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The local cultural and recreational value of nature on St Eustatius

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List of abbreviations

CE	Choice experiment
CI	Confidence interval
CS	Consumer surplus
CM	Choice modelling
CVM	Contingent valuation method
IVM	Institute for Environmental Studies Amsterdam
PS	Producer surplus
SCF	Saba Conservation Foundation
SIDS	Small island developing states
TEV	Total economic value
WTP	Willingness to pay

Summary

St Eustatius, is a small island in the Caribbean and a special municipality of the Netherlands. As many other small islands, St Eustatius' marine and terrestrial ecosystems are vulnerable to external disturbances, such as natural disasters but also pressures from human behaviour. Multiple stresses can lead to degradation of ecosystems, if these are not able to recover until the next disturbance. As ecosystems provide benefits to people, so called ecosystem services, the value of these services decreases, as the ecosystem degrades. Economic valuation of ecosystem services identifies the costs and benefits of human interaction with nature, e.g. construction, and helps to develop long-term development strategies that take ecosystem services into account. This research is evaluating the local recreational and cultural services that ecosystems on St Eustatius provide to their residents and their value to the inhabitants, as part of a larger study on the total economic value (TEV) of the island's natural environment. To this end, a household survey with an embedded choice experiment is used. The results of the survey show that: (1) Half of the population has a general willingness to pay (WTP) for nature management; (2) the biggest perceived threats to the environment are oil spills, solid waste and invasive species; and (3) that the people of St Eustatius want see livestock on the island fenced and archaeology managed. The total aggregated annual WTP of all households on St Eustatius for the conservation of terrestrial land is 29,000 USD and for the marine ecosystems 65,000 USD. Residents of St Eustatius are willing to pay 41,000 USD for the management of archaeological heritage. An interesting result is that the people are keen on managing the roaming livestock by contributing additionally 64,000 USD on an annual basis.

1 Introduction

St Eustatius is a small tropical island located just North of St Kitts and Southwest of Saint Martin/St Maarten. Also known under its more common name Statia, it has made itself a reputation as, inter alia, a beautiful dive spot, two national parks that attract hikers and a rich historical and archaeological heritage thanks to its great importance as a centre of trade in the 18th century. However, these and other prominent features of St Eustatius are threatened by the pressures that are typical for small tropical islands. Due to the spatial restrictions and the traditional isolation from other ecosystems, St Eustatius' ecosystems are vulnerable to disturbances, be it either the direct or indirect consequences of human behaviour. Garbage is polluting the environment and invasive species have been brought to the island and disrupt the local ecosystem. Consequently, the value of the services that St Eustatius' ecosystem provides will be decline if these threats are not tackled in an appropriate and timely manner.

In order to initiate responses to these threats, it is vital to determine the value of the ecosystem services to the people that benefit from them. Once the value is known, it can be used for, amongst others, raising awareness, damage assessment, extended cost-benefit analyses or budget allocation in general. In short, economic valuation of ecosystem services helps to understand the trade-offs between conservation and development. As a past study in a similar setting (Wolfs *et al.*, 2012) has shown, the results of economic valuation can be consulted or even incorporated in decision-making. To this end, the total economic value (TEV) is used, which includes values adding up to an economic value. The more common total financial value does not include non-market values. Subsequently, as the aforementioned study demonstrated, the TEV highlights the importance of the contribution of the natural environment to the economy and well-being by including values that are enjoyed outside formal consumer markets.

These non-market values are, however, often less tangible and unperceived, making them more difficult to determine. Parts of the local recreational and cultural services that an ecosystem provides are non-use values, for example the cultural value of a coral reef or an historical site. One technique to determine these values is choice modelling, which uses a choice experiment to determine the willingness to pay for nature conservation by the inhabitants. Using this technique, framed by a structured questionnaire and aimed at households on St Eustatius, this paper attempts to answer the following question:

What is the cultural and local recreational value of St Eustatius' marine and terrestrial ecosystems to its inhabitants?

Chapter 2 will start give background on the island St Eustatius after which Chapter 3 will explain the methodology of valuing ecosystem services and the underlying methodology of the choice experiment. Chapter 4 will treat the results of the survey and the valuation. In Chapter 5 conclusions are drawn and recommendations based on the study results are given.

2 Background St Eustatius

St Eustatius has been a trading hotspot in the colonial times of the 17th and 18th century. Due to its strategic position, i.e. a harbour that is protected from rough waters, it has been fought over numerous times and changed hands at least 22 times (SECAR, 2013). It played an important role in the American revolutionary war, when most of the trade, considered to be illegal, went through its harbour. Eventually, it moved from being a Dutch colony to become part of the Dutch Antilles. Together with Saba and Bonaire[1], it became part of the Netherlands as a special municipality in 2010.

However, due to its Caribbean geographical position, the environment on St Eustatius is very different from that in the other Dutch provinces (see the map in Figure 1). St Eustatius has a dry and mountainous terrain with flora mainly consisting of the dry and thorny acacia and the colourful but invasive coralita. Additionally, the more than 50 different bird species on St Eustatius, of which ten are endemic to the region, cannot be seen in the natural environment of the mainland Netherlands (Rojer, 1997). St Eustatius is known for its more than 30 dive spots and their coral patches, which are home to sharks, turtles, rays, and many more tropical marine species. Additionally, the nearby marine protected area of the Saba Bank is home to whales, which sometimes can be seen along the coasts of St Eustatius. Most of St Eustatius' coastal waters are protected and both the Northern and Southern tip of the island are national parks or park reserves (see **Error! Reference source not found.**). The national parks, named Quill and Boven, as well as the coastal waters to a depth of 30 meters are managed by the St. Eustatius National Park organization (STENAPA, 2013).

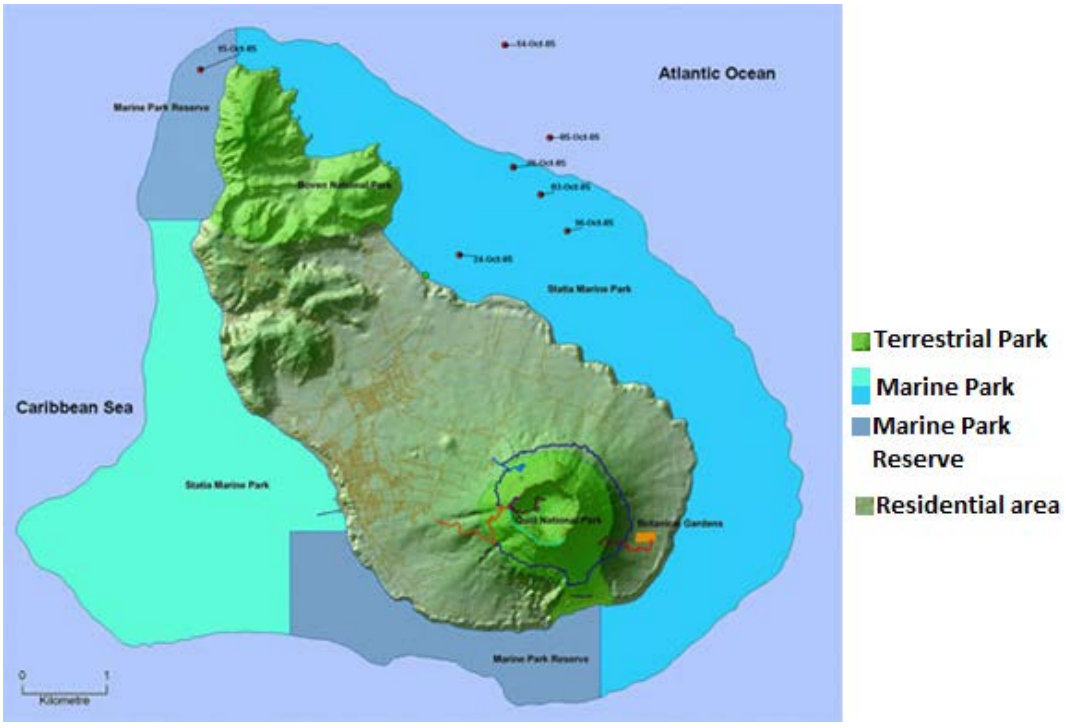

Figure 1 Map of St Eustatius (Source: STENAPA, 2013)

[1] Together known as the BES islands [B(onaire), (Sint)E(ustatius) and S(aba)]

Despite the large fraction of protected areas, St Eustatius' marine and terrestrial ecosystems are threatened with degradation. While some threats are universal, such as global warming, others are more region-specific, such as hurricanes. Since both are natural processes, yet fuelled by human behaviour worldwide, not much can be done to address these threats, at least not locally. Other threats, however, are very specific to St Eustatius, such as fishing, diving or the hazards of oil transhipment, for which St Eustatius is still a major port. An oil spill might destroy the entire tourism industry in the region (Griffith& Ashe, 1993). Additionally, as many other islands, St Eustatius' ecosystems are threatened by pollution and solid waste, due to limited space on a small island (Forster *et al.*, 2011).

The Territorial waters of St Eustatius also include a part of the Saba Bank (Figure 2). The Saba Bank is very valuable as a spawning ground for fish, for preserving biodiversity as well as for fishermen from surrounding islands, as fish becomes more abundant in the sur Islands are also especially vulnerable to the impacts of invasive species, as their ecosystems have evolved in geographic isolation and are very sensitive towards any disturbance (Wilcove *et al.*, 1998). Particularly the lack of species naturally preying on the invasive species lets them spread undisturbed, especially in the unfilled ecological niches of an island (CBD, 2013). Invasive species on St Eustatius are lionfish, coralita and livestock. Lionfish are threatening the entire Caribbean and as predator fish without a lot of natural enemies, they spread while reducing the juvenile endemic fish stocks (Albins & Hixon, 2011). Free-roaming livestock is also a threat and causes erosion as a result of overgrazing and trampling, which eventually threatens the marine ecosystem as sediments flow into the sea and disrupt coral functioning (Fleischner, 1994; Maina *et al.*, 2012). Laws that prohibit free-roaming livestock have hardly been enforced since the 1960s, which led to their population rise (Ministry of Economic Affairs,, Agriculture and Innovations, 2011). The invasive species coralita is posing a serious threat to the endemic vegetation of St Eustatius. Other threats include mining sand from the beaches for construction activities, which might result in the destruction of nesting sites for turtles and permanent beach erosion.

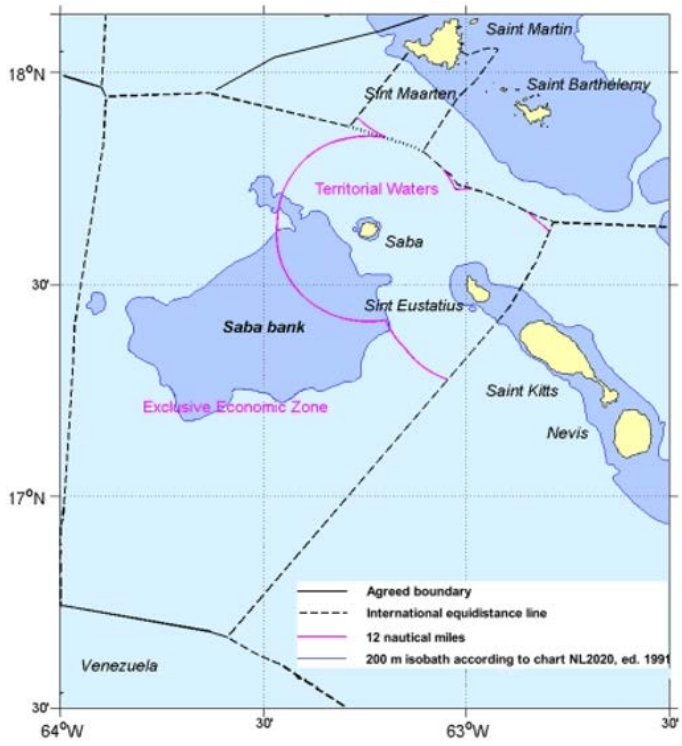

Figure 2 Map of Saba Bank (Source: openi.nlm.nih.gov)

2.1 Theoretical background

Valuing ecosystem services

The choice of the valuation technique to be used depends on whether the service can be actually used or not. Therefore, first a distinction is made between use and non-use value. A framework of the TEV can be seen in Figure 3. See annex B for a more in depth explanation on ecosystem services and economic valuation. Use values can be sub-divided into direct and indirect use values. While both can be used, the former has an extractive element, which the latter lacks. An example for a direct use value is the provision of fish for recreational fishing. The non-use values on the other hand can be sub-divided into bequest and existence value. Bequest value refers to services that only future generations will experience, such as avoided damage to St Eustatius' ecosystems from climate change. Existence value refers to the intrinsic appreciation of nature, e.g. of a rare species, which in the case of St Eustatius would be the lesser Antillean iguana. Finally, option values represent the last category of ecosystem services. Option means that while they are currently neither used nor non-used, they might become very valuable in the future. An example for an option value on St Eustatius would be the genetic material of medicinal plants that have not yet been discovered by the pharmaceutical industry. The recreational and cultural values that St Eustatius' ecosystem provides belong both to the direct use values as well as to the non-use and option values. Thus, only a part of the TEV is determined in this study.

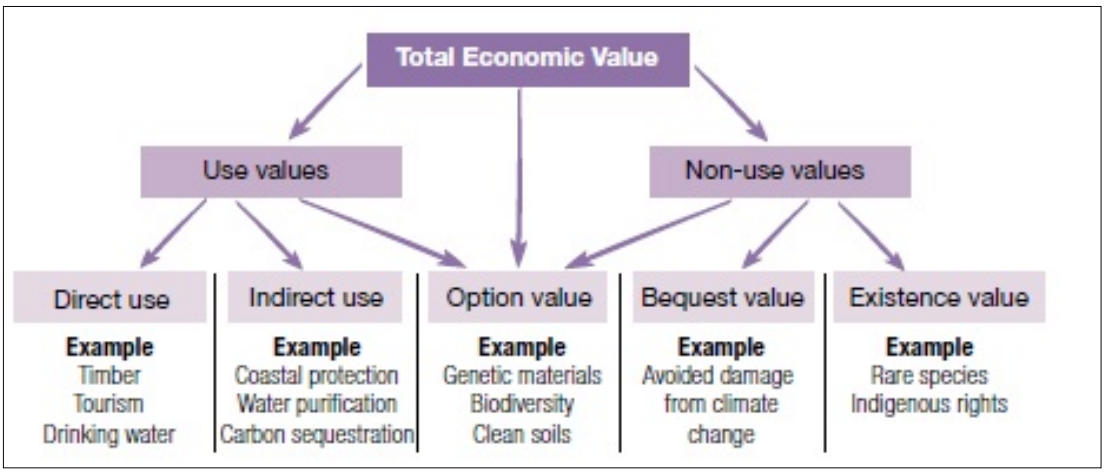

Figure 3 Framework of a total economic value study (source: van Beukering et al., 2007)

Valuation of ecosystem services

The local recreational and cultural value is the value of the service provided by the natural environment to its residents. For example that residents enjoy going to the beach in the weekend or walking at the end of the day around the Quill. To determine the local recreational and cultural value of St Eustatius' marine and terrestrial environment to its inhabitants a household survey was conducted on St Eustatius in the month of May and June 2013. The survey's main objective is to determine the residents' willingness to pay (WTP) for nature management. Apart from that, the survey determined people' perception of their surrounding ecosystems, which may potentially explain motives for the WTP.

Some services that are valued are public goods, as they are non-rival and non-excludable; everybody can enjoy them at the same time without diminishing the service, e.g. the ocean view, while others are quasi-public goods, everybody can enjoy them but in the meantime impact the service, e.g. too many divers diminish the value of a diving spot for other divers. Hence, a non-market economic valuation technique has to be used to determine their value since public goods do not have a market price (TEEB, 2010).

According to van Beukering *et al.* (2007), the most appropriate economic valuation technique for (quasi-) public goods and services in the specific case of a small island is choice modelling (CE). Choice modelling involves asking a respondent indirectly for their willingness to pay or willingness to accept, which makes it an indirect stated preference method. Instead of asking directly for the respondents' WTP as in contingent valuation methods, choice modelling makes use of a choice experiment, which determines WTP indirectly. In the experiment, respondents are confronted with alternative scenarios that exhibit combinations of the same attributes but with different levels, see paragraph 2.2 for more information on attributes and CE. To determine the respondents WTP, one of the attributes has to be in monetary terms. This could take the form of a tax, a voluntary contribution or another payment. The rationale behind the changing levels is that it indicates the trade-offs that people make. On the one hand, by repeating this process throughout the experiment with the scenarios changing levels, strategic response behaviour is avoided, the true preferences of the respondent are revealed and thus the WTP is determined. On the other hand, the constant re-shuffling of the attributes levels may lead to illogical scenarios, making it more difficult to decide for the respondents.

2.2 Choice modelling

Design of the choice experiment

As mentioned, the choice experiment confronts the respondent with different scenarios with changing levels of attributes. The levels go from low to high and the monetary value attribute, which is included in each scenario, indicates a person' WTP to go from one level to the next. Since the respondent has to choose between scenarios and the scenarios' attributes have different levels, the respondent usually has to choose a scenario that is not to his entire satisfaction. Basically, by choosing a scenario that contains a higher value of attribute A than of attribute B, the respondent' preference is shown, as he has to trade off one attribute against the other. Therefore, it is important that the choice experiment is designed in a way that is relevant to the respondents, i.e. the attributes and their levels must be reasonable, in order to best simulate actual decision-making. Especially when evaluating non-market goods such as the state of the ecosystem. The CE allows respondents to answer intuitively by assigning a value to a package of attributes, called option A, B or future scenario, instead of an individual attribute, thereby making trade-offs between options. Through this choice for certain options, the respondent intuitively assigns a value to a specific attribute (Hanley, Wright& Adamowicz, 1998). The attributes that were chosen for the choice experiment in this studies underlying survey have been adapted from previous choice experiments, i.e. from the same study that was undertaken on Bonaire (Lacle, Wolfs, van Beukering & Brander, 2012). Additionally, a workshop engaging local stakeholders and training of the interview team ensured that the attributes were in accordance with local realities. The attributes that were ultimately chosen and their respective levels are listed in Table 1.

Table 1 Overview of attributes and corresponding levels

Attribute	Level 1	Level 2	Level 3	Level 4	Level 5
Coastal waters	Poor	Moderate	Good	Excellent	
Landscape quality	Poor	Moderate	Good	Excellent	
Archaeology	Unmanaged	Managed			
Livestock management	Free Roaming Animals	Fenced Animals			
Contribution	$0/year	$24/year	$60/year	$180/year	$500/year

Coastal waters: refers to the quality of the coastal waters and the quality of the coral patches. While the waters can be used for diving, snorkelling and swimming, the coral patches are the habitat and nursery for marine life. Moreover, water quality includes factors such as visibility and pollution. Hence, coastal waters provide direct use values such as dive tourism and non-use values in general, such as habitat for rare species. The chosen levels range from poor, moderate, good and excellent.

Landscape quality: refers to the beauty of the landscape and its attractiveness for recreational activities such as hiking. Additionally, it refers to the vegetation quality and pollution, especially by littering and car wrecks. The chosen levels range from poor, moderate, good and excellent.

Archaeology: refers to the possibility of visiting historical sites and view displayed artefacts, a remnant of the rich colonial history. The chosen levels are managed and unmanaged.

Livestock management: refers to the management of livestock on the island. Since they are not native to the island, they pose a threat to the terrestrial ecosystem and eventually to the marine ecosystem by causing erosion. The chosen levels are free roaming animals and fenced animals.

Contribution: refers to the financial contribution that all inhabitants of St Eustatius would have to pay per year. While the contributions would only be used for nature management, it was not tied to a specific organization. It is expressed in USD and ranges from $0, $24, $60, $180 to $500 per year.

Design of choice sets and the survey

During the choice experiment, respondents were asked to choose between three scenarios, which were combined in a choice card. While the first two scenarios, scenario A and B, vary in every choice card, the third scenario, 'expected future without extra management', remains the same in all six choice cards that the respondents were confronted with. The latter scenario included only the first level of each attribute. The choice cards were compiled with the Sawtooth software. The program compiled eight choice sets with six different choice cards plus one common card, which was used to explain the choice experiment. The common card portrayed the most easily understandable combinations of the attributes' levels, i.e. all attributes at their highest level with a high contribution, all attributes at their lowest level without contribution and one in between. This was used to ensure that the respondents understand the functionality of the choice experiment. The common card can be seen in Figure 4.

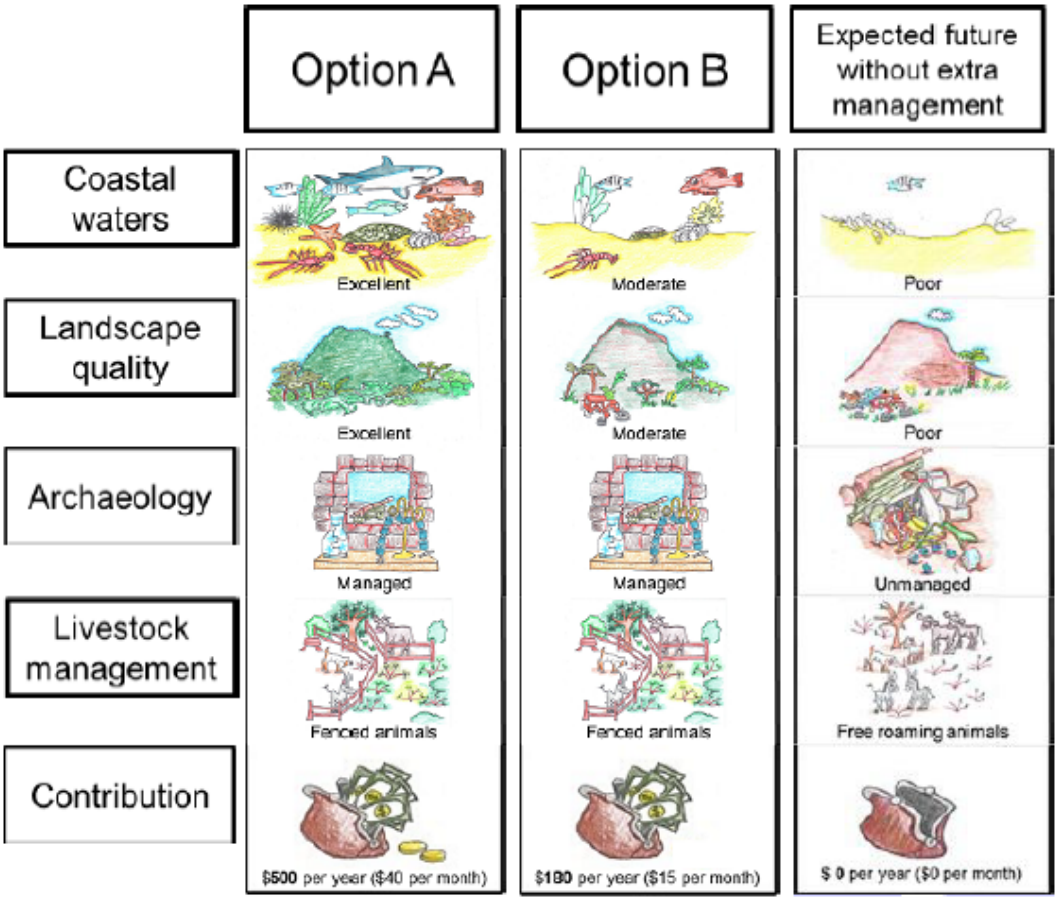

Figure 4 Common card used in the choice experiment

The choice experiment was part of a survey, which asked respondents supporting questions related to St Eustatius' environment. These questions were asked in order to reveal possible associations between a respondent' WTP and categories such as age and education. While most of the questions were adapted from the same survey on Bonaire, the survey was made to fit St Eustatius. The questionnaire and the CE and especially the payment vehicle were tested and discussed in focus groups consisting of residents of St Eustatius. Also, accounting for the large Latin community on St Eustatius, the survey was provided in English and Spanish. An initial version was tested on the interviewers and other locals. Their input helped the researchers recalibrate the survey, its questions and the possible answers. Ultimately, the survey comprised 32 questions in eight categories. The questionnaire can be found in Annex A.

3 Results

3.1 Sample and representativeness

The targeted number of respondents was 400 households; eventually 402 households completed the survey. All interviews were conducted by a team of local interviewers, most of whom had already conducted surveys for the Central Bureau of Statistics of the Netherlands (CBS). As information on households on St Eustatius is either non-existent or confidential the sampling approach involved the use of the network of the interviewers. After every ten surveys, the interviewer contacted the research team to obtain a new choice set. This procedure was followed to ensure that all choice set were equally used.

The lack of household data and comprehensive districting of the island did not allow for a geographical distribution of the survey in accordance to the actual dispersion. Yet, this was counter-balanced by the small size of the island, which makes geographic variations of opinions rather unlikely. Despite requests to the interviewers to refocus the interviewing strategy towards more male, non-Caribbean respondents, the final sample provides a somewhat suboptimal representation of the island's population. As can be seen in Figure 5, there is a slight tendency towards female respondents, even though there are slightly more males on the island, as the latest available census data indicate. This can be explained by the interviewers' tendency towards interviewing in their social circles, such as church groups. With an interview team that consists only of women and the tendency towards female dominated church groups, it is not surprising that women are slightly overrepresented. Nevertheless, the sample provides a sufficiently good representation of the population.

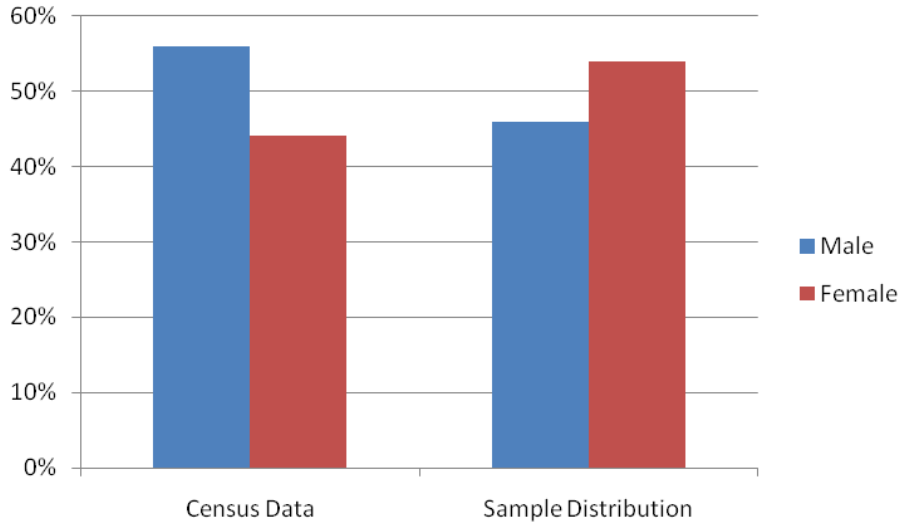

Figure 5 Gender distribution of sample compared to Census Office (2013)

A similar bias can be observed in the age distribution of the sample. As can be seen in Figure 6, age categories 18-25, 26-35 and 46-55 are slightly overrepresented, when compared to the latest available census data. Age category 36-45 is rather overrepresented, while age categories 56-65 and 66+ are underrepresented. This can also be explained by the structure of the interview team and their tendency to interview their peers. While the youngest interviewer fell into the lowest age category, the oldest interviewer fell into the fourth category.

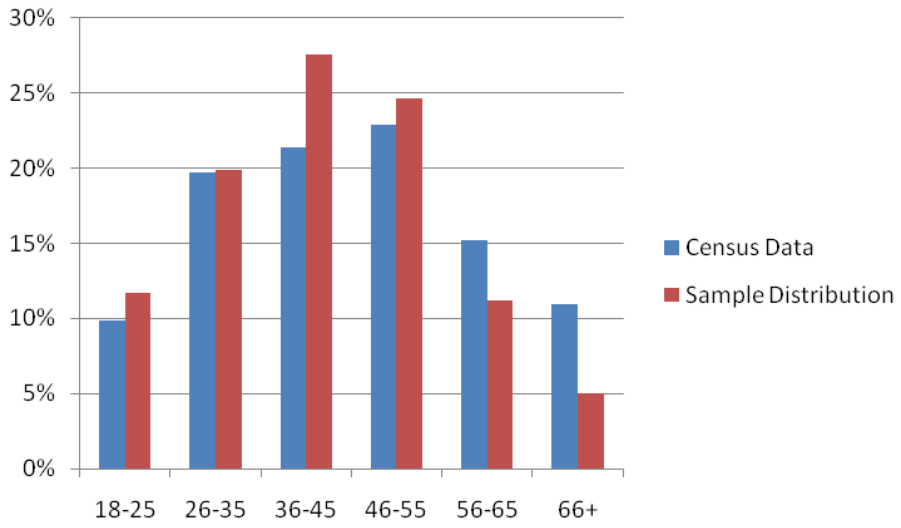

Figure 6 Age distribution of sample compared to Census Office (2013)

Besides gender and age of the inhabitants, the census data also included the country of birth of the inhabitants. Unfortunately, due to the recent political changes in the Dutch Caribbean, the statistic refers to every person born before 2010 on St Eustatius, Saba, Bonaire, Curaçao and Sint Maarten and before 1986 on Aruba as the Netherlands Antilles, instead of the respective island' name. Therefore, it was not feasible to make a meaningful distinction between the six former islands of the Netherlands Antilles. However, the statistics on the other countries of birth are well interpretable. From Figure 7 it can be concluded that people from the Dutch Caribbean are overrepresented when compared to the census data. Yet, it is unknown whether the people in the census data were born on St Eustatius or another island in the Dutch Caribbean. Additionally, people that were born in the Netherlands are also somewhat overrepresented. As a result, the other groups are underrepresented, especially those that were born in the United States and Canada. A possible explanation for this is, again, the structure of the interview team, which consisted only of locals, and a possible preference for interviewing peers, such as friends and neighbours.

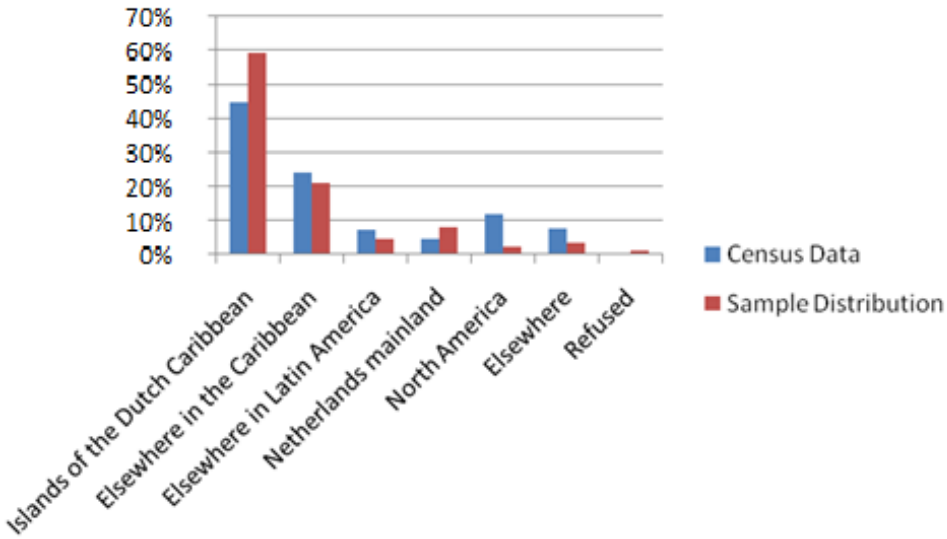

Figure 7 Distribution of country of origin of sample compared to Census Office (2013)

Despite the lack of any official information on the highest completed level of education of St Eustatius' inhabitants, the results of the survey can still be interpreted to some extent. The results, which can be seen in Figure 7 show that there is an accumulation of respondents with lower to higher-medium degrees, i.e. High school, MBO and Bachelor' degree. There are less people with very low or very high degrees, i.e. primary school and Master' degree. Even though it might be considered rather representative, this cannot be confirmed because of lack of proper data.

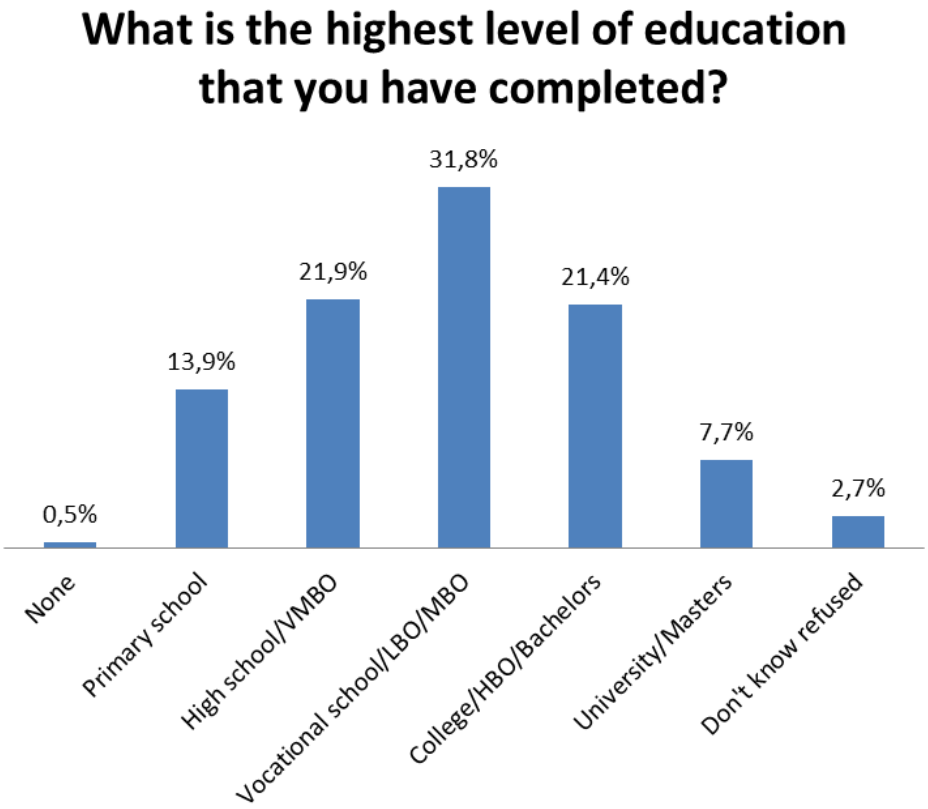

Figure 8 Respondents' highest completed level of education

3.2 Experience of nature by the people of St Eustatius

Recreation

To better understand the population' involvement with their surroundings, the survey asked respondents to indicate how often they participate in recreational activities in nature. The results can be seen in Figure 9 and indicate large differences in most activities based on the origin of the respondent. In general, non-Caribbean born respondents are a lot more active in nature than Caribbean born respondents. This is true for all activities, although with a large spread in differences. While the average number of times of fishing is almost the same, non-Caribbean born respondents go snorkelling more than ten times as much, i.e. 1.9 times per year against 19.7 times per year. Although not as large, the average number of times of diving is also different for both groups, i.e. 1.9 times a year for Caribbean born respondents compared with 16 times for non-Caribbean born respondents.

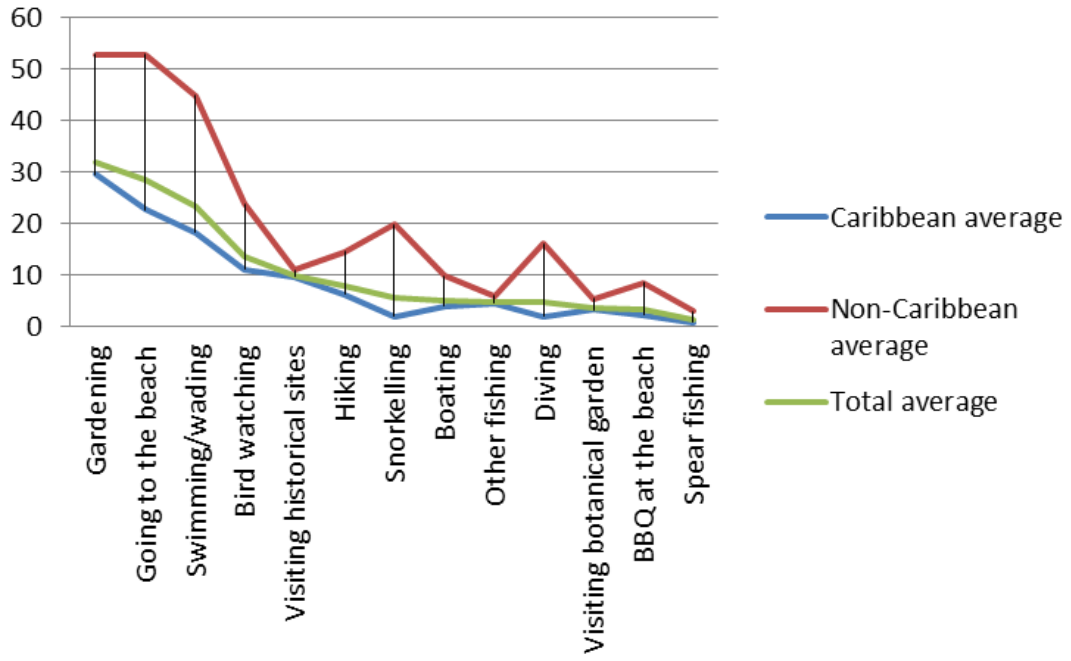

Figure 9 Average number of times per year that respondents participate in an activity in nature[2]

Some activities have, on the one hand, a relatively high participation but, on the other hand, are mostly only done a few times a year. These activities are hiking, barbecuing at the beach and visiting historical sites or the botanical garden. This can be explained by the fact that all of these activities require some sort of preparation, e.g. purchasing barbecue material, or have a tendency to become uninteresting when repeated too often. Especially, visiting historical sites and the botanical garden have a participation rate of only once a year. The activity that has by far the most active participants is gardening, 16.4 percent of all respondents participate in gardening multiple times a week, hence the high average number of participation. Finally, while some individual respondents indicated that they like to listen to the ocean, watch the waves or worship at the beach, the only notable other activity is going for walks.

Recreational fishing

In the first question it was asked whether the respondent or someone in their household fish for recreational purposes, of which 16.4 percent of respondents affirmed (see Figure 10). When compared to the earlier question about other forms of fishing, there is a discrepancy of ten respondents between the two answers. Some of the derogations can be explained by the occupation of some respondents that indicated their profession as fishermen that do not see fishing as a recreational activity. However, the full derogation cannot be explained by the survey' results. Moreover, the results show that in the large majority of households that fish for recreation, there is only one household member that pursues this activity.

[2] The answers were recorded with the following parameters: Never=0, Once a year=1 time/year, Once a month=12 times/year, Once a week=52 times/year and More than once a week =150 times/year

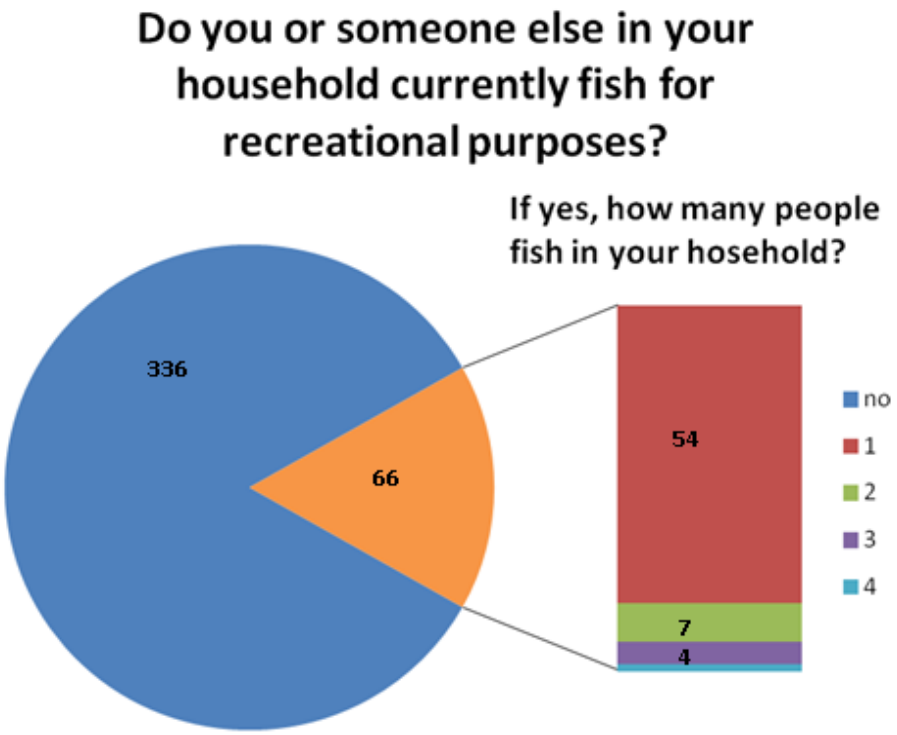

Figure 10 Frequency of households that fish for recreational purposes

Furthermore, the survey asked recreational fishers to indicate the number of trips in the last two months, their average catch per fishing trip and the type of fishing (shore or boat fishing). Table 2 present the number of trips, which is relatively low, with a mean value of close to three trips and a median value of one trip in two months. Yet, the latter shows that there is a large spread between the individual recreational fishers when it comes to the size of their catch. While some fishers have not caught a fish at all, others state that they catch up to one hundred kilograms of fish or 27 fish per trip. However, these are clearly outliers as the median catch is four fish and six kilograms respectively. At least half the respondents only go shore fishing (the median for shore fishing is 100 percent and zero percent for boat fishing), yet (the mean values indicate that) on average, 1 out of 3 fishing trips made is by boat.

Table 2 Number of trips in the last two months, average catches and types of fishing

		Trips	Avg catch #	Avg catch kg	Shore fishing	Boat fishing
N	Valid	58	49	22	66	66
Mean		2.84	4.86	11.91	.6462	.3386
Median		1.00	4.00	6.00	1.0000	.0000

Figure 11, indicates that a large majority of recreational fishers, i.e. 76 percent enjoy fishing or find it relaxing. Approximately half of all recreational fishers catch for food, a third to give the catch to family and friends and smaller fractions of respondents indicated further motivations.

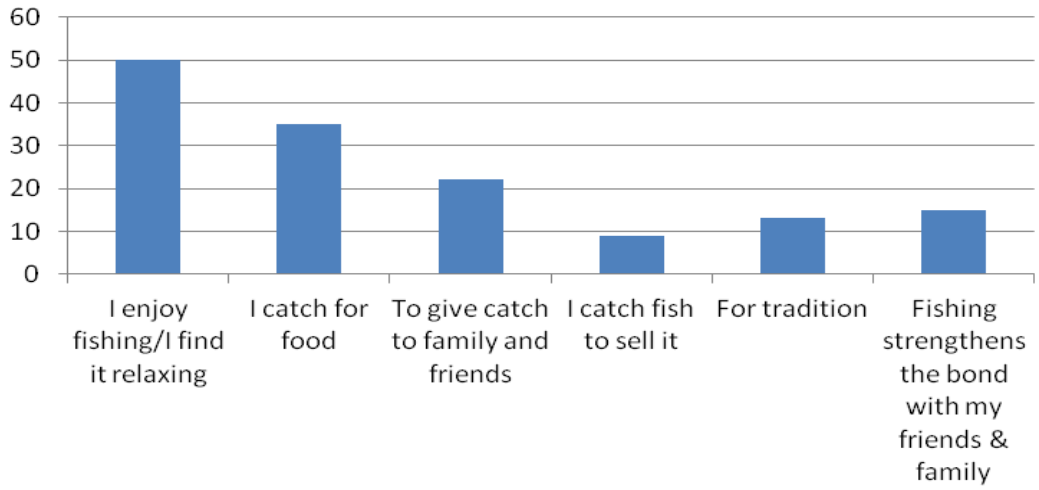

Figure 11 Motivations for recreational fishing in absolute numbers of fishermen in the sample.

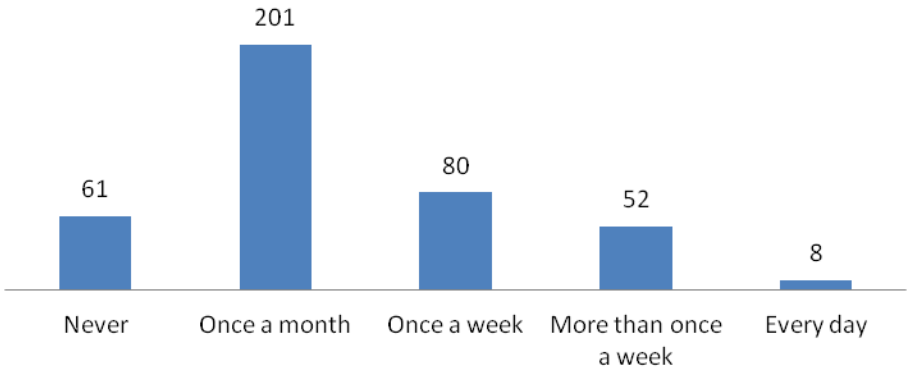

Figure 12 Frequencies of eating locally caught fish or lobster

Use of local resources

One section of the survey was devoted to inquire the locals' use of medicinal plants that grow on St Eustatius. Medicinal plants present an alternative to prescription drugs, have no costs and have usually been used for many generations. More than three quarters of the respondents use local medicinal plants. Figure 13 indicates that out of eleven medicinal plants that were selected, only five are used by more than 50 percent of all medicinal plant users, namely; Curaçao sage, aloe, sour sop, bitter root and lemon grass. Especially Curaçao sage, which is used by approximately 90 percent of the medicinal plant users, has a very high use frequency, more than 60 percent of all users use it at least once a week. On the other hand, gum tree and coralita have almost no users. Apart from several respondents that further indicated the use of basil, lime, mint and cinnamon, which are not known as traditional medicinal plants. Unlike the participation in activities in nature, there is only one noteworthy difference in the use of medicinal plants between Caribbean and non-Caribbean born respondents, namely Curaçao sage.

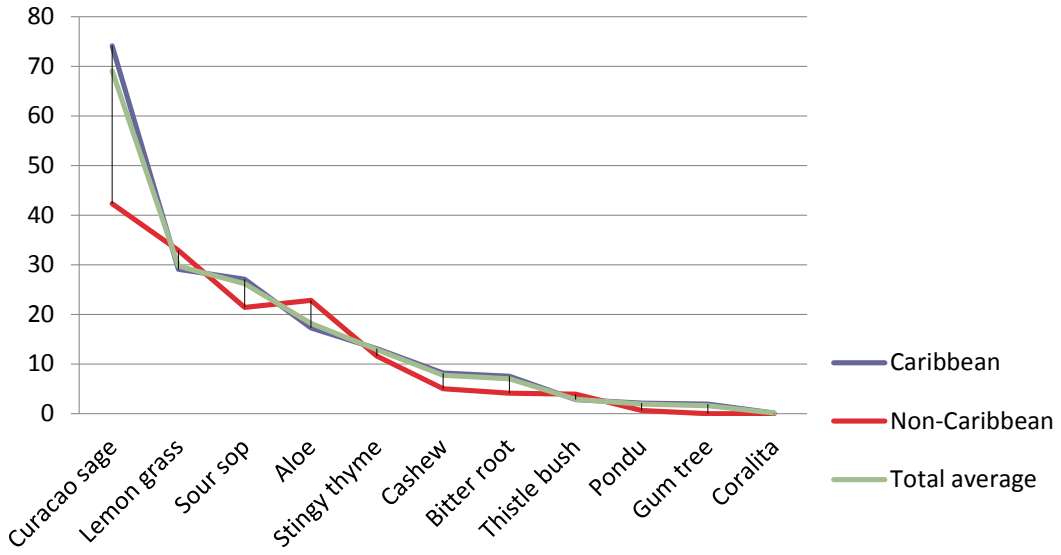

Figure 13 Usage of medicinal plants by residents based on their origin: Average number of times of medicinal plant use by origin

Saba Bank

Two questions in the survey were dedicated to the Saba Bank to enquire its perceived value to the residents of St Eustatius. In the first question the interviewer asked the respondent whether he or she is familiar with the Saba Bank, which 74 percent have affirmed. A follow-up question was about the features of the Saba Bank. Figure 14 shows that 52 percent of respondents, whom are familiar with the Saba Bank, indicate that they think that the Saba Bank is important for fisheries. 13 percent indicated that they think that it is an important spawning ground for fish. The relatively high rates for these two characteristics hint that the residents of St Eustatius have an understanding of the importance of spillover effects that protected areas have on the quality of their surrounding waters. 11 percent of other respondents answered not to know what was special about the Saba Bank. All other characteristics were mentioned less than 10 percent of the time.

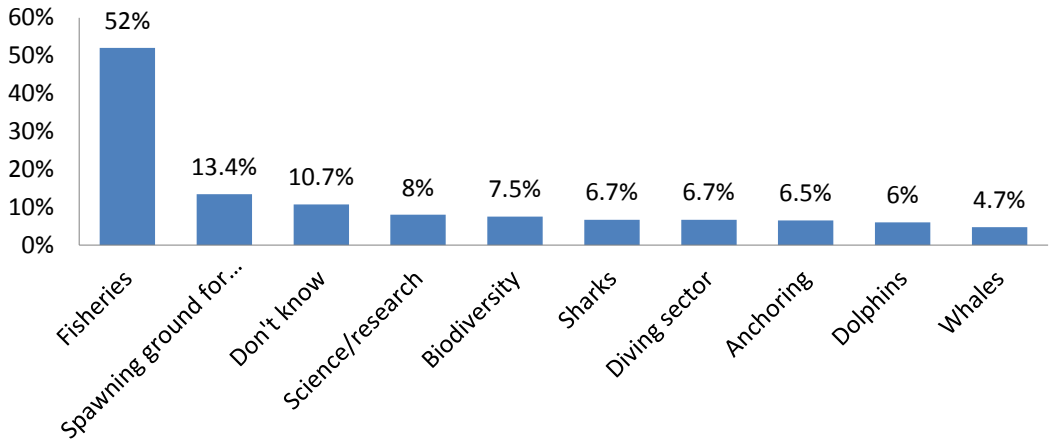

Figure 14 Respondents' perception about what is special about the Saba Bank

Environmental awareness

Throughout the survey, respondents were asked four independent questions about their environmental awareness and their perception of environmental issues. The first question asked respondents how environmentally aware they perceive themselves to be. The answer was given on a Likert scale from not at all environmentally aware to very much environmentally aware. **Error! Reference source not found.** displays that the distribution of environmental awareness is almost perfectly bell-shaped and thus normally distributed.

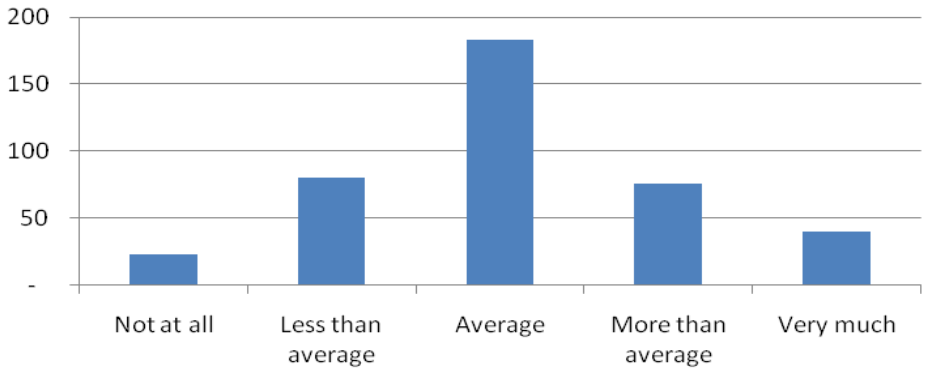

Figure 15 Distribution of environmental awareness of sample

Figure 16 indicates that a large majority of respondents avoided littering and bought locally grown fruit and vegetables. About half of the respondents sought environmental information on different media channels and purchased environmentally friendly products. All other activities have rather low participation rates, especially the purchase of park tags. While the low purchase rate of marine park tags is in line with the diving rates from Figure 9, the low purchase rate of trail tags is not in line with the relatively high hiking rate. Two possible explanations are that either people do not hike in the national parks but somewhere else or they simply enter the parks without a valid trail tag. If the latter explanation is valid, this could be caused by the lack of effective control mechanism upon entering the parks.

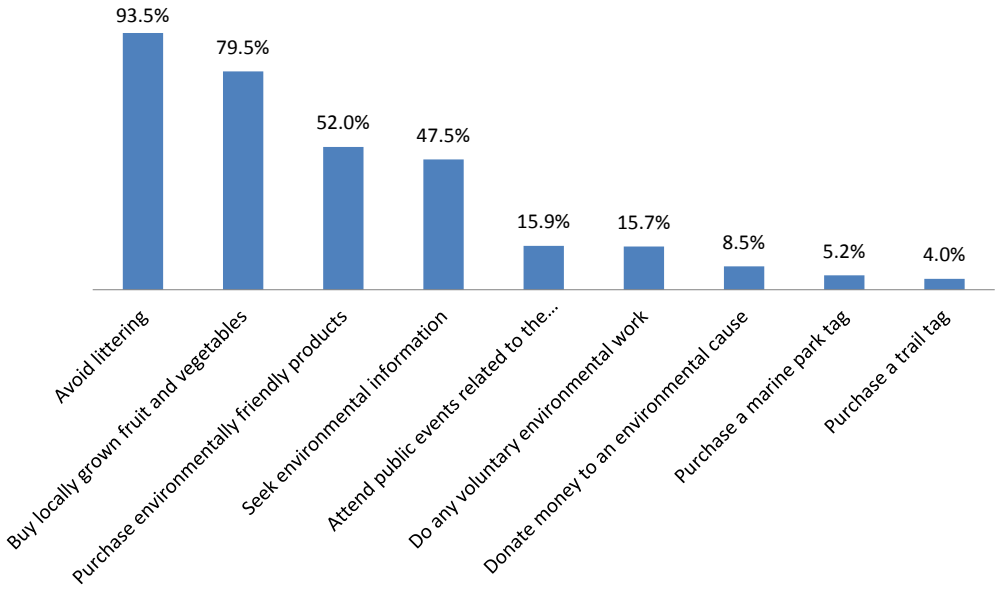

Figure 16 Participation rate in activities related to the environment

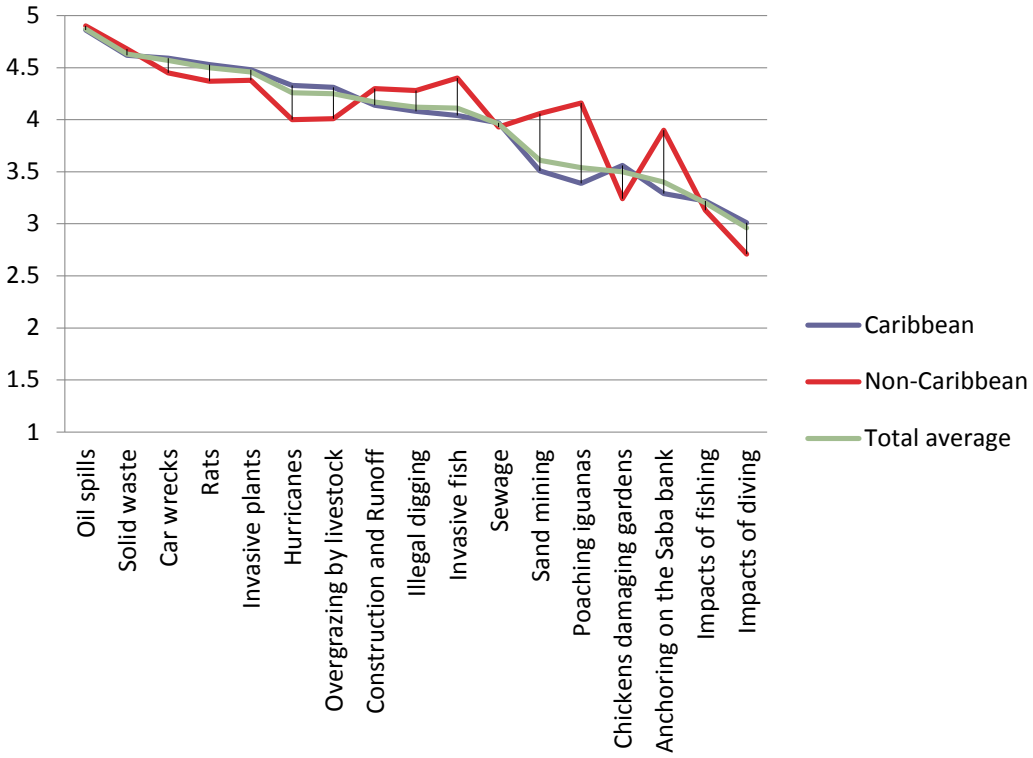

Figure 17 Average perception of environmental threats by origin

The respondents were asked to rank their perception of potential environmental threats on a Likert scale from 1 to 5, with 1 being not important at all and 5 being very important. The results can be seen in Figure 17 and indicate that 5 threats are on average seen as very important, namely oil spills, solid waste, car wrecks, rats and invasive plants (score 4.5 – 5). 10 threats were perceived as somewhat important. Only 3 potential threats were perceived as neutral namely the impacts of diving, of fishing and anchoring on the Saba Bank.

While the perceptions of potential threats of non-Caribbean and Caribbean born respondents does differ to some extent, being 4 threats, namely sand mining, poaching iguanas and anchoring on the Saba Bank. Immigrants might not be used to poaching iguanas and sand mining either, which might lead to them rating these potential threats higher. Note that the respondents had the possibility to say that they do not know, which was indicated with 0, these are subtracted from the values.

A further question in the survey confronted respondents with statements about the environment, some of which were rather provocative. These statements are purely hypothetical. While some of the statements were formulated in a way that made it easier for respondents to indicate agreement, e.g. “Healthy nature is crucial for my family and me.”, other statements were pointing in the opposite direction, e.g. “NuStar can do whatever they want, regardless of the environment.” The results in Figure 18, which are on a scale from 1 to 5, where 1 is strongly disagree and 5 is strongly agree, show that out of 8 statements, 4 were rejected by the majority and 3 were agreed upon.

The statements are:

1. “Cows should roam freely.” – This statement was disagreed upon by 85.5 percent and demonstrates that residents of St Eustatius are generally not satisfied with free roaming livestock. Even though the statement specifies cows, it is reasonable

to assume that other livestock evokes same responses. However, it cannot be deduced whether the respondents disagreed because the cows pose a road hazard or because they are degrading the island.

2. "NuStar should be allowed to do whatever they want, regardless of the environment." – Arguably the most provocative statement, as it confronts the respondents with two underlying factors of St Eustatius' economy, i.e. the biggest employer and nature. However, the statement was rejected by 84 percent of the respondents. The environment plays an important enough role to be taken into account by any big employer on the island.
3. "As long as the animals don't destroy my property, they're not my problem." – This statement was disagreed upon by a majority of 81.1 percent of all respondents. This disagreement might reflect the solidarity of residents of St Eustatius when faced with a problem that concerns everyone.
4. "The container harbour should be build, even if it causes the lower town beach to disappear." – The idea of building a container harbour is a good reflection of the dilemma between developing and conserving. While only an idea, it presents how economic valuation can be used in particular on St Eustatius. In general, however, the statement was largely disagreed upon, with 67.3 percent totally disagreeing and another 8.5 percent somewhat disagreeing.
5. "I am in favour of additional protection of St Eustatius' archaeological heritage." – This statement was supposed to evoke agreement but averaged only indifference to weak agreement among the respondents, with 40.5 percent being neutral and 44.5 percent somewhat to totally agreeing, respectively. Only a small minority of 15 percent was against additional protection. The overall reception of archaeology indicates that people are generally aware of their archaeological heritage but are divided on whether the current state of protection is sufficient or can be improved.
6. "Littering is an urgent problem on St Eustatius." – As littering also falls under solid waste, the high degree of agreement, 77.6 percent, is not surprising.
7. "St Eustatius should spend a large amount of money on improving the garbage dump." – The statement addresses the solid waste problem, which has been identified as one of the biggest threats to the environment on St Eustatius (Figure 17). It has been agreed upon by 81.4 percent of the respondents, the percentage of respondents that totally agree (scale 5) is 54.5 percent.
8. "Healthy nature is crucial for my family and me." – This statement has been agreed upon by 86.1 percent of the respondents, with 65.7 percent totally agreeing. This large agreement shows that residents of St Eustatius must care about the health of their environment.

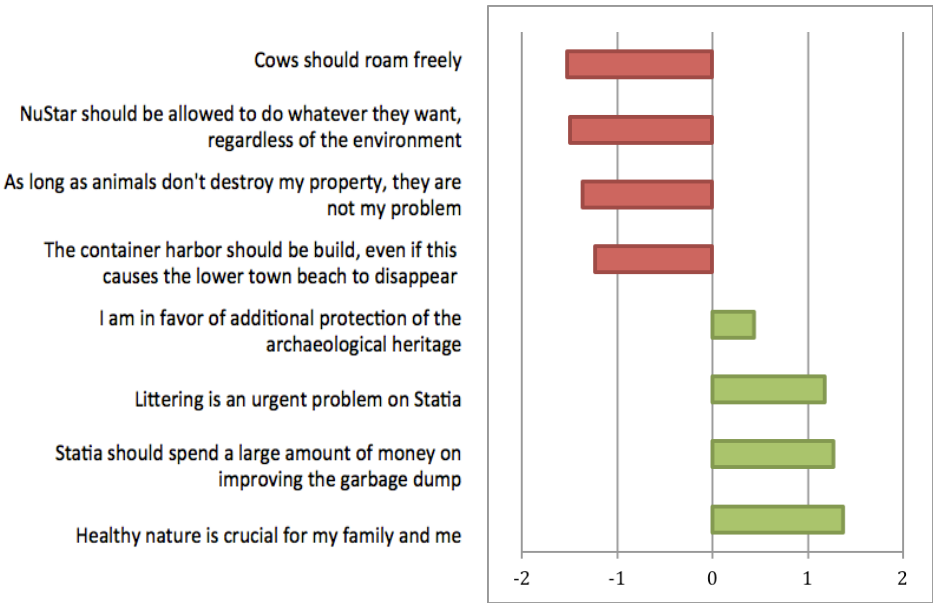

Figure 18 Average agreement with statements that were proposed to the respondents

3.3 Willingness to pay preparedness

One of the goals of the survey was to find out the total WTP of St Eustatius' inhabitants, for which the choice experiment is used. Almost half of the respondents are in general willing to pay for nature management. A second question asked respondents that affirmed their willingness to pay if they had a preference for an organization that would be in charge of funds collected for nature management. A majority indicated that they would prefer STENAPA to manage funds for nature management. Around a fifth of the respondents that are willing to pay would prefer the government of St Eustatius to be in charge. As respondents had the opportunity to specify another organization that was not among the answer options, some respondents indicated that they would prefer a combination of STENAPA and either the government of St Eustatius, of the Netherlands or both.

In order to find out if there are any socio-demographic variables that influence respondents' WTP, Pearson Chi-Square tests were conducted. If the test results presented statistical significance of an association, Phi and Cramer' V tests were performed to test the strength of that association. The variables that were selected for cross tabulations with WTP are gender, employment sector, income, education, nativity to St Eustatius, environmental awareness, environmental score, threat score, existence of recreational fishers in a household, activity score and medicinal plant use score. The scores were calculated by adding all individual values of a respondent in an answer category. In the threat score, a lower score indicates a lower perception of threats on average. For both medicinal plant use and activity score, all values of actual use or activity were added, i.e. the option 'never' was not included as not to disturb the meaningfulness of the score. The results of the cross tabulations can be seen in Table 3. As can be seen there are four associations that are statistically significant at the five percent level, namely education, environmental awareness, environmental score and threat score, and one association that is significant at the ten percent level, i.e. nativity to St Eustatius.

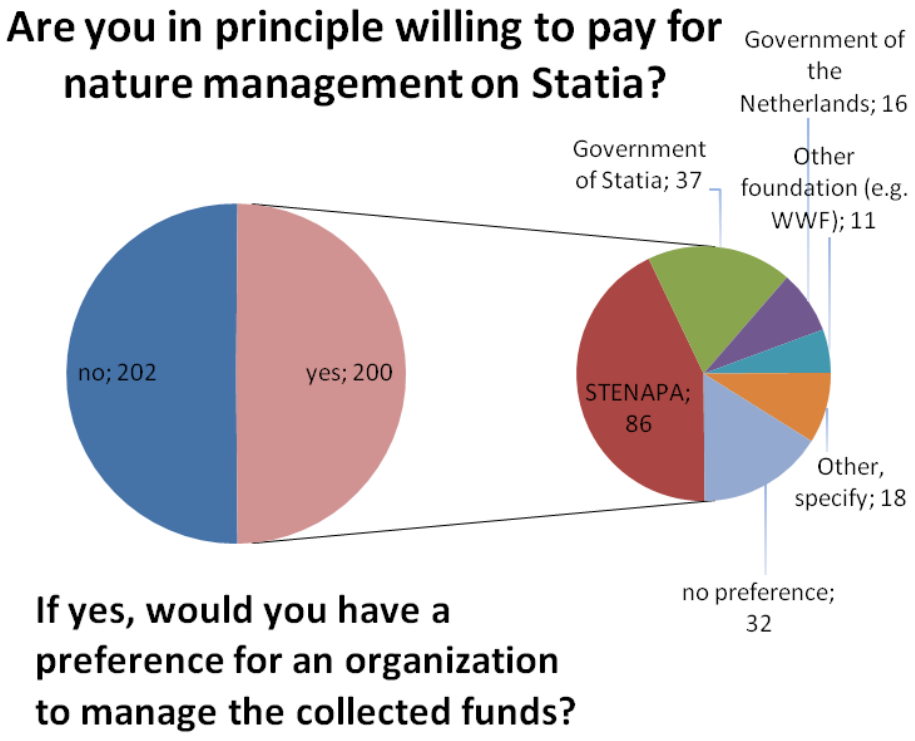

Figure 19 Respondents' WTP and their preference for managing organization

Table 3 Pearson Chi-Squared test

Variable	Coefficient	p-value
Gender	.000	.994
Employment	6.575	.474
Income	16.365	.567
Education	17.132	.017
Born on St Eustatius	3.057	.080
Environmental awareness	25.060	.000
Environmental score	35.625	.000
Threat score	77.107	.021
Activity score	44.232	.378
Medicinal plant use score	33.481	.541
Recreational fisher	1.309	.253

In order to test the strength of these associations, Phi and Cramer' V tests were performed on the statistically significant associations. The results can be seen in Table 4 and show that the strongest statistically significant association exists between threat score and WTP, meaning that the higher a respondent' threat score the higher the preparedness to pay for nature management. On the other end of the scale, a weak statistically significant association can be seen between nativity to St Eustatius and WTP. Note that the association is close to zero, indicating that there is not much difference between people born on St Eustatius and people born elsewhere in their willingness to pay for nature management.

Table 4 Phi and Cramer' V tests on statistically significant associations

	Threat score	Environmental awareness	Environmental score	Education	Born on St Eustatius
Phi	.438	.250	.298	.206	-.087
Cramer' V	.438	.250	.298	.206	.087

3.4 Choice experiment

From the results of the Choice experiment the WTP by the respondents the contribution people are willing to make to nature conservation is measured.

WTP per attribute

From the responses that were given in the choice experiment, the respondent's willingness to pay can be determined. A multi-nomial 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) (please see Annex C for details on WTP calculations).

Within Figure 20 one can see the WTP per month per household for the management of nature and the relative importance between attributes expressed by the respondents when choosing between different scenarios. The willingness to pay per month for an improvement in nature to the highest quality levels and management of livestock and archaeology on the island is estimated to be 13.80 USD per household per month.

What is prominent is the high value assigned to 'Quality of coastal water', which is relatively more than the value for the 'Natural landscape'. The attribute 'Free roaming livestock management' also provides a positive utility to respondents that is of equal magnitude as the coastal water attribute, meaning that the population of St Eustatius prefers to see management of free-roaming animals and thus the fenced scenario and is willing to contribute significantly to tackle the problem of roaming animals on the island. It has to be noted that there is a large interaction between the quality of the natural landscape and the free roaming of animals on St Eustatius. If seen together, it becomes evident that people on St Eustatius are in general willing to pay more for conservation of the terrestrial ecosystems.

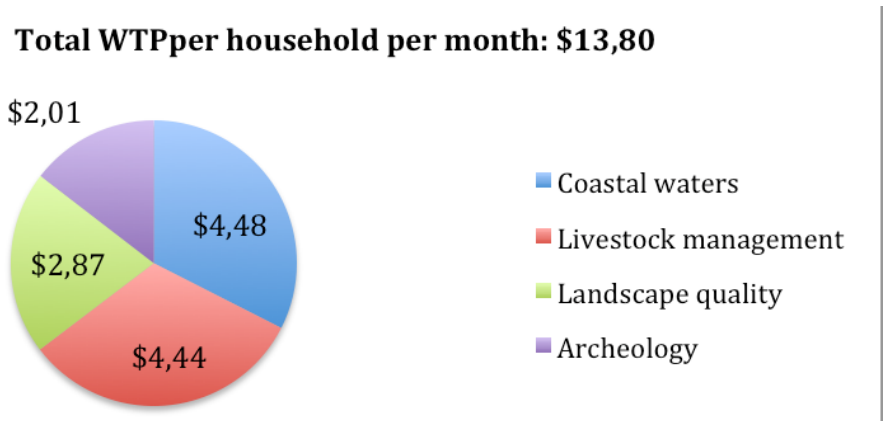

Figure 20 Total WTP per household per month

There is also a positive WTP for additional archaeological management on the island of 2 USD per household per month. Indicating that additional management of the islands archaeological heritage is important to the people of St Eustatius.

Attributes

Figure 21 displays how much weight the attributes had for the respondents in making their choices, from 1 not important at all, to 5, very important.

1. Livestock management was seen by 70.9 percent as very important and 12.7 percent as somewhat important. This confirms the findings from Figure 17, Figure 18 and Figure 20 demonstrate that livestock is seen as a large threat to St Eustatius and that respondents have a high WTP to counter this threat.
2. Landscape quality was considered very important in making their choices by 55.6 percent and somewhat important by 22.1 percent. This confirms that the respondents' WTP for landscape quality is lower compared with the WTP for livestock management.
3. Coastal waters have been similarly rated as landscape quality, with 53.6 percent choosing very important and 21.3 percent somewhat important. As landscape quality and coastal waters have almost equally influenced the respondents' choices, considering the results. This leads to the assumption that the differences between the two WTP derive from the fact that economic development is usually associated with terrestrial development. This might be misinterpreted as no trade-offs exist between coastal waters and economic development.
4. Archaeology is perceived rather indifferent, with 36.8 percent of respondents perceiving it neutrally. However, 22.6 percent and 27.8 percent view it as somewhat important and very important, respectively. This confirms the assumption made in Figure 18, that despite a generally favourable opinion towards archaeology, it is not seen as a high priority.

While contribution was rated as very important by 35.1 percent and somewhat important by 18.8 percent, it was also the attribute seen by the most as not important at all, namely 15.8 percent as opposed to between 2.3 and 5.3 percent for the other attributes. A possible interpretation is that people want to see nature management in practice, even if the costs outweigh the benefits.

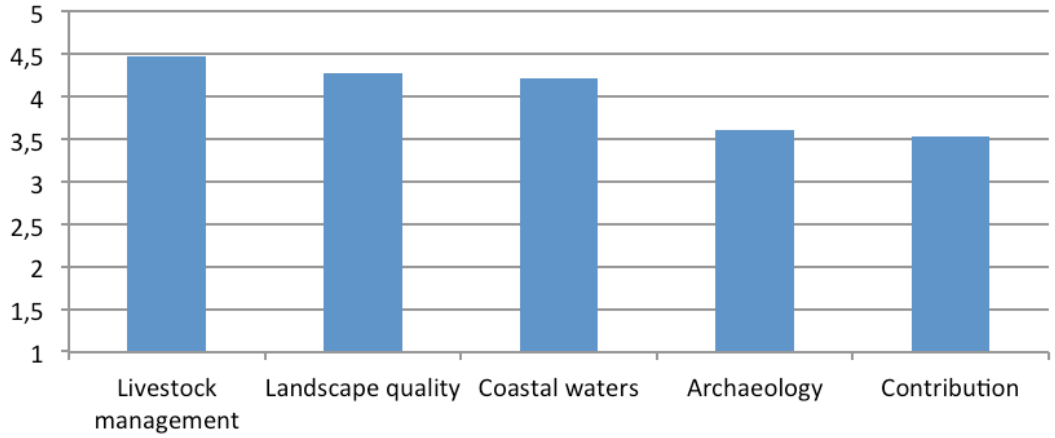

Figure 21 Which items influenced the respondents in making their choice?

Opt-out option

In case a respondent refused to participate in the choice experiment or chose the 'expected future scenario' four times or more, the interviewers asked the respondent a follow-up question, enquiring the reasoning behind this. The results can be seen in Figure 22 and show that more than a third of respondents that opted out did so because they thought the costs were too high. Another quarter of respondents was not confident that the money would be used solely for nature management.

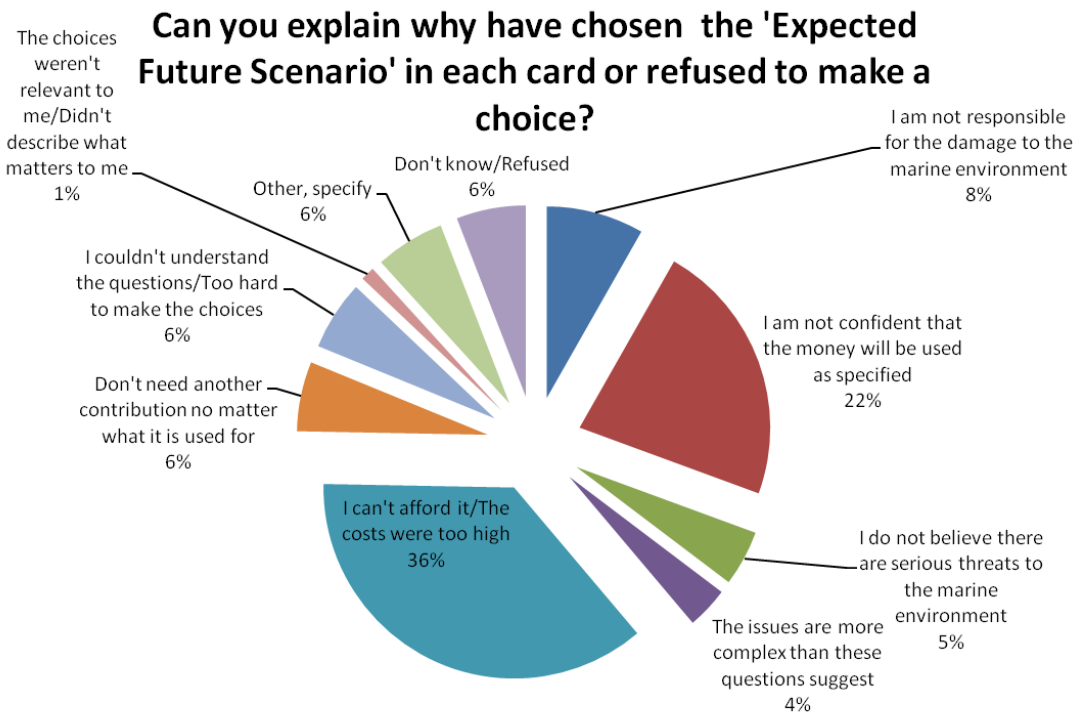

Figure 22 Reasons for opting-out

Differences in WTP

Some differences have been found in the levels of WTP between different respondents. Of which the results are presented in Table 5. It is noted that levels of WTP where not significantly influenced by people with different origin or a higher income. An interesting result is that the level of environmental awareness contributes to a higher WTP, indicating that awareness raising programs contribute to the support for environmental protection. The result that people considered the payment vehicle in the CE are WTP less than people who did not, indicates that the initial results of the CE suffer from hypothetical bias (see appendix C).

Table 5 Differences in the amount people are willing to pay between respondents with different characteristics

Characteristic	Change in WTP
Age: older part of society	Lower
People with children	Higher
Environmental awareness high	Higher
University level education	Higher
People that took high notion of the payment attribute	Lower
Recreational fishermen	Lower
People that regularly visit the botanical garden	Higher

Total WTP per year

According to the Strategic Development Plan of St Eustatius (RBOI, 2010), there were 1,050 households for 3,500 people in 2010. As there is no more recent data, this study assumes a constant household size of 3.33 members per family. Therefore, there should be around 1,200 households for 4,008 residents that reside on the island in 2013. For the overview of the WTP per attribute per household per month and the total WTP per attribute per year see Table 6.

Table 6 Total WTP per scenario

Scenario	Excellent coastal water quality	Natural landscape management	Livestock management	Archaeological management
WTP per household per month	$4.48	$2.01	$4.44	$2.87
Total WTP per year	**$65,000**	**$29,000**	**$64,000**	**$41,000**

4 Conclusions and recommendations

4.1 Conclusion

This research has shown that the residents of St Eustatius are aware of the service the natural environment provides them, the residents do value this service and they do understand threats to their small islands' natural environment. The ecosystems of a small island have a heightened sensitivity towards external disturbances, due to their remoteness and isolation as an island. Invasive species can spread easily as they have no predators. Additionally, solid waste and littering are real threats, due to the limited available space. A specific threat for St Eustatius' ecosystems is the risk of an oil spill. This is confirmed by the perceptions of the respondents of the household survey. Moreover, the people of St Eustatius are strongly involved with their environment, as is demonstrated by the high usage of medicinal plants and the high participation in activities such as going to the beach. The level of agreement to the statements in the survey has presented that there is generally favourable opinion towards the environment and a concern about real or potential threats. This is expressed by half of the respondents generally being willing to pay for nature management. Using a choice experiment, the total WTP for the recreational and cultural services that are provided by St Eustatius' ecosystems can be approximated at 158,000 USD per annum.

4.2 Limitations

The research has to be seen within its limitations. One of these is the self-limiting capacity of the choice experiment. Due to its restriction to a few attributes, in order to keep it comprehensible, other attributes are left out. The ones that are included do not capture the entire range of factors that contribute to it, for example landscape quality did not include the terrestrial biodiversity. Moreover, by making a choice a respondent merely indicates a preference for an attribute but not which aspect of the attribute. For example, if a respondent expressed a preference for livestock management, it is still unknown whether the preference is motivated by the fencing of livestock, the reduction of animal numbers or another aspect that was not preselected, such as the creation of jobs such as shepherd. Hence, although the selection of attributes and their levels are tested in focus groups, it still is subject to the judgment of the researchers, who in this choice experiment have acted to the best of their knowledge. Moreover, a workshop for local stakeholders brought new insights and allowed the researchers to adapt the survey questions and the choice experiment. Additionally, the links between the attributes or rather the ecosystems they describe are very complex for people to thoroughly understand (Lacle *et al.*, 2012).

Respondents might not have understood the questions and consequently give an answer they would not have made when understood. Moreover, the respondents might have hidden their actual preferences from the interviewer and given a sociable more acceptable answer. Finally, the response rate is unknown, as non-responses have not been recorded.

4.3 Recommendations

Based on the findings of the survey, several recommendations can be made.

The **free-roaming livestock** is arguably one of the most important issues that need to be tackled. The choice experiment showed that livestock management is the most influential attribute and has the highest WTP of all attributes. Moreover, the statement "Cows should roam freely" was the most disagreed upon, even more than people agreed to "Healthy nature is crucial for my family and me". While it was not the threat that was perceived the most important, overgrazing by animals was still recognized as an important threat. Besides, overgrazing and trampling lead to erosion and are therefore a real threat to the environment. Strict enforcement of existing or newly implemented laws concerning the prohibition of free-roaming livestock is an option to ensure the cessation of this issue. Registration of livestock can help enforcing laws against owners. Another option is raising awareness and underlining the negative impacts of free-roaming livestock, thus promoting self-regulation of the owners of livestock. An extended cost-benefit analysis of livestock can be useful to highlight the impacts.

The respondents indicated that the **quality of coastal waters and the natural landscape** was very influential during the choice experiment. By demonstrating that St Eustatius' landscape can have a good quality without hampering economic development, visible action could be taken, for example by removing car wrecks, coralita and improving the garbage dump. Since these three are among the threats perceived the most important, this could lead to more support for further management. The initial investments could then be recovered by a contribution from the population. Finally, raising awareness has a high priority, so that support for nature management can be heightened or that self-regulation is increased. Especially the coastal waters, its corals and the biodiversity should be preserved so that future income, e.g. by dive tourism, is saved.

The survey has shown that the people of St Eustatius have a positive attitude towards their **archaeological heritage** and additional protection thereof. Raising awareness or improving the attitude towards the heritage can increase the people of St Eustatius' pride of their island. This might eventually be translated into higher awareness towards environmental issues and a more sustainable lifestyle.

Acknowledgements

This study would not have been possible without the support of numerous people and organizations on St Eustatius. It was great to start our visit with a discussion with the Executive Council, government officials of the St Eustatius government and employees of STENAPA. We would like to express our gratitude to commissioner Tearr and the Executive Council for their hospitality and the time mister Tearr took to share his vision.

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Annex A Questionnaire Household Survey

RECREATIONAL AND CULTURAL VALUE TO RESIDENTS OF STATIA

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

HELLO MY NAME IS..... AND I AM HELPING THE VU UNIVERSITY AMSTERDAM WITH THEIR RESEARCH CALLED "WHAT'S STATIA'S NATURE WORTH". WE ARE DOING A SURVEY TO SEE HOW IMPORTANT NATURE IS TO THE PEOPLE OF STATIA. WITH NATURE WE MEAN TREES, FLOWERS, OCEAN AND BEACH AND WE WANT YOUR OPINION ABOUT THIS. **EVERYTHING THAT YOU TELL US WILL BE KEPT STRICTLY CONFIDENTIAL**. THE INTERVIEW WILL TAKE ABOUT THIRTY MINUTES. WOULD YOU BE WILLING TO PARTICIPATE?

I. General Questions

1. Were you born on Statia?

1] Yes	☐ (GO TO QUESTION 4)
2] No	☐

2. If not, where are you from?

1] Aruba	☐	7] Elsewhere in Latin America	☐
2] Curaçao	☐	8] Netherlands mainland	☐
3] St Maarten	☐	9] North America	☐
4] Saba	☐	10] Elsewhere, specify:	☐
5] Bonaire	☐	11] Refused	☐
6] Elsewhere in the Caribbean	☐		

3. For how many years have you been living on Statia?

4. In which district/neighbourhood on Statia do you live?

5. How many people live in your house that are part of your family?

1] Number of adults		2] Number of children	

II. Environmental awareness

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

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

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

	1] Yes	2] No
1] Seek environmental information (*on internet, TV, newspaper, radio etc*)	☐	☐
2] Attend public events related to the environment	☐	☐
3] Avoid littering	☐	☐
4] Buy locally grown fruit and vegetables (*Friday market*)	☐	☐
5] Purchase environmentally friendly products (*reusable bags etc*)	☐	☐
6] Purchase a marine park tag	☐	☐
7] Purchase a trail tag	☐	☐
8] Donate money to an environmental cause (*e.g. a nature conservancy organization*) IF YES, SPECIFY: ..... USD IN LAST YEAR	☐	☐
9] Do any voluntary environmental work (*e.g. clean up beach/ nature*) IF YES, SPECIFY: .....HOURS IN THE LAST YEAR	☐	☐
10] Other environmentally friendly activities, please specify: …	☐	☐

8. How important do you consider the following potential threats facing the marine and land environment on Statia? (*1 being not important at all and 5 being very important*)

	ot nportant	ot very nportant	eutral	omewhat nportant	ery nportant	on't Know
1] Poaching iguanas	1	2	3	4	5	0
2] Overgrazing by livestock	1	2	3	4	5	0
3] Invasive/foreign plants (*e.g. Coralita*)	1	2	3	4	5	0
4] Rats	1	2	3	4	5	0
5] Chickens damaging gardens	1	2	3	4	5	0
6] Invasive fish (*e.g. lionfish*)	1	2	3	4	5	0
7] Sand mining	1	2	3	4	5	0
8] Digging without permission	1	2	3	4	5	0
9] Construction and runoff	1	2	3	4	5	0
10] Sewage	1	2	3	4	5	0
11] Solid waste and litter	1	2	3	4	5	0
12] Impacts of diving / snorkelling	1	2	3	4	5	0
13] Impacts of fishing	1	2	3	4	5	0
14] Anchoring on the Saba Bank	1	2	3	4	5	0
15] Oil spills	1	2	3	4	5	0
16] Hurricanes	1	2	3	4	5	0
17] Car wrecks	1	2	3	4	5	0
18] Other, specify:	1	2	3	4	5	0

9. Are you in principle willing to pay for nature management on Statia?

1] Yes, CONTINUE WITH QUESTION 10	☐
2] No, CONTINUE WITH QUESTION 11	☐

10. Would you have a preference for one of the following organizations to manage the collected funds? Check most preferred answer.

1] STENAPA	☐	4] Other foundation (*e.g. WWF*)	☐
2] Government of Statia	☐	5] Other, specify:	☐
3] Government of the Netherlands	☐	6] Don't know / no preference	☐

III Choice experiment

REFER TO THE INTERVIEW PROTOCOL

IMPORTANT: FILL VERSION NUMBER____

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

SHOW THE **EXAMPLE CHOICE CARD** HERE

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

1. Quality of coastal waters for fishing and recreation activities (*diving, snorkelling, swimming*). This takes into account reef quality (*fish, algae and coral biodiversity*) as well as water quality (*clarity, pollution etc.*).
2. Natural landscape refers to the landscape beauty and the attractiveness for recreational activities on Statia (*e.g. hiking*). This takes also into account the vegetation quality, as well as car wrecks and litter.
3. Archaeology refers to the possibility to visit historical sites and displayed artefacts. This takes into account the maintenance of the site, accessibility etc.
4. Free roaming animal management refers to management options to control the livestock on Statia (*i.e. goats, sheep, cows, donkeys, pigs and chickens*).
5. The contribution per year would be contributed financially by **all Statians** and would be used strictly for environmental management on the island.

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

Please look at the 3 options shown in the example card. To make a choice between the 3 options you should look at all of the items that shape the option (quality of marine environment, archaeology management, contribution, etc.).

- In **Option A** the quality of the Marine environment is excellent, the quality of the natural landscape is excellent, archaeology is managed, the livestock is fenced and there are fewer animals, and you contribute $500 per person per year.

- In **Option B** the quality of the Marine environment is moderate, the quality of the natural landscape is moderate, archaeology is managed, the livestock is fenced and there are fewer animals, and you contribute $180 per person per year.

- In the **third option**, the "Expected future without extra management" option, the threats to the environment are not dealt with and so the situation has deteriorated compared with today. The quality of the Marine environment is poor, the quality of the natural landscape is poor, archaeology is not managed, the livestock roams freely, but there is no need to pay an additional contribution. This option will remain the same in all 6 choice questions that you will be asked.

Options A and B are different in each question. Please note that none of the options will be perfect from your point of view and that some decisions may be difficult. Every card represents a new choice and has nothing to do with the previous choice.
[FOR THE FIRST CHOICE CARD TRY NOT TO HELP THE RESPONDENT TOO MUCH, UNLESS HE REALLY DOESN'T UNDERSTAND. JUST BRIEFLY POINT OUT THE DIFFERENCES BETWEEN THE OPTIONS IF NECESSARY BUT TRY TO GIVE A BALANCED PRESENTATION. DO NOT LET YOUR VALUES AND PREFERENCES INFLUENCE THE RESPONDENT'S CHOICE!! AFTER ALL CHOICES ARE MADE, ASK THE RESPONDENT THE FOLLOW UP QUESTIONS. IF THE RESPONDENT REFUSES TO MAKE A CHOICE, TRY TO FIND OUT WHY.]

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

Choice Set	1. Option A	2. Option B	3. Option C	Refused
Choice Card 1				
Choice Card 2				
Choice Card 3				
Choice Card 4				
Choice Card 5				
Choice Card 6				

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

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

[ONLY ASK THE FOLLOWING QUESTION IF THE RESPONDENT HAS CHOSEN SCENARIO "EXPECTED FUTURE WITHOUT EXTRA MANAGEMENT" EACH TIME OR REFUSED TO MAKE A CHOICE, OTHERWISE SKIP TO QUESTION 14]

13. You have chosen the 'Expected Future Scenario' in each card or refused to make a choice. Can you explain why? (*Check only one)*

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

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

	ot important	ot very nportant	eutral	omewhat nportant	ery important
1] Quality of coastal waters	1	2	3	4	5
2] Natural Landscape quality	1	2	3	4	5
3] Archaeology	1	2	3	4	5
4] Free roaming animal management	1	2	3	4	5
5] Yearly contribution	1	2	3	4	5

IV. Statements

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

Statement	ompletely isagree	omewhat isagree	eutral	omewhat gree	ompletely gree
1] Healthy nature is crucial for my family and me.	1	2	3	4	5
2] NuStar should be allowed to do whatever they want, regardless of the environment.	1	2	3	4	5
3] The container harbor should be build, even if it causes the lower beach to disappear.	1	2	3	4	5
4] Cows should roam freely	1	2	3	4	5
5] As long as the animals don't destroy my property, they're not my problem.	1	2	3	4	5
6] Statia should spend a large amount of money on improving the garbage dump.	1	2	3	4	5
7] I am in favor of additional protection of the archaeological heritage.	1	2	3	4	5
8] Littering is an urgent problem on Statia	1	2	3	4	5

V. Recreation

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

	1] Never	2] Once a year	3] Once a month	4] Once a week	5] More than once a week
1] Hiking	☐	☐	☐	☐	☐
2] Bird watching	☐	☐	☐	☐	☐
3] Going to the beach	☐	☐	☐	☐	☐
4] Visiting historical sites	☐	☐	☐	☐	☐
5] Gardening	☐	☐	☐	☐	☐
6] Diving	☐	☐	☐	☐	☐
7] Snorkelling	☐	☐	☐	☐	☐
8] Boating/ sailing/ kayaking	☐	☐	☐	☐	☐
9] Spear fishing	☐	☐	☐	☐	☐
10] Other forms of fishing	☐	☐	☐	☐	☐
11] Swimming/ wading	☐	☐	☐	☐	☐
12] Visiting the botanical garden	☐	☐	☐	☐	☐
13] BBQ at the beach	☐	☐	☐	☐	☐
14] Other, specify:	☐	☐	☐	☐	☐

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

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

18. Do you make use of medicinal plants?

1] Yes 19	CONTINUE WITH QUESTION	☐
2] No 20	CONTINUE WITH QUESTION	☐

19. If yes, which plants and how often?

	1] Never	2] Once a year	3] Once a month	4] Once a week	5] More than once a week
1] Lemon grass	☐	☐	☐	☐	☐
2] Gum/ Tourist/ Terpentine Tree	☐	☐	☐	☐	☐
3]Pondu/Belly-ache Bush	☐	☐	☐	☐	☐
4] Bitter Root/Wild Tamarind/Tan Tan	☐	☐	☐	☐	☐
5] Sour Sop	☐	☐	☐	☐	☐
6] Aloë	☐	☐	☐	☐	☐
7] Cashew (Cherry)	☐	☐	☐	☐	☐
8] Curacao Sage/Bush Tea	☐	☐	☐	☐	☐
9] Thistle Bush/Prickly Poppy	☐	☐	☐	☐	☐
10] Stingy/Spanish Thyme	☐	☐	☐	☐	☐
11] Coralita	☐	☐	☐	☐	☐
12] other, specify:	☐	☐	☐	☐	☐

VI. Saba Bank

20. Have you ever heard about the Saba Bank?

1] Yes CONTINUE WITH QUESTION 21	☐
2] No CONTINUE WITH QUESTION 22	☐

21. In your view, what is special about the Saba Bank?

THERE IS A LIST WITH KEYWORDS, IF THE RESPONDENT IS MENTIONING ONE OR MORE OF THESE WORDS CHECK THEM! DO NOT READ THE OPTIONS TO THEM!

Keywords	Checkbox	Keywords	Checkbox
1] Fish sector/fisheries (on Statia)	☐	7] Biodiversity	☐
2] Diving sector	☐	8] Science/Research	☐
3] Fish are born & fed	☐	9] Anchoring	☐
4] Whales	☐	10] Do not know	☐
5] Dolphins	☐	11] Other…	☐
6] Sharks	☐		

VII. Recreational Fishing in your household

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

1] Yes	CONTINUE WITH QUESTION 23	☐
2] No	CONTINUE WITH QUESTION 27	☐

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

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

24. How many fishing trips did your household make in the last two months and what was the average catch?

1] # Fishing trips in the last two months	
2] Average catch per trip	# fish _____ or _____ kg

25. What motivates members of your household to go fishing? Check all applicable boxes

1] I enjoy fishing/ I find it relaxing	☐	5] For tradition: my family has always fished	☐
2] I catch for food	☐	6] Fishing strengthens the bond with my friends & family	☐
3] To give catch to family and friends	☐	7] Other, specify …	☐
4] I catch fish to sell the fish	☐		

26. How often do people in your household go shore or boat fishing?

Type	Checkbox	Percentage
1] Shore fishing	☐	
2] Boat fishing	☐	

VIII. Demographics

[REMINDER: FOLLOWING QUESTIONS ARE FOR STATISTICAL PURPOSES ONLY]

27. Gender:

1] Male	☐	2] Female	☐

28. How old are you?

1] 18-25	☐	4] 46-55	☐
2] 26-35	☐	5] 56-65	☐
3] 36-45	☐	6] 66+	☐

29. In which field are you employed?

1] Construction	☐	5] Retail	☐
2] National Parks	☐	6] Tourism	☐
3] Government	☐	7] Service	☐
4] Oil transshipment	☐	8] Other, please specify:	☐

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

1] None	☐	5] MBO	☐
2] Primary school	☐	6] College/HBO/ Bachelors	☐
3] High school / VMBO	☐	7] University / Masters degree or other post-graduate	☐
4] LBO, vocational school	☐	8] Don't know/refused	☐

31. What is the total income earned in your house before taxes in US $ last month? (*Refer to income card and remind the respondent that you are not aware of the meaning of the income categories due to the random lettering)*

LETTER: …….

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

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

Name (optional): _____
Phone (optional): _____
E-mail (optional) _____

Annex B Ecosystem services and economic valuation

Ecosystem services

The functions of an ecosystem are manifold, ranging from the provision of goods, e.g. timber, the regulation of processes, e.g. water filtration, or other benefits that people derive from it, e.g. the recreational and cultural value (Cesar, van Beukering, Pintz & Dierking, 2002). All the functions that create direct or indirect benefits for humans are ecosystem services (MA, 2005). An overview of the types of ecosystem services and how they benefit human well-being can be seen in Figure 22. However, it has to be stressed that an ecosystem function is only considered an ecosystem service when benefits accrue to people. Hence, ecosystem services are not consistently equally valued but rather depend on the perception of different stakeholders. This is especially true for recreational and cultural services. For example, an old person, who loved to hike when young, might no longer be able to go hiking but instead, enjoys walking and taking in scenery. In general, ecosystem services benefit different stakeholders at different times (Hein *et al.*, 2003). Thus, the value for some ecosystem services differs greatly between individuals, as it relies solely on that individual' perception. There might also be conflict between different ecosystem services, recreational services can have adverse effects on the value of cultural services, e.g. excessive tourism can lead to the depreciation of an ecosystem' aesthetic value.

On St Eustatius, recreational services are, amongst others, relaxing on the beach, hiking in the national parks and diving in the coastal waters. Cultural services are, amongst others, the archaeological artefacts, cultural heritage and medicinal plants. Furthermore, ecosystem services can in general be substituted, however there are no perfect substitutes for a lost ecosystem and its corresponding services (Chee, 2004). For example, an artificial lake can substitute a wetland in terms of fish, recreation or water filtration but might not be able to replace the lost habitat of some species. For St Eustatius, this means that an artificial beach might have the same recreational value as a natural beach but turtles might not use it to lay their eggs. As a result of nature being intrinsically all encompassing, people do not only obtain an added value from but are inherently dependent on ecosystem services. Therefore, they need to be economically valued so that people realize their importance and can make informed decisions that benefit their well-being the most.

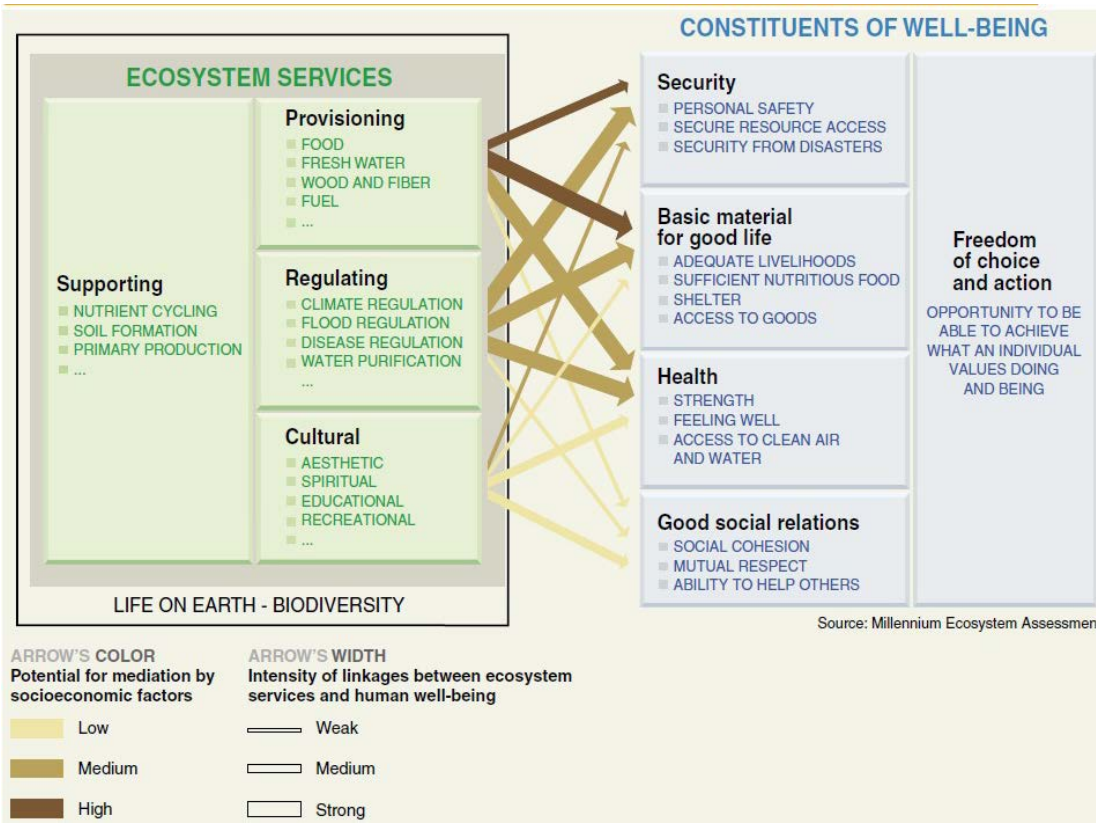

Figure 22 Linkages between ecosystem services and human well-being (Source: MA, 2005)

Economic valuation of ecosystem services

Economic valuation of ecosystem services is usually performed in terms of money. A main reason for this is to make it more comparable to the costs and benefits of all other human activities that impact nature, for example building a hotel. Other reasons include determining compensation for damages, creating the most effective tool for nature management or simply raising awareness (Van Beukering *et al.*, 2007). Nonetheless, in a hot topic such as the environment, the debate on the usefulness of economic valuation of ecosystem services is still ongoing. While some scholars such as Salles (2012) have opposed the debate about economic valuation, saying that nature is infinitely valuable since we can't live without it, others such as van Beukering *et al.* (2007) take a more pragmatic approach. Realizing that change is the consequence of decisions, they target decision-makers, using the language that everybody from small-scale farmer to CEO understands: money.

Economic valuation of ecosystem services is used to highlight the trade-offs that occur when changes in the provision of ecosystem services happen (Constanza *et al.*, 1997). A common example for this is a construction activity, which disrupts an ecosystem. When the value of the ecosystem services that would be lost because of the construction is known, decision-makers have a valuable resource for cost-benefit analysis at hand. If the lost value is higher than the gained benefit, the construction might be halted. If, however, the gained benefit outweighs the lost value of the services, the construction activity can go on, as human well-being is ultimately raised.

Especially Small Island Developing States (SIDS) depend on the economic valuation of ecosystem services, as van Beukering *et al.* (2007) point out. SIDS such as St Eustatius

are characterized by a 'small population, limited resources, remoteness, susceptibility to natural disasters, vulnerability to external shocks, and excessive dependence on international trade' (UN, 2013). In the past, their ecosystems recovered fairly quickly after external shocks, such as hurricanes. Combined with the pressures that humans lay on them, e.g. construction, their ecosystems are no longer able to recover at the traditional pace. Yet, the biggest challenge is the pressure that results from multiple stressors. For example, if erosion is coupled with unsustainable agricultural techniques, the ecosystem is likely to degrade in the long run. Economic valuation of ecosystems helps SIDS to plan future development, by including all affected ecosystem services in decision-making and identifying long-term costs and benefits (van Beukering *et al.*, 2007).

Unfortunately, as already mentioned, not everything can be as easily measured as the value of timber that a tree produces in a year. A value as complex as the perceived value of recreational and cultural services requires a different approach. This approach, choice modelling, will be explained in the next chapter. Ultimately, when adding all the values of the services that are provided, one arrives at the Total Economic Value (TEV) of an ecosystem. The TEV is different from the total financial value in that it is not limited to use values but also to non-use values and option values. Hence, the TEV is bound to be higher than the total financial value and can significantly increase the economic value of nature, in this case of a tropical island, which has been shown in other studies on the TEV of a similar island (Wolfs *et al.*, 2012).

In the aforementioned study, the researchers found out that the TEV of Bonaire is $105 million as opposed to a financial value of $37 million or almost three times as much (van Beukering *et al.*, 2013). The project, called 'What is Bonaire' Nature Worth?' was conducted by the consultancy firm Wolfs Company in collaboration with the VU University Amsterdam on behalf of the Dutch Ministry of Economic Affairs, Agriculture and Innovation. This thesis is part of a similar project 'What is St Eustatius' Nature Worth?', which is conducted by the same researchers under the name Wolss Company and this time on behalf of the newly formed Ministry of Economic Affairs of the Netherlands. The Dutch public has an interest in protecting Dutch islands in the Caribbean and their environment, as it does protecting that of the mainland, as van Beukering, Botzen and Wolfs (2012) have shown. Due to their spatial limits, small islands' economies have a relatively high dependence on their ecosystems, which can be seen in the many small islands relying almost exclusively on tourism. While St Eustatius is not highly dependent of tourism, this branch still incurs income for the island and due to its low volatility is a means of long-term economic development, as has been shown on other Caribbean islands, e.g. St. Kitts (Croes, 2006).

There are three fields of application of the results of the study. First, it will give local decision-makers insights for short and long-term decision-making. One possible application would be a better understanding of trade-offs between development and conservation. Second, it will provide input for national decision-making processes, e.g. budget allocation for conservation. Third, the study will enlarge the rather thin section of academic literature on the Dutch Caribbean and other Caribbean islands. Therefore, future research will be made easier, as the data can, for example, be used for conducting extended cost-benefit analyses. Moreover, the results can be used as an impetus for economic valuation of nature on other islands.

Annex C WTP Calculation

For the analysis of the choice experiment, a multi-nomial logit regression was performed on the attributes of the choice set. For the regression to be performed, all attributes except for 'contribution' were dummy coded. Since 'contribution' serves as the payment vehicle, it was coded as a continuous variable. The results, which can be seen in Table 7, show that the coefficients of all but one attribute are statistically significant at the 1 percent level with p=.000.

Table 7 Multi-nomial logit regression results, willingness to pay with 95% confidence intervals

	Coefficient	SE	P	WTP	Lower CI	Upper CI
ASC	-0.081	0.119	0.498			
Coastal water: moderate	0.590	0.084	0.000	628	395	1,070
Coastal water: good	0.715	0.090	0.000	761	516	1,222
Coastal water: excellent	0.815	0.086	0.000	867	605	1,379
Landscape quality: moderate	0.431	0.084	0.000	458	269	753
Landscape quality: good	0.305	0.086	0.000	325	141	589
Landscape quality: excellent	0.521	0.094	0.000	555	352	882
Archaeology: Managed	0.365	0.050	0.000	388	256	627
Livestock: fenced	0.807	0.051	0.000	858	626	1,353
Contribution	-0.001	0.000	0.000			
N	2250					
R^2 Pseudo	0.095					

The estimated coefficients are used to calculate mean household willingness to pay (WTP) for each change implied by the attribute levels. The three columns on the right show three different values for WTP. The first column shows the average WTP of a household for a move from the lowest to the indicated level of the attribute. The highest average WTP exists for a move from poor to excellent quality of the coastal waters. The values in the second and third column were determined using the Krinsky and Robb (1986) procedure, which estimate 95 percent confidence intervals (CI) for each WTP estimate. The CI means that there is a 95 percent certainty that the mean household WTP falls in this interval between Lower CI and upper CI. Therefore, in the case of the aforementioned move from poor to excellent quality of coastal waters, there is a 95 percent certainty that households are willing to pay between $605 and $1,379 for this move.

Additional analysis

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

The coefficients calculated for each attribute with the multi-nomial model are still valid, which means that the relative WTP for different attributes in the CE can be used. To estimate the total WTP for nature conservation the payment vehicle is used: the average WTP is calculated based on the different levels of the payment vehicle that were chosen by the respondents. This average is assumed to represent the maximum WTP for nature conservation per respondent. Based on the relative WTP for the scenario that includes the highest attribute levels, the average WTP is divided. Because the relative WTP for different attribute levels is still valid, the absolute WTP for the highest level of each attribute is determined. After the WTP for the highest attribute levels is calculated, the lower levels can be determined with the relative WTP between the levels of an attribute as well. Results are presented in Table 8.

Table 8 WTP estimates based on the average fee for nature conservation chosen in the choice experiment

	Coeff	WTP per household per month	WTP per household per year
ASC	-0.08	$-0.44	$-5.33
Coastal waters: moderate	0.59	$4.38	$52.61
Coastal waters: good	0.71	$4.70	$56.40
Coastal waters: excellent	0.81	$4.48	$53.82
Natural landscape: moderate	0.43	$2.37	$28.44
Natural landscape: good	0.31	$1.68	$20.16
Natural landscape: excellent	0.52	$2.87	$34.43
Archaeology: managed	0.36	$2.01	$24.08
Livestock: fenced	0.81	$4.44	$53.27