of tourists is not the answer but quality of tourists in other words repeat guests.