

Recreational and land use survey for Lac Bay Bonaire



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Recreational and land use survey for Lac Bay Bonaire

A study towards mapping human activities in Lac Bay Bonaire and its catchment area and advising about the current management system.

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Bachelor thesis in scope of the study Integrated Coastal Zone Management at Van Hall Larenstein, Leeuwarden, The Netherlands.

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(Picture front page: Shot of Lac Bay from out of the mangroves, by author)



Preface

This report is written as the final part of the bachelor study Integrated Coastal Zone Management. The research assigner A. Debrot, has made it possible for us to work on a part of a study by IMARES towards improving the management of Lac Bay, Bonaire. Here for a data collection on site of two months took place, followed by processing the data and writing this report.

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Summary

Lac Bay is a shallow lagoon of about 700 hectares, separated from the open sea by a shallow coral dam and for a large part surrounded by mangroves (Debrot et al., 2010 A). The bay is a designated RAMSAR wetland of international significance (RAMSAR Convention, 2011) and an IUCN IBA (Important bird area) (Debrot et al., 2010 A). The bay has been losing effective seagrass nursery habitat according to studies in 1961 and 1998, also Engel (2008) concludes that since 2001 seagrass beds have been decreasing (Debrot et al., 2010 A). Over the past decades the number of visitors on Bonaire and to Lac has been increasing dramatically (Bonaire Tourism Corporation, 2009) particularly from cruise ships. This increase is expected to reflect itself on the Lac Bay. It is feared that recreational pressure in combination with land use issues and natural processes can cause the carrying capacity of the bay to be exceeded. The current management plan of Lac Bay might not be able to cope with the current and expecting rising of user pressure.

Prior to this project it was unclear how much human activity was actually taking place in and around Lac bay, where these activities occur, and what possible threats these may mean to the environment of Lac Bay. Various studies are being conducted in the area to provide a foundation for future management in the area. This report forms a part of those studies and focuses on a recreational and land use survey of Lac Bay. The main question for this research was; 'How are the Lac Bay and its catchment area being used, what are the threats, what should be improved and what recommendations on the management plan can be given for future usage of the area?'

User distribution and densities were monitored for 31 days at Lac Bay during the spring tourist season of 2011 (March – April). Questionnaires were performed with various groups using the bay (N=616) and various stakeholders were interviewed.

The majority of recreational use of the Lac Bay is concentrated on and around the Sorobon Peninsula (Fig.4). The major water based activities are windsurfing and swimming/wading. Other water based activities include kayaking and snorkelling. While Lac stands out for its international biodiversity value, relatively little current use was directed towards nature activities. Most anthropogenic use could be classified as beach and sports-related (sunbathing and windsurfing).

A large difference in visitor numbers was observed between cruise days and non- cruise days. The highest amount of visitors recorded was 760 individuals present simultaneously. Average visitor numbers on cruise days is 359 and peak between 1-2 pm. On week days and weekends in which no cruise ships are present, human densities peak respectively with 187 (week) and 260 (weekend) persons later in the afternoon (3 pm).

Awareness of regulations at Lac differed significantly between the groups cruise tourists, stay over tourists, residents and locals, and was also generally low. Less than half of the respondents were aware of the Lac Bay zoning plan (fig 5). Unawareness of this plan and lack of implementation leads to some activities taking place where they are not supposed to. Overall it was found that the vast majority of water based activities are occurring in the "blue zone" of the zoning plan. This shallow area is covered with a sandy bottom where recreational activity can do less harm than in other areas where fragile sea grasses, mangroves and corals can be found. Most windsurfing activity takes place outside the area with the most concentrated sea turtle densities.

Occasionally human activity takes place in and around the mangroves by fishermen, windsurfers and kayak tours. These activities lead to disturbance of present birdlife. Some activities also take place on the coral dam. Physical impacts with coral patches are likely to occur with all types of usage present here due to the turbulence of the water. Collisions between surfers and coral patches have also occurred in the past. The amount of activity on the coral dam is low but sensitivity of the corals is high. Shallow waters make physical impacts a contributing potential problem in an area where the corals are already affected by eutrophication and dying off due to overgrowth by calcareous (Slijkerman et al., 2011).

Based on user surveys at Sorobon, social carrying capacity for the present kind of visitor and present kind of usage begins to become an issue around 250 beach visitors. Between 401 and 500 visitors a turnover point is reached beyond which the majority of respondents consider it too busy on the beach for their personal enjoyment. All facilities are according to the majority of the respondents (at least 61,7%) present in adequate amount, no more or less is necessary. Interviewed stakeholders agree that the social carrying capacity is at a good balance at the moment, and should not be exceeded more.

The Lac Bay catchment area was mapped using satellite imagery combined with field exploration and amounts to 22.6 km² of surrounding lands. This area consists of natural deciduous and dry-evergreen vegetation types and at least 213 kunukus (farms on Bonaire). Fresh water surface-flow to the bay is affected by approximately 54 dams or more, and groundwater flow by many (uncounted) wells. No new data on the density of amounts of grazers per hectare could be acquired for the area but due to concentrated husbandry livestock (goat and sheep), densities certainly are higher than 1 animal per hectare. Such densities exceed ecological carrying capacity and are not sustainable. Sustainable densities which have been found to allow recovery of endangered plants in comparable ecosystems (Christoffelpark Curaçao) are maximum 0,1 animals per hectare. Therefore, in the natural areas surrounding Lac Bay measures are needed to reduce livestock densities. Recent studies by Slijkerman et al. (2011) show that eutrophication in the bay exceeds threshold levels for tropical shallow water benthos (like corals) and that deterioration is occurring. Aside from humans, livestock and erosion due to agricultural practices on the kunukus likely also form part of the eutrophication problem.

This research suggests the need for a set of measures which can be used on the one hand to preserve and enhance the Lac visitor experience in accordance with social carrying capacity, and on the other hand preserve and enhance the natural values of Lac Bay.

Possible measures falling under the first category include:

- a) Developing sunbathing and water sport possibilities elsewhere on Bonaire to distribute user densities from Lac Bay.

Possible measures falling under the second category include:

- a) Improving the implementation of the zoning plan with some small adjustments, proper demarcation and increased awareness.
- b) Organize several facilities at Sorobon more properly, car parking, garbage disposal and public toilets.

- c) Many stakeholders agree that a visitor centre at Sorobon would be a good idea to increase awareness about Lacs environments and applicable guidelines.
- d) Reduce livestock densities in the Lac Bay catchment area.

Some other points from the current management plan are also still not implemented. Currently insufficient funding seems to be available for these points. Governmental financial support and obligation to pay a STINAPA nature fee upon arrival at the airport could provide with funding needed to finance points of recommendation. Visitor perceptions indicate that facilities at Sorobon are adequate. No more expansions are recommended.

Finally, key recommendations for further study include:

- a) Research on up to what extent tourists facilities are contributing to the eutrophication at Lac.
- b) Research on effect of sunscreen on coral bleaching at Lac.
- c) In order to obtain a clear overview of land use in the catchment area more research is recommended which can be carried out through aerial photography and further performing the developed questionnaire of this research.

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1 Introduction

Tourism is one of the most important driving forces behind the Caribbean economy (Goodwin, 2008). This economic contribution comes with a price. Damage to coastal habitats is caused by uncontrolled development of marine recreational activities, marine water contamination and solid waste generation. As a result, the carrying capacity of such areas can be exceeded and in some cases impacts are irreversible (EC, 2007). Tourism numbers at Bonaire are much lower than at many other Caribbean destinations (CTO, 2010), but over the past decades the number of visitors has been increasing (Bonaire Tourism Corporation, 2009). This increase is expected to reflect itself on the Lac Bay. It is feared that recreational pressure in combination with land use issues and natural processes can cause the carrying capacity of the bay to be exceeded (Debrot et al., 2010 A).

1.1 Area description

Lac Bay is one of the most important natural areas on Bonaire (figure 1). The bay is managed by the National Parks Foundation Bonaire (STINAPA). STINAPA is the management authority for the waters around Bonaire until a depth of 60 meters, the Bonaire National Marine Park (BNMP), including Lac Bay, and the Washington Slagbaai National Park (WSNP) (STINAPA, 2009). Lac Bay is a shallow lagoon with a surface of 700 hectares, protected from the open sea with a coral dam and for a large part surrounded by mangroves (Debrot et al., 2010 A).

Lac Bay is a designated RAMSAR wetland of international significance (RAMSAR Convention, 2011) and a IUCN IBA (Important Bird Area) (Debrot et al., 2010 A). In this area, multiple types of habitats can be found. Around the bay three types of mangrove vegetation can be found, (red mangrove, *Rhizophora mangle*, black mangrove, *Avicennia germinans* and white mangrove, *Laguncularia racemosa*), as well as the green buttonwood (*Conocarpus erectus*) (Debrot et al., 2010A). A large part of the sandy seabed of the bay is covered by sea grass. The turtle sea grass, *Thalassia testudinum*, is an important food source for the protected Green Turtle (*Chelonia mydas*) as well as the Hawksbill Turtle (*Eretmochelys imbricata*). It is also a habitat for the endangered Caribbean Queen Conch. On the coral dam several endangered types of corals can be found; *Acropora palmata*, *A. cervicornis* and *A. prolifer*. Also the Rainbow Parrotfish (*Scarus guacamaya*) can be found here, as well as some other IUCN red list species (Debrot et al., 2010 A).



Figure 1 Map of Bonaire and site of Lac Bay (STINAPA, 2003)

Next to the natural values in this area, Lac Bay is extensively used for human purposes, mainly recreation. The area around the bay is often used for agricultural purposes. At the Sorobon peninsular (figure 2) one of the few Bonairean sandy beaches can be found which makes a suitable place for sunbathing and swimming. Lac Bay is also a popular place for windsurfing, snorkelling and kayaking. Around Lac Bay two hotels can be found: 'Sorobon Beach Resort' and the 'Kontiki Beach Club'. Next to Sorobon Beach resort two beach bars can be found, 'Jibe City Beach Bar' and 'The Beach Hut.' Also two windsurf centres are located here; 'The Windsurf Place' and 'Jibe City.' The Sorobon peninsula is visited by stay over tourist as well as cruise tourists, who are dropped off at the beach and only stay for several hours. Also foreign residents and locals from Bonaire visit the place for work or recreational purposes. All these visitors may in greater or lesser extend interact with nature by disturbing the wildlife and touching, collecting or walking over sea grass and coral reefs (Kats, 2007).



Figure 2 Sorobon peninsular with facility locations in Lac Bay (ref. google maps)

In the catchment area (figure 3), which ultimately drains nutrients and sediment to Lac Bay, the majority of human activity takes place in the north. Land in this area is mainly used for keeping livestock such as goat, sheep and poultry and for agricultural purposes. It is unclear up to what extent activities in the catchment area influence Lac Bay. Livestock frequenting the area mainly consists out of goats and sheep. Because these animals are roaming free and are grazing on the areas vegetation, erosion takes place, causing sedimentation towards the bay which ultimately can negatively affect the water circulation of Lac by clogging (Slijkerman et al., 2011). Also sedimentation in the bay causes reduced light transmission in the water, and sediment deposition on vegetation and the reef. This negatively influences the health and growth of both (Debrot et al, 2010A). Sedimentation is also being caused by ploughing the land for agricultural purposes. The catchment area also affects the Lac Bay due to the disturbed flow of surface water. Wells and dams extract fresh water on which the mangrove system is dependant (Kathiresan, 2005).



Figure 3 Lac Bay and catchment area (all within the green line) (ref. google earth)

1.2 Problem description

Over the past years Bonaire has seen a significant increase in visitor numbers. From 2000 to 2008 an increase of approximately 25.000 annual visitors can be observed. Also the number of cruise ships mooring on Bonaire has increased over the last years, and will keep increasing over the next years (Bonaire Tourism Corporation, 2009) It is expected that this increase in visitor numbers also reflects itself on Lac Ba. NGO's suspect that this increasing number of visitors is putting pressure on the environment, leading to deterioration of Lacs environment, it is however unclear up to what extent (Debrot et al., 2010 A). Lac Bay, being a designated RAMSAR site and IUCN IBA, must be preserved and protected during these increasing visitor numbers.

The increasing user pressure in combination with land use issues in the area has made the Dutch ministry of economic affairs, agriculture and innovation (EL&I) decide that research needs to be conducted in the area to provide a foundation for future management of the area. The current management plan of Lac Bay may perhaps not be able to cope with the current and expecting rise of user pressure. In order to get information about the current situation EL&I has assigned the research institute IMARES to the task of assessing the situation at Lac Bay and give recommendations. This assessment has led to the following research projects (Debrot et al., 2010 B):

- 1 Mangrove restoration demonstration pilot study
- 2 Baseline ecological study of the zonation of aquatics communities
- 3 Recreational and land use survey for Lac Bay and its catchment area**
- 4 Study of avifaunal habitat use of Lac Bay

This thesis is focussed on the third project. Prior to this research it was unclear to what extent activities in the Lac bay exactly take place, at which locations and what possible threats to the environment of Lac Bay are caused by this. Because it is expected that the increasing visitor numbers on Bonaire reflect themselves on Lac Bay, these uncertainties are of increasing importance. The combination of recreational use of the bay and the land use issues in the catchment area puts a pressure on the Lac Bay environment, which possibly leads to deterioration of Lacs natural values. With the obtained information in this research, advice on possible improvements for the current management plan can be given, in order to make it more capable to cope with the increasing user pressure. The data can also be used as input for IMARES to determine the carrying capacity of the bay.

The basis for this research is thus that it is unclear to what extent certain activities take place in and around the bay and which threats this has as result. Data on the current human activity in the bay is necessary to determine where improvements in the current management might be possible and necessary in order to cope with the increase in visitor numbers.

1.3 Political structure

When reading this introduction, one might wonder why a Dutch ministry has interests in a problem boutique on Bonaire. EL&I is involved because the Netherlands Antilles have stopped existing on the 10th of October 2010. This island group, existing out of five islands; Bonaire, Curaçao, St. Maarten, St. Eustatius and Saba, now has a new administrative structure within the kingdom of the Netherlands. Curaçao and St. Maarten now have the status of an autonomous country within the kingdom, just as is the case with Aruba since 1986. Bonaire, Saba and St. Eustatius, also known as the BES islands have become municipalities of the Netherlands. On these islands Dutch legislation will replace the Antillean legislation over time (Rijksoverheid, 2011). Since the first of September 2010 the Dutch government is working under a new name on the BES islands: Rijksdienst Caribisch Nederland (RCN). The different Dutch ministries work together within the RCN on the BES islands. One of these ministries is the mentioned ministry of Economic Affairs, Agriculture and Innovation (EL&I). This ministry works towards a Netherlands with innovation power, where doing business is at the top of the agenda and with the environment and natural beauty, healthy food, sustainability and animal welfare in mind. In caring for the BES natural values, they work together with the Island Councils, environmental organizations, the national forest service of the Netherlands and the ministries of infrastructure and environment. (Rijksdienst Caribisch Nederland, 2011)

1.4 Study objectives

The recreational and land use survey will give input for an improved management plan of Lac Bay which can cope with the increasing user pressure, in which recent developments and ideas are included. This research will give information about how the research area is being used at present time and which opinions users have about the area. Based on this information, recommendations will be given for the management plan. The results from this research will also help IMARES with determining the total carrying capacity of Lac Bay, with the input on social carrying capacity.

Main question

How are the Lac Bay and its catchment area being used, what are the threats, what should be improved and what recommendations on the management plan can be given for future usage of the area?

Sub questions

The main question will be answered with answers to the following sub questions:

1. *How and up to what extend is Lac Bay being used?*
2. *Is there room for further development in the area, taking social carrying capacity into account?*
3. *Does current usage comply with the rules of the current management plan?*
4. *Which anthropogenic threats are caused by the current use of Lac Bay?*
5. *What opinions do users have about the current situation in the Lac Bay?*
6. *What are points of improvement on the current management?*
7. *How is the catchment area of Lac Bay being used?*

1.5 Reading guide

In this paragraph the report is described in short for the reader to get an overview. In chapter 2 the used methodology for this thesis is described. It describes how data was collected and processed and which methods were used. Chapter 3, about the current management plan gives delineation on the management plan of Lac Bay currently used by STINAPA to determine their management strategies. It is described what the plan stands for and what parts are mainly discussed in this research.

The main body of this report consists out of chapter 4, herein all data on the human use of Lac Bay can be found. The sub-chapters in this part each describe a sub question (1-5), a conclusion of each of them can be found at the end of each sub-chapter. In chapter 6 will be focussed on the catchment area of Lac Bay. Although the information which has been found is very limited, some information is presented. After this follows a discussion on the research, how representative is this report and what can be improved for follow up studies. On the basis of the information which has been presented the thesis is completed with conclusions and recommendations.

At the end of the report the reader can find a 'Glossary', in which all used abbreviations can be found. In 'Appendix A' a map of Lac Bay is included on which all the local names of locations in the bay can be found.

2 Methodology.

In order to determine how and to what extent Lac Bay is being used and what resulting threats are, information of previous research is used in combination with new data and information from questionnaires of recreational and land use (Appendix B, F and J), interviews (Appendix G) and monitoring (Appendix C). The data collection on Bonaire happened in the period April – May 2011.

The data collection and report is split in two parts, Lac Bay itself and the catchment area. Lac Bay herein contains the Lac Bay visitor questionnaire, focussed on recreation (Appendix B) conducted on the Sorobon peninsular. A questionnaire for taxi drivers (Appendix F) was also designed, because they bring and take cruise tourists to and from Lac Bay. Monitoring's were performed from the Sorobon peninsular as well, capturing visitor numbers and activities at different times and days. Also several entrepreneurs in the Lac Bay area were interviewed (Appendix G). For the catchment area of Lac Bay questionnaires for kunuku (farm) owners were conducted (Appendix J) to get an impression of land use. The area was also explored by car with a GPS and literature has been studied.

In order to answer the main question seven sub questions have been brought forward, which have also been mentioned in chapter 1. The first five questions are focussed on Lac Bay and number 7 is focussed on the catchment area. At question 6 improvements for the management of the area are suggested. At each question is explained how the data for this was collected.

1. *How and to what extent is Lac Bay being used?*

Observations and monitoring's on activities in Lac Bay have been carried out in the past by Sea Turtle Conservation Bonaire (STCB), Progressive Environmental Solutions (PES) and IMARES. The reports and literature resulting from this was used to get an impression of the usage of Lac Bay and to get an expectation on the results for this report. Results from interviews with stakeholders, monitoring's and visitor questionnaires are used to give results on this question and to compare with previous literature.

2. *Is there room for further development in the area, taking social carrying capacity into account?*

This research can give an impression on the social aspect of carrying capacity, with information from Lac visitor questionnaires in combination with monitoring data and interviews with stakeholders. The results from this question can be used by IMARES as input for the determination of the total carrying capacity.

3. *Does current usage comply with the rules of the current management plan?*

Using monitoring results indicates how well regulations from the management plan relating zonation of the Bay work. Interviews with applicable stakeholders give information about their opinions on the rules. Information about awareness of regulations is a result of the Lac Bay visitor questionnaires.

4. *Which anthropogenic threats are caused by the current use of Lac Bay?*

During monitoring's visible interactions with nature have been written down. Data from the Lac Bay visitor questionnaire gives an indication on fauna disturbance by water recreants. Data collected with the taxi drivers questionnaires gives information on traffic around Lac Bay.

5. *What opinions do users have about the current situation in the Lac Bay?*

Conclusions have been drawn from interviews with applicable stakeholders and the discussions from the stakeholder meeting.

6. *What are points of improvement for the current management plan?*

Based on results from previous sub questions recommendations are given on how to improve the current management. Literature on management tools can be applied to this.

7. *How is the catchment area of Lac Bay being used?*

Literature research on usage of the catchment area and general threats of this way of usage, consulting applicable management entities, developing a questionnaire for landowners and exploring the area by car with GPS.

2.1 Literature

Literature was studied before starting the survey and was used for designing the survey. Expected findings are based on reports from Progressive Environmental Solutions, Wageningen IMARES and Sea Turtle Conservation Bonaire.

- *Progressive Environmental Solutions. Lac – Implementation of long term monitoring and research plan – Year one (2007)*
- *Assessment of RAMSAR site Lac Bonaire. June 2010. Adolphe Debrot, Erik Meesters, Diana Slijkman.*
- *Lac Buoy Placement Project Progress Report # 1. For the period November 2008 – December 2009 Carina Kalke , Kris Kats, Mabel Nava, Marlene Robinson. April 2010*

2.2 Survey design

Questionnaire

Lac visitor questionnaire (Appendix B)

The surveys have been conducted in the months March and April. In these months approximately 14400 people visit Bonaire, based on counting's in 2008 (Bonaire Tourism Corporation, 2009). It is unknown how many of these visitors actually visit Lac Bay, and it has been decided not to determine this number in this research. However, it is assumed that this number reaches up into thousands and therefore a mathematically endless population has been used. A sample size of 385 respondents has been determined, taking the following formula into account (Hilbrants, 2007).

$$n \geq \frac{z^2 \times p(1-p)}{F^2}$$

n = Sample size

z = Standard deviation: 1,96 with 95% confidence.

p = Percentage. 50%

F = Confidence interval: 5%

In the progress of the surveys the decision has been made to increase the number of questionnaires. This would lead to a lower confidence interval with a marge +/- (3,89) and enables more possibilities to draw reliable conclusions from different sub groups which are now larger. A total of 614 questionnaires were conducted.

In some cases the total sample group has been divided into sub groups; stay over tourists, foreign residents, cruise tourists and native Bonaireans. Respondents have been randomly picked, causing stay over tourists to be a larger sub sample than other sub groups. The sample sizes of the different sub groups can be seen in table 1. Visitor types falling under the category 'other,' have not been specified here because no conclusions have been drawn from this particular sub group. The exact marge levels for each sub group cannot be determined because the total research populations are unknown. However, by estimating the populations, an indication of the real marge +/- can be given. For cruise tourists and stay over tourists a population of 5000 individuals has been assumed. For foreign residents a population of 1500 has been assumed and for native Bonaireans a population size of 500 is assumed. The percentages mentioned in table 1 refer to the percentage of respondents giving a certain answer. The higher or lower this percentage is (ranging from 50% onwards) the lower the marge +/- will be. Calculating the marge +/-s through the following formula has resulted in table 2.

Cruise tourists	Stay over tourists	Foreign residents	Native Bonaireans
55	364	130	45

Table 1. sample sizes

$$F = p \pm z * (\sqrt{p * 1 - p / n}) * (N - n) / N$$

F= marge +/-

P= Percentage

Z =Standard deviation: 1,96 with 95% confidence

n= Sample size

N= Population size

	Marge +/-			
percentage	cruise tourists	Stay over tourists	Foreign residents	Native Bonaireans
0,5	13.14	4.95	8.22	13.95
0,6	12.88	4.85	8.05	13.67
0,7	12.05	4.53	7.53	12.79
0,8	10.51	3.96	6.57	11.16
0,9	7.89	2.96	4.93	8.37

Table 2 Marge +/-

The goal of the questionnaire is assessing up to what extend visitors are aware of certain regulations, finding out how visitors experience their stay, identifying threats and determining what activities visitors are involved in. Next to this also some demographic features are collected, such as country of origin and age.

Taxi questionnaire (Appendix F)

On request of RCN, a taxi driver questionnaire was set up. Taxi drivers transport cruise tourists from the pier where the cruise ships dock. Taxi's driving to Sorobon have two possibilities for which road to take, one road leading close to the mangroves (Kaminda di Sorobon), which might be a threat for nature due to noise, causing disturbance for birds in the mangroves, and killing animals crossing the road. The other possibility for the drivers is to take the road around the airport and along the district Belnem, crossing the area called Lima. This road possibly causes less disturbance for the mangroves and Lac Bay. Also, taxi drivers might be of influence of the awareness of visitors in Lac Bay. They are able to give information to their clients in the taxi. Information on which road they choose and their willingness to give information is gathered with this questionnaire. All taxi drivers that take clients to and from Sorobon that were found at a day a cruise ship was present were questioned, a total of 15 taxi drivers were questioned.

Kunuku questionnaire (Appendix J)

Information on the catchment area of Lac Bay was gathered by questioning kunuku owners who's land lies in the catchment area. They were asked about the numbers and kind of livestock they keep, if and what type of agriculture they perform, and information on any waterworks they have on their land, such as dams and wells. A total of 17 kunuku owners were surveyed. Reaching these respondents was particularly difficult because owners are rarely present on their land.

2.3 Monitoring

Monitoring Lac Bay was a consistent way of data collection for the project. At each survey day all human activities in the bay have been monitored on 7 consistent times of the day. The first monitoring was at 9 am, then again every 1,5 hours until the last at 6 pm. At each monitoring point all users of the bay were counted, present at that specific moment. This has resulted into data about to what extend each activity takes place and on which location on the zoning plan. Counted activities involve the number of people on the beach and the number of people participating in different water based activities. This data was recorded on monitoring sheets (Appendix C). Three Lac visitor questionnaires were conducted at the same time as a monitoring, to be able to find connections between answers in the survey with the number of visitors in Lac Bay at the same time.

In total 31 survey days have been carried out. These days have been spread out taking the cruise schedule and week (end) days into consideration. During Eastern surveys were also carried out. An overview of the monitoring days and the cruise schedule can be found in Appendix D.

2.4 Stakeholders

Information from stakeholders has been collected through conversations, interviews and a stakeholder meeting. A number of stakeholders in Lac Bay area have been interviewed in order to get an impression of their points of view on the area. Minutes of the interviews can be found in Appendix G. Contacted stakeholders include: Sea turtle conservation Bonaire, Jibe City, The Windsurf Place, Beach Bar, Kontiki Beach club, Mangrove Info and Activity Center, the restaurant at Cai, Sorobon Beach Resort and a couple of fishermen. These stakeholders were chosen to interview since they are active in and around the bay, either themselves or they provide activities for visitors in the bay. They are closely involved in the bays management since they are users themselves. They are able to give opinions on how they perceive the management and development in Lac Bay.

At the 3rd of May a presentation about the data collection part of this research was given. All people who were involved in the data and information collection were invited, as well as some other people interested in the project. After the presentation a number of discussion points were brought forward of which the minutes can be found in Appendix G.

2.5 The focus on Sorobon

In an early stage of the data collection it was decided that the focus of data collection on recreational activities should lie on the Sorobon peninsular. This decision was made because most recreation is focused on or originates from this location.

Locations where recreational use was expected can be seen in the circled areas in figure 4. The yellow area refers to the beach in front of the Kontiki Beach Club. Driving by this location on a daily basis showed that almost no recreational activity on this beach is occurring. The beach is generally deserted. For these reasons no structural monitoring was carried out on this location. The brown zone refers to the Mangrove Kayak and Info Center. Throughout the year on average 10 kayakers participate in the tours on a daily basis. It was not considered necessary to conduct structural monitoring at this location since data on how many people visit the mangroves is already recorded by the Center. The green circle refers to the Cai peninsular. During the week almost no recreational activity can be observed here. During the weekends some activity can be observed during the afternoon

when the local bar is opened. At these times around 50 visitors can be seen on this location as was indicated by several visitations. No structural monitoring was carried out here due to the relatively low amount of recreational use. The blue area in which the Sorobon peninsular is indicated is where all beach recreation is focused. Also all water based recreation originates from the Sorobon peninsular. For this reason it was decided that Sorobon is most suitable for carrying out monitoring and survey activities.



Figure 4. Locations with recreational activity.

3 Current management plan

With this research recommendations to the current management of Lac Bay will be given. In this chapter you can read specifications from the current management plan and points which have been paid attention to during the data collection. At the end of this research improvements on this plan will be given as part of the conclusions from the collected information. All information in this chapter comes from the management plan of Lac Bay (STINAPA, 2003).

3.1 Objectives

Important in giving advice for the management is to keep the overall objectives and goals for Lac Bay in mind. The objective identified for Lac Bay is: To protect the natural environment of Lac Bay together with the naturally occurring species from degradation and preserve the aesthetic appeal of Lac Bay as an unspoiled and underdeveloped area whilst promoting day recreational use, to ensure that the area is as quiet as possible at night.

To ensure this, the management plan must address the following goals:

- I Promote day recreational use, not exceeding the environmental carrying capacity of the area.
- II Conservation of Lac Bay's mangrove, sea grass beds and associated wildlife.
- III Preserve its aesthetic and unspoiled nature.

All management activities have to be aimed to achieve Lac Bay's primary function, to protect and conserve (endangered) species and the habitats they utilise.

All activities taking place in Lac Bay are therefore necessarily subjected to the primary goal and can only be allowed when they are not detrimental to attaining this goal of nature conservation. Hence some activities need not be permitted and others only with strict regulations to ensure the activity is not detrimental to the objective. Therefore use of the bay should be confined as much as possible to specific areas in the bay and they should be promoted as day recreation only. To meet this end a zoning plan has been developed to restrict most activities. Explanation on the zoning plan can be read in paragraph 3.4.1.

3.2 Governance

STINAPA is responsible for the management in Lac Bay. STINAPA manages large parts of the natural areas on Bonaire including Washington Slagbaai National Park (WSNP) and the Bonaire National Marine Park (BNMP), which consists of three parts; all waters around the island till a depth of 60 meters, the island of Klein Bonaire and Lac Bay.

In the management plan, Lac Bay is identified as the water area including the sea grass beds and mangroves, the land peninsulas Cai and Sorobon and a 500 meter buffer zone landward of the high water mark. This area is designated as a National Park and RAMSAR site since 1980 (RAMSAR convention, 2011). Meaning the area is a wetland of international importance and subsequently should be managed accordingly. The objectives for Lac Bay are based on this.

3.3 Legislation

The Verordening Marien Milieu (VMM) or Nature Ordinance for Bonaire is the legal document under which various aspects of the marine environment are protected and regulated. The VMM contains a chapter with specific rules and regulations for Lac Bay. The important chapters of the VMM for the management of Lac Bay are: Chapter 2 general articles, Chapter 3 fisheries and Chapter 4 special regulations for the use of Lac. The VMM is necessary for the management of Lac Bay to enforce the regulations. (Eilandsraad, 1984)

3.4 Management of Lac Bay

In this paragraph management tools currently used in Lac Bay are set out as well as points that are already named in the management plan that need attention or work. During the data collection period these tools and points of interest of the current management plan are given attention. It is monitored how well this is functioning and if those points of interest are already developed.

3.4.1 Zoning plan

To confine usage of the bay to specific areas a zoning plan has been set up. This will help prevent conflicts between activities that might be dangerous to perform close to each other, and to prevent activities in unique habitats. This zoning plan (figure 5) is the clearest tool in the management plan, it is used during monitoring to check whether activities take place in the correct zones and during questionnaire is found information about the awareness of this zoning plan.



Figure 5. Lac Bay zoning plan (source: STINAPA brochure on Lac Bay)

Zone	Description
White	Quiet area: Should be left undisturbed as possible
Blue	Windsurf and kayaking zone
Yellow	Unsupervised snorkelling, swimming and kayaking
Green	Guided kayaking and snorkelling
Orange	Guided snorkelling
Red	Swimming, snorkelling and general beach recreation

Table 3 Overview of usage zones in Lac Bay

White zone

A large part of Lac Bay has been set aside for nature and wildlife without disturbance from activities. Access to the area is permitted to traditional fishing methods and occasional educational or cultural trips only. For other activities written approval from the management is necessary.

Blue zone

The open water area of the bay can be used for windsurfing and kayaking. The area is deep enough not to create disturbance for sea grass beds and other shallow areas. This zone may conflict with boats, since they use a shipping lane from the fishermen pier at Sorobon to Cai and out of the bay to the open water. For the boats no separate zone was made.

Yellow zone

This area is located near the coral dam and around the patch reefs. As this area is mainly a sandy area with patch reefs relatively little damage can be done here. People tend to go here for snorkelling on the patch reefs and kayaking combined with snorkelling. For the kayaks in this area a few moorings should be placed so they can tie off the kayaks and need not to anchor, the crosses in the yellow zone in figure 5 relate to locations for these moorings.

Green zone

Since there are kayak tours in the bay, this area has been used for the kayak trips. The green zone has been created to confine the tours to their old routes and concentrate activities in the mangroves to a particular area. Guided tours can be held here, the tour guide needs to follow a course at STINAPA to be sure they are aware of the rules and regulations in the area. A maximum of two groups of 10 persons in the morning and afternoon are permitted for kayaking. Snorkelling is permitted for 1 group of 10 persons in the morning and afternoon, this because snorkelling is likely to do more damage to the area.

Orange zone

Is set aside for guided snorkelling. This area is too small for kayak tours, but is still interesting for a snorkelling trip. A maximum of 2 groups of 10 persons in the morning and afternoon is permitted, under supervision of a properly trained tour guide.

Red zone

This area has no specific guidelines and is used mainly for swimming, snorkelling and general beach recreation. This area has been created mainly for safety reasons as the bay is used heavily by other water sports enthusiasts.

Also part of the zoning plan are the sea grass beds, the ones in front of the beach at Sorobon are marked with swim lines to prevent people from walking over them. They fall in no specific area, since they grow all over the bay. The patches that lie away from the beach are not marked, since they lie in deeper water and it is less harmful to have activities on the surface.

3.4.2 Points of interest

Other things that are named in the management plan that need attention or work are named in this paragraph. These points have no clear management tool, and in advance of the data collection it was not clear which points were and which were not already performed. During the data collection period several of these points came to notice, thus we can discuss whether or not this goal has been reached or needs more work or a different approach.

- A permanent present ranger for Lac Bay needs to be appointed.
- Every effort to increase the Marine Parks means should be taken, such as raising the park fees and including all users, so effective enforcement can be carried out in Lac Bay and in the Marine Park as a whole.
- The road leading to the Cai peninsular needs to be improved and at strategic points culverts have to be placed. The existing flume needs to be lowered and repaired or be replaced by a culvert. This road effectively blocks fresh water run off entering the bay. Freshwater is needed for a healthy mangrove stand.
- Public toilets need to be available at Sorobon and Cai and the existing toilets should be repaired.
- The fishermen pier at Sorobon provides a good and safe anchorage for boats. There is an oil receptacle, however it does not have a collection basin in case it starts to leak or breaks. A collection basin should be installed under the oil receptacle
- Also a garbage collection point should be made available where fishermen could leave there fish waste, which nowadays ends up in the water.
- For the fishermen at Cai a new pier on pillars should be built as well. Currently they use a concrete pier. The piers are broken and only partly removed. These structures however interfere with the long shore current and as a consequence erosion of the beach is taking place.

- At Sorobon still some structures, which were supposed to be temporarily, are not removed. These structures have been put up for the windsurf competition and were according to the permit only temporarily.
- At Sorobon some shelters where barbecues are held regularly in homemade barbecues. However this causes some nuisance as most of the time charcoal will get in the sand and there are no places where to put the leftovers of the barbecue and thus usually end up on the beach or in the garbage bins which are not designed to take hot ashes. To promote good and environmental friendly shelter areas, permanent durable barbecues need to be built and receptacles for hot ashes.
- Both at Cai and Sorobon visitors park their car right on the beach as close to the water as possible. Especially in the dune areas at Sorobon it can be noticed and the dune vegetation is disappearing which will have subsequently consequences for the dune stability. Therefore it is proposed to have designated car parking lots before the beach areas.
- Information should be provided to the general public and where necessary to specific stakeholder groups explaining what and why rules and regulations in Lac Bay are necessary.

Afterwards the data collection it was clear that a ranger especially for Lac Bay had already been appointed. The road leading to Cai was in renewal during the data collection, but there were no culverts, or they were clogged. The public toilets at Cai were dysfunctional, and complains were heard about the maintenance of the public toilets at Sorobon. At Sorobon, there is no collection point for garbage from the fishermen, as well as garbage bins for barbecue ashes. The pier at Cai is not yet improved. The 'temporarily' structures at Sorobon are removed, but visitors can still park their cars on the beach and in the dunes.

More information on these points is collected during the data collection period and they will be included in the conclusions and recommendations of this research.

4 Human use of Lac Bay

This chapter is the main body of the report. Here will be focussed on the usage of the bay and its surrounding mangroves and beaches, particularly Sorobon.

4.1 How and in what amount is Lac Bay being used?

Recreational use of Lac Bay is focussed on and around the Sorobon Peninsula (figures 2 and 6). Several businesses are located here, from which most water based recreation originates. In Lac Bay the major water based activity is windsurfing. Other water based activities include kayaking, snorkelling and swimming. Beach recreation can be observed on the entire Sorobon beach. The most crowded area is around Jibe City and The Windsurf Place/ The Beach Hut. Native Bonaireans often visit the bay in weekends. They can be found at the tip of the Sorobon peninsula, near the fishermen pier and at the Cai peninsula (appendix A) where a bar can be found which is only opened in the weekends.



Figure 6. Sorobon peninsular (ref.: google.maps)

4.1.1 Businesses and organizations.

In the Lac Bay multiple businesses, NGO's and governmental organizations can be found. The outline of these different stakeholders will limit itself to the ones who are directly involved as explained in the methodology. Therefore governmental organizations will not be discussed here. Two NGO's are active in the area, STINAPA and Sea Turtle Conservation Bonaire (STCB)

Stichting Nationale Parken Bonaire STINAPA

STINAPA is a non-profit organization which has been appointed by the Bonaire government for the management of the Bonaire National Marine Park (BNMP) Lac Bay also falls under the management authority of STINAPA. Details about the management of Lac bay by STINAPA can be read in chapter 3.

Sea Turtle Conservation Bonaire (STCB)

STCB is a non-governmental research and conservation organization that has been protecting sea turtles since 1991. STCB's mission is to ensure the recovery and protection of Bonaire's sea turtle populations throughout their range. In Lac Bay STCB is active due to the large number of sea turtles which can be found here to feed on the sea grass beds which can be found throughout the bay. In 2008 the sea grass beds in front of the windsurfing centres started to significantly decline in size and density due to increased trampling activity as a result of increased user pressure. The beds were also damaged by scarring of windsurf equipment. This has led to the placement of sea grass protection lines in cooperation with Progressive Environmental Solutions. (Nava, 2011)



Figure 7. Sea grass lines at Sorobon (by author)

Businesses in Lac Bay are focussed on the Sorobon peninsula. These include; Sorobon Beach Resort, Jibe City, The Windsurf Place and the Beach Club. Other businesses in the bay include the Mangrove Info and Activity Center and the bar at the Cai peninsula.

Hotels/ resorts

In Lac Bay area two businesses can be found which offer facilities for over-night stays; Sorobon Beach Resort and Kontiki Beach Club. The Sorobon Beach Resort (SBR) offers room for 60 guests per night, divided over its 24 apartments. The average occupation rate of these apartments is 60%. In an interview (Appendix G) the manager of SBR mentioned that he strives to become a CO₂ neutral business within 5 years in accordance with a plan the manager is going to develop with the Bonairean spatial planning authority.

Kontiki Beach Club (KBC) also has room for 60 guests a night. The average occupancy per night is 40, of which about 70% is a windsurfer. The owners of KBC are planning to expand their business. Before constructions on the expansion start an environmental impact assessment needs to be finished. In an interview (Appendix G) the owners mention that they strive to do this as environmental friendly as possible.

Windsurf centers

At the Sorobon peninsula two windsurf centers can be found; Jibe City and The Windsurf Place. Jibe City has been started in 1988 and The Windsurf place started in 1986. In an interview (Appendix G) the owner of The Windsurf Place mentions that renting out his windsurf equipment alone is not enough to make his business survive. Therefore cruise tourism is an important source of income through the rental of chairs on the beach. These chairs can be found around the Beach Bar which is part of The Windsurf Place but rented out to a different manager. Jibe City is also affiliated with a beach bar, but this bar has different owners. The amount of equipment rented by both windsurf centers is unknown but the monitoring results give a good indication.

Bars/restaurants

Three bars can be found. At the Sorobon peninsula Jibe City and The Beach Bar. These bars attract visitors throughout the week. At Cai the Lac Bay Weekend Bar can be found. Here visitors can only be found in the weekend when the bar is open.

Mangrove tours

The main operator of kayak tours through the mangroves is the Mangrove Info and Activity Center (MIAC). These tours only take place in the green zone in accordance with the zoning plan (Figure 5). On average throughout the year around 10 people participate in the tours per day with a maximum of 8 kayaks per tour in accordance with the management plan. Tours are also carried out by another business called Outdoor Bonaire on a smaller scale. In an interview (Appendix G) the owner of MIAC states that there is good communication between her and the other operator so that the maximum permissible kayakers present in the area is not being exceeded. MIAC is planning to broaden its amount of activities to snorkel trips around the coral patches on the coral dam. If tours turn out to be detrimental to corals due to physical contact the organization of tours will be discontinued.

4.1.2 Recent developments

During the project on Bonaire it was noticed that some developments are taking place within the businesses at Lac Bay.

At the Sorobon peninsular a new dive shop has recently opened between Sorobon Beach Resort and Jibe City, adjacent to the parking spots. No permit has been given for this shop. During conversations the manager of STCB mentioned that they expect that this will draw more visitors to the area.

Jibe City has started using an existing building for renting four apartments to visiting tourists and windsurfing teachers. Discussion is going on about whether the existing permit allows this or not.

The Sorobon Beach Resort has changed owners in December 2010. The resort used to be an nudist resort but is now open for regular public. The switch of ownership might lead to an increase in the number of people visiting the resort to stay over or make use of its restaurant and private beach.

The Kontiki Beach Club is currently in the procedure for an environmental impact assessment for an expansion of the hotel to keep its business feasible. Two new buildings will be constructed for visitor accommodation. two other smaller buildings will be constructed for storage and accommodation for employees. These buildings have been marked in green in figure 8. An increase of on average 42 visitors is expected, taking a 65% occupancy rate into account. The current average is 16. An increase of 14 cars is expected, with a current average of 6 (Geoconsult, 2010).

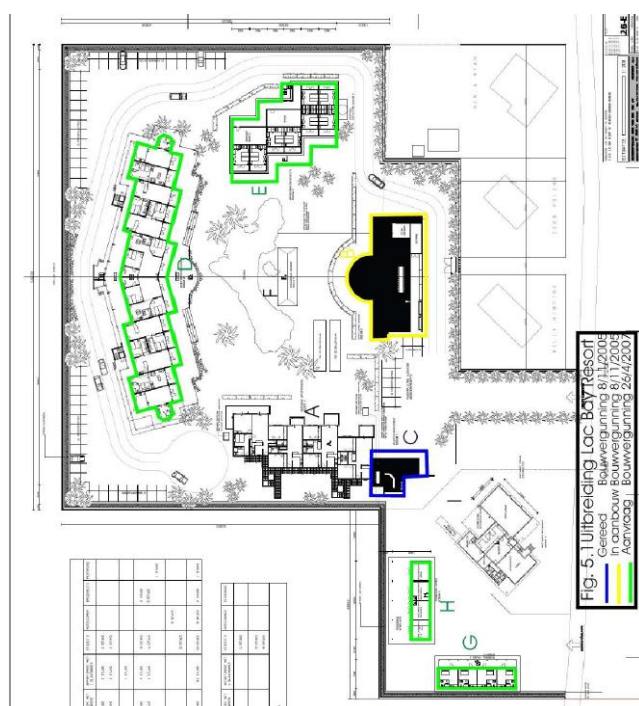
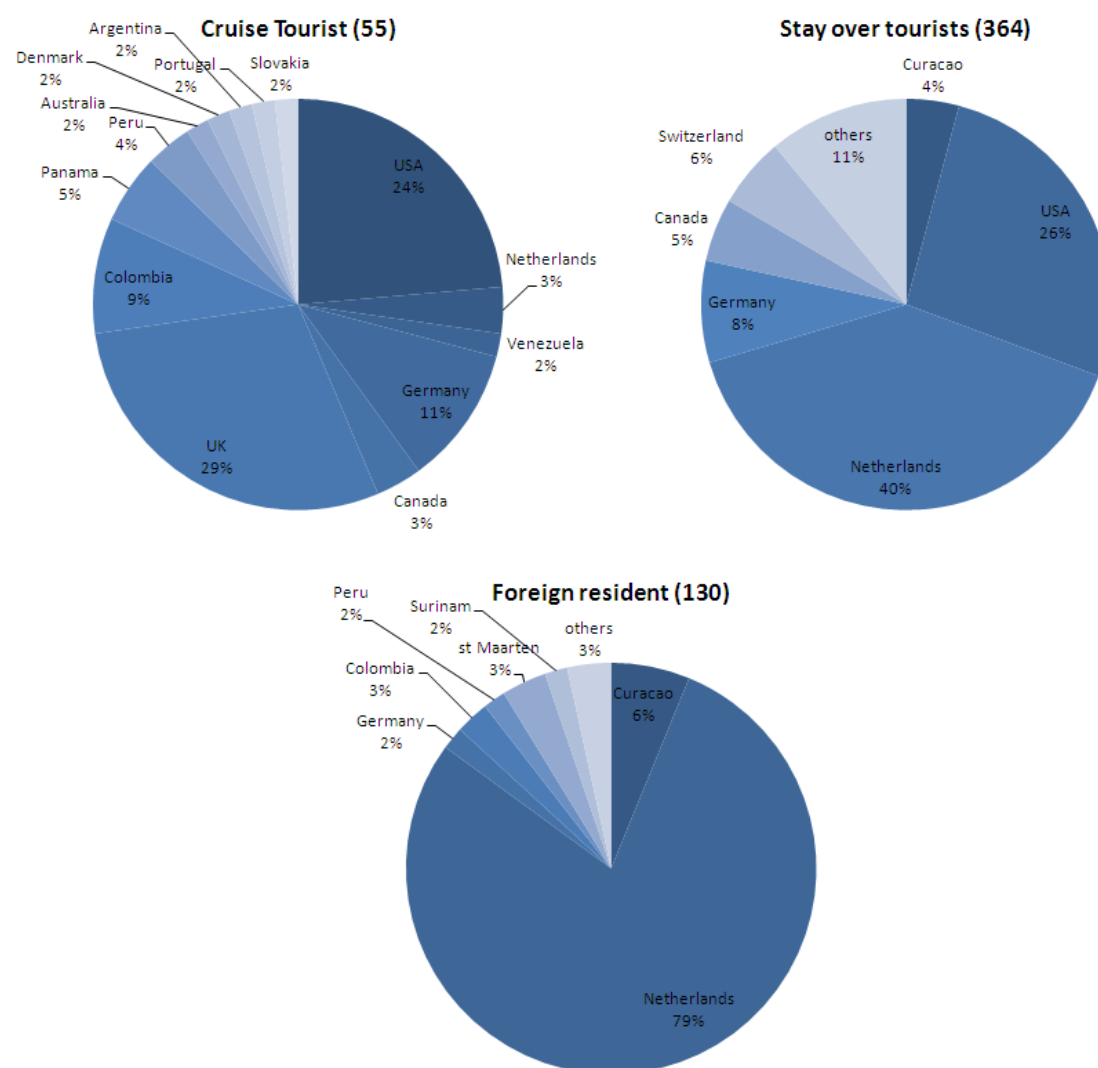


Figure 8 marks the expansions of Kontiki Beach Club. The location of Kontiki in relation to Lac Bay can be found in figure 2. Buildings marked in green are in the procedure for requesting a permit. The yellow buildings are under construction and blue has already been completed. All the unmarked buildings are part of the original hotel (Geoconsult, 2010).

Figure 8. Expansion plan Kontiki Beach Club. (Geoconsult, 2010)

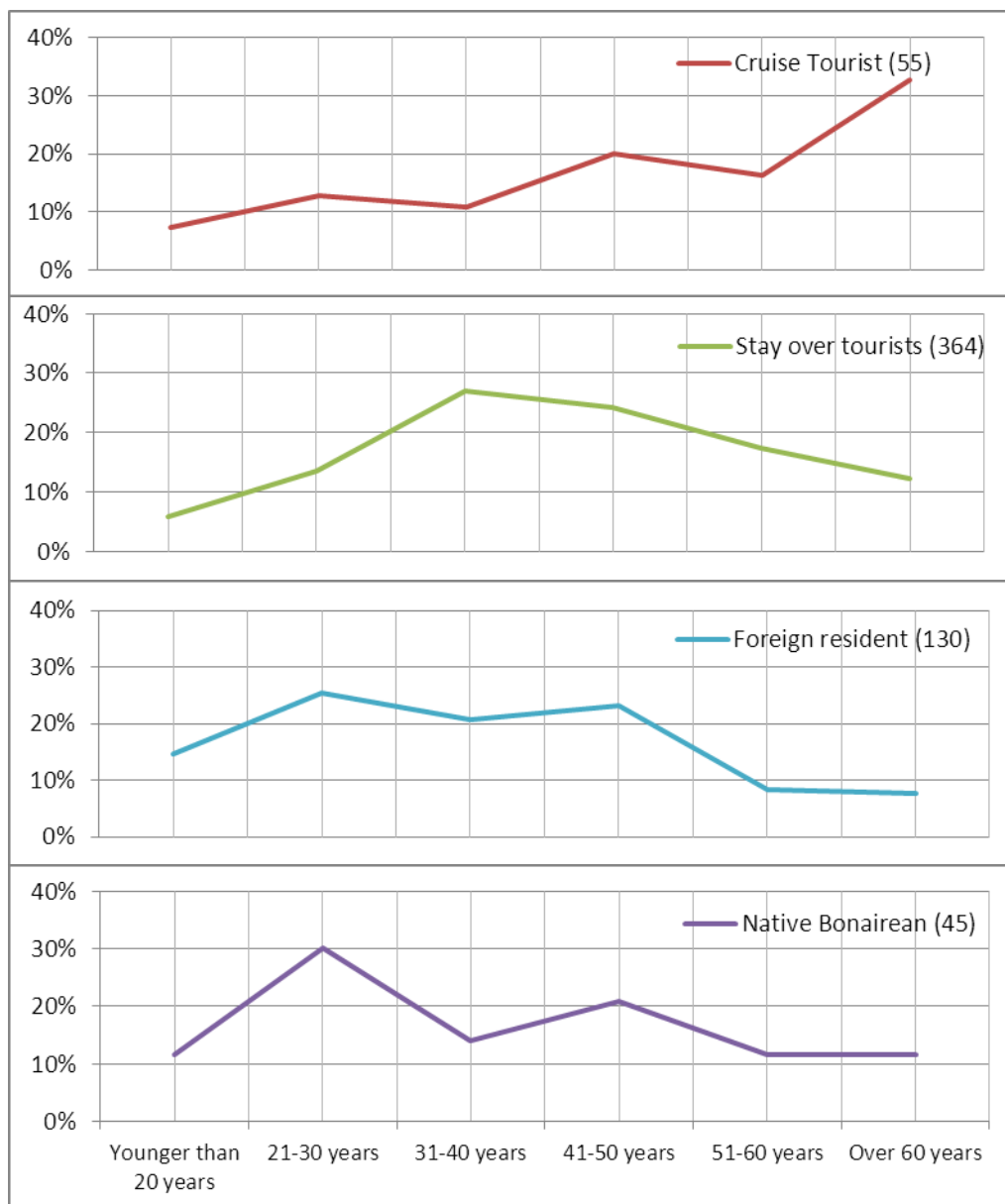
4.1.3 Results; Who is the Lac Bay tourist?

The businesses mentioned in the previous paragraph facilitate the visitations of a large number of people. When determining how Lac Bay is being used, it is considered valuable to know who the visitor actually is. This information can be particularly useful when distributing information amongst visitors or creating awareness about certain topics. In this report in some cases the total research sample is divided into four categories; stay over tourists, cruise tourists, foreign residents and native Bonaireans. Amongst cruise tourists a large variety can be found in the nationalities. The UK and USA were the most common nationalities found. Also Southern American tourists were often seen. These nationalities depend on the types of cruise ships present on Bonaire on the monitoring days, and are thus not intended to be a representation of the real mixture of nationalities but solely an indication. Amongst foreign residents the majority (79%) originates from the Netherlands, which can be explained by the status of Bonaire as part of the Netherlands. Stay over tourists also show a high number of Dutch nationalities (40%) Followed by tourists from the USA (26%) The category native Bonaireans has not been mentioned, since these are of course all Bonairean. Respondents were randomly picked, causing the sample sizes to differ, making stay over tourists more representative than other sub groups.



Graph 1. Visitor nationalities.

As can be seen in graph 2. Lac is being visited by all age groups in all sub groups. Cruise tourist are relatively older, showing 33% over 60 years of age. Stay over tourists show a peak at 31-40 years with 27%. Amongst foreign residents a large number of relatively younger people can be found. Amongst older age categories the curve shows a slightly lower percentage although it stays relatively constant until 51-60 years where the curve drops to 8%. Amongst native Bonaireans a large group of young people can be found. 30% is between 21 and 30 years of age.



Graph 2. Age categories.

	Younger than 20 years	21-30 years	31-40 years	41-50 years	51-60 years	Over 60 years
Cruise Tourist	7%	13%	11%	20%	16%	33%
Stay over tourists	6%	13%	27%	24%	17%	12%
Foreign resident	15%	25%	21%	23%	8%	8%
Native Bonairean	12%	30%	14%	21%	12%	12%

Table 4.

4.1.4 Results; Expected findings

In 2007 the foundation Progressive Environmental Solutions published its findings of a research in Lac Bay. The socio- economic parameters of this report have been a major contribution to the expected findings. Prior to the survey an assessment of Lac Bay was carried out in June 2010 by researchers from Wageningen IMARES. The resulting report of this assessment has also contributed to some expectations. Findings in these reports which are considered applicable to this sub question are mentioned below

Progressive Environmental Solutions. Lac – Implementation of long term monitoring and research plan – Year one (2007)

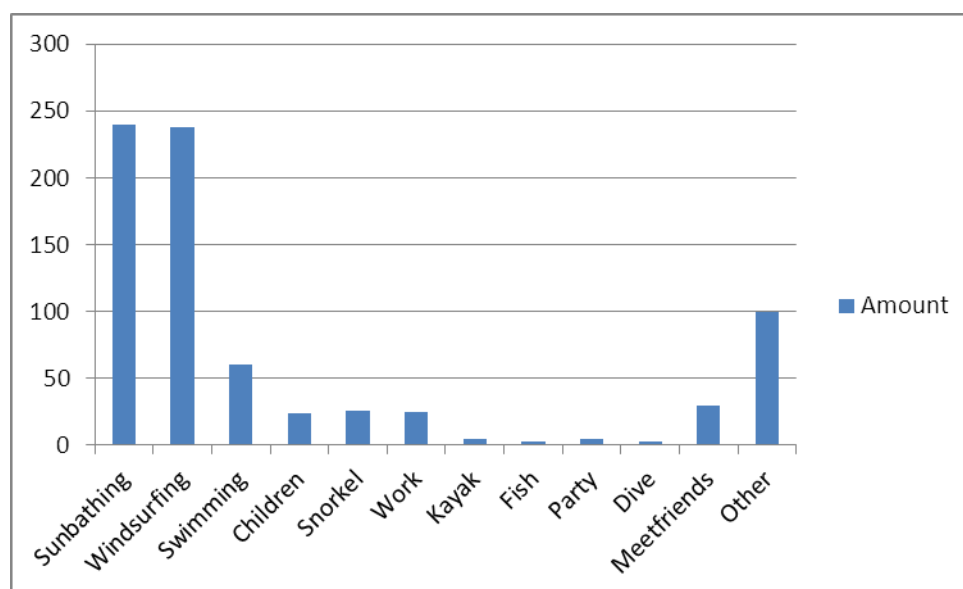
- *During the weekends and during cruise ship days the Sorobon area was very crowded. The beaches as well as the water in front of these beaches were highly populated. People were seen walking through the sea grass beds to reach deeper water. Dangerous situations arose when people walked or swam between the windsurfers.*
- *Kayaking from Sorobon is not supervised and in general people are interested in snorkelling on the reef. The kayakers are able to rent kayaks at Sorobon Beach Resort or one of the windsurf centres and kayak without a guide through the bay towards the mangroves and the reef, something that should be supervised. Snorkelling activities take place on and around the reef and are unsupervised. Tourists bring their own equipment or rent their mask and snorkel at the businesses at Sorobon and can be seen at times crossing the reef by foot*

Assessment of Ramsar site Lac Bonaire. June 2010. Adolphe Debrot, Erik Meesters, Diana Slijkman.

- *20 years ago an occasional windsurfer could be seen. Nowadays two windsurf centres and a windsurf club are present. At top days sometimes around 100 surfers could be seen in the bay in 2004.*
- *With the increasing number of cruise ship visitors to the area has come an increasing number of people snorkelling, wading and kayaking at the barrier reef.*
- *Cruise ship tourists visit the beaches in Sorobon. Anecdotal stories report 100's of tourists visiting the beaches on such days. Since cruise ships visits to Bonaire have increased recently, the number of day tourists have presumably increased as well. Because of lack of other alternatives in the area, most of these tourists concentrate in a very small area.*

4.1.5 Results; Statistical results

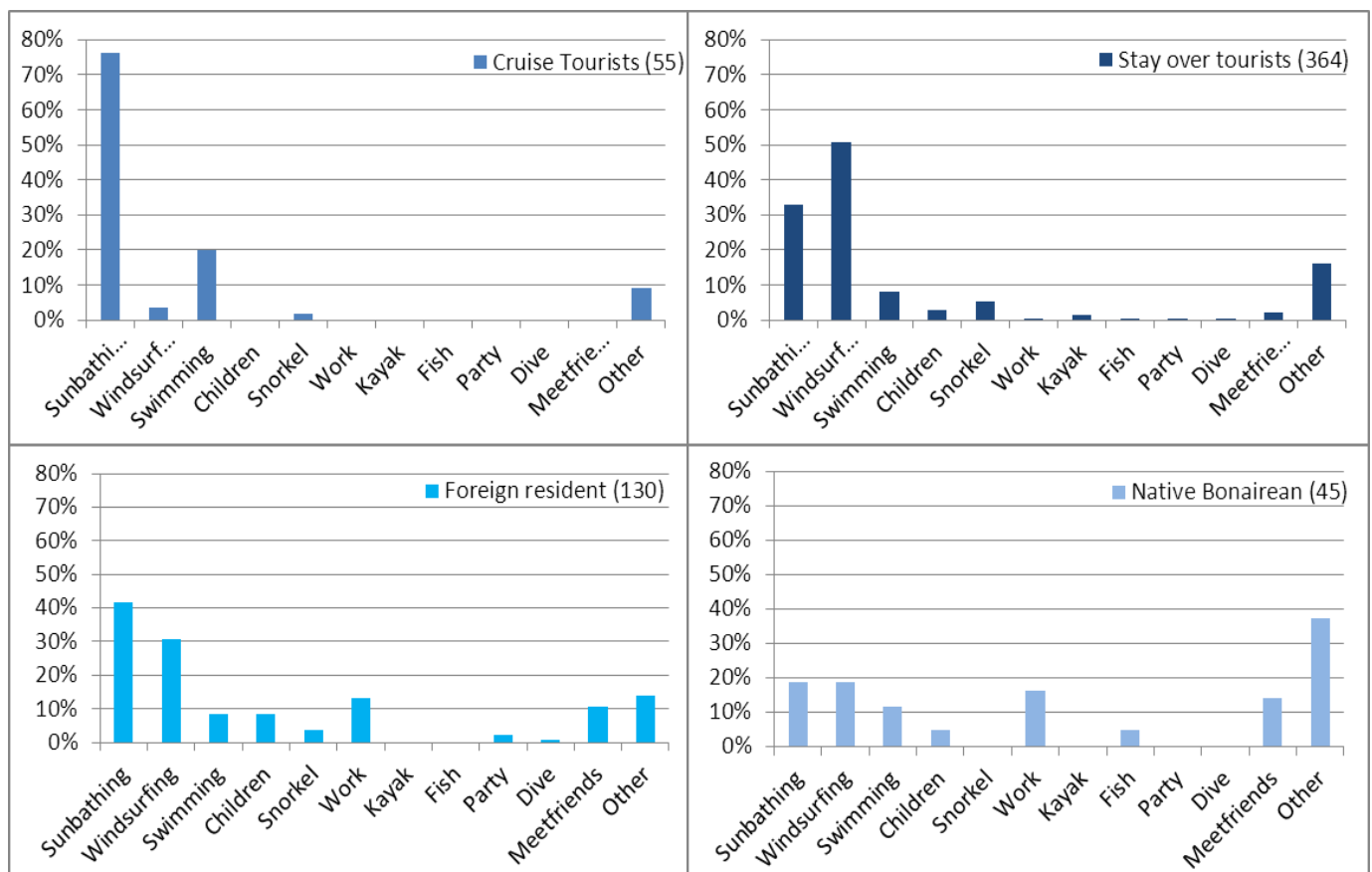
Statistical results applicable to the question; How and in what amount is Lac Bay being used, will be thoroughly discussed and presented. This concerns data about in what amount certain activities are taking place in general and on particular types of days and particular types of questionnaire respondents. The numbers of visitors in the bay throughout the day will also be discussed.



Graph 3. Counted answers to question 4 (Appendix B)

Visitors were asked which activity they practice during their stay in Lac Bay. With overall activities in graph 3 all answers of all respondents (616) are taken into account. Respondents were allowed to give multiple answers. This causes the total number of answers to be higher than the number of respondents. Each bar indicates the total number of respondents who participate in a certain activity. As can be seen the primary activities undertaken in Lac Bay are sunbathing and windsurfing. Under other fall answers which did not fall under the given categories and were not considered valuable to individually mention in the dataset because these answers were too general or only given a very small number of times. These answers include; relaxing, having a barbeque, watching the surfers and drinking. The activity children is associated with people who visit Lac Bay because it is a good place for their children to spend the day. This answer was not one of the given categories. These answers were given under the option; other, please specify. Applicable tables can be found in Appendix E under 4.1.4. Despite its special natural values, Lac Bay generally not visited for activities with the sole purpose of a natural experience, such as snorkeling, diving and kayaking. Instead Lac is mostly visited for sports (windsurfing) and sunbathing.

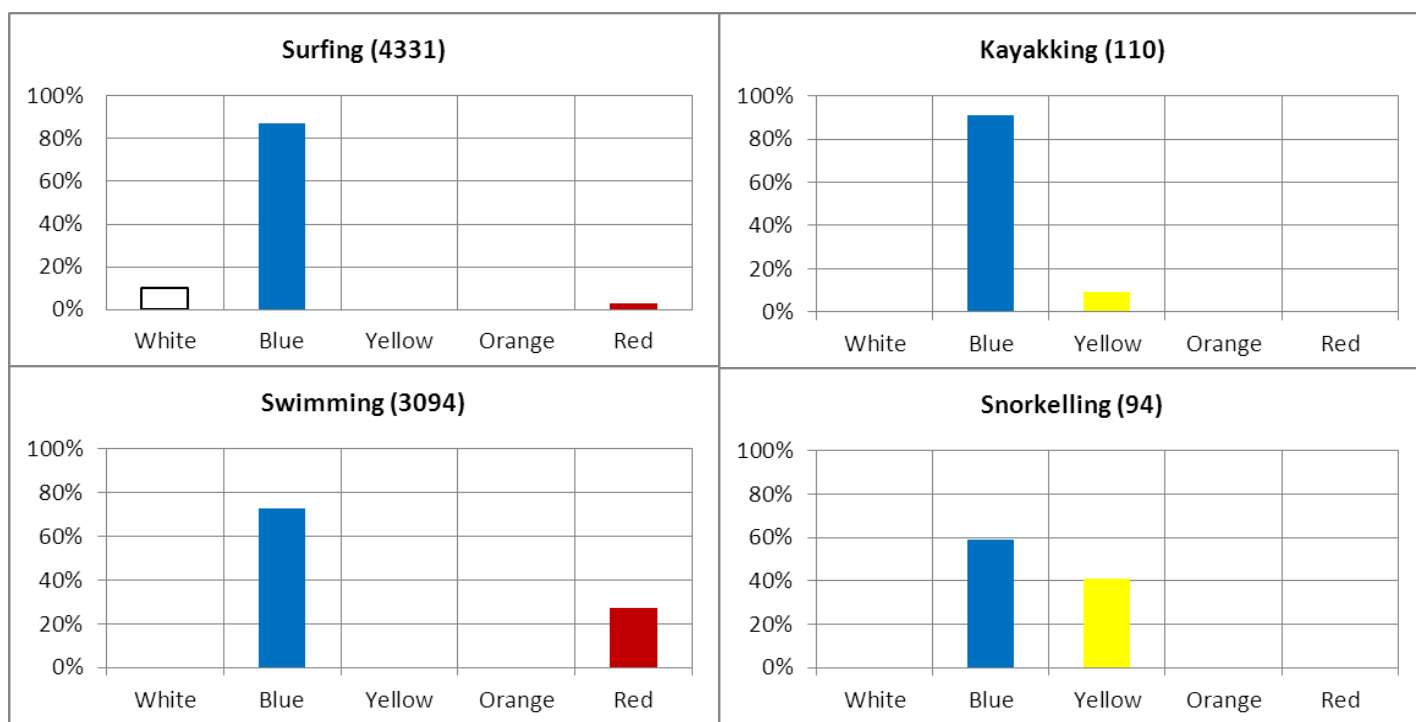
The major activities are sunbathing and windsurfing as could already be seen in graph 3. A large difference however can be seen between cruise tourists and other types of visitors. Almost 80% of the cruise ship tourists reply that they visit Lac Bay for sunbathing. Foreign residents follow up on sunbathing counting just over 40%. Stay over tourists primarily visit Lac for windsurfing. More than 50% of these respondents visit the bay for this purpose. Native Bonaireans show a large peak on activities as 'other'. Their specification on this answer mainly shows general answers such as relaxing and hanging out, and very specific answers which were not considered valuable. More specific answers mostly imply having a barbeque in the pier area at the top of the Sorobon peninsula (figure 2). Applicable tables can be found in Appendix D. As can be seen in table 2, large differences can be seen in the number of respondents per sub group. The percentages in graph 4 have been determined by making a crosstab (Table 10, Appendix E) with the counts of different types of respondents participating in certain activities. The percentages which these counts are of the total sample of the visitor type in question have been calculated resulting in (Table 11, Appendix E)



Graph 4. Activities per visitor type.

Locations of activities

In graph 5 can be seen where water based activities in the bay occur and in what amounts. The colours which are indicated refer to the applicable zone in the zoning plan (Figure 5). Most activity is focussed on the blue zone which is situated in front of the Sorobon beach. Specifications of the zonation's can be found in paragraph 3.4.1



Graph 5. Amounts of water based activities in relation to the zoning plan.

Snorkeling

Monitoring snorkelling activities around the patch reefs has turned out being particularly difficult due to long distances and poor visibility. A total number of 39 people snorkelling in the yellow zone has been recorded on the 31 monitoring days. It can be concluded that the number of people snorkelling in the area is relatively low since only 4% of the questionnaire respondents mentions he or she visits Lac bay for the purpose of snorkelling. 55 snorkelers have been seen in the blue zone. Applicable tables can be found in appendix E, Statistical results of chapter 4.1.

Kayaking

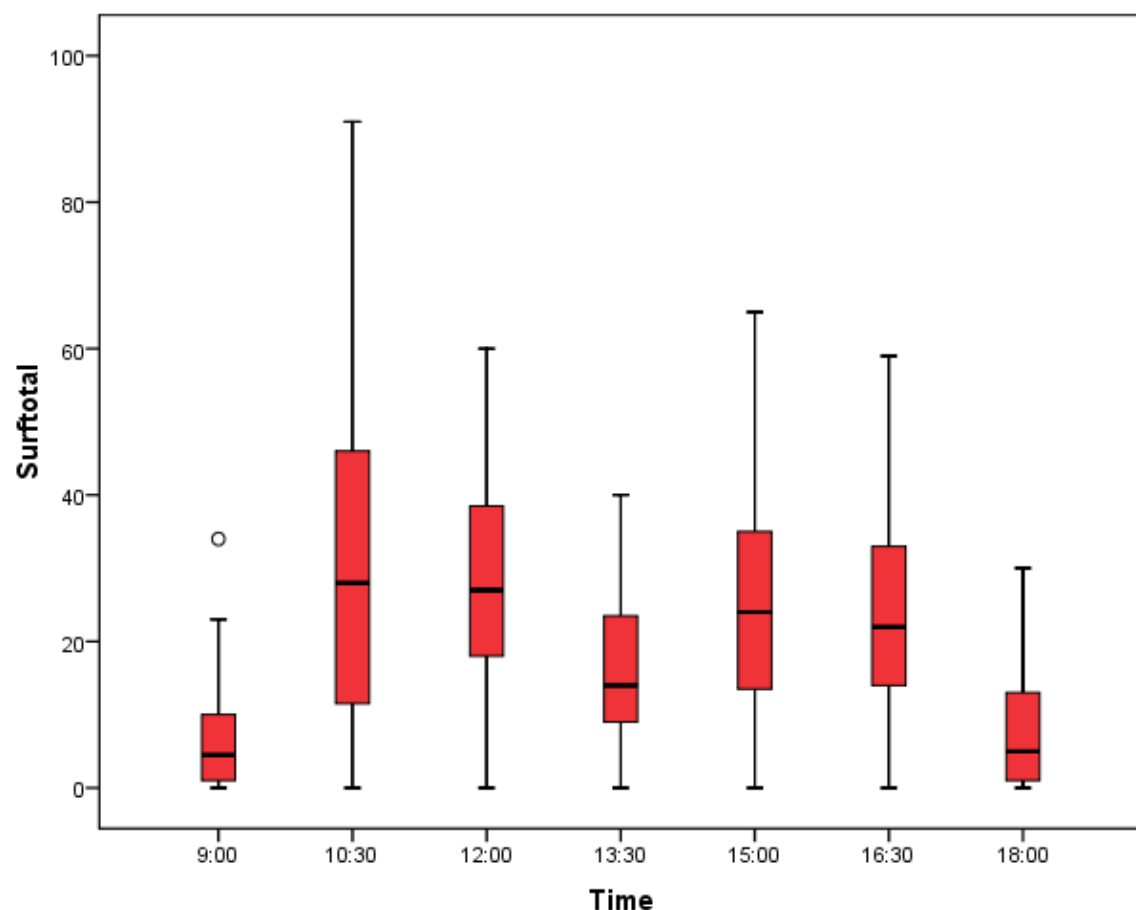
During the 31 monitoring days 110 kayakers were spotted during the scheduled monitoring times. Out of these only 10 individuals were seen in the yellow zone. This could be explained by the fact that most kayakers seem to be children who tend to stay closer to the beach. 97 individuals were seen in the blue zone, mainly close to the beach though such detailed locations have not been recorded. Three kayakers were seen in the sea grass beds. Applicable tables can be found in appendix E, Statistical results of chapter 4.1

Windsurfing

Graph 6 shows the development of the number of surfers over time through boxplots. The number of windsurfers is dependent on several factors. At the monitoring's of 9:00 and 18:00 the numbers are relatively low because surfers have not arrived yet or already left. Around the clock of 13:30 the number of surfers is also relatively low. This could be explained by surfers heading back to shore for lunch or because of the heat during this time of the day. The means of the total number of surfers lie between 7 and 30 individuals (table 4) whereas the highest recorded number was 91. The lowest numbers were recorded during low wind speeds. Because the number of surfers is subject to the mentioned factors the number of surfers spotted at different monitoring's has a very large range as can be seen in graph 6. As can be seen in graph 5, the vast majority of the windsurfers can be found in the blue zone. Only 7% of the surfers were spotted in the white zone, 2% was seen in the red zone. In total 2 individuals were seen in the yellow zone at one occasion. Windsurfing activity in non-designated zones will be further discussed in 4.3.2.

Table 4. Means of numbers of surfers at different times.

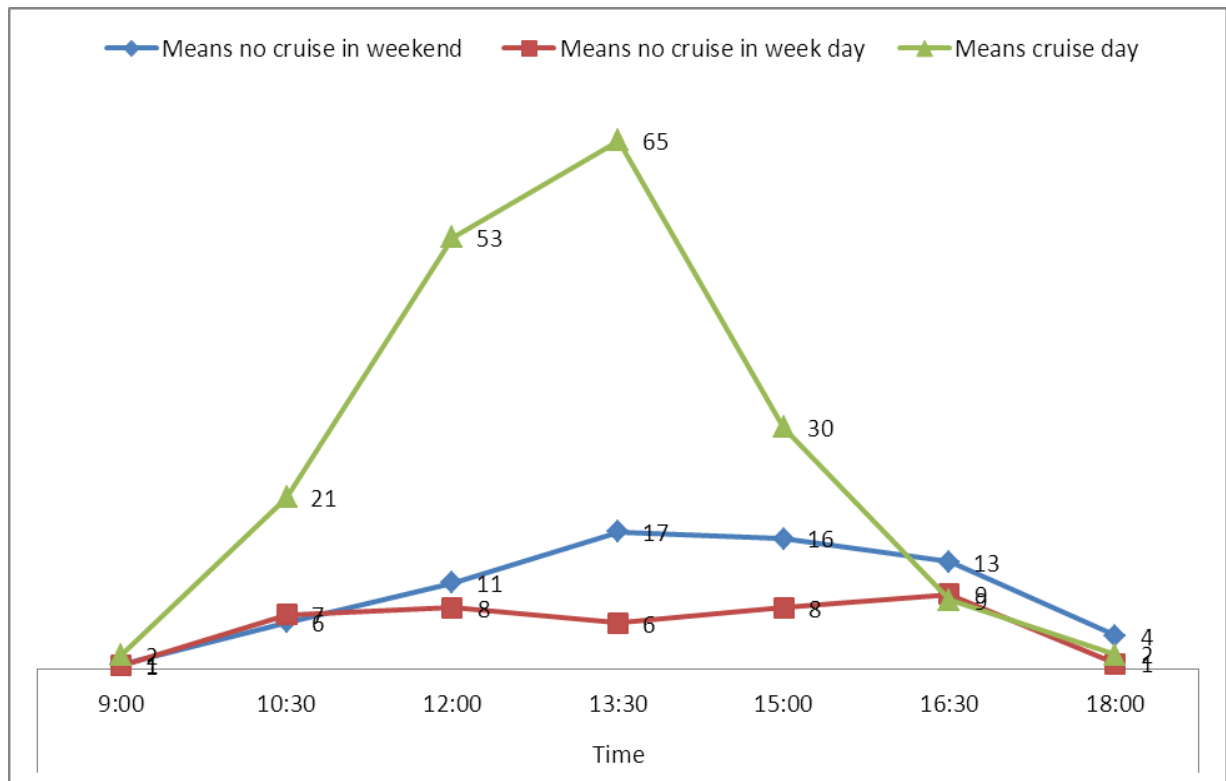
Time	9:00	10:30	12:00	13:30	15:00	16:30	18:00
Mean	7,27	30,48	28,03	17,32	26,32	24,10	7,69



Graph 6. Boxplots with the total number of surfers in the total area divided over time.

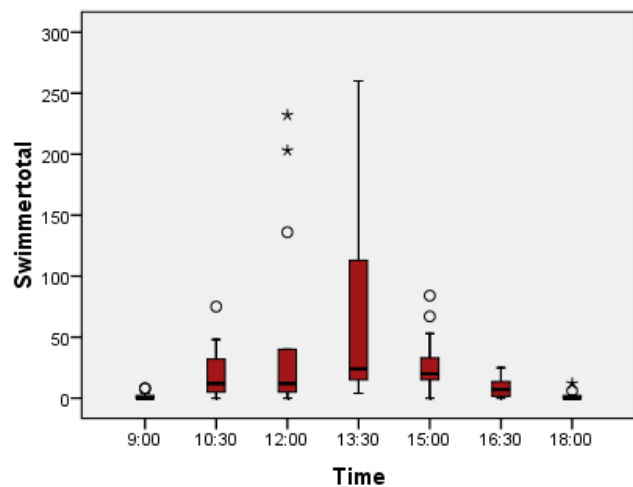
Swimming

Graph 7 shows the development of the number of swimmers in the area over time. As can be seen there is a large difference in numbers of swimmers on cruise days. On cruise days it is busiest on the water around 13:30. On days without cruise tourists the average number of swimmers is lower with a difference between week days and weekends, which can be explained by the applicable overall visitor numbers which are higher in weekends. In order to make the graph more accurate data which originates from eastern has been left out due to several activities organized on the beach. The applicable table can be found in appendix E.



Graph 7. Development means of swimmers over time.

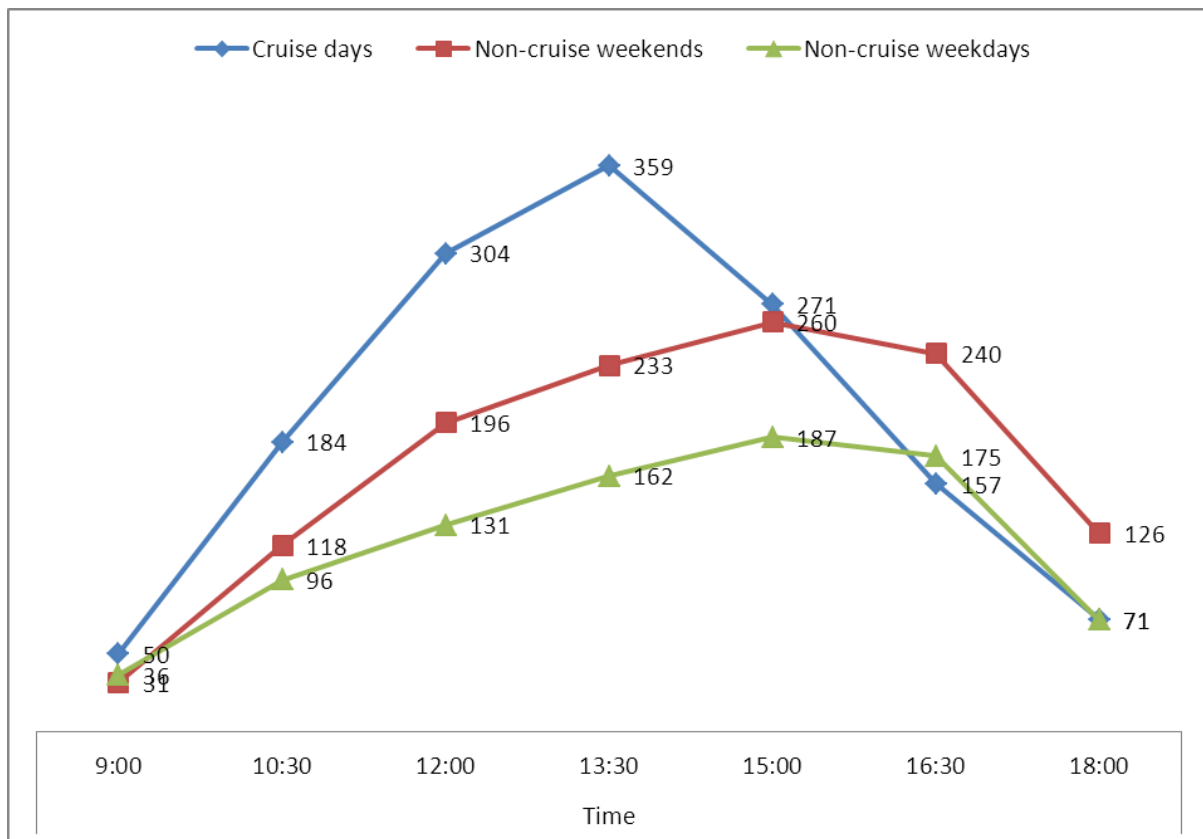
Graph 8 shows the development of swimmers on cruise days through boxplots. Especially around 13:30 a large range can be observed, indicating that the number of swimmers can largely differ per cruise day. The highest number of swimmers spotted at a particular moment was 260. The applicable table and boxplots for the other daytypes can be found in appendix E.



Graph 8. Boxplots of swimmer numbers over time during cruise days

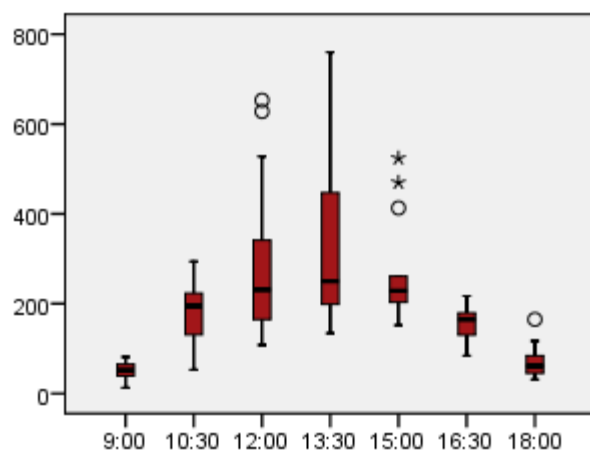
Total visitor numbers throughout the day.

The visitor numbers of which the means are illustrated in graph 9 involve the sum of all counted visitors present at a particular moment. Both water and land based. As can be seen, on cruise days on average a larger number of visitors can be found than on non-cruise days. Visitor numbers during cruise days have their peak around the clock of 13:30 whereas the peak of non-cruise days can be found around 15:00. Applicable tables can be found in Appendix D. The highest recorded visitor number was 760 individuals



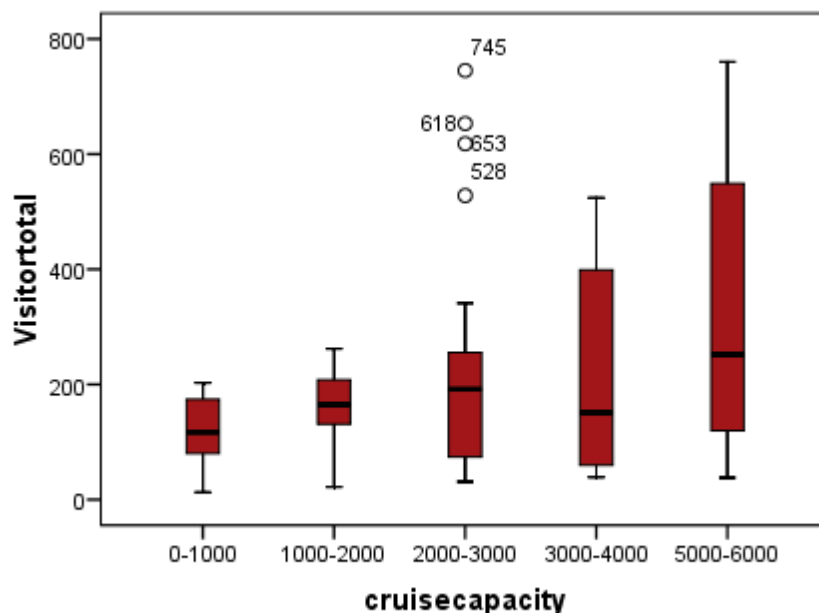
Graph 9. Means visitor numbers on particular day types.

As can be seen in graph 10 a large range can be found in visitor numbers during days with cruise ship visitors at 12:00, 13:30 and 15:00 hours. This indicates that the number of visitors per cruise day differs depending on the cruise ship which has docked. On non-cruise days a much smaller range can be found with lower visitor numbers (Appendix E)



Graph 10. Visitor numbers in boxplots on cruise days.

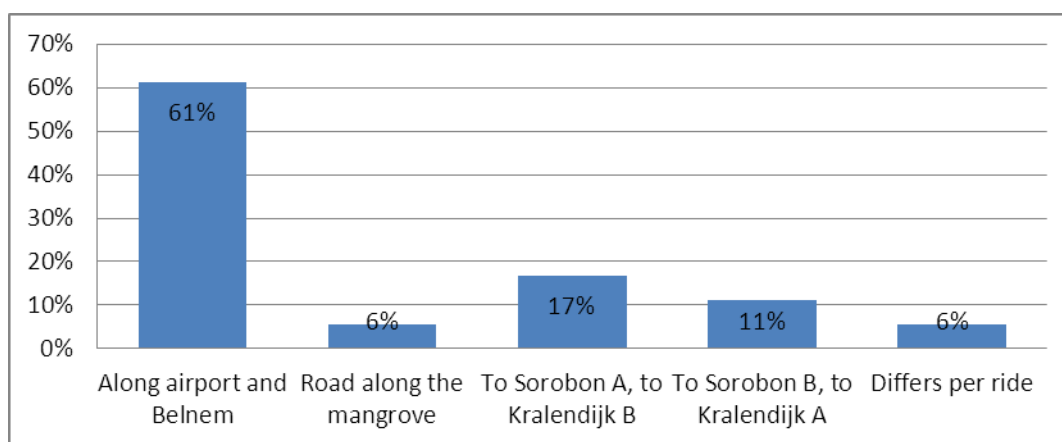
No significant relation can be found between the capacity of a ship and the total number of visitors present with the data that is collected, because the number of visitors also depends on the type of cruise tourists. Moreover, the capacity of the ship is not an accurate representation of the number of cruise tourists actually being on the ship. Graph 11 shows boxplots which show the number of visitors counted in the bay in relation to the cruise capacities of the present ships. Although no significant relation could be found, the graph does indicate that it has influence. The highest capacity present during a monitoring day was 5546. On this day two ships were docked at the same time, the Grandeur of the Seas and the Emerald Princess. As mentioned, the number of people on the beach also depends on the type of cruise tourists on the ship. All the outliers which can be seen under 2000-3000 are originating from two monitoring days with the Grandeur of the Seas. This shows that on days with the Grandeur of the Seas the number of visitors is very high, although its capacity is average (2446) Cruise tourists from the Grandeur of the Seas who answered the questionnaire were all from South American Countries such as Panama, Venezuela and Colombia. From this information it can be concluded that the different cruise ships themselves have a determining effect on user pressure. A graph with boxplots relating visitor numbers with different particular cruise ships can be found in Appendix E, graph 3.



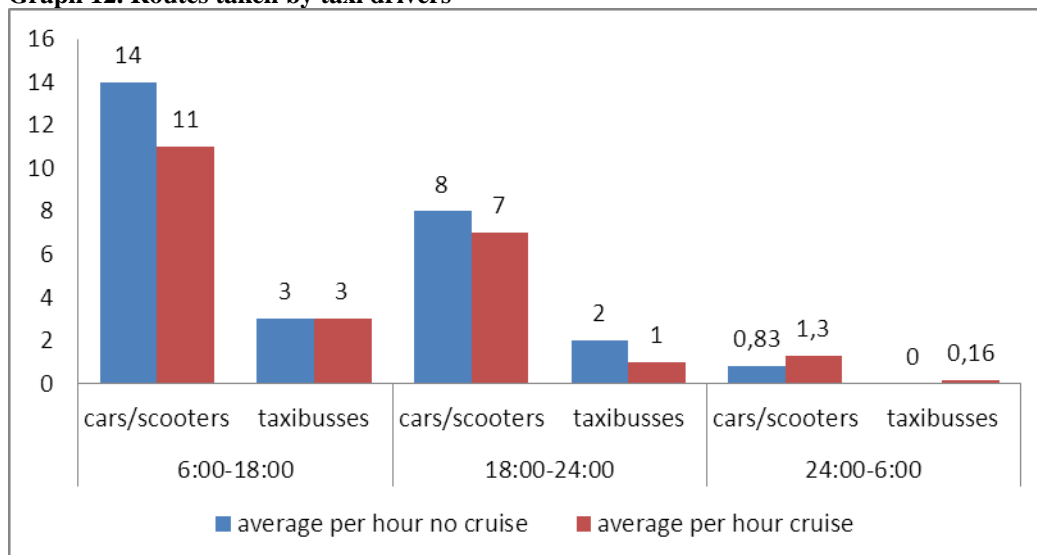
Graph 11 Counted visitors during monitorings in relation to the capacity of the present cruise ships

4.1.6 Results; Traffic

The recreational activities in the lac Bay inevitably lead to traffic moving from and to the bay, and to the Sorobon peninsula in particular because here most recreational activity takes place. One of the roads to Sorobon (Kaminda di Sorobon) leads closely along the mangroves, rendering it plausible for traffic to disturb birdlife in the mangroves. It can be expected that especially on cruise ship days traffic density on this road is much higher. Results from a questionnaire held amongst 15 taxi drivers indicate that the majority of taxi traffic leads along the airport and Belnem (graph 12). This can be confirmed by traffic observations of Geoconsult in 2010 in front of the Kontiki Beach Club. Observations were done for 2 days, one with and one without cruise ship. On 08-03-2011 (no cruise) and on 09-03-2011 (cruise). As can be seen in graph 11, the average number of taxi busses per hour monitored was not higher during the cruise day.



Graph 12. Routes taken by taxi drivers



Graph 13. Results traffic monitoring (Geoconsult 2011)

The traffic monitoring also shows a lower average of cars and scooters on cruise days, whereas a higher number was expected. The found information indicates that cruise tourism does not increase the number of traffic along the mangroves, but for more representative information more monitoring is needed.

4.1.7 Answer to sub question

As expected on the basis of the report by PES the Lac Bay area is indeed very crowded, especially during days on which cruise ship tourists are present. Though it was expected to find most kayakers around the patch reefs in the yellow zone (figure 5, paragraph 3.4.1), most kayakers stay in the blue zone where no patch reefs can be found. During scheduled monitoring's kayakers were also not seen in the white zone and thus not close to the mangrove vegetation. Snorkelling activities were difficult to monitor because snorkelers in the water were hard to distinguish from a long distance. Despite this monitoring difficulty it can still be concluded that the number of snorkelers in the yellow zone is lower than expected since only 4% of the questionnaire respondents mentions he or she visits Lac Bay for snorkelling.

The highest recorded number of windsurfers present in the scheduled survey days was 92. However, numbers reaching this high are uncommon. Most surfers can be seen in the bay from 10:30 hours to 16:30 hours. During these times the means of the number of surfers present range from 17 to 30 with 17 falling in the afternoon at 13:30 hours (Table 4). This might be explained by lunch time around this time of the day. The numbers of surfers present depends on multiple factors, making the number differ per day. Since swimmers/waders are using the same area as windsurfers close to the beach at Sorobon, activities take place close to each other. Although this sometimes seems like a dangerous situation, no accidents were seen or heard of.

As expected a large difference in visitor numbers can be observed during cruise days. The highest number of visitors recorded was 760 individuals. On this day two cruise ships were present at the same time. All cruise recreation and most recreation in general is focussed at Sorobon and in front of the beach bars in particular. Cruise ship tourism at Sorobon is focussed at the Beach Hut. The number of cruise ship tourists not only depends on the cruise ship capacity, but also on the type of cruise ship tourists as was indicated with the Grandeur of the Seas. Cruise tourism does not seem to increase the number of traffic along the mangroves as was indicated by the questionnaire held amongst taxi drivers and traffic monitoring by Geoconsult. More monitoring of traffic is needed for more representative conclusions.

4.2 Is there room for further development in the area, taking social carrying capacity into account?

The recreational and land use survey will give input which can be used for an improved management plan of the Bay which can cope with the increasing user pressure. The results from this research will help IMARES with determining the carrying capacity of Lac Bay. The collected data for this part of the project can be used to determine social carrying capacity, and give input for the total carrying capacity. Other input for the total carrying capacity is gathered in other researches by IMARES, as described in the problem description.

4.2.1 What is (social) carrying capacity?

Carrying capacity refers to a number of individuals that can be supported in an area within natural resource limits, without degrading the natural existing social, cultural and economic environment in the present or future (Carrying Capacity Network, 2001).

The carrying capacity for an area can be altered by improved technologies, or changed for the worse by increased pressures such as population increase. This because if the environment in the area is degraded, it is no longer able to support the number of people who could formerly stay there on a sustainable basis. Result is that the carrying capacity shrunk. It is important not to exceed the carrying capacity, since no population can live beyond the environment's carrying capacity for very long. The area will degrade and can support fewer individuals over time (Carrying Capacity Network, 2001).

The limiting factor in calculating carrying capacity is the area. One thing to determinate the capacity is the ecological footprint left in the area. As said before carrying capacity can be altered by improved technologies, such as improving waste management, economic use of water or the usage of renewable energy, all things to reduce the ecological footprint in the area. Exceeding carrying capacity does have benefits, but for a short term. Example; cutting down forests faster than they grow back results in obtaining a lot of timber, but on a long range there will be no forests left to chop. Not to mention the consequences a serious degree in forest areas will have on ecology (International Environment Forum, 2010).

The social aspect in determining the carrying capacity can be estimated with user opinions. By asking questions directly to visitors one can determine whether people find it too crowded on the beach with the present number of users. Also information on the availability of certain facilities on the beach can be gathered this way. Social carrying capacity is a dynamic aspect based on opinions and can be influenced by factors such as personality, sex or cultural background (De Ruyck, Soares and McLachan, 1997).

4.2.2 Results on social carrying capacity based on questionnaires

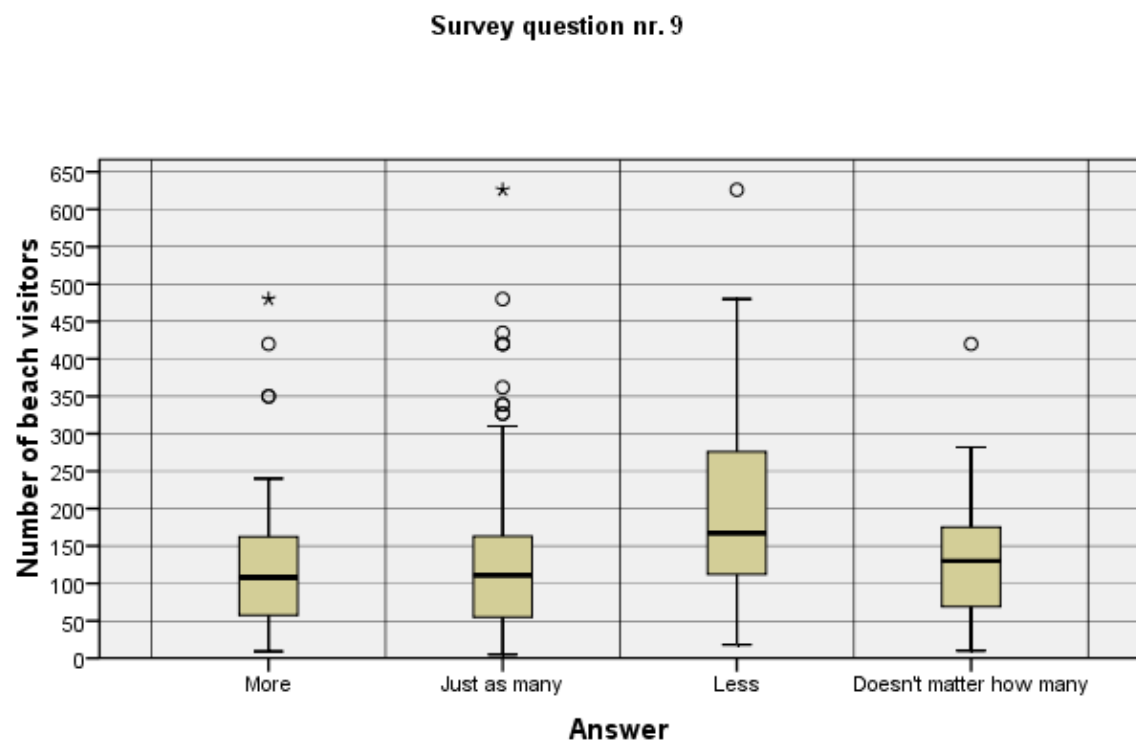
The social carrying capacity at Sorobon beach can be determined by beach visitors crowding perception at different densities. This information was obtained by counting all visitors in Lac Bay and the beach of Sorobon every 1,5 hour on 31 monitoring days and by conducting questionnaires (appendix B) at the same times.

Visitor numbers

One of the questions concerning social carrying capacity was;

“For me to fully enjoy this visit at this moment I would prefer the presence of: *More / Less/ Just as many/ Doesn't matter how many* beach visitors than are present at this time.”

Associating the answers on this question with the counted number of beach visitors on the same time results in the following graph;

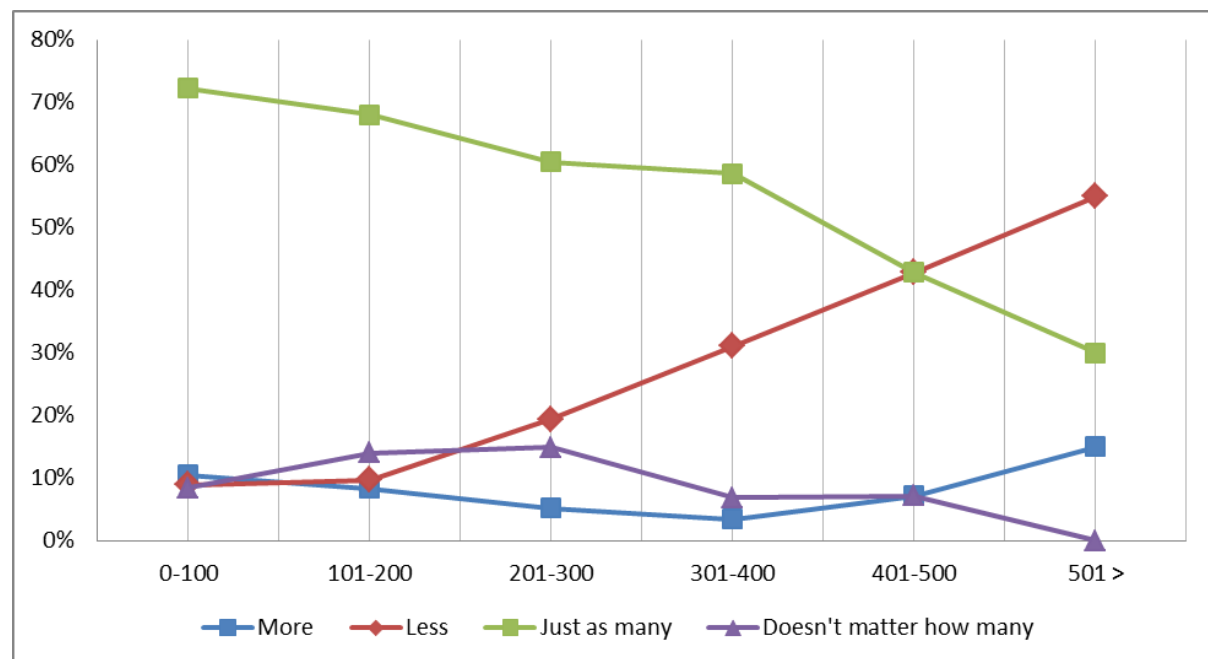


Graph 14 Answer to the question whether people prefer the presence of *More / Just as many / Less / Doesn't matter how many* beach visitors that are present at the moment of questioning.

Table 4 Means of nr. of beach visitors with answers to question 9

		Beach Visitors	
		Mean	Count
Answer	More	127	51
	Less	193	91
	Just as many	121	403
	Doesn't matter how many	129	71

In graph 14, you see that the maximum value of beach visitors, except for outliers and extremes, for respondents to choose the option 'More', is close to 250. The maximum value of beach visitors for respondents to answer 'Just as many' is close to 300. The mean of the number of beach visitors for respondents to answer 'More' (127), is naturally lower than that for them to answer 'Less' (193).

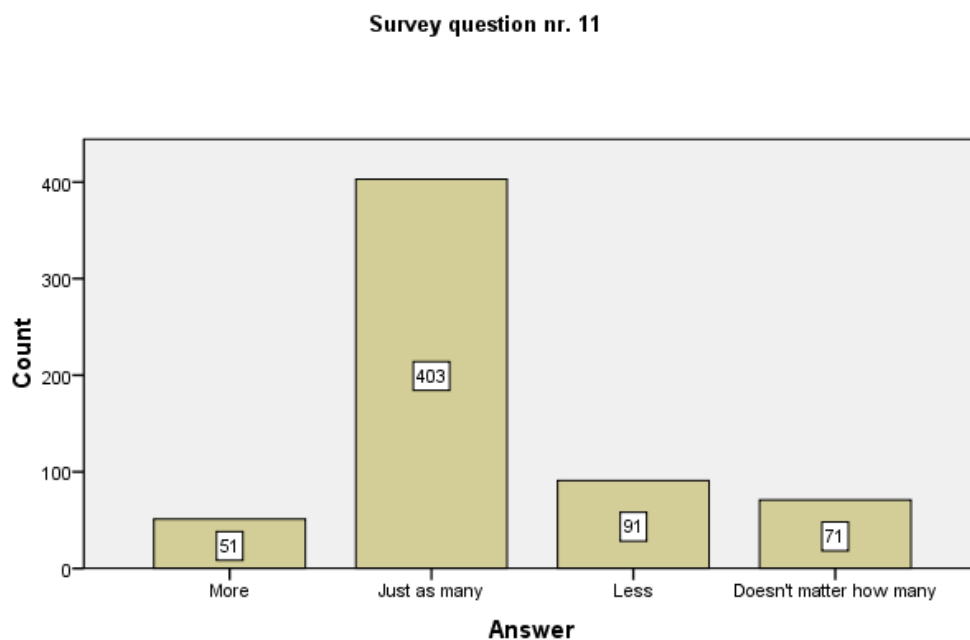


Graph 15 Percentages of answers to question 9 set out to visitor numbers present at that time (exact data on numbers of answers in Appendix D, statistical results of 4.2)

Graph 15 presents the results of question 9 in a different way. Herein the percentages of the answers are set out to the number of beach visitors present at the time of asking. The numbers of beach visitors are placed in classes per 100. In this graph you can see clearly that the line for answers 'Just as many' drops when the visitor number rises, while the line for 'Less' rises. These lines cross at the class of visitors 401-500, after this point a higher percentage of respondents prefer fewer visitors. With the results from graph 14, social carrying capacity for the present kind of visitor and present kind of usage begins to become an issue around 250 beach visitors. Between 401 and 500 visitors a

turnover point is reached beyond which the majority of respondents consider it too busy on the beach for their personal enjoyment.

From the 616 respondents for question 9 in the questionnaire (appendix B), the answers are divided as seen in graph 16. Herein is seen that the majority of respondents give the answer '*Just as many*'. The answer least given is '*More*'. This could be explained by the assumption that people do not want to see Lac Bay overexploited; that the overall number of visitors is ok, but there should not be more people.



Graph 16 Distribution of answers to question 9

Cruise ship remarks

A notable thing that came up while surveying, was that several people mentioned the cruise ship tourism, while this was never mentioned in the questionnaire. People for example answered question 11 with '*Just as many*', with the remark that it is too busy when there is a cruise ship present. As can be seen in table 5, 60 of the 616 respondents mentioned the cruise ships as negative influence on Lac Bay, close to 10%. This was not a regular question of the questionnaire, so no real statistical results can be drawn to this.

		Cruise remark			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	60	9,7	9,7	9,7
	no	556	90,0	90,3	100,0
	Total	616	99,7	100,0	
Missing	System	2	,3		
Total		618	100,0		

Table 5 Cruise ship remark

Facilities numbers

Another aspect in social carrying capacity is whether visitors think facilities are provisioned in adequate amounts. To get results on this matter the next question was included to the questionnaire (question nr. 8, appendix B);

“What is your opinion about the current availability of the following facilities at Lac Bay?

Restaurants and bars: *enough / prefer more / prefer less / no opinion*

Hotels and resorts: *enough / prefer more / prefer less / no opinion*

Shops: *enough / prefer more / prefer less / no opinion*

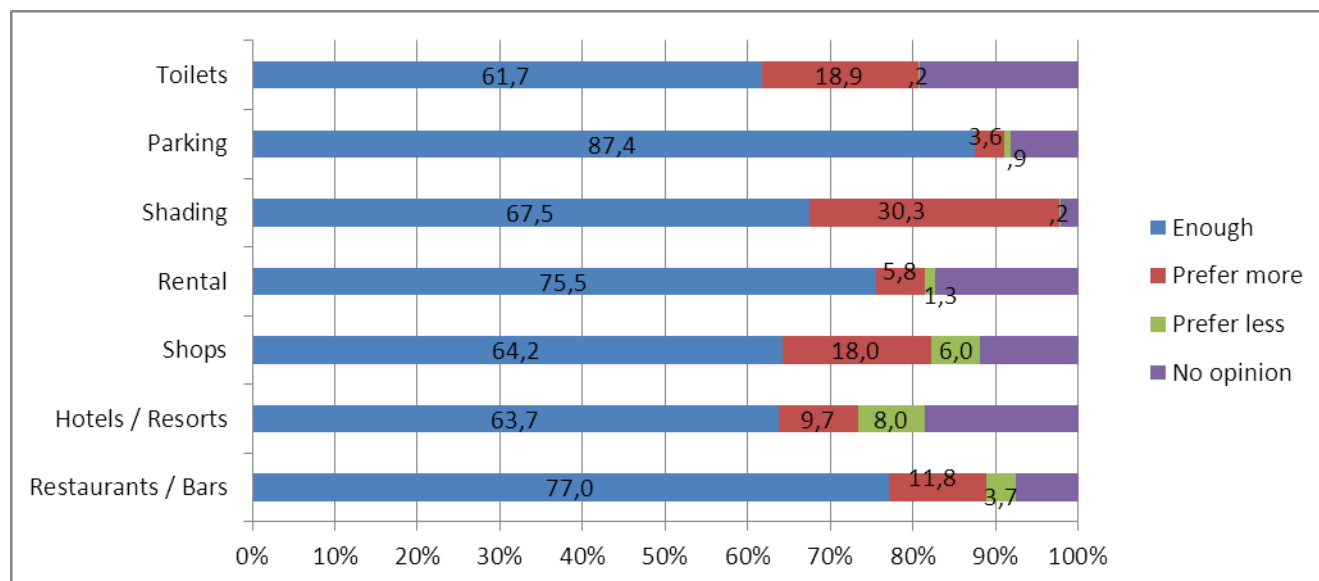
Rental: *enough / prefer more / prefer less / no opinion*

Shading: *enough / prefer more / prefer less / no opinion*

Parking: *enough / prefer more / prefer less / no opinion*

Toilets: *enough / prefer more / prefer less / no opinion*”

Results of this question can be found below in graph 16;



Graph 16 Opinion on current availability of different facilities at Lac Bay

In graph 16 can be seen that the majority of respondents, at least 61,7%, is of the opinion that all facilities are present in sufficient numbers. The three facilities that should be in higher numbers according to the respondents are; shading (30,3%), toilets (18,9%) and shops (18,0%). Herein should be noted that also 6% of the respondents gave the answer that they would like to see less shops, for toilets and shading only 0,2% of the respondents answer they would like to see less of those facilities. Few respondents gave the answer that they would like to see less of some of the facilities, the most given in this is; hotels / resorts (8,0%). The 'no opinion' answers were given mostly by people who according to themselves did not know much about the area, only just arrived or did not use some of these facilities yet. More specified data can be found in Appendix D, Statistical results of chapter 4.2.

What comes to notice looking at the results of this question for different types of visitors (cruise tourist, stay over tourist, local resident of native Bonairian), can be seen in Appendix D, Statistical results of chapter 4.2. Herein is seen that the respondents type 'Native Bonairian', answers less than the other types with 'No opinion', also noticeable is that this type of visitor answers with 'Prefer more', more than the other visitor types. The first of this can be explained by the respondent being a native, knowing the area and for this have an opinion about the facilities. The second might be explained by the respondent visiting the area often enough to miss certain facilities.

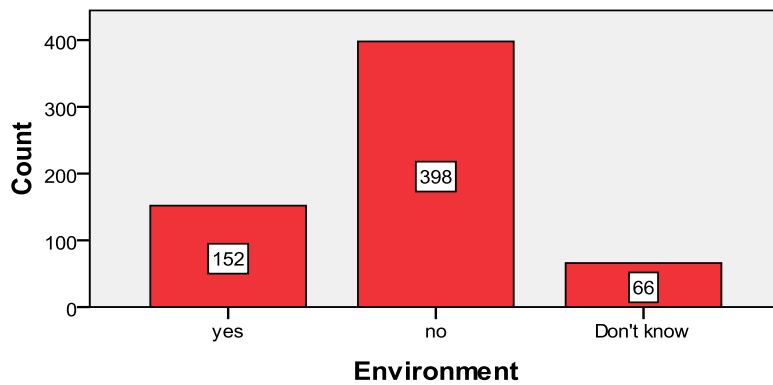
About the cruise tourists can be said they answer of all visitor types the most with 'No opinion', for parking this is even over 63%, which can be explained that most cruise tourist arrive by taxi or tour bus. Another notable thing is that almost 45% answers that they would prefer more shading on the beach. This could be explained by them visiting the place for the first time, and notice such things, while other visitors might get used to it. It may also be associated with the fact that the beach is more crowded when a cruise ship is present, and thus the spots in the shade are taken.

About the stay over tourists and local residents are no striking results seen.

Environmental awareness

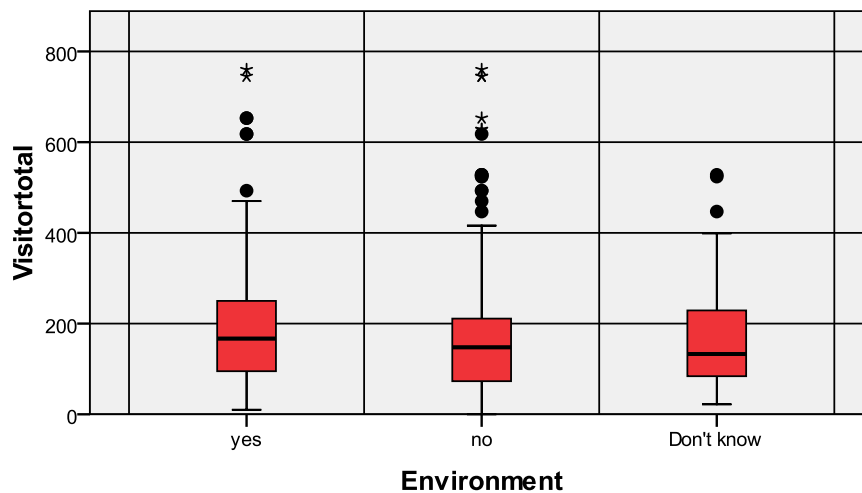
Question 10 of the Lac Bay visitor questionnaire was: 'Do you think tourism in Lac Bay with this number of visitors is a threat to its environment?' And could be answered with: 'Yes / No / Don't know.' It gives a perception of visitors on whether they think recreational use is harmful to Lacs environment in relation with the number of visitors present at the time of asking.

In graph 17 the distribution of the answers given to this question can be seen. The majority (398) answers with 'no'. 66 answers with 'don't know', this answer was given by people who thought they did not have enough knowledge about the area to give an answer to this question, or simply did not have an opinion about it.



Graph 17 Distribution of answers to question 10.

Graph 18 shows boxplots which present information about the answer to this question and the number of visitors counted at the same time. It shows that people give the answer 'yes' with higher visitor numbers (max. 480), explaining they think higher visitor numbers are harmful to the environment. People who answer they do not think the current number of visitors is harmful, stop when the number of visitors reaches over 410. According to this people think the carrying capacity of the area reaches up to 410 visitors, with higher numbers all respondents answer they think this is harmful for the environment, except for outliers and extremes.



Graph 18 Answers to question 10 related to the number of visitors present at the time of asking.

4.2.3 Opinions of interviewed stakeholders

Through interviews with several stakeholders in the area information is gathered about what the opinion is about the current number of entrepreneurs in the area, and whether the area could use more development, more facilities or perhaps less of those.

Maarten de Groot, manager of the Beach Hut, thinks that the current quantity of tourism on Bonaire is enough and should not be extended to further levels. He has a positive opinion about the current

rules in the Lac area about not allowing more constructions. He believes that people visit Lac Bay for the current scenery, developing the area would change this view.

Elly Albers, Mangrove Info & Activity Centre, is against more development in the Lac Bay area. Only this would be an unrealistic aim, since entrepreneurs are always looking for ways to make money. It has to be remembered though, that tourism on Bonaire exists because of the nature, thus this should be maintained.

Harry van den Ouweelen, manager of Sorobon Beach Resort, tells that people visit Lac Bay for the scenery and tranquillity. By developing the area and facilities short term profit can be made, but in the end this will exceed the carrying capacity, destroy the original nature and drive out the tourists who came for this. He thinks that development is possible, but only with the present number of entrepreneurs, they have to develop only their own property and this should be done in line with nature.

Martin and Miriam van Bakkum, owners of Kontiki Beach Club, mention that people visit Lac to enjoy the nature, they often have guests visiting Bonaire multiple times because they love the area so. Development is ok, providing that this is done in an eco-friendly way. Expanding the current number of facilities or entrepreneurs should not be done; the area has reached its maximum. Educational development would be a good idea, information signs and trails through the mangroves or watch towers.

Christine van Dijk, owner of the Jibe City Beach Bar together with Willem van Dijk, is not in favour of more development in the area. She likes the scenery as it is now, and believes that this is what attracts the tourists.

Robert and Monique van Berkel, owners of Jibe City, are realistic about them being entrepreneurs and hereby development of their company is desirable. They try to do this as much as possible in accordance with nature. They say the current number of entrepreneurs in the area is in good balance.

Elvis Martinus, owner of The Windsurf Place, would not like to see more entrepreneurs in the area. He claims that it would be too difficult to make more money out of the area, also the pressure on nature would become too high. In the years developing The Windsurf Place he has always tried to do this as much as possible in line with nature, this should always be done.

4.2.4 Answer to sub question

From the results of the question if people would like to see *more / less / just as many* or *it does not matter how many* beach visitors at the time of questioning, associated with the actual number of beach visitors at that time, it can be concluded that most people answer with 'just as many'. For respondents to choose the option '*More*', the maximum number of beach visitors is close to 250. The number of beach visitors starts overreaching social carrying capacity from about 250; with higher numbers respondents do not answer they would like to see more visitors. From 401-500 beach visitors majority of respondents is of the opinion the social carrying capacity is over reached. The social carrying capacity for Lac Bays Sorobon peninsular lies here for at a maximum of 500 beach visitors, people start to feel uncomfortable with higher numbers than 250.

This value for respondents to answer '*Just as many*' is close to 300. Based on this, it can be concluded that the social carrying capacity based on user opinions, lies around a maximum of 300 beach visitors at the same time on the Sorobon peninsular of Lac Bay.

All facilities are according to the majority (at least 61,7%) of the respondents of the questionnaire in adequate amount, no more or less is necessary. The facilities wherefore respondents answer 'prefer more' in highest amounts are shading (30,3%) and toilets (18,9%). The facilities wherefore respondents answer mostly 'enough' are parking (87,4%) and Restaurants / Bars (77%). Based on this it can be concluded that no more facilities are very necessary, least to be expanded is the parking availability. The one facility to expand would be to offer more shading on the beach, more umbrellas, (palm) trees or huts. Based on the number of facilities the social carrying capacity according to respondents of the questionnaire is at a good balance.

Looking at the results from the question whether people think tourism in Lac Bay is a threat to its environment with the number of visitors at the time of asking, it appears that people think tourism in Lac Bay is harmful when the visitor numbers reach over 410.

The majority of the interviewed stakeholders agree that Lac Bay is an extraordinary habitat, and that tourism exists here for the area and nature as it is now, with this number of facilities, entrepreneurs and visitors. According to the interviewed stakeholders the social carrying capacity is at a good balance at the moment, and should not be exceeded more.

4.3 Is current usage occurring within the rules of the current management plan?

This chapter focuses on how well the current recreational usage of the bay is complying with the applicable regulations from the management plan. Visitors were asked whether they are aware of certain regulations and monitoring has been carried out in order to indicate whether usage is occurring on correct locations in relation to the zoning plan (Figure 5).

4.3.1 Expected findings based on literature

Before starting the survey some findings were already expected based on literature which had already been published about usage of Lac.

Progressive Environmental Solutions. Lac – Implementation of long term monitoring and research plan – Year one.

- *Occasionally wind surfers were observed within the protected areas or non-windsurfing zones, following the zonation published in the Lac Brochure (STINAPA-Bonaire).*
- *The kayakers are able to rent kayaks at Sorobon Beach Resort or one of the windsurf centres and kayak without a guide through the bay towards the mangroves and the reef, something that should be supervised.*
- *Kayaking within the mangroves is allowed only with a registered guide. This, however; becomes increasingly difficult to control as more people visit Lac.*
- *Novice windsurfers who don't realize their proximity to the dam, have broken fins while crossing over the corals.*
- *Paths have been made through the beds to Awu Blanku by removing the plants in the areas of Sorobon Beach Resort, Jibe City and Bonaire Windsurf Place. Although sandy paths are available, people can be seen on a daily basis, walking, playing in or windsurfing over the remaining beds.*

Assessment of Ramsar site Lac Bonaire. Adolphe Debrot, Erik Meesters, Diana Slijkman. June 2010

- *Sea grass coverage appears to have largely decreased in the bay, including near shore areas where trampling is a major problem*

Lac Buoy Placement Project Progress Report # 1. For the period November 2008 – December 2009 Carina Kalke , Kris Kats, Mabel Nava, Marlene Robinson. April 2010

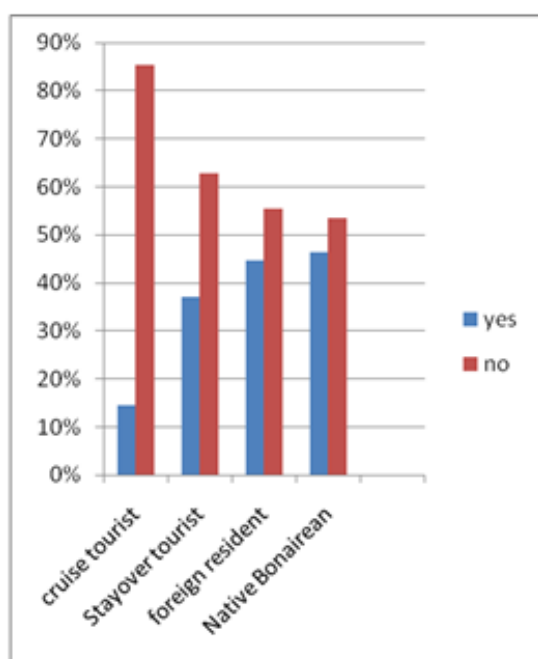
- *Sea grasses at Lac's Sorobon peninsula were undergoing a significantly rapid decline in size and density. The on-going damage was an apparent result of trampling by waders and windsurfers as recreational use of Lac began a steep increase*

4.3.2 Statistical results

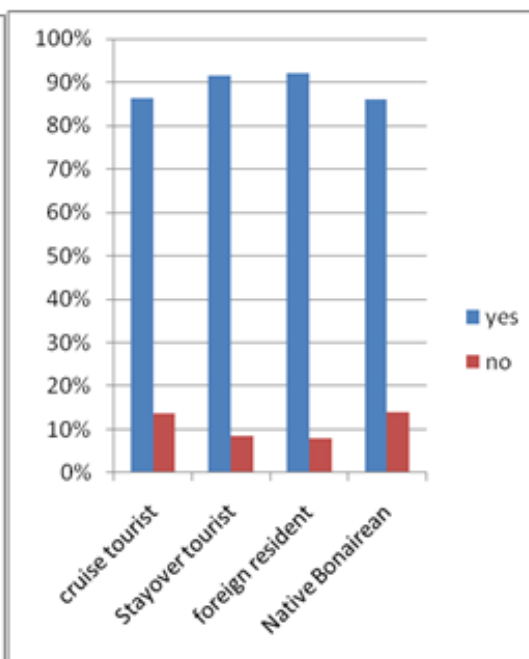
During the scheduled monitoring's the location on which particular activities occurred have been recorded. This can give an indication of how well regulations on restricted areas are functioning. During the questionnaire visitors were also asked whether they are aware of the zoning plan (Figure 5.) and whether they are aware that they are not allowed to cross the sea grass lines or not.

Awareness of regulations

Graph 19 shows up to what extend different visitor types are aware of the zoningplan in Lac Bay. As could be expected, cruise tourists know the least about the zoning plan. Only 15% of these respondents is aware of the zoningplan. This can be explained by the short time they spent on Bonaire and Lac in particular. Visitors who stay on Bonaire for a longer time are more aware of the zoning plan. 37% of the stayover tourists answers that they know about the zoning plan. Out of the foreign residents 45% and out of the native Bonaireans 47% answers they know about the zoning plan. Though a higher percentage can be found amongst residents, still more than half of the respondents is unaware of the fact that a zoning plan is present in the area. A chi-square tests shows that a significant association can be found between the types of visitors and awareness of visitors.



Graph 19. Awareness of the zoning plan amongst different visitor types



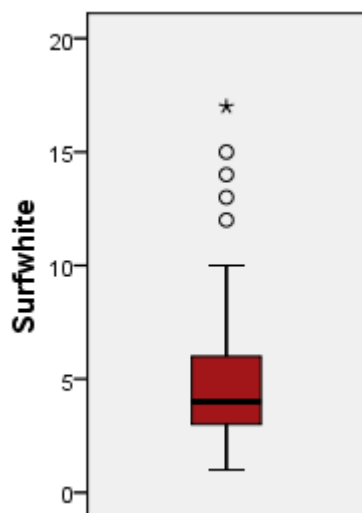
Graph 20. Awareness of sea grass lines amongst different visitor types

Graph 20 shows that the majority of the visitors is aware that they are not supposed to cross the sea grass lines. No large differences can be found amongst different visitor types. Overall 91,2% of the respondents answered that they know that they should not cross the seagrass lines. With a chi square-test, no significant association could be found between types of visitors and awareness of the sea grass lines. Applicable tables can be found in Appendix E.

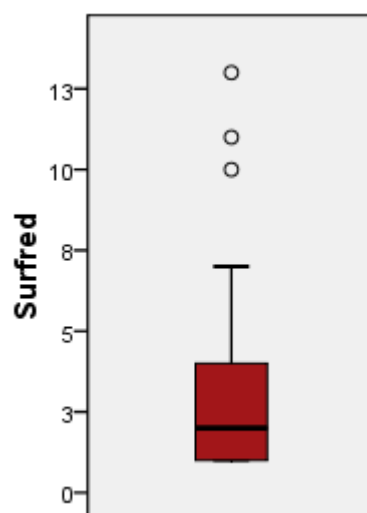
Windsurfing

As can be seen in graph 5, the vast majority of the surfers is staying in its designated blue zone. Specifications on the zonation of the bay can be found in paragraph 3.4.1, figure 5. A relatively small number of surfers can be found in the white zone. Experienced surfers often mentioned that they prefer going to the white zone because the conditions for freestyle windsurfing are good, the water is flat due to the sea grass beds and it is less crowded. The majority of the surfers in Lac are beginners or people following lessons, which explains why most surfers stay in blue. Also, in order to reach the white area, deep water has to be crossed at the edge of the blue zone. While people are able to stand in the rest of the blue area. This also might explain why people do not enter the white zone. Only two windsurfers were seen in the yellow zone during the scheduled monitoring's. During overall observations sightings of surfers in the yellow zone, where the coral dam can be found, are also highly uncommon. People renting their equipment are generally instructed where it is unsafe to surf, herein the coral dam is also included.

The number of surfers in the white zone range from 1 to 17 individuals. However, sightings of more than 10 surfers in the white zone present at one time are rare (graph 21). In the red zone the number ranges from 1 to 13, but here sightings above 7 are rare (graph 22). Cases in which no surfers were present were not selected.



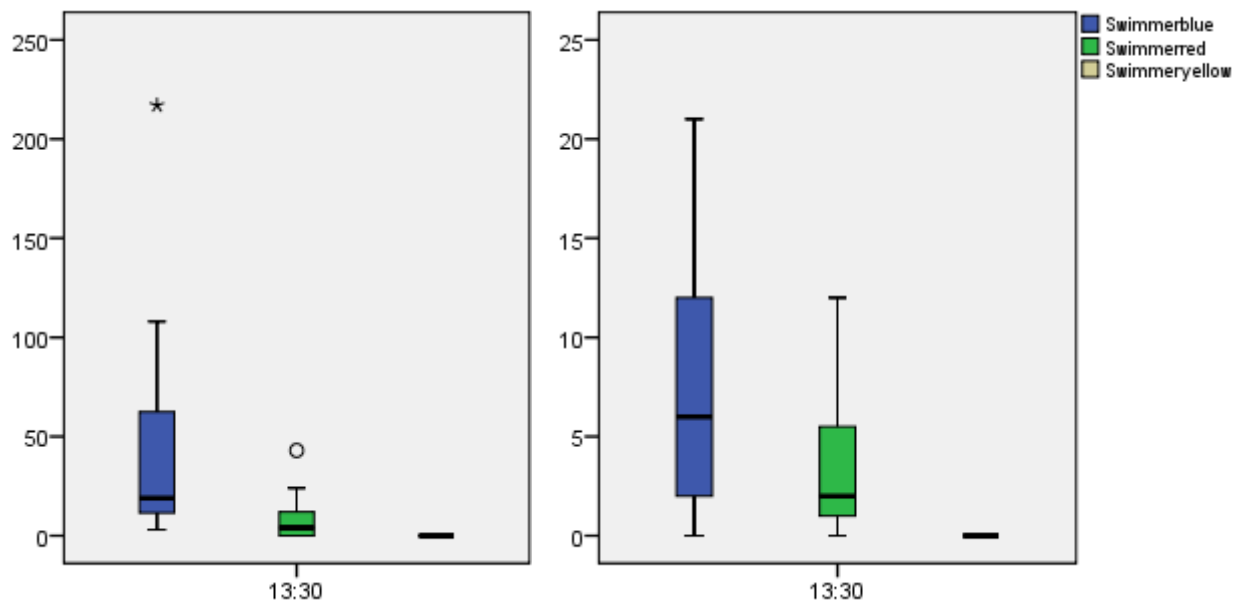
Graph 21. surfers in white



Graph 22. Surfers in red

Swimming/wading

In graph 23 and 24 can be seen in which zone swimming and wading activity is taking place on both cruise and non-cruise days. Specifications of the zonation of the bay can be found in paragraph 3.4.1, figure 5. In this case all monitoring's of 13:30 hours are taken into account. As can be seen in graph 6, this time generally shows the highest number of swimmers on the day, with a mean of 6 on non-cruise week days, 17 on non-cruise weekends and a mean of 65 on cruise days. In order to ensure representativeness, monitoring's during holidays have been left out due to the organization of several activities on the beach on these dates. In the graph can be seen that both on cruise and non-cruise days the majority of swimming and wading activity can be observed in the blue zone. Though more precise locations within this zone were not recorded it can be concluded on the basis of long term observations that this activity mostly takes place close to the beach, mainly in front of the two beach bars. Especially on cruise days tourists tend to wade further away from the beach, causing them to hinder the windsurfers present at that moment. Although this might seem dangerous, no accidents were recorded and conversations with returning visitors indicate that no serious incidents have occurred so far. The blue zone is not a designated swimming zone like the red zone, but swimming and wading activities here cannot be avoided because no other suitable location is available.



Graph 23 and 24 Swim/wading locations on cruise (left) and non-cruise (right) days 13:30.

Up to what extent the large numbers of cruise ship visitors are contributing to the number of people present in the yellow zone, in which the coral dam can be found (3.4.1) remains unclear when looking at the dataset. Almost no swimmers/waders were seen in the yellow zone during scheduled monitoring's, although this has occasionally been seen on other moments. It can be concluded that the number of people swimming/wading in the yellow zone is very low, just as the number of snorkelers and kayakers. Visitors seem to rather not swim/wade to the reef due to the long distance. Visitors also generally go bare foot and would risk encountering sea urchins and sharp coral rubble. The yellow zone is not a designated swimming/wading area.

Sea grass trampling

Over the 31 monitoring days a total number of 37 individuals have been seen walking across the sea grass at 16 separate monitoring's. With a chi square has been concluded that no significant relation between the total number of visitors and the number of people walking on the sea grass can be found on the basis of this data. Overall observations do indicate that the number of people walking across the sea grass remains low or non-existent during high visitor numbers. As mentioned, 91,2% of the questionnaire respondents knows they are not supposed to cross the sea grass lines. A large number of the recorded trampling occurs by visitors who wish to go from the Sorobon Beach resort to Jibe City. Because a fence is placed between these businesses visitors often walk around it through the sea grass. A door will be placed in the fence in order to prevent this from happening in the future. Sometimes kayakers can also be seen in the sea grass beds, but this seems to be uncommon since only 3 kayakers were seen in the sea grass during the monitoring's. The number of trampling sightings and overall observations in comparison with information from the studied literature about trampling in previous years indicates a decrease of trampling activity. In 2010 Sea Turtle Conservation Bonaire carried out monitoring's of sea grass trampling in which they found the following;

During 40 hours and 39 minutes of survey, we observed 134 windsurfers going inside the sea grass beds, 92 people crossing them, 18 people swimming snorkelling or resting inside the beds and even one member of the windsurfing business staff kayaking inside the sea grass beds (Kalke, 2010).

These 40 hours and 39 minutes were unequally divided over 11 days spread out over the dates 25/02/10 to 06/04/10. During the monitoring's in 2011 no visitors were seen windsurfing, resting or snorkelling in the sea grass beds. Hereby it should be noted that STCB used on-going monitoring of sea grass trampling over time, whereas the method of this research involved consistently writing down all activities happening only at a given time every 1.5 hours.



Figure 8 Cruise ship tourists walking around the sea grass (Wentink, 2011)

Kayaking

Graph 5 shows on which locations kayaking activity has been observed. Kayaking in Lac Bay has only been recorded in the yellow and blue zone during the scheduled monitoring's. Also during overall observations no kayakers have been seen in zones other than blue and yellow where kayaking is allowed according to the zoning plan. No kayakers have been seen close to the mangroves since these lie adjacent to the white zone where no kayaks have been spotted. Overall observations indicate that most kayakers are children who tend to stay closer to the beach. As mentioned, three kayakers were seen on the sea grass beds. Kayak tours taking place in the green zone were not included in the monitorings, because those were not visible from the Sorobon peninsula. Based on this information it can be concluded that kayaking is occurring in accordance with the zoning plan.

4.3.3 Answer to sub question

As was expected on the basis of the used literature, occasionally windsurfers were seen in designated non surfing zones. Specifications of the zonation of the bay can be found in paragraph 3.4.1, figure 5. Precise locations in these zones were not recorded but overall observations show that many of the surfers in the white zone can be found close to the mangroves. During the scheduled monitoring's no kayakers were seen in the white zone, nor close to the mangroves. Occasionally kayakers can be seen on the barrier reef, but the majority of the kayaking activity can be seen in the blue zone, mostly close to the beach at Sorobon. It can be concluded that windsurfing occurring in the yellow zone, where the coral dam can be found, is uncommon. Windsurfers are instructed where it is dangerous to go when equipment is rented to them. Anecdotal stories do however indicate that incidents with collisions between windsurfers and the patch reefs have occurred. Proper indication of where the yellow zone starts could prevent this from happening in the future. Most swimming and wading activity takes place in the blue zone along the beach, and at the beach bars in particular. Although this is not a designated zone for swimming this activity can and should not be avoided since there is no other proper location. The amount of visitors trampling the sea grass has turned out to be surprisingly low. A large part of the recorded trampling occurred around the fence between SBR and Jibe City. Here a door will be constructed which will stop trampling in the future on this particular location. Comparison of the found data with literature from PES indicates a change for the better.

4.4 Anthropogenic threats caused by the current use of Lac Bay

The wide range of different (recreational) activities are potentially hazardous factors which can put pressure on the environment through disturbance, trampling and pollution.

In 2007 the foundation Progressive Environmental Solutions published its findings after monitoring the Lac Bay for several years. The chapter about socio economic activities in the bay, along with other literature has been a major foundation for the expected findings about several activities, along with a publication from IMARES in which Lac Bay is assessed.

Kris Kats, Progressive Environmental Solutions. Lac – Implementation of long term monitoring and research plan – Year one (2007)

- *Although most wind surfers are surfing within the Awa Blanku area and although there have been restricted areas designated in the bay, some surfers surf outside of the designated areas. As the popularity of windsurfing in the waves is increasing, greater numbers of windsurfers are passing through the channel at Cai to sail on the other side of the reef. This has and will continue to lead to greater incidence of contact with the barrier reef.*
- *In the Awa Blanku area people go snorkelling around the patch reefs. Permits have been given to one company to conduct group snorkels to the barrier reef area and at least 3 dive operations offer dives near this area.*
- *Tourists bring their own equipment or rent their mask and snorkel at the businesses at Sorobon and can be seen at times crossing the reef by foot*
- *In times when the water is especially shallow, people can be seen walking on and over the coral dam. Kayakers often attempt to cross the dam in an effort to reach the dive/snorkel site “White Hole”*
- *Kayakers often attempt to cross the dam in an effort to reach the dive/snorkel site “White Hole” but again scrape kayaks and paddles against the corals as they cross, or in shallow times, end up dragging kayaks across the dam.*

Assessment of Ramsar site Lac Bonaire. June 2010. Adolphe Debrot, Erik Meesters, Diana Slijkman.

- *With the increasing number of cruise ship visitors to the area has come an increasing number of people snorkelling, wading and kayaking at the barrier reef. With increased usage, increased damage should be anticipated. It may be necessary to restrict the use of this area for commercial purposes.*

4.4.1 Anthropogenic threats to the coral dam

Recreational use of the bay can pose threats to the coral dam through physical impacts, eutrophication and pollutants. All are described in the paragraphs below.

Anthropogenic physical impacts on the coral dam

As mentioned in chapter 4.1 monitoring snorkelling activities around the patch reefs, the yellow zone (3.4.1), has turned out being particularly difficult. Snorkelers are hard to spot at long distances, since they are almost completely submerged. A total number of 39 people snorkelling in the yellow zone has been recorded on the 31 monitoring days. Despite monitoring difficulties it can be concluded that the number of people snorkelling in the area is relatively low since only 4% of the questionnaire respondents mentions he or she visits Lac for the purpose of snorkelling. The water around the patch reefs can be particularly turbulent and shallow, making it likely that novice snorkelers who do go to this area get into physical contact with the corals. How much physical contact between snorkelers and the coral patches actually occurs is unknown but it can be assumed that this is uncommon since people do not go here very often. Occasionally the snorkelers can be seen standing up or wading across the coral dam. It should be noted that this does not necessarily mean that these individuals are trampling coral because a large part of the dam is covered with coral rubble or sand, where no harm is done when people walk over it.

Occasionally fisher anglers can be seen on the barrier reef around Punta Mewchi (Appendix A). It is unclear up to what extent they actually trample coral, for the same reason as the snorkelers walking in the area.

As mentioned in chapter 4.1, only 2 windsurfers were spotted in the yellow zone, both at the same occasion. Overall observations also indicate that the presence of windsurfers in the yellow zone is highly uncommon. Windsurfers are instructed where it is dangerous to go when they are renting equipment. Herein the coral dam is also included. Statements by PES and anecdotal stories do indicate that collisions between surfers and the reef patches have occurred. No windsurfers were seen attempting to cross the barrier reef during monitoring's nor during general observations.

As can be seen in graph 5, 9% of the total number of kayakers was seen in the yellow zone where the coral patches can be found. Physical contact between these kayakers and the reef is plausible but it was not possible to monitor such events.

Eutrophication and the coral dam

Recent research at Lac Bay (Slijkerman, et al, 2011) shows that the ecosystem is under stress of eutrophication (Slijkerman et al., 2011). The research concludes that apart from other factors human use of the bay can be one of the contributors to this stress through improper grey-water disposal and lacking of proper sewage from docks, beaches, restaurants and resorts. Nutrient poor waters are a requirement for healthy coral reefs. When an increase of nutrients takes place, this results in increases of algae because algal growth is a direct response to nutrient uptake (Smayda, 1990). The nutrient levels in Lac Bay exceed the threshold levels for open coral reef systems. Near Sorobon (fecal) bacteria levels are exceeding bathing water standards, which might also originate from human sources. Interviews with entrepreneurs show that many of the used septic tanks are of old

age. Some are leaking and need to be replaced or repaired. Nutrient rich grey water is often used for watering the plants, subsequently causing nutrients to end up in the ecosystem. An expansive bloom of calcareous has been determined, which is capable of overgrowing other organisms, including corals. Moreover, this bloom is affecting the structural integrity of the reef crest, which is being degraded by boring organisms. These are associated with the algae, and are eroding the reef structure. Degradation of the reef can cause it to lose the protective role it plays as a barrier between the open sea and the semi enclosed Lac Bay (Slijkerman et al.,2011).

Sunscreen and the coral dam

The many tourists entering the water, especially during cruise days, might have an anthropogenic impact on the coral dam through the usage of sunscreen. Research by Danovaro et al., (2008) shows that usage of sunscreen in areas with coral reefs can lead to coral bleaching. Results in this research indicate that sunscreens have a rapid effect on hard corals and cause bleaching by damaging the symbiotic zooxanthellae. It is estimated that, on average, about 25% of the sunscreen ingredients applied to the skin are released into the water over the course of a 20 minute submersion. It is estimated that up to 10% of the world's coral reefs are threatened by sunscreen-induced bleaching. The impact of sunscreens can be expected to be crucial at coastal reefs with low water renewal and strong tourist vocation. In Lac Bay water circulation is restricted (Slijkerman et al.,2011) and on days with cruise tourism hundreds of tourists can be seen swimming and wading through the water while having sunscreen applied to the skin.

4.4.2 Anthropogenic disturbance in the mangroves

Two businesses organize guided tours through the mangroves; The Mangrove Info and Activity Centre and Outdoor Bonaire. The kayak groups are always accompanied by a certified guide, and regulations seem to be generally followed (PES, 2007). Despite the fact that these tours are legal, they cause detrimental effects to the mangrove environment. The tours lead through areas with foraging, resting and breeding birds. Heron populations are vulnerable to disturbance because the mangroves are their breeding habitat. Breeding herons can be scared off their nest leaving behind their eggs exposed(Figure 9) When the egg is exposed for more than 15 minutes it will not hatch (Debrot, 2011). During participation in one of the mangrove tours 5 herons were seen flying off as the kayaks approached. The owner of the Mangrove Kayak and Info Centre stated that she estimates an average of 10 kayakers per day on a yearly basis. These kayakers can only found in a small part of the total area of mangrove vegetation in accordance with the zoning plan.



Figure 9. Heron egg exposed. Debrot 2011

As mentioned in 4.3.2. the vast majority of the windsurfers can be found in the blue zone. Only 7% of the surfers were spotted in the white zone (graph 5). These surfers generally move back and forth across the water, often in close proximity of the mangroves. This could lead to disturbance of birdlife.

The increasing user pressure at Lac Bay causes the traffic intensity around the bay to increase. The current intensity is unknown, but it can be assumed that it is busier in the high season. Some information on traffic intensity has been presented in 4.1.6. Traffic around Lac is focussed on the

Kaminda di Sorobon, a road which leads close to the mangroves. High traffic intensities might lead to disturbance of birdlife and road kills.

According to the Lac Bay Management plan no activity is permitted in the mangroves situated in the white zone. In this case traditional fishing activities are excluded. In the bay, 19 fishermen can be found fishing in and around the mangroves on a regular basis, according to a local fisherman at Mangel Altu (Appendix A) Another fishermen at Cai claimed that at the Cai peninsula alone around 30 fishermen can be found. According to mr. R. De Leon, manager of the STINAPA Bonaire marine park it is difficult to exactly tell how many fishermen are present in the bay since many Bonaireans tend to see themselves as fishermen although they do not fish on a regular basis. The fishermen often launch and dock their small boats in the mangroves along the Kaminda di Sorobon. These fishermen move through the mangroves in order to reach open water and at times also fish within the mangroves. This activity results into disturbance of present birdlife. Two fishermen mentioned that they mainly fish on mangrove snappers, jack fish and barracuda.

4.4.3 Anthropogenic disturbance of sea turtles

Occasionally windsurfers experience an encounter with sea turtles in the Lac Bay. Lac Bay with its sea grasses is an important habitat for the Green Turtle (*Chelonia mydas*) and the Hawksbill Turtle (*Eretmochelys imbricata*)

Windsurfers who had already been on the water at the moment when their questionnaire was conducted were asked whether or not they had seen any sea turtles that day. It turns out that out of 121 respondents, 15 had seen one or more sea turtles (14%). Observations of sea turtles surfacing for air by STCB indicate that most sea turtles can be found on the locations indicated in white in figure 10. These white boxes indicate netting locations for research purposes which have been placed at these locations due to the higher abundance. The area around which many nets were situated is generally too far upwind for windsurfers to go to. Some respondents mentioned that they often see turtles near Kontiki Beach Club when they are surfing in the white zone (figure 5). Encounters between windsurfers and sea turtles can result in disturbance of foraging and resting behaviour.

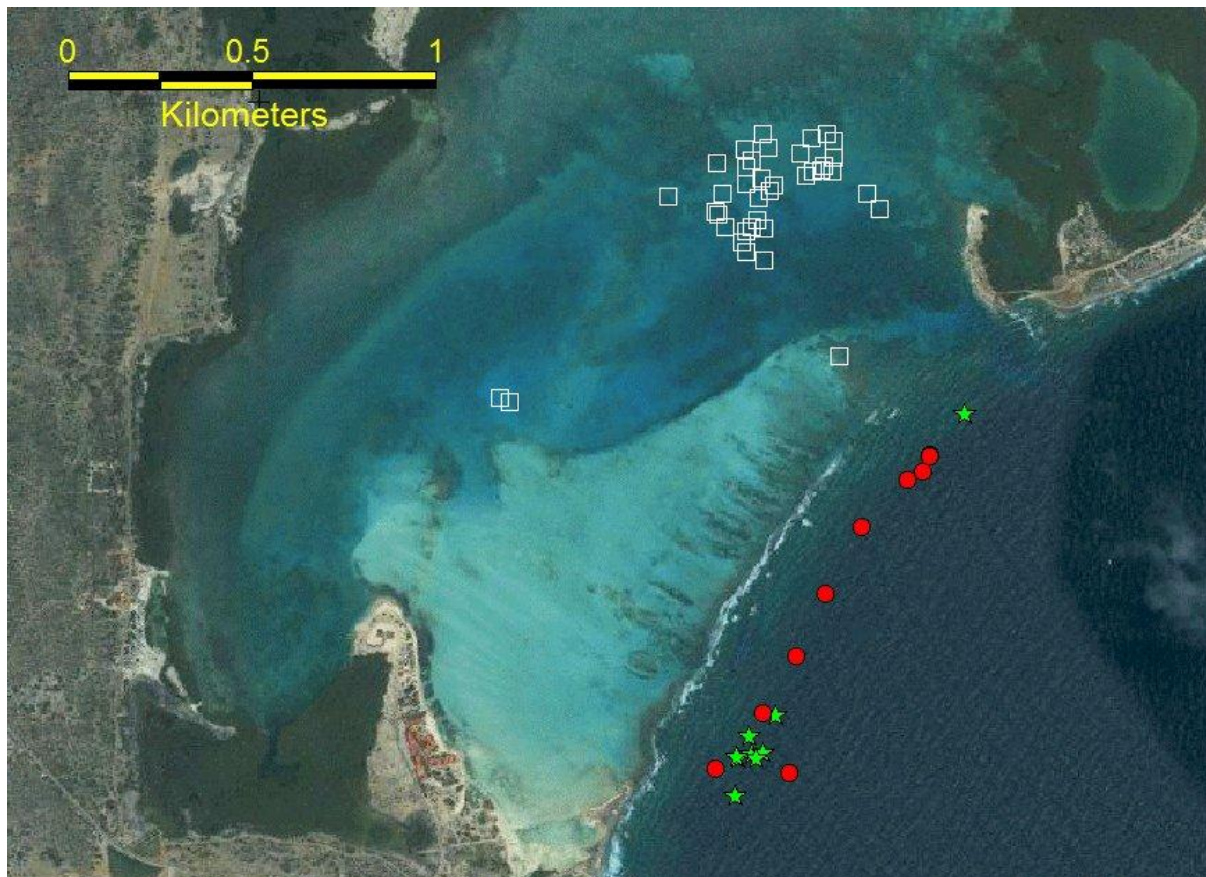


Figure 10. Netting locations inside Lac Bay (white boxes), and locations of hand-captured green turtles (green stars) and hawksbills (red circles) on the reefs outside Lac Bay. (STCB, 2007)

Anecdotal stories from several windsurfers indicate that collisions between windsurfers and sea turtles have occurred in which fins of the surfboard were broken. These collisions however seem to be rare, most people answer the turtles are very fast and notice the surfers soon and move away from them.

It should be noted that despite these disturbances the sea turtles in Lac Bay seem to be flourishing. Behind the coral dam a relatively high number of these animals can be found due to the foraging opportunities in the bay. In Appendix E, Statistical results of chapter 4.5, can be seen that particularly the number of Green Turtles has been increasing during the last years. From 2008 to 2009 an increase of Hawksbill could also be observed (Kalke, 2009).

4.4.4 Sea grass trampling

Sea grass beds and in particular turtle grass, *Thalassia testudinum* Is an important food source for the green turtle. Sea grass also gives shelter for young fish and helps to stabilize sediments (Debrot, 2011). Engel (2008) concludes that sea grass coverage appears to have largely decreased in Lac Bay. Herein near shore areas such as Sorobon are included where trampling is a major problem (Giardini 2008) Comparison of this literature and findings of STCB in 2010 (Kalke, 2010) with the findings presented in this report indicate a decrease of sea grass trampling as was mentioned in 4.4.2. This can lead to the recovery of these beds in the future, but expansion of the beds is unlikely due to the amount of anthropogenic activity around the beds, where activity is not restricted.

4.4.5 Answer to sub question

Activity on the coral dam has been lower than was initially expected. No windsurfers have been seen attempting to cross the coral dam, of which also no anecdotal stories have been heard. Occasionally kayakers and snorkelers can be seen on the coral dam. Although these numbers have turned out to be low, damage could be done to the corals due to the turbulent water in the area and peddles touching the coral patches. Wading activity did not occur on the coral dam during the monitoring, although during overall observations this has occasionally been seen. Sometimes a few fisher anglers at Punta Mewchi (Appendix A) can be seen, possibly disturbing the benthic community at this location. Proper indication of the yellow zone and its regulations could increase awareness and limit detrimental effects. In this case it should be noted that not all wading activity on the coral dam implies coral trampling activity since the coral can be found in individual patches surrounded by rubble and sand. Almost no windsurfing activity was observed on the coral dam. However, anecdotal stories and literature do indicate that collisions between surfers and coral patches have occurred. In order to obtain a more accurate image of anthropogenic physical threats on the coral dam, more research is needed. Recent research shows that the coral dam and the Lac Bay ecosystem in general are under stress of eutrophication which partially originates from human sources. This has led to an algal bloom which subsequently can lead to degradation of the coral dam.

Several activities in or in close proximity to the mangroves have been identified. Windsurfers can be seen in the white zone (3.4.1) throughout the day, often close to the mangroves, which could lead to disturbance of birdlife. Traffic along the road Kaminda di Sorobon also leads in close proximity to the mangroves. This could also lead to disturbance, but in order to draw conclusions on this matter more research is needed. Mangrove tours lead to disturbance as well as was seen during participation in one of the mangrove tours. Fisherman move through and around the mangroves which causes disturbance as well.

Disturbance of sea turtles is frequenting in the bay due to windsurfing activity. It is assumed that at sightings of sea turtles leads to disturbance of foraging and resting behaviour. Anecdotal stories also indicate that collisions between windsurfers and sea turtles have occurred. It should be noted that despite these anthropogenic disturbances sea turtles can be found in the bay in increasing numbers over the past years (Kalke, 2009).

Comparisons of used literature with the monitoring results indicate a decrease of sea grass trampling activity.

4.5 Food for thought; Opinions of users about the current management in Lac Bay

Multiple stakeholders were asked about their opinion on the current management of lac Bay. Points of improvement and new ideas were brought forward. This information was collected during conversations, interviews, questionnaires and during a discussion round between different stakeholders at Sorobon Beach Resort. In various conversations held with STINAPA it came forward that they welcome changes in the management plan, as long as they are (cost) effective and do not require more manpower than necessary.

4.5.1 Opinions of multiple entrepreneurs about current management by STINAPA

Various interviews and conversations have been held with entrepreneurs in the Lac Bay. Their opinions on how the bay is currently managed were also brought forward. Their general thoughts are outlined in this paragraph. Interviewed stakeholders were owners or managers of the following businesses:

- The Beach Hut
- Mangrove Info & Activity Centre
- Sorobon Beach Resort (SBR)
- Kontiki Beach Club
- Jibe City Beachbar
- Jibe City
- The Windsurf Place

Several stakeholders have stated that in general, STINAPA is adequately present in the Lac Bay area. At Sorobon the rangers are responsible for checking whether the visitors are in the possession of a Nature Fee tag. It was stated that next to this responsibility, their presence at Sorobon also puts them in an ideal position to limit sea grass trampling and enforce other regulations. It has also come to notice that some entrepreneurs would like to be more able to increase awareness about the Lac Bay and its regulations. When doing so they would consider it helpful if STINAPA could assist them by supplying them with tools, such as extra brochures and information signs. The two beach bars at Sorobon already have information signs, but perhaps some extra at strategically chosen locations would be an improvement. Information signs at the entrance of the bars would be visible for all visitors.

Some stakeholders expressed their concerns about illegal activities in the bay such as sand mining and poaching. They notice these activities mainly take place during the night when no authorities are present. Therefore they stress that enforcement during the night would be desirable, although they understand that this would be an expensive operation.

4.5.2 Remarks given by respondents of the Lac Bay visitor questionnaire.

During surveying, some remarks were made by respondents about the area. Several remarks given are related to litter. It was stated by several respondents that too much litter can be found in the pier area which is left behind by people who spend the day on this location. This could be caused by a lack of education or awareness, or the lack of trashcans. Other remarks relating to the pier area are the public toilets, which are poorly maintained and dirty. Some Bonaireans also stated that the pier is rotting and should be replaced. Some respondents were worried about the environment of Lac Bay. They have been visiting Lac Bay several years and according to them the amount of seagrass is decreasing.

Many questionnaire respondents had remarks about the cruise tourism in the area. When investigating crowding perceptions many answered that the current number was satisfactory, but that they do not like the number of visitors during cruise days. Remarks about cruise tourists were also given when respondents were asked whether tourism at Lac is harmful to its environment or not. In total almost 10% of all questionnaire respondents had a negative remark about cruise tourism, even though this topic was not specifically mentioned in the questionnaire.

4.5.3 Opinions of stakeholders about various discussion points given at the meeting

On the third of May 2011, a presentation was given about the data collection and its preliminary results. Attendees were persons who were interviewed, who helped collecting data or who were in any other way interested in the research. After the presentation several discussion points were raised about Lac Bay. These points included ideas about how Lac Bay could be managed in the future, and how management could cope with current bottlenecks. The minutes of this discussion can be found in Appendix I. In this paragraph comments of this discussion concerning this chapter are described.

Environmental awareness amongst visitors should be improved. Everybody present seems to be in favour of this idea. Businesses in the area could make a huge difference in awareness creation because they are in direct contact with tourists, and an immediate change will be noticeable. Once you have explained tourists about the special natural values of Lac they immediately are more careful and appreciate their time here more. The focus should not only lie on environmental awareness, but on cultural awareness as well.

Sorobon needs a visitor centre. People have positive reactions about the idea because people should get the feeling they enter a special area, like an entrance or striking entrance sign. Also an information centre is a good idea to follow up on the first discussion point, improving awareness.

Without nature fee a compulsory entrance fee. The idea would be to have an entrance for Lac Bay, where visitors show their nature fee tag. Visitors who have a tag can drive through straight. Visitors who do not have a Nature Fee can buy one at the entrance, or they could buy a Lac Bay entrance fee. The general thought on this discussion point is: why is the Nature Fee not being charged at the airport customs? This way you reach all the visitors to Bonaire, except for the cruise tourists.

Disadvantage about this is that it could be too general, and it would not help creating awareness for Lac Bay.

There should be a maximum number of visitors allowed access to the area at a time. This would have to be corresponding with the carrying capacity. Most people disagree with this idea, locals should always be allowed to visit at will, and you could create a lot of competition with this. Taxi drivers rushing to the area to get their clients in before the entrance close. Better would be to have more areas where over which tourists can be distributed, more beaches or activities on Bonaire could be a solution.

What to do with the pier area? People mention that there is too much litter lying around this area, also around the parking lot. The pier area is a place which is primarily being used by local Bonaireans and some find it important to maintain this value in future plans for this specific area. Because there are no businesses adjacent to this part of the beach it is not subject to regular cleaning, a proper way of garbage disposal should be put in place. Another point is that there is not a designated place for visitors to park their car. Cars can be found too close to mangrove vegetation and the beach. It is stated that the cars should not be parked so close to the beach so that more suitable space for recreation will be made. Perhaps part of the area would be suitable for sports activities. In the pier area also a large hole filled with old construction debris can be found. Some find that this place should be cleaned up. Perhaps something cultural can be done here, for example about windsurfing which the bay is so famous for.

Creating a new beach on Bonaire in order to reduce pressure on Sorobon is a good idea? It is brought forward that on Curaçao making an artificial beach turned out devastating for the reef. On Curaçao it destroyed hundreds of meters of reef. In response another project on Curaçao is mentioned, where they successfully made an artificial beach which left the coral reef intact. They made a wooden platform to support a beach above the actual water. Such a beach could be relatively sustainable and could relieve recreational pressure at Sorobon. It is also stated that the recreational pressure could be diverted to Bonaire's other tourist attractions.

4.6 Literature study on management tools

To get ideas on improvement for the management plan the book 'Coastal planning and management', by R. Kay and J. Alder was used as reference (Alder & Kay, 2005). Herein many management strategies are explained. In this paragraph several are described with what their disadvantages and advantages may be when applied to Lac Bay. These could be used to help improve current existing management tools for Lac Bay or to get new ideas.

Policy and legislation. Are very clear tools, easily managed if the responsible manager has the authority and manpower for implementation and enforcement. It includes the rules and regulations for visitors and entrepreneurs in the area, what is allowed and what not. In Lac Bay already exists policy and legislation, all of it is described in the current management plan. These tools however work correctly if the manager has enough authority and manpower. Thus in order to improve the current implementation and enforcement, STINAPA could be equipped with more employees, who are allowed to enforce the rules and regulations in Lac Bay. For more manpower more funding is needed.

→ Regulation includes the rules of what users are allowed or not to do in an area. The basis for this is that the majority of the community tends to comply with the law, and thus compliance with the management initiatives is achieved. For the part of the community that does not comply, regulation in combination with enforcement is used.

→ Enforcement is a management activity with which outcomes are generally achieved in a relatively short time when compared to other management mechanisms. Enforcement however will work generally temporarily and short term; as long as the area is patrolled and the enforcement agency had a high profile in the community, there will be compliance. This is a time consuming and expensive tool, and can be stressful for the enforcers. For this it is important to understand why people do not comply with regulation. Is this due to a lack of understanding the purposes of management initiatives, disagreement with them, economic motives or lack of awareness? By creating awareness and communication with the community these problems may be reduced, and there will be less need for enforcement.

Guidelines. Guidelines for an area are less forceful than formal policy and legislation. Guidelines may guide users in the desired direction for using the area, but it is not necessary. Guidelines may work if awareness and commitment by users is high. If guidelines work correctly in an area less enforcement by the managing authority is necessary, this helps to save manpower and financial needs. The rules and regulations in Lac Bay could be seen as guidelines, the zonation plan and people not being allowed to walk over the seagrass. For these guidelines to work properly people should be educated about the rules and regulations itself, they have to be aware what is allowed and what not. And for people to follow these rules and regulations they have to be committed to them. For this people should understand why these rules exist and how they are helping the environment by complying with them. More education and information can help achieve this goal.

Zoning. Zoning is based on separating an area into zones and controlling the activities within. It is possible to link a zoning plan with other management tools. Activities that can be undertaken to implement a zoning plan are mainly communication, education, Environmental Impact Assessment and enforcement. The effectiveness of a zoning plan will ultimately rely on the community's acceptance of this plan and the government's commitment to provide the resources to implement it. Studies have shown that where the public has been actively and meaningfully involved in the planning process there is a greater acceptance of the plan, its regulations and implementation. Lac Bay already has a zoning plan that may come to better justice with a few adjustments and raised awareness by users. It is unclear to users where certain zones start and end. The current zoning plan is based on guidelines, making it hard to enforce. If either the guidelines or policy and legislation are more improved in the area, people may be more committed to complying with the existing zoning plan.

Economics instruments can help to cover the costs that occur while managing an area. On Bonaire and Lac Bay STINAPA already handles the Nature Fee, which each user of the Bonaire National Marine Park has to buy. Users can be fined if they are not in the possession of such a fee. The problem with this instrument is that it is hard to reach all users, and it is time consuming to control. This tool could be used more effectively if a way is found to reach more or all users, and a less time consuming way to control. Several times the idea is heard to collect the Nature Fee at the airport customs, this way you reach all visitors to Bonaire, making it unnecessary to control users.

Collaborative and community-based management is a way of managing an area which has the potential to help address problems at the local level. Where management decisions are made that affect the former activities of locals, management becomes a part of their lives. For example in Lac Bay, the ban on Conch fishing; fishermen who made a living out of this could become part of STINAPA and help in Conch restoration projects. Also more cooperation between STINAPA and stakeholders is an example of this. Locals could be more involved with the management by becoming rangers. More commitment to rules can be obtained by improving communication with stakeholders.

5 Points of improvement on current management

As recreational use of Lac Bay is increasing, points where the current management is falling short are becoming apparent. Therefore, points on which improvement is recommended are described. Some of these points have already been brought forward in previous chapters, and are bundled here. Based on these points recommendations can be given for further research and improvements on the current management plan. In an improved management plan these points should be taken into consideration to prevent or minimize threats.

As recreational use of Lac Bay is increasing, points where the current management is falling short are becoming apparent. Therefore, points on which improvement is recommended are described. Some of these points have already been brought forward in previous chapters, and are bundled here. Based on these points recommendations can be given for further research and improvements on the current management plan. In an improved management plan these points should be taken into consideration to prevent or minimize threats.

➤ **Visitors are unaware of the natural values Lac Bay has to offer.**

Despite Lac's high amount of natural values and its designation as a RAMSAR site and IUCN IBA, visitors seem to not visit Lac for its natural values but for leisure and sport instead. Many visitors stated that tourism is not harmful to the environment because in their opinion there is nothing to harm anyway.

➤ **Entrepreneurs are insufficiently able to contribute to environmental awareness.**

Multiple entrepreneurs have stated that they want to be more capable of distributing information about Lac Bay and its natural values, but do not see this as their responsibility.

➤ **Visitors are unaware of regulations.**

On this matter compliance with the zoning plan (figure 3) is a problem. As can be seen in graph 14, many visitors are unaware where they are supposed to practice what activity. When activities occur in non-applicable zones, no enforcement is taking place. Respondents to the questionnaire often did not understand why a zoning plan is necessary.

➤ **Lack of facilities for garbage disposal leads to littering.**

Littering on the beaches occurs because no trashcans are available and there are no proper ways to dispose of hot barbecue ashes. Litter in front of the businesses is generally cleaned, but at the pier area litter can be found at all times.

➤ **Public toilets are in a poor condition.**

No clear division of responsibilities for the maintenance of public toilets is apparent. This has led to the toilets at Cai being dysfunctional and the ones at Sorobon being extremely dirty.

➤ **More designated parking spots at Sorobon are needed.**

The low number of designated parking spots leads to cars being parked on the beach and close to mangrove and dune vegetation leading to encroachment.

➤ **The construction debris at the Pier area at Sorobon should be cleaned up.**

Still old debris of a resort which used to be built at Sorobon can be found lying in a hole at Sorobon. Cleaning up this debris will make the area look more proper and would make free space for other purposes.

➤ **Insufficient funding hampers STINAPA in carrying out management tasks to the fullest.**

According to R. de Leon, manager of the Bonaire Marine Park, several points of action in the management plan from 2003 have not yet been carried out due to budget constraints. (3.4.2) Steps to be taken in the future need proper funding in order to be successful.

➤ **Recreational use contributes to eutrophication of Lac's ecosystem.**

Recent research by Slijkerman et al, (2011) shows that eutrophication in Lac bay is occurring through nutrient enrichment. Recreational use at Sorobon is pointed out as one of the potential causes.

➤ **Usage of sunscreen might lead to coral bleaching.**

Research by Danovaro, et al (2008) shows that usage of sunscreen in areas with coral reefs can lead to coral bleaching. Results in this research indicate that sunscreens have a rapid effect on hard corals and cause bleaching by damaging the symbiotic zooxanthellae. Due to the low water circulation and the presence of tourism this might also be applicable to Lac Bay.

How these points can be improved will be discussed in the overall recommendations, chapter 10.

6 Land use survey

Since the first colonists set foot on Bonaire the islands natural resources have been depleted or misused. From the 17th century onwards forest growth on Bonaire has been systematically neglected. Valuable species were harvested such as *Haematoxylon brasiletto* and *Guaiacum officinale*. Logging occurred for the purpose of collecting firewood and the production of charcoal. Replanting did not occur. Moreover, due to the uncontrolled grazing of goat and sheep natural recovery of vegetation was hindered. For these reasons the original vegetation has made place for (thorny) bushes and cactuses. At some places almost all vegetation has completely disappeared. Due to wind and water erosion (and anthropogenic causes) a severe denudation of the soil has occurred. As a result (1) precipitation is less capable of penetrating the soil, (2) the limited amount of available land for agriculture is further being eroded and (3) the precipitation flows off towards the sea (Gewald et al. 1971). This situation is also applicable to the catchment area of Lac Bay (figure 11). In this area the mentioned process subsequently drains nutrients and sediment towards the Lac Bay. Because goats and sheep are roaming free and are grazing on the areas vegetation, erosion takes place, causing sedimentation towards the bay which ultimately can negatively affect the water circulation of Lac by clogging. Sedimentation in the bay also causes reduced light transmission in the water, and sediment deposition on vegetation and the reef. This negatively influences the health and growth of both (Slijkerman, 2011). Sedimentation is also being caused by ploughing the land for agricultural purposes (Debrot, 2011) and traffic in off-road areas (Slijkerman, 2011). The large numbers of animals in the area can also cause the bay to be enriched with nutrients. Groundwater flows and runoff from the catchment area can contain nutrients from goat, sheep and donkey manure. Nutrient enrichment can lead to eutrophication of the Lac Bay ecosystem as was mentioned in 4.4. The catchment area also affects the Lac Bay due to the disturbed flow of surface water. Wells and dams extract fresh water on which the mangrove system is dependant ((Kathiresan, 2005)).

Due to the effects which the catchment area potentially has on Lac Bay, an overview is strived to be given of relevant activities in the area. Some information has been found, but more research is necessary.

6.1 Catchment area

The catchment area of Lac Bay can be defined as the area around Lac Bay in which superficial water is eventually drained towards the Lac Bay.

6.1.1 Determining the Lac Bay Catchment area

The catchment area of Lac Bay was defined with the usage of the software Quantum GIS with a GRASS GIS plug-in. In this software a map with DEM data at Bonaire was used. In this map the differences in heights can be determined. These heights were used in determining the streams of superficial water flow in the area. The combination of heights and the directions in which these streams are flowing has provided the information to determine the actual catchment area. With a measurement tool in the software an estimated surface of 22.6 km² was determined, in which the bay itself and the mangroves are excluded. Through geo-referencing this map could be overlaid with a google maps photograph the Lac Bay area, resulting in figure 3, the catchment area.

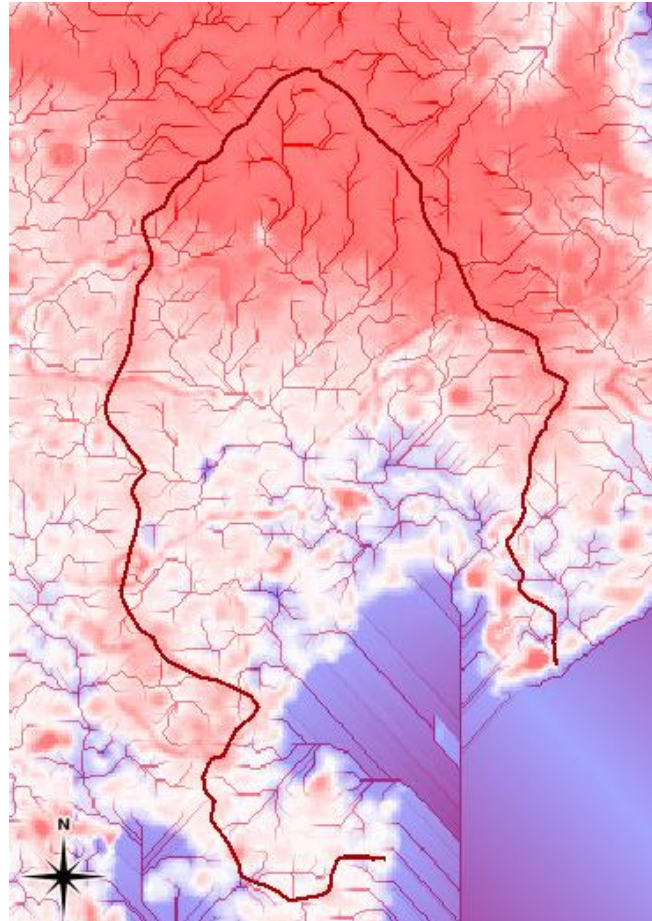


Figure 11. Superficial water streams from high to low, indicating the catchment area. (Wentink, 2011)

6.2 Activities in the catchment area

The majority of human activity takes place in the north of the catchment area. Land in this area is mainly used for keeping livestock such as goat, sheep and poultry and for agricultural purposes, a farm on Bonaire is called a 'kunuku'. It is unclear up to what extent activities in the catchment area influence Lac Bay.

Wells and dams

Wells and dams are placed to supply water for the kunukus. This water is mainly used for agricultural purposes. With these structures the original water flow towards Lac Bay, is interrupted, which causes less fresh water to end up at the mangroves.



Figure 12. Well driven by a windmill (By author).



Figure 13. Dam collecting water (By author).

Figure 14 indicates activities in the catchment area which alter the superficial water. Herein it should be noted that more dams and wells are present in the area. Unfortunately it was not possible to reach all locations during data collection because the majority of the area is inaccessible and limited time was available. Black lines indicate dams which were present in 1984 according to the Kadaster map. Most of these dams are probably still present in the area in the same size. Some of the dams which were found were not present on the Kadaster map. This indicates that the number of dams has been increasing since then. The wells indicated are found next to the road and are available for public use. Some are driven by a windmill (figure 12). An unknown number of kunukus has wells present on their own land. Out of 17 questioned kunuku owners, 4 stated that they have a well on their own land. 8 respondents stated that they have dams on their parcel, ranging up to 4 dams per individual respondent.

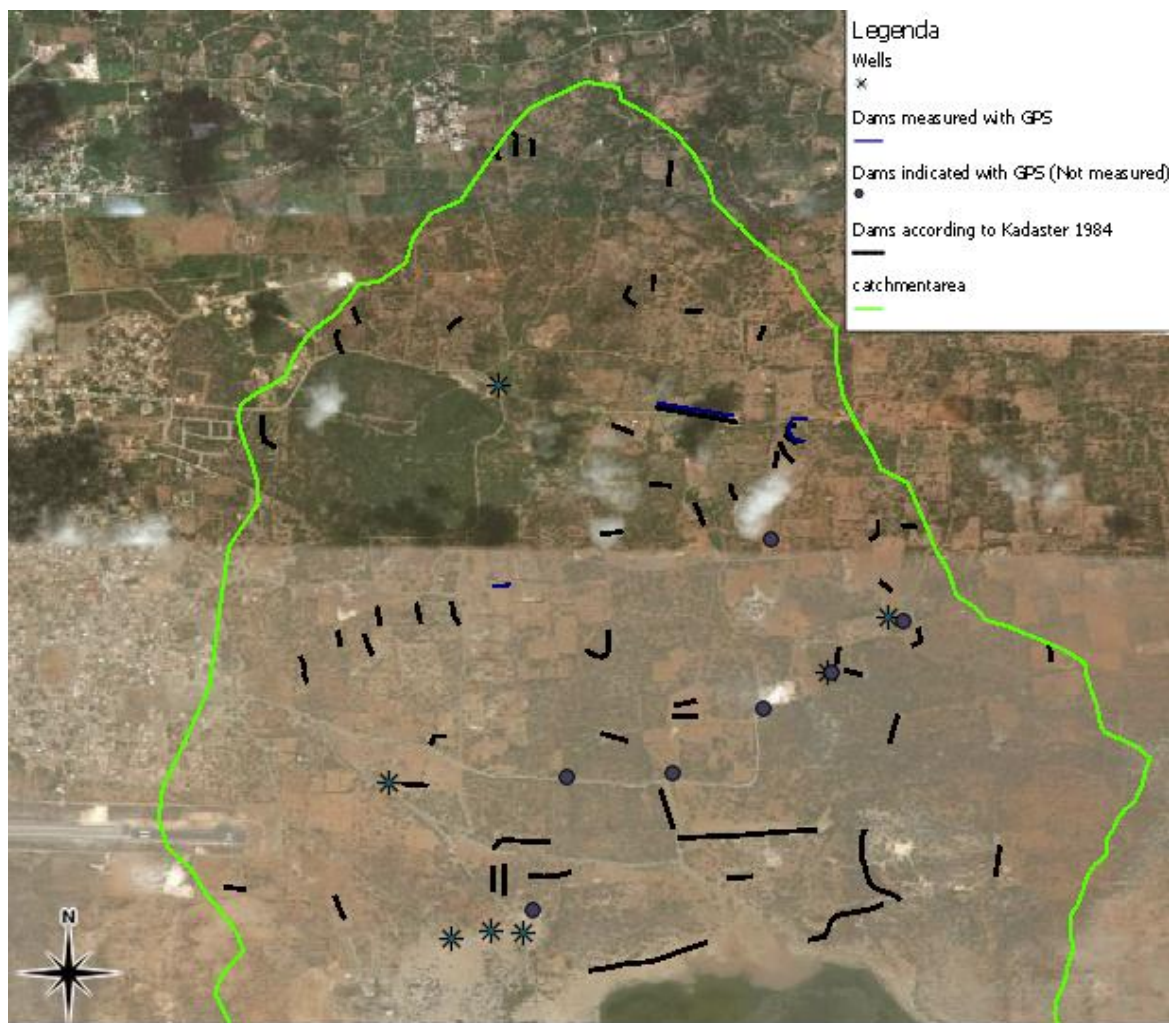


Figure 14. Locations of water related activities (By author).

Livestock

The main activity at the kunukus is keeping livestock. This livestock mainly consists out of goats and some sheep. Donkeys can also be found in low numbers. These animals do not have owners and can be considered wild animals. Livestock is often let loose to roam free across the mundi (bush), during the day, allowing them to strip off a large part of the surrounding vegetation. This causes erosion and eventually lets water streams take the sediment to the bay. The livestock can also cause eutrophication through nutrient enrichment originating from livestock manure. (Slijkerman, 2011)

As mentioned, the livestock on Bonaire mainly consists out of goats. An exact number of goats on Bonaire is difficult to determine but in recent research an estimation was given of 25.000 to 26.000 goats and around 5000 sheep (Nolet, et al., 2009).

Goats are very important to the native Bonaireans. These animals are capable of making use of the available vegetation under extreme circumstances (French, 1970). Therefore the breeding of these animals is not primarily dependent on the land they live on, but on the goats themselves. For many Bonaireans goats are an interesting investment. With enough rain the goats can have young twice a year, so that every year on 100 goats on average 100 young survive (it should be noted that in times

of drought fertility can decrease with 30%). Goats are seen as a sort of insurance. In difficult times some animals can be sold. An adult goat can on average be sold for about 50 USD. Goats have always been an important export product to Curaçao and Aruba (Nolet, et al., 2009).

According to Mr. Eemers, director of Dienst LVV (service for agriculture, livestock and fishery) it is officially forbidden to let goats loose. Currently however, this rule is not being followed like it used to be, and enforcement is barely occurring. According to many kunukus and Nolet et al. (2009) letting the goats out to roam free enables them to feed on the islands vegetation, rendering it unnecessary to feed them. This saves money and enables the owner to keep more goats.

Number of goats and the carrying capacity

For Bonaire the LVV service at Curaçao has determined the total number of goats that the environment can sustain without degradation. A carrying capacity of 14 goats per hectare in the rain season and only 1 goat per hectare in the dry season (In which 30.000 goats are assumed on 7.000 hectares of suitable ground for livestock) was determined. This means a carrying capacity of 7.000 goats in the dry season. Since this season endures for about 8 months of the year this would be a good guideline for the carrying capacity in general. This would mean that the total population would have to decrease to ¼ of the current number (Nolet et al., 2009).

Research in the Washington Slagbaai National Park by Debrot (2009) showed that 1 goat per hectare is present here. According to Debrot, this number still leads to degradation of the vegetation. A study in the Christoffel Park on Curaçao, shows that general vegetation and rare species are starting to improve at cattle densities of 1 on 10 hectares. These areas are comparable to the Lac Bay catchment area.

It can be assumed that in the Lac Bay catchment area these densities are being exceeded. In Lac Bay, the total amount of suitable land for livestock is unknown. The total area encompasses about 2260 hectares. Based on information from DOMEIN, a total number of at least 213 kunuku's in this area can be found, of which many are holding livestock, either roaming free or on the parcel. A total of around 300 kunuku's is estimated for the entire catchment area. 17 kunuku owners were asked about their number of livestock and hectares they own. Unfortunately this sample is too low to give an indication of the number of goats per hectare in the catchment area, and thus more need to be asked. Numbers per respondent ranged between 0 and 80 goats and 0 to 30 sheep. On parcels of which the surface in hectares and its owner was unknown, high numbers were counted as well, sometimes ranging over a hundred goats and sheep. Anecdotal stories indicate that one of the largest kunuku's in the catchment area, Kunuku Warahama, contains hundreds of goats, sheep and other cattle.

Although an indication of the actual density of livestock in the catchment area cannot be given, the number of grazers is probably much higher than the mentioned values for the carrying capacity, based on literature, anecdotal stories, observations and the questionnaire.

Livestock back on the parcels

As mentioned earlier, legally it is not allowed to let livestock roam free. The first step in restoring Lac (especially the mangrove area) is to stabilize shorelines by reducing sediment transport into the system. Enforcing this law, requiring kunukus to keep their livestock within the fenced boundaries of their properties, in combination with decreasing vehicular traffic in off-road areas could reduce the sedimentary problems (Slijkerman et al. 2011). According to Mr Eemers (director of LVV), the LVV service is working towards this. In this matter some problems need to be faced. Some kunukus currently have more livestock than their own parcels can sustain (Nolet et al., 2009). This would mean that as a result of this plan some people will have to sell a part of their livestock. Moreover, since livestock will not be able to feed itself sufficiently while being within the boundaries of the parcels, owners will have to buy food. Cooperation with and support from kunukus would be important for the plan to be successful.

Agriculture

Some kunukero's use their land for agricultural purposes, to grow fruits and vegetables. In order to make the land suitable for this purpose, plowing needs to be done. This also causes more sediment to end up in the bay.



Figure 15 Plowing of the land can cause sedimentation.

Information on agricultural activities can be found through the developed questionnaire. From the information which has already been found with the 17 respondents no conclusions can be drawn. More respondents need to be found for a representative sample.

6.3 Land use conclusion and recommendations.

It is indicated that the dams which were measures by Kadaster in 1984 are still present. An increase of dams is highly probable. A more precise overview of the number of dams and wells in the area could not be given due to problems with GPS material, inaccessibility of the research area and a lack of time. For a more precise overview of water draining activities, more research is needed.

Precise locations of dams and wells could very well be determined through aerial photography. Extra exploration of the area on the ground with GPS can provide more information as well. The problem with this method is the mentioned inaccessibility of many areas due to fencing and very thorny bushes and cactuses. From the road visibility is often hindered by vegetation and fences.

Usage of the developed questionnaire could also give a good indication of the number of dams and wells if the majority of the kunukus can be reached.

Observations, literature, questionnaires and counting's indicate that the carrying capacity for the number of grazers is probably being exceeded, assuming a carrying capacity of 1 goat per hectare. An indication of the actual number of livestock per hectare could not be given because planned research methods on this matter turned out to be unsuitable for this area. A precise view on the number of goats in the catchment area could be given through aerial photography. By using the developed questionnaire a precise overview of cattle in the area can also be achieved if a representative number of the kunukero's can be reached.

LVV is currently working towards a situation in which livestock is being held within the boundaries of the kunuku parcels. Achievement of this goal will mitigate the sedimentary problem in the area. Cooperation with and support from kunukus is important in achieving this goal.

An overview of agricultural use of the catchment area can be given with the developed questionnaire and through aerial photography. No information on agricultural use in the area could be obtained in this survey due to the low number of questionnaire respondents which could be reached.

Overall, aerial photography seems to be the most suitable method for giving an overview of land-use in the catchment area. The developed questionnaire can also turn out being a good method, which can give more precise information on agricultural land-use. Moreover the questionnaire enables the research to collect other information as well, such as whether respondents support the plans of LVV on livestock or not. Problem in this matter is that kunukus are often difficult to reach because they are usually not present at their parcels.

The names of almost all kunukus can be found at DOMEIN, where they are registered. Most of this information has already been obtained. Although much of the information seems to be out of date, it can be helpful in determining who to contact. Cooperation with agricultural services LVV and Kria Bon (where food for livestock is on sale) could be of great help in contacting kunukus in the catchment area.

Discussion

In this chapter several points will be discussed about the research methods and interpretation of the results in order to improve further research in the future.

Recreational use

The period of data collection for this research concerned the months March and April 2011. These months are considered the tourism high season (Debrot, 2010). During the data collection several cruise ships docked (Appendix D), but in the months May – September, no relevant cruise ships dock at Bonaire (Bonaire Tourism Corporation, 2009). This period is expected to give different results than the period for this research. This research thus gives an indication of the tourist season from October – April, and not for the whole year round. In order to determine the human use in Lac Bay for the whole year, monitoring in the other months is recommended. In this case it should be noted that it has never been the intention to give an overview of the whole year, but only the high season.

During this research beach visitors were randomly chosen for surveys. This gives an impression of the types of visitors for Lac Bay. The types were separated in the groups; native Bonaireans, foreign residents, stay over tourists and cruise tourists. In order to give more representative conclusions on these different types of visitors they should be surveyed separately. For example, 55 cruise tourists were surveyed during this research, with the annual number of cruise tourists, 175.702 (data of 2008) (Tourism Bonaire, 2009), this has resulted in high margins +/- making drawn conclusions less valuable. Therefore all information which is given on the basis of questionnaire answers by cruise tourists should be regarded as an indication in which the given margins +/- (table 2) are taken into account.

For this research monitoring and surveys have been conducted only from the Sorobon peninsula. This decision has been made because Sorobon appeared to be the most active area for visitors and entrepreneurs. For future research however, it could be expanded to the Cai peninsular as well. Cai is a smaller area, with less human activities. In the weekends however, some visitors can be found here because the local bar at Cai is opened and a band comes here to play music. Horseback riding tours also happen at Cai several times a week, the tour has a short break here and participants can enter the water with the horses. During the week some fishermen are active from Cai. For this research it was decided to focus the monitoring and surveys at Sorobon, after it was clear the larger part of human activities took place there. A more accurate view for activity in the whole bay could be given by including the Cai peninsular in the weekends when the local bar is opened. Overlooking the bay with a telescope from the Sorobon peninsular might enable one to monitor the Cai peninsular from Sorobon. A telescope could also provide with more accurate results, this way numbers and locations of water recreants can be determined with more accuracy. Especially snorkelers who are almost completely submerged and hard to spot could be monitored better with a telescope.

Monitoring for this research was done at set times. At these times all activities and to what extend were monitored and their locations in relation to the zoning plan. Monitoring took approximately 5-15 minutes a time, depending on the number of visitors. This is a good way of monitoring to get an overall impression of numbers of users over the day. For more specific numbers, on subjects such as people walking over the sea grass or the barrier reef, a research like the one from STCB is

recommended (Kalke, 2010). For this research monitoring was done over time. For a research like this the researcher monitors a certain amount of time continuously, to note how many times a certain event takes place within this time.

Land use

It was indicated that the carrying capacity for grazers in the catchment area is being exceeded. However, because the actual grazer density could not be determined, it is unknown up to what extent. An indication was also given of the minimal number of dams and wells in the area. Some dams which were indicated on the map from Kadaster were checked in the field and were found, indicating that the dams which are indicated are still present at this time. However, due to the inaccessibility of the area, the majority has not been visited. Therefore it is possible that some of the dams which are indicated are actually removed or expanded.

Conclusions

On the basis of monitoring's, questionnaires interviews and conversations answers have been given to the given sub questions. These answers are combined in the general conclusion below, subsequently giving an answer to the main question:

How is the Lac Bay and its catchment area being used, what are the threats, what should be improved and what recommendations on the management plan can be given for future usage of the area?

As expected on the basis of the report by PES (Kats, 2007) the Lac Bay area and the Sorobon peninsular in particular is indeed very crowded, especially during days on which cruise ship tourists are present. A large difference in visitor numbers can be observed between cruise days and non-cruise days. Visitor numbers amongst different cruise days also differ, depending on the capacity of the ship and its type of visitors. The highest number of visitors recorded was 760 individuals. On this day two cruise ships were present at the same time. All cruise recreation and most recreation in general is focussed at Sorobon and in front of the beach bars in particular. On cruise days it is busiest at 1:30 pm. Here the mean lies at 359 visitors. On week days and weekends in which no cruise ship is present the highest number of visitors can be found at 3 pm. Means at this time lie respectively at 187 and 260 visitors.

Most people visit the bay for sunbathing and windsurfing. Occasionally water based activities can be observed in non-applicable zones. In all questioned visitor categories was seen that less than half of the respondents was aware of the Lac Bay zoning plan (paragraph 3.4.1.). This is causing some visitors to practice their activity where they are not supposed to. The presence of activities in non-designated zones is also being caused by the fact that the zoning plan is not being indicated in the area and because users are not aware of the reasons why the zoning plan is necessary.

Windsurfing is the most observed water based activity in the bay. Counts of surfers ranged up to 92 individuals at a time, although such numbers are rare. Occasionally windsurfers were seen in designated non-surfing zones, the white zone in particular. Overall observations show that many of the surfers in the white zone can be found close to the mangroves. It can be concluded that windsurfing occurring on the coral dam (yellow zone) is uncommon, as it was not recorded during monitoring's. Windsurfers are instructed where it is dangerous to go when equipment is rented to them. Anecdotal stories do however indicate that collisions between windsurfers and coral patches have occurred. Proper indication of zonation in the area could prevent this from happening in the future.

Swimming and wading is the second most observed water based activity in the bay. On non- cruise days the number of people swimming and wading through the water stays relatively low, with a mean of 6 individuals on non-cruise week days and 17 on non-cruise weekends. On cruise days a mean of 65 individuals was found. The highest counted number of individuals was over 200 individuals at a time. Most swimming and wading activity takes place in the blue zone along the beach, and at the beach bars in particular. Although this is not a designated zone for swimming this activity can and should not be avoided since there is no other proper location. Up to what extend the large numbers of cruise ship visitors is contributing to the number of people swimming/wading

in the yellow zone, in which the coral dam can be found remains unclear when looking at the dataset. Few swimmers/waders were seen in the yellow zone during scheduled monitoring's, although this has occasionally been seen on other moments.

It can be concluded that the number of snorkelers in the bay is lower than expected because only 4% of the questionnaire respondents mentions he or she visits Lac Bay for snorkelling and since not many snorkelers were recorded during the monitoring. Snorkelling activities on the coral dam have turned out to be low. Less than half of all snorkelers were seen on the coral dam, in total 39 individuals. How much physical contact between snorkelers and the coral patches actually occurs is unknown but it can be assumed that this is uncommon since people do not go here very often. The water around the patch reefs can be particularly turbulent and shallow, making it likely that novice snorkelers who do enter this area get into physical contact with the corals. Occasionally the snorkelers can be seen standing up or wading across the coral dam. It should be noted that this does not necessarily mean that these individuals are trampling coral because a large part of the coral dam exists out of coral rubble and sandy bottoms. The Mangrove Info and Activity Centre intends to organize snorkel tours around the coral dam in the future. If this leads to an increase of contact the organization of the tours is intended to be discontinued.

Just as snorkelling the number of kayakers is quite low. During the 31 monitoring days 110 kayakers were spotted during the scheduled monitoring times. Out of these only 10 individuals were seen in the yellow zone where the coral dam can be found. 97 individuals were seen in the blue zone, mainly close to the beach. Most kayakers are children who tend to stay close to the beach. Three kayakers were seen in the sea grass beds. No kayakers were seen in the white zone, nor close to the mangroves at scheduled monitoring's and overall observations. These observations exclude the kayak tours of the Mangrove Info and Activity Centre, they are rarely visible since a large part of the tour takes place in channels through the mangroves.

Most visitors are aware that they are not supposed to cross the sea grass lines, which is reflected by a positive result in the monitoring where trampling activity was low. A large part of the recorded sea grass trampling occurred around the fence between SBR and Jibe City. Here a door will be constructed which will stop trampling in the future on this particular location.

Overall the recreational pressure on the coral dam seems to be lower than was initially expected. However, even low amounts of physical contact between recreants and coral patches have detrimental effects which should be taken into account. The number of activity around the mangroves has turned out to be present at almost all times during monitoring's, leading to disturbance of present birdlife. This is caused by the windsurfers who often go here, fishermen who move through and around the mangroves and kayak tours. Disturbance might also be caused by traffic at Kaminda di Sorobon. Disturbance of sea turtles by windsurfers also occurs, probably often near Kontiki Beach Club, based on anecdotal stories. Sea turtles are most abundant at the end of the coral dam as was indicated in figure 10. This is generally too far upwind for windsurfers.

Recent research shows that the coral dam and the Lac Bay ecosystem in general are under stress of eutrophication which partially originates from human sources. This has led to an algal bloom which subsequently can lead to degradation of the coral dam.

Based on user surveys at Sorobon, social carrying capacity for the present kind of visitor and present kind of usage begins to become an issue around 250 beach visitors. Between 401 and 500 visitors a turnover point is reached beyond which the majority of respondents consider it too busy on the beach for their personal enjoyment. Regarding the number of facilities at Lac Bay, the majority of respondents agree that they are in adequate amount. The facility that visitors would like to see more the most is shading. The majority of the interviewed stakeholders agree that Lac Bay is an extraordinary habitat, and that tourism exists here for the area as it is now, with this number of facilities, entrepreneurs and visitors. According to the interviewed stakeholders the social carrying capacity is at a good balance at the moment, and should not be exceeded more.

Key points of improvement on the current management are that visitors are unaware of the zoning plan, a lack of environmental awareness, more proper facilities are needed for car parking, garbage disposal and proper maintenance and cleaning of public toilets is needed. Moreover, insufficient funding currently hampers STINAPA in carrying out management tasks to the fullest.

In the catchment area it can be concluded that the environmental carrying capacity of grazers is being exceeded. Future plans of LVV to hold livestock within the boundaries of parcels can reduce sedimentation and could lead to a reduction of the number of livestock in the area. More research is needed on the exact grazer densities, water draining activities and agricultural use of the area.

Recommendations

Because recreational pressure is focussed on Sorobon, most recommendations are applicable to this peninsular. Recommendations are given for management and further research.

Adaptations of the zoning plan. Currently the zoning plan is not being implemented. The majority of the visitors is unaware of the plan, zonation's are not marked in the area and no enforcement is being carried out. Moreover, the current situation in the blue and orange zone leads to a confusing plan. Adaptations can lead to a plan which is clearer, leading to more compliance. Most swimming and wading activity takes place in the blue zone in front of the beach bars and windsurf centres, although this is not a designated swimming area. We recommend the zoning plan to be adapted so that swimming on this location complies with the zonation. Although windsurfing is occurring in this same area, no dangerous situations have been observed and no stories of accidents have been heard of. Instead of attempting to separate windsurfing and swimming, visitors should be made aware of the different types of usage in the blue zone to further mitigate risks. Areas where people can swim without surfers in the same area can be found in front of The Beach Hut, the Sorobon Beach Resort and in the red zone. People should be aware of these possibilities. Guided snorkelling in the orange zones (Boka Djukfes and in front of Koniki Beach Club) is not occurring. Therefore it would be possible to add these areas to the white zone, to expand the non-activity nature area of the bay and keep the zoning plan simple and clear.

Proper indication of the zones. Proper indication of the locations of each zone with the use of buoys and swim lines could make it clear where people are allowed to go and where they are not. In combination with increased awareness this can lead to higher rates of compliance.

Awareness about the environment and its regulations. More than half of the visitor is unaware of the zoning plan, causing some activities to take place in areas where they are not supposed to. Increasing awareness about the zoning plan can lead to a decrease of activities on improper locations. Visitors can read where zones are located, why, and what they should keep their eyes on for their own safety and the environment. This can be achieved by more efficient distribution of the STINAPA brochure on Lac Bay, which contains a map and explanation on the zoning plan. Based on interviews and conversations it can be concluded that stakeholders are willing to help increasing awareness about Lac's natural values and its regulations. More cooperation between STINAPA and entrepreneurs could be a great contribution to achieving this goal. Entrepreneurs should indicate when they need those brochures, and STINAPA rangers can supply them since they pass by on a daily basis. Also strategically placed information signs with the zoning plan can support this goal. Clearly visible places are for example; the entrances of the Sorobon Beach Resort, Jibe City, The Windsurf Place, the Sorobon pier, the beach at the Kontiki Beach Club and the Cai peninsular. The placement of a visitor centre at Sorobon could be a key factor in awareness about the environment and its regulations. During the discussion round of the presentation attendees seemed to be agreeing that a visitor centre such the one at the Slagbaai National Park could be a good way to increase awareness about the environment and regulations/guidelines in Lac Bay.

Garbage disposal. This is one of the action points from the management plan in 2003. However, this has yet to be carried out. Littering occurs throughout the Sorobon peninsula. In front of the businesses this is not always apparent because it is regularly cleaned. At the pier area however, litter can always be found as well as disposed barbeque ashes. Proper ways to dispose of ashes and litter should be provided for.

Public toilets. Visitors who stay at the pier area of Sorobon often complain about the public toilets which are dirty and poorly maintained. The toilets at Cai have been dysfunctional since a couple of years and should be repaired. It is currently unclear who is responsible for maintaining and cleaning the public sanitary facilities at Lac Bay. This problem should be resolved through proper communication between applicable governmental and managing organizations.

Parking spots at Sorobon. Currently a low number of designated parking spots is present. Especially on busy days cars are being parked too close to mangrove and dune vegetation leading to encroachment. Cars are also being parked close to the beach in the pier area, turning the ground into a tough pavement unsuitable for recreation. More designated parking spots should be created and parking cars on other locations should no longer be allowed.

Visitor centre at Sorobon. Many stakeholders find it important that visitors become aware of the importance of the area they are spending their time at. Many seem to agree that a visitor centre could be a key factor in increasing awareness about the Lac Bay environment. Here people could learn about what natural values can be found, what efforts are being taken to conserve and what they can do to protect it. Visitors could also go here for brochures, nature fee tags and souvenirs which support foundations such as STINAPA and STCB or subscribe to the adopt a conch programme (<http://conchbonaire.org/>)

Developing sunbathing and water sport possibilities elsewhere on Bonaire to distribute user densities from Lac Bay.

Recommendations for further research

Recreational use contributes to eutrophication of Lac's ecosystem.

Recent research by Slijkerman et al, (2011) shows that eutrophication in Lac bay is occurring through nutrient enrichment. Recreational use at Sorobon is pointed out as one of the potential causes. It is currently unclear what state the septic systems at this location and around Lac in general are in. Various entrepreneurs stated that their septic tanks are very old and one even stated that it is probably leaking. It should be investigated in what state the septic systems are right now. Based on this information action should be taken to mitigate discharge of pollutants and nutrients if necessary.

Usage of sunscreen might lead to coral bleaching.

Research by Danovaro, et al (2008) shows that usage of sunscreen in areas with coral reefs can lead to coral bleaching. Results in this research indicate that sunscreens have a rapid effect on hard corals and cause bleaching by damaging the symbiotic zooxanthellae. Because of the water based recreational use of Lac Bay, especially during cruise days and due to the low level of water circulation, sunscreens might cause coral bleaching at Lac as well. This statement is solely based on literature research and can be confirmed with further research on site.

Traffic disturbance at Kaminda di Sorobon. It is considered plausible for the traffic at Kaminda di Sorobon to be a disturbance for bird life in the adjacent mangroves. More research on different traffic densities and applicable effects could clarify this.

More research on land use. Although some information has been found, we recommend more research to be carried out on the use of the catchment area. It is still unclear how many grazers can be found in the area, how many dams and dams are placed. Also currently no information is available on agricultural use and ploughing. Information can be found through aerial photography and usage of the developed questionnaire used for this research as well.

More funding is needed.

According to R. de Leon, manager of the Bonaire Marine Park, the fact that several points of action in the management plan from 2003 have not yet been carried out is caused by budget constraints. These points can be found in (3.4.2). The recommendations given in this chapter involve more costs, of which the visitor centre in particular. The recreation in Lac Bay and all the revenue it generates is largely dependent on the environment by which it is hosted. Therefore preserving it is not only the interest of STINAPA and the other foundations, but all businesses and governmental organizations as well. Funding the efforts taken to preserve Lacs environment are not only the responsibility of STINAPA, but also other interested parties. The new political structure on Bonaire can perhaps provide with possibilities for Dutch governmental funding through RCN. More funding can also be created by more efficient usage of the Nature Fee tag. Currently it seems like many tourist make use of the Bonaire Marine Park without paying the required nature fee. Many stakeholders, including government officials pointed out that it would perhaps be better to obligate visitors to pay the fee at their arrival on the island at the airport. This way no one will be missed, thus increasing the nature fee revenue.

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Glossary

BES islands - Bonaire, St. Eustatius and Saba, islands in the Caribbean, municipalities of The Netherlands

BNMP – Bonaire National Marine Park

DROB - Department of Physical Development and Management on Bonaire

EL&I - Dutch ministry of Economic Affairs, Agriculture and Innovation

IMARES - Institute for Marine Resources & Ecosystem Studies, part of Wageningen Universities

IUCN - International Union for Conservation of Nature

KBC - Kontiki Beach Club

Kunuku - Name of a farm on Bonaire

LVV - Office of Agriculture and Fisheries on Bonaire

PES - Progressive Environmental Solutions

RAMSAR - Convention on Wetlands of International Importance

RCN - Rijksdienst Caribisch Nederland, Dutch government on the BES islands

SBR - Sorobon Beach Resort

STCB - Sea Turtle Conservation Bonaire

STINAPA - National Parks Foundation Bonaire, management authority of the Bonaire Marine National Park (BMNP) and Washington Slagbaai National Park (WSNP)

TCB - Tourism Corporation Bonaire

VMM - Verordening Marien Milieu, Nature Ordinance for Bonaire

VROM - Dutch ministry of Housing, Spatial Planning and Environment

Appendices part 1; Human use of Lac Bay

A Map of Lac Bay with local names

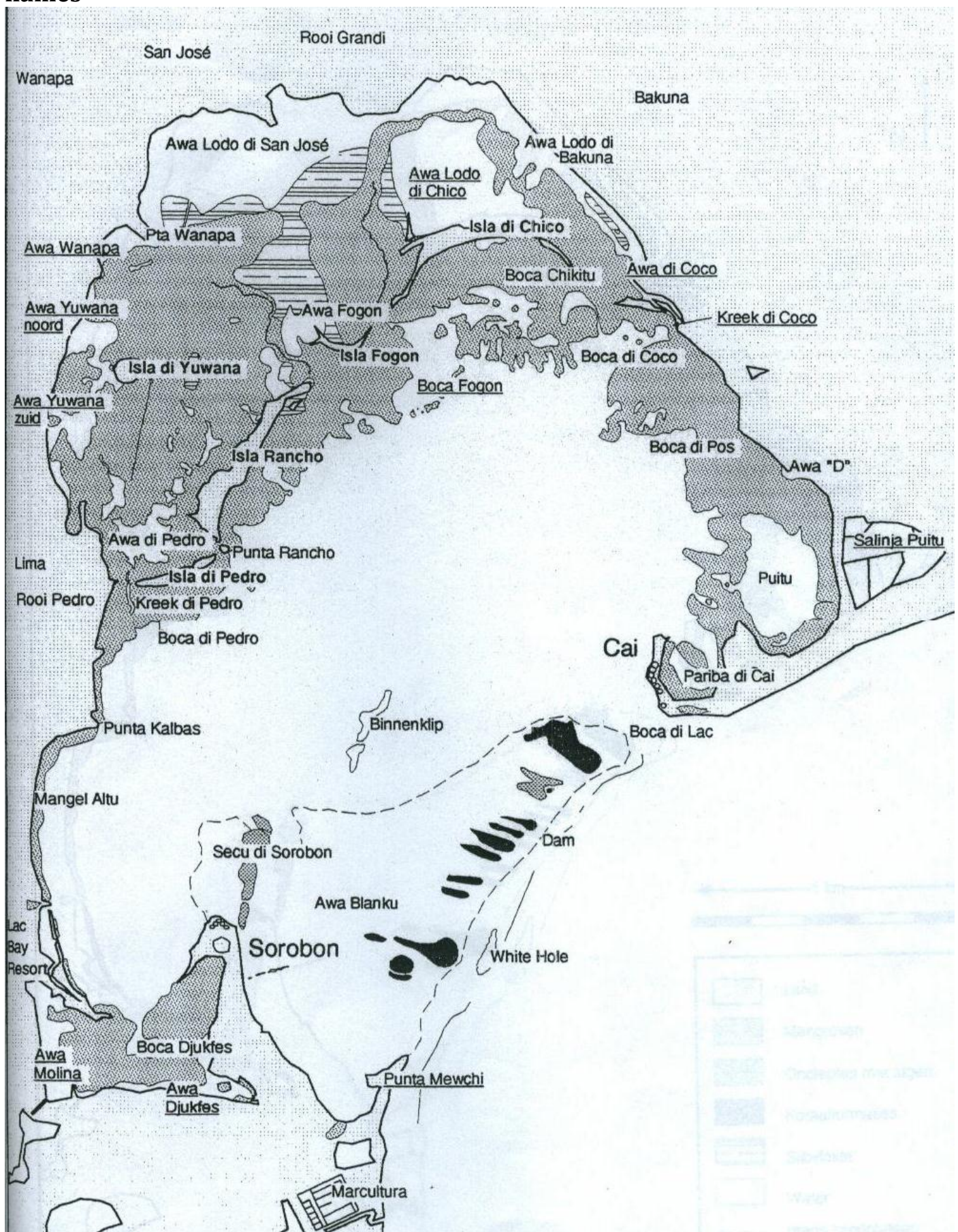


Figure 16 Map of Lac Bay with local names (Kats, 2007)

B Lac Bay visitor questionnaire

1) What is your country of origin?

Bonaire ____ Curaçao ____ Aruba ____ USA ____ Netherlands ____ Venezuela ____
Germany ____ France ____ Canada ____ Other _____

2) Age category

Younger than 20 yrs	21-30yrs	31-40 yrs
41-50 yrs	51-60 yrs	Over 61 yrs

3) Type of visitor

Cruise tourist	Native Bonairean
Stay over tourist	Other, please specify.....
Foreign resident	

4) What did/do you do in the Lac Bay during your stay?

Sunbathe	Snorkel	Fish
Dive	Windsurf	Swim
Hike	Work	Kayak
Meet friends	Party	Other, please specify

5) If an activity in or on the water, did you spot a sea turtle today?

- A Yes, one
B Yes, if more than one, how many?.....
C No

6) For how long have you been in the water? <1h / 1 / 2 / 3 / 4 / 4> /

7) Are you aware of the places where you are and where you are not allowed to practice your activity?

- A I am aware of the zoning map, where is explained where you are allowed to safely; swim, snorkel, kayak and windsurf. Yes/No
B I am aware I shouldn't cross the lines around the seagrass beds Yes/No

8) What is your opinion about the current availability of the following facilities at Lac Bay?

Restaurants and bars:	enough / prefer more / prefer less / no opinion
Hotels and resorts:	enough / prefer more / prefer less / no opinion
Shops:	enough / prefer more / prefer less / no opinion
Rental:	enough / prefer more / prefer less / no opinion
Shading:	enough / prefer more / prefer less / no opinion
Parking:	enough / prefer more / prefer less / no opinion
Toilets:	enough / prefer more / prefer less / no opinion

9) For me to fully enjoy this visit at this moment I would prefer the presence of: More/ Less/ Just as many/ Doesn't matter how many beach visitors than are present at this time.

10) Do you think tourism in the Lac Bay with this number of visitors is a threat to its environment?

- Yes/No/Don't know
Why do you think so?

C Monitoring sheet human activity Lac Bay

DATE:	WEATHER CONDITIONS
OBSERVER:	TEMPERATURE:
TIME:	WIND:
LOCATION:	CLOUD COVERAGE:
	PERCIPITATION:

	ACTIVITY	NUMBER	LOCATION (MATCHES ZONING PLAN Y/N)	EXTRA
1				
2				
3				
4				
5				
6				
7				
8				
9				

D Cruise schedule and monitoring days

Table 6 Cruise schedule

2010/2011 CRUISE SEASON AS PER NOVEMBER 23RD 2010										
CALLS	DAY	DATE	NAME	ARR/DEP	AGEN	PIER	RMK	CAP	PAX	C.LINE
103	Thursday	March 3, 2011	Caribbean Princess	1100-2000	MAD	Safe berth	Conf	3100		Princess Cruises
104	Thursday	March 3, 2011	Noordam	0800-1700	MAD	Safe berth	Conf	1918		HAL
105	Friday	March 4, 2011	Grandeur of the Seas	0700-1600	MAD	Safe berth	Conf	2446		Celebrity/RCCL
106	Friday	March 4, 2011	Emerald Princess	1200-2000	MAD	Safe berth	Conf	3100		Princess Cruises
107	Sunday	March 5, 2011	Freewinds	0600	MAD	S.pier		150		Majestic C.L.
108	Monday	March 7, 2011	Zuiderdam	0700-1600	MAD	N.Pier	Conf	1918		HAL
109	Tuesday	March 8, 2011	Freewinds	2200	MAD	S.pier				
110	Wednesday	March 9, 2011	Constellation	0800-1600	MAD	Safe berth	Conf	2034		Celebrity/RCCL
111	Thursday	March 10, 2011	Sea Princess	0800-1800	MAD	Safe berth	Conf	2016		Princess Cruises
112	Thursday	March 10, 2011	The World	0800-2400	MAD					
113	Friday	March 11, 2011	The World	0000-2400	MAD	Safe berth	Tent			Residen Sea
114	Saturday	March 12, 2011	The World	0000-1300	MAD	Safe berth	Tent	500		Residen Sea
115	Sunday	March 13, 2011	Freewinds	0600-2200	MAD	Safe berth		150		Majestic C.L.
116	Sunday	March 13, 2011	Maasdam	0800-1700	MAD	Safe berth	Conf	1258		HAL
117	Monday	March 14, 2011	Aida Vita	0800-1600	MAD	Safe berth	Conf	1260		Aida Cruises
118	Monday	March 14, 2011	Emerald Princess	1200-1900	MAD	Safe berth	Conf	3100		Princess Cruises
119	Tuesday	March 15, 2011		Berth availability	request					
120	Thursday	March 17, 2011	Caribbean Princess	1100-2000	MAD	Safe berth	Conf	3100		Princess Cruises
121	Friday	March 18, 2011	Grandeur of the Seas	0700-1600	MAD	Safe berth	Conf	2446		Celebrity/RCCL
122	Sunday	March 20, 2011	Freewinds	0600	MAD	Safe berth	Conf	150		Majestic C.L.
123	Tuesday	March 22, 2011	Freewinds	2200	MAD	Safe berth	Conf			
124	Wednesday	March 23, 2011	Constellation	0800-1600	MAD	Safe berth	Conf	2034		Celebrity/RCCL
125	Wednesday	March 23, 2011	Noordam	0800-1700	MAD	Safe berth	Conf	1918		HAL
126	Thursday	March 24, 2011	Queen Victoria	1230-1800	MAD	Safe berth		1980		Cunard
127	Friday	March 25, 2011	Sea Princess	0800-1800	MAD	Safe berth	Conf	2016		Princess Cruises
128	Sunday	March 27, 2011	Freewinds	0600-2200	MAD	Safe berth		150		Majestic C.L.
129	Monday	March 28, 2011	Aida Vita	0800-1600	MAD	Safe berth	Conf	1260		Aida Cruises
130	Monday	March 28, 2011	Star Princess	0700-1400	MAD	Safe berth	Conf	2600		Princess Cruises
131	Wednesday	March 30, 2011	Hanseatic	0800-2300	BAS	Safe berth	Conf	200		
132	Thursday	March 31, 2011	Caribbean Princess	1100-2000	MAD	Safe berth	Conf	3100		Princess Cruises
133	Friday	April 1, 2011	Leopant		????					
134	Friday	April 1, 2011	Grandeur of the Seas	0700-1600	MAD	Safe berth	Conf	2446		Celebrity/RCCL
135	Wednesday	April 6, 2011	Constellation	0800-1600	MAD	Safe berth	Conf	2034		Celebrity/RCCL
136	Thursday	April 7, 2011	Sea Princess	0800-1800	MAD	Safe berth	Conf	2016		Princess Cruises
137	Monday	April 11, 2011	Emerald Princess	1200-2000	MAD	Safe berth	Conf	3100		Princess Cruises
138	Thursday	April 14, 2011	Caribbean Princess	1100-2000	MAD	Safe berth	Conf	3100		Princess Cruises
139	Friday	April 15, 2011	Grandeur of the Seas	0700-1600	MAD	Safe berth	Conf	2446		Celebrity/RCCL
140	Tuesday	April 19, 2011	Star Princess	1200-1900	MAD	Safe berth	Conf	2600		Princess Cruises
141	Wednesday	April 20, 2011	Constellation	0800-1600	MAD	Safe berth	Conf	2034		Celebrity/RCCL
142	Thursday	April 28, 2011	Caribbean Princess	1200-2000	MAD	Safe berth	Conf	3100		Princess Cruises
143	Friday	April 29, 2011	Grandeur of the Seas	0700-1600	MAD	Safe berth	Conf	2446		Celebrity/RCCL

Monitoring days in Lac Bay

Date	Cruise	No cruise	Weekday	Weekend
04.03.11	X		x	
06.03.11		x		x
09.03.11	X		x	
10.03.11	X		x	
12.03.11	X			x
13.03.11	X			x
15.03.11	X		x	
17.03.11	X		x	
18.03.11	X		x	
20.03.11		x		x
21.03.11		x	x	
22.03.11	X		x	
24.03.11	X		x	
27.03.11		x		x
28.03.11	X		x	
29.03.11		x	x	
31.03.11	X		x	
02.04.11		x		x
03.04.11		x		x
05.04.11		x	x	
07.04.11	X		x	
08.04.11		x	x	
10.04.11		x		x
12.04.11		x	x	
15.04.11	x		x	
17.04.11		x		x
22.04.11		x	x	
24.04.11		x		x
25.04.11		x	x	
26.04.11		x	x	
27.04.11		x	x	
Total:	31	14	17	21
				10

Table 7 dates of monitoring days in Lac Bay

E Statistical results

Table 8. Number of visitors questionnaires per visitor type

	Frequency	Percentage
Cruise Tourist	55	9
Stay over tourists	364	59,4
Foreign resident	130	21,2
Native Bonairean	43	7
Other	21	3,4
Total	613	100

Chapter 4.1

Activities practiced by visitors.

Table9. Absolute total number of answers given on certain activities. (Graph 3)

	Sunbathe	Windsurf	Swim	Children	Snorkel	Work	Kayak	Fish	Party	Dive	Meeting friends	Other
Number	240	238	60	24	26	25	5	3	5	3	30	100

Table10. Absolute numbers of visitors answering they participated in certain activities. Divided amongst visitor types.

	Type				
	Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other
Sunbathing	42	120	54	8	16
Windsurfing	2	185	40	8	3
Swimming	11	30	11	5	3
Children	0	11	11	2	0
Snorkel	1	19	5	0	1
Work	0	1	17	7	0
Kayak	0	5	0	0	0
Fish	0	1	0	2	0
Party	0	2	3	0	0
Dive	0	2	1	0	0
Meetfriends	0	8	14	6	2
Other	5	59	18	16	2

Table 11. Percentages of the total respondents participating in certain activities. (Graph 4)

	Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other
Sunbathing	76%	33%	42%	19%	76%
Windsurfing	4%	51%	31%	19%	14%
Swimming	20%	8%	8%	12%	14%
Children	0%	3%	8%	5%	0%
Snorkel	2%	5%	4%	0%	5%
Work	0%	0%	13%	16%	0%
Kayak	0%	1%	0%	0%	0%
Fish	0%	0%	0%	5%	0%
Party	0%	1%	2%	0%	0%
Dive	0%	1%	1%	0%	0%
Meetfriends	0%	2%	11%	14%	10%
Other	9%	16%	14%	37%	10%

Locations in the zoning plan and number of activities monitored in there:

Table12. Absolute numbers of activities in zonations

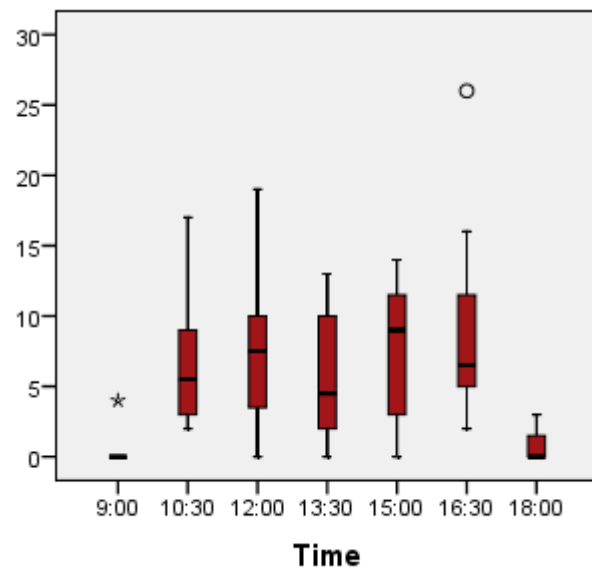
	Zone				
	White	Blue	Yellow	Orange	Red
Windsurf	434	3758	2	0	138
Swim/wade	0	2263	2	0	829
Snorkel	0	55	39	0	0
Kayak	0	100	10	0	0

Table13.Percentages of amounts of activities in zonations

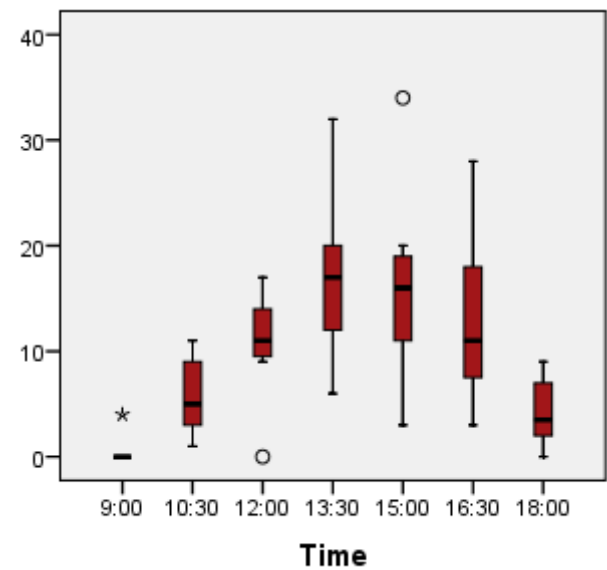
	Zone				
	White	Blue	Yellow	Orange	Red
Windsurf	10%	87%	0%	0%	3%
	White	Blue	Yellow	Orange	Red
Swim/wade	0%	73%	0%	0%	27%
	White	Blue	Yellow	Orange	Red
Snorkel	0%	59%	41%	0%	0%
	White	Blue	Yellow	Orange	Red
Kayak	0%	91%	9%	0%	0%

Table 14. Means of swimmer numbers on different day types.

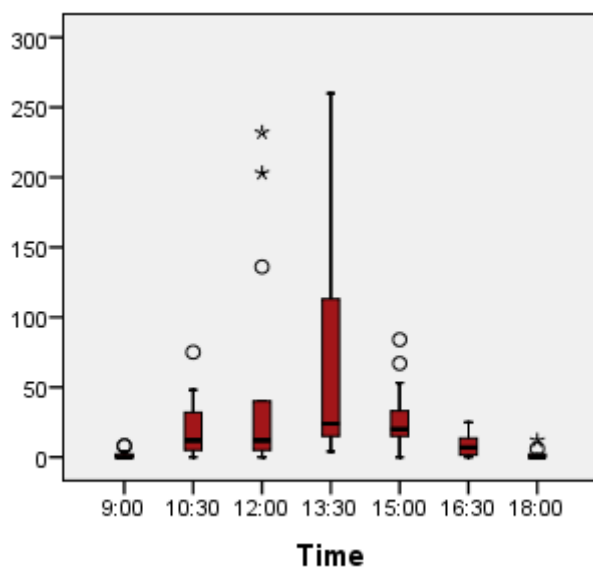
Means number of visitors	Time						
	9:00	10:30	12:00	13:30	15:00	16:30	18:00
Cruise days	50	184	304	359	271	157	71
Non-cruise weekends	31	118	196	233	260	240	126
Non-cruise weekdays	36	96	131	162	187	175	71
All days	41	139	220	263	241	185	86



Graph 25. Total amount of swimmers on non cruise week days. (Holidays excluded)



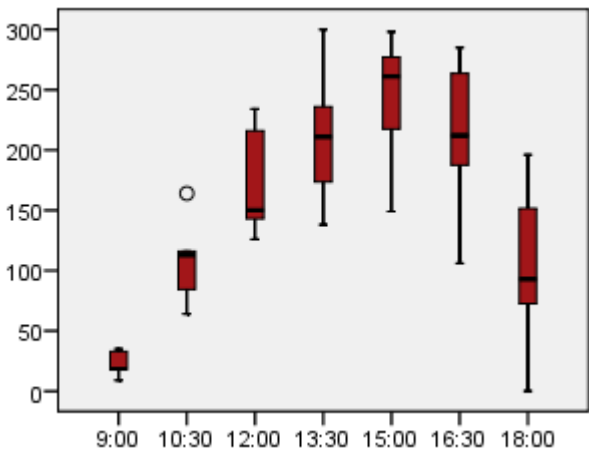
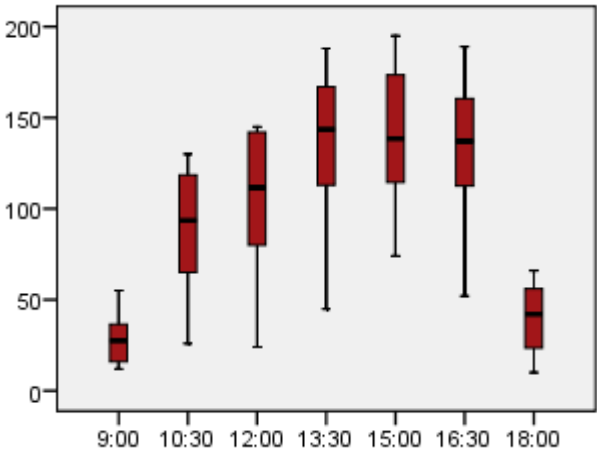
Graph 26. Total amount of swimmers on non cruise weekends. (Holidays excluded)



Graph 27. Total amount of swimmers on cruise days.

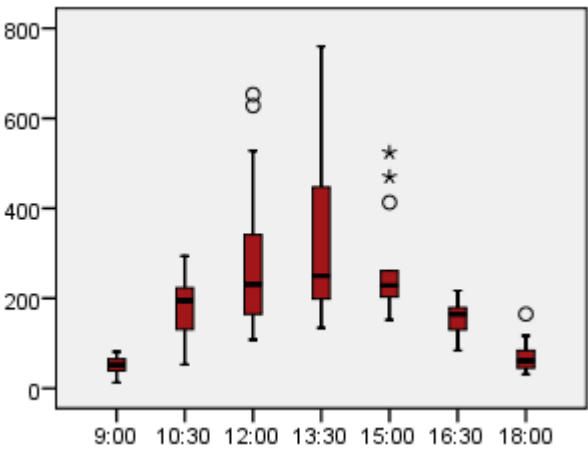
Table 15 Means of total visitor numbers on different day types.

Means number of swimmers	Time						
	9:00	10:30	12:00	13:30	15:00	16:30	18:00
Non cruise week days	41	139	220	263	241	185	86
Non cruise weekends	36	96	131	162	187	175	71
Cruise days	31	118	196	233	260	240	126

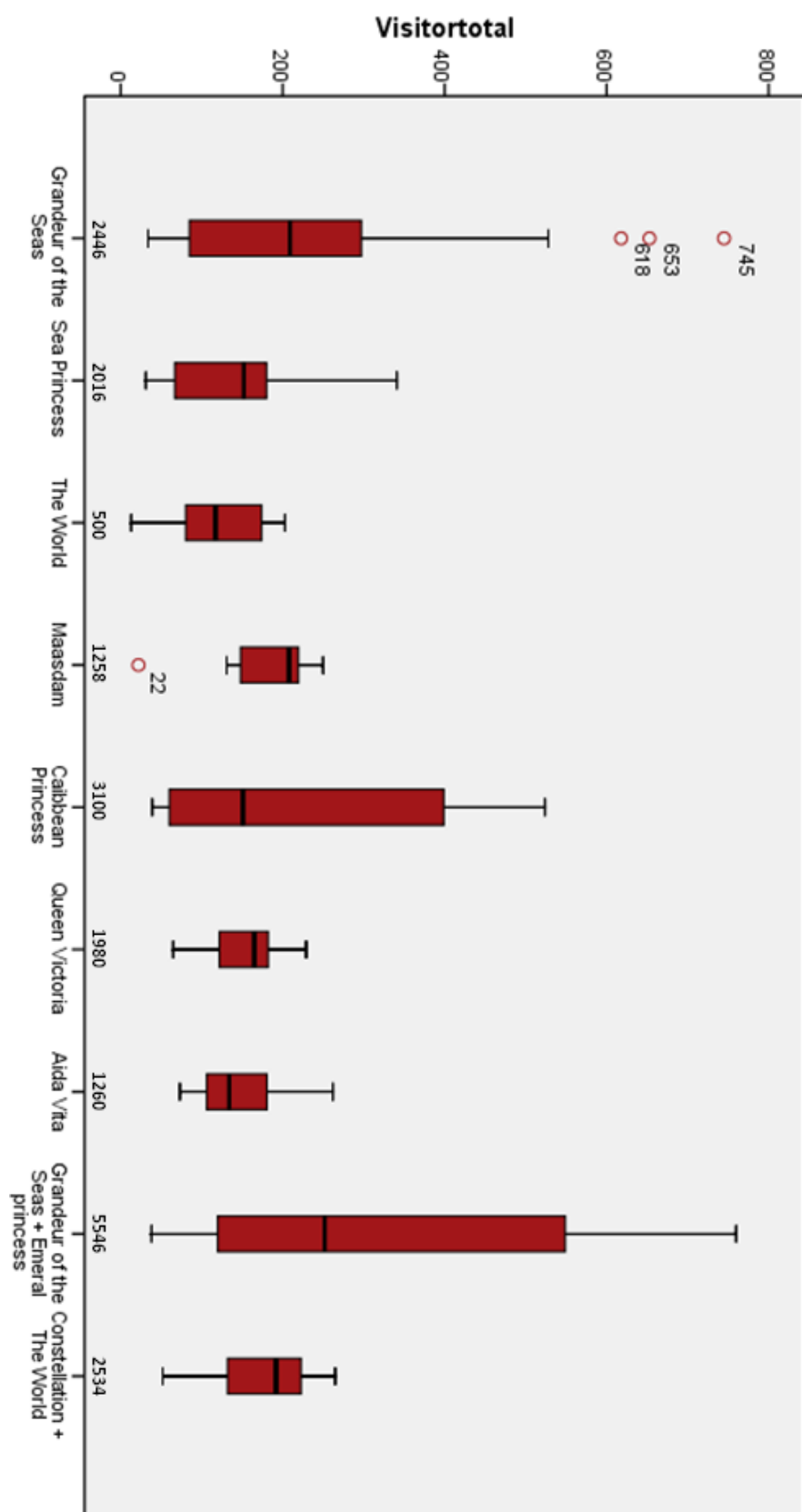


Graph 28.Visitor numbers in boxplots on non- cruise week days. (holidays excluded)

Graph non- c



Graph 30. Visitor numbers in boxplots on cruise days.



Graph 31. Total number of visitors in relation to presence of different cruise ships. Capacity indicated above cruise ship names.

Chi square. Relation between cruise capacity and total number of visitors.

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	297,933 ^a	276	,174
Likelihood Ratio	216,568	276	,997
Linear-by-Linear Association	7,348	1	,007
N of Valid Cases	84		

a. 350 cells (100,0%) have expected count less than 5. The minimum expected count is ,08.

Table 16

Chapter 4.2

Data used for graph 15, with exact number of answers for each class.

		More	Less	Just as many	Doesn't matter how many	Total
Visitorclass	0-100	20	17	138	16	191
	101-200	19	22	155	32	228
	201-300	7	26	81	20	134
	301-400	1	9	17	2	29
	401-500	1	6	6	1	14
	501 >	3	11	6	0	20

		More	Less	Just as many	Doesn't matter how many
Visitorclass	0-100	10%	9%	72%	8%
	101-200	8%	10%	68%	14%
	201-300	5%	19%	60%	15%
	301-400	3%	31%	59%	7%
	401-500	7%	43%	43%	7%
	501 >	15%	55%	30%	0%

Frequency tables of question 8 (Appendix B):

RestaurantBar		Frequency	Percent	Valid Percent
Valid	Enough	463	74,9	77,0
	Prefer More	71	11,5	11,8
	Prefer Less	22	3,6	3,7
	No Opinion	45	7,3	7,5
	Total	601	97,2	100,0
Missing	System	17	2,8	
Total		618	100,0	

Table 17 Frequencies for the number of restaurants and bars

HotelResort		Frequency	Percent	Valid Percent
Valid	Enough	383	62,0	63,7
	Prefer More	58	9,4	9,7
	Prefer Less	48	7,8	8,0
	No Opinion	112	18,1	18,6
	Total	601	97,2	100,0
Missing	System	17	2,8	
Total		618	100,0	

Table 18 Frequencies for the number of hotels and resorts

Shops		Frequency	Percent	Valid Percent
Valid	Enough	386	62,5	64,2
	Prefer More	108	17,5	18,0
	Prefer Less	36	5,8	6,0
	No Opinion	71	11,5	11,8
	Total	601	97,2	100,0
Missing	System	17	2,8	
Total		618	100,0	

Table 19 Frequencies for the number of shops

Rental		Frequency	Percent	Valid Percent
Valid	Enough	454	73,5	75,5
	Prefer More	35	5,7	5,8
	Prefer Less	8	1,3	1,3
	No Opinion	104	16,8	17,3
	Total	601	97,2	100,0
Missing	System	17	2,8	
Total		618	100,0	

Table 20 Frequencies for the number of rental places

Shading		Frequency	Percent	Valid Percent
Valid	Enough	397	64,2	67,5
	Prefer More	178	28,8	30,3
	Prefer Less	1	,2	,2
	No Opinion	12	1,9	2,0
	Total	588	95,1	100,0
Missing	System	30	4,9	
Total		618	100,0	

Table 21 Frequencies for the amount of shading

Parking		Frequency	Percent	Valid Percent
Valid	Enough	514	83,2	87,4
	Prefer More	21	3,4	3,6
	Prefer Less	5	,8	,9
	No Opinion	48	7,8	8,2
	Total	588	95,1	100,0
Missing	System	30	4,9	
Total		618	100,0	

Table 22 Frequencies for the number of parking places

Toilets		Frequency	Percent	Valid Percent
Valid	Enough	363	58,7	61,7
	Prefer More	111	18,0	18,9
	Prefer Less	1	,2	,2
	No Opinion	113	18,3	19,2
	Total	588	95,1	100,0
Missing	System	30	4,9	
Total		618	100,0	

Table 23 Frequencies for the number of toilets

Cross tabs for visitor type x opinion on availability of facilities (question 8, appendix B):

RestaurantBar * Type Crosstabulation

			Type					Total	
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other		
RestaurantBar	Enough	Count	33	288	98	26	16	461	
		% within Type	67,3%	80,2%	77,2%	61,9%	76,2%	77,1%	
	Prefer More	Count	9	27	20	11	3	70	
		% within Type	18,4%	7,5%	15,7%	26,2%	14,3%	11,7%	
	Prefer Less	Count	1	11	6	4	0	22	
		% within Type	2,0%	3,1%	4,7%	9,5%	,0%	3,7%	
	No Opinion	Count	6	33	3	1	2	45	
		% within Type	12,2%	9,2%	2,4%	2,4%	9,5%	7,5%	
	Total		Count	49	359	127	42	21	598
			% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 24

HotelResort * Type Crosstabulation

			Type					Total
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other	
HotelResort	Enough	Count	15	239	85	31	11	381
		% within Type	30,6%	66,6%	66,9%	73,8%	52,4%	63,7%
	Prefer More	Count	10	25	16	6	0	57
		% within Type	20,4%	7,0%	12,6%	14,3%	,0%	9,5%
	Prefer Less	Count	0	25	18	4	1	48
		% within Type	,0%	7,0%	14,2%	9,5%	4,8%	8,0%
	No Opinion	Count	24	70	8	1	9	112
		% within Type	49,0%	19,5%	6,3%	2,4%	42,9%	18,7%
Total		Count	49	359	127	42	21	598
		% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 25

Shops * Type Crosstabulation

			Type					Total
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other	
Shops	Enough	Count	23	238	84	28	10	383
		% within Type	46,9%	66,3%	66,1%	66,7%	47,6%	64,0%
	Prefer More	Count	15	45	31	11	6	108
		% within Type	30,6%	12,5%	24,4%	26,2%	28,6%	18,1%
	Prefer Less	Count	3	20	10	3	0	36
		% within Type	6,1%	5,6%	7,9%	7,1%	,0%	6,0%
	No Opinion	Count	8	56	2	0	5	71
		% within Type	16,3%	15,6%	1,6%	,0%	23,8%	11,9%
	Total	Count	49	359	127	42	21	598
		% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 26

Rental * Type Crosstabulation

			Type					Total
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other	
Rental	Enough	Count	24	278	101	33	15	451
		% within Type	49,0%	77,4%	79,5%	78,6%	71,4%	75,4%
	Prefer More	Count	6	12	11	6	0	35
		% within Type	12,2%	3,3%	8,7%	14,3%	,0%	5,9%
	Prefer Less	Count	0	5	3	0	0	8
		% within Type	,0%	1,4%	2,4%	,0%	,0%	1,3%
	No Opinion	Count	19	64	12	3	6	104
		% within Type	38,8%	17,8%	9,4%	7,1%	28,6%	17,4%
	Total	Count	49	359	127	42	21	598
		% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 27

Shading * Type Crosstabulation

			Type					Total
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other	
Shading	Enough	Count	27	245	89	18	16	395
		% within Type	55,1%	69,8%	73,0%	42,9%	76,2%	67,5%
	Prefer More	Count	22	97	32	21	5	177
		% within Type	44,9%	27,6%	26,2%	50,0%	23,8%	30,3%
	Prefer Less	Count	0	1	0	0	0	1
		% within Type	,0%	,3%	,0%	,0%	,0%	,2%
	No Opinion	Count	0	8	1	3	0	12
		% within Type	,0%	2,3%	,8%	7,1%	,0%	2,1%
	Total	Count	49	351	122	42	21	585
		% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 28

Parking * Type Crosstabulation

			Type					Total
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other	
Parking	Enough	Count	18	328	113	34	18	511
		% within Type	36,7%	93,4%	92,6%	81,0%	85,7%	87,4%
	Prefer More	Count	0	6	7	6	2	21
		% within Type	,0%	1,7%	5,7%	14,3%	9,5%	3,6%
	Prefer Less	Count	0	2	1	2	0	5
		% within Type	,0%	,6%	,8%	4,8%	,0%	,9%
	No Opinion	Count	31	15	1	0	1	48
		% within Type	63,3%	4,3%	,8%	,0%	4,8%	8,2%
	Total	Count	49	351	122	42	21	585
		% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 29

Toilets * Type Crosstabulation

			Type					Total
			Cruise Tourist	Stay over tourists	Foreign resident	Native Bonairean	Other	
Toilets	Enough	Count	11	240	75	23	12	361
		% within Type	22,4%	68,4%	61,5%	54,8%	57,1%	61,7%
	Prefer More	Count	13	44	32	15	6	110
		% within Type	26,5%	12,5%	26,2%	35,7%	28,6%	18,8%
	Prefer Less	Count	0	0	0	1	0	1
		% within Type	,0%	,0%	,0%	2,4%	,0%	,2%
	No Opinion	Count	25	67	15	3	3	113
		% within Type	51,0%	19,1%	12,3%	7,1%	14,3%	19,3%
	Total	Count	49	351	122	42	21	585
		% within Type	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Table 30

Chapter 4.3

4.3.2

Table 31. Awareness of regulations amongst different visitor types.

		Zonemap		Total
		yes	no	
Type	Cruise Tourist	8	47	55
	Stay over tourists	135	229	364
	Foreign resident	58	72	130
	Native Bonairean	20	23	43
	Other	5	16	21
Total		226	387	613

Table 32 Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	18,391 ^a	4	,001
Likelihood Ratio	20,170	4	,000
Linear-by-Linear Association	4,644	1	,031
N of Valid Cases	613		

a. 0 cells (,0%) have expected count less than 5. The minimum expected count is 7,74.

Table 33

		Seagrasslines		Total
		yes	no	
Type	Cruise Tourist	44	7	51
	Stay over tourists	329	30	359
	Foreign resident	118	10	128
	Native Bonairean	37	6	43
	Other	21	0	21
Total		549	53	602

Table 34 Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5,232 ^a	4	,264
Likelihood Ratio	6,684	4	,154
Linear-by-Linear Association	,655	1	,418
N of Valid Cases	602		

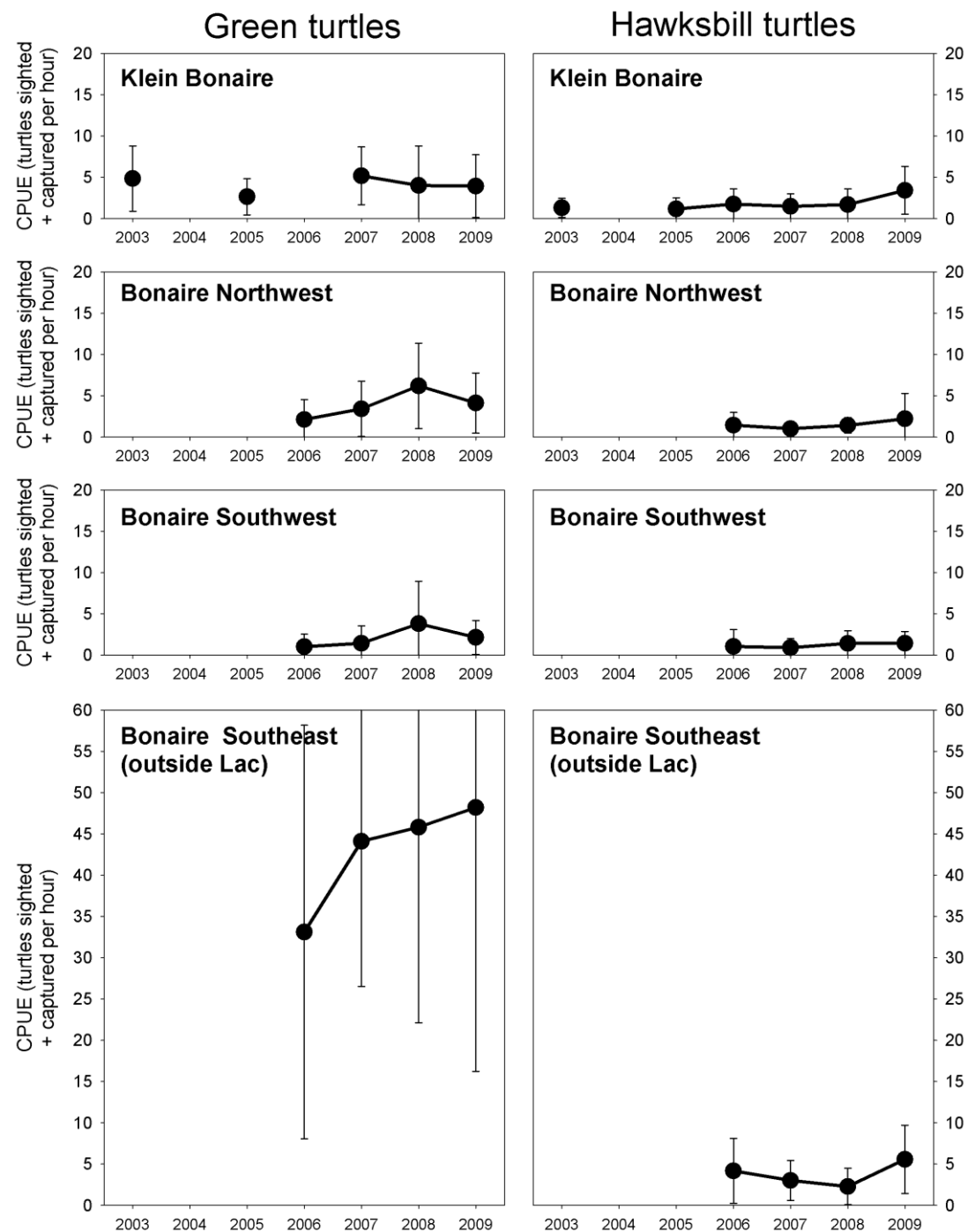
a. 3 cells (30,0%) have expected count less than 5. The minimum expected count is 1,85.

Table 35. Chi-Square Tests on the association of visitor numbers and seagrass trampling

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	80,000 ^a	75	,325
Likelihood Ratio	48,355	75	,993
Linear-by-Linear Association	1,295	1	,255
N of Valid Cases	16		

a. 96 cells (100,0%) have expected count less than 5. The minimum expected count is ,06.

Chapter 4.4



Graph 32 (Kalke, 2009)

F Taxi drivers questionnaire

Datum:

Interviewer:

Tijd:

Locatie:

1 Hoeveel personen neemt u maximaal mee tijdens een taxirit?

Aantal personen:

2 Hoeveel kost een rit per persoon voor vervoer van de pier in Kralendijk naar Lac Sorobon?

US\$

3 Hoeveel kost een rit per persoon voor vervoer van Lac Sorobon naar de pier in Kralendijk?

US \$

4 Denkt u persoonlijk dat mensen dit veel, weinig of een goed bedrag vinden?

Veel / Weinig / Goed bedrag / Weet ik niet

5 Vertelt u uw klanten ook iets over het gebied waar u ze heenbrengt, in dit geval Lac Baai?

- ☐ Mangrove bossen ☐ Natuurbescherming (aanraken van zeegras en koraal)
- ☐ Nature fee STINAPA ☐ Zeeschildpadden, Flamingo's, Conch
- ☐ Mogelijke activiteiten (kajakken, surfen, snorkelen, zwemmen,)
- ☐ Zoneringplan van STINAPA voor menselijke activiteiten in Lac Baai
- ☐ Anders:.....

6 Zou u bereidt zijn informatie over Lac Baai te verstrekken aan uw klanten in de vorm van folders of een informatiebord in uw taxi?

Ja / Nee / Misschien / Weet ik niet

7 Welke weg neemt u wanneer u tussen de pier in Kralendijk en Lac Sorobon heen en weer rijdt?

- a) Kaya IR. Randolph Statius Van Eps (langs het vliegveld en Belnem)
- b) Kaminda Sorobon (kronkelweg langs de mangrove)
- c) Naar Sorobon A, naar Kralendijk B
- d) Naar Sorobon B, naar Kralendijk A
- e) Verschilt per rit
- f) Weet ik niet

8 Hoe vaak rijdt u vandaag heen en weer tussen Kralendijk en Sorobon?

1 / 2 / 3 / 4 / 5 / 6 / 7

G Interviews stakeholders Lac

Statements in this chapter are personal opinions and points of view, they do not necessarily represent facts.

28 april 2011

Maarten de Groot, The Beach Hut

The Beach Hut is ontstaan via Roger en Elvis, die 15 jaar geleden The Windsurf Place hebben opgezet, bestaande uit een aantal containers waarvan er 1 dienst deed als keuken. De surfschool en de bar samen werden te druk voor Roger en Elvis, die besloten het bar gedeelte te verhuren. Vanaf 1 augustus 2008 huurt Maarten het horeca gedeelte.

Sindsdien is hij het langzaam gaan uitbreiden tot een levendige bar met ruimte voor veel mensen. Hij heeft nu zo'n 200 ligbedden die voor 5 US\$ verhuurd worden, een overdekt restaurant gedeelte met zitruimte, een bar en een lounge gedeelte. Hij probeert lokalen te betrekken bij zijn business door zoveel mogelijk van zijn inkopen te doen bij Bonairianen. Hij heeft geen lokalen werken in zijn restaurant, die zijn naar zijn mening niet efficiënt genoeg.

Hij merkt duidelijk dat het eiland steeds drukker wordt, voornamelijk door cruiseschepen. Hij heeft natuurlijk wel een voordeel aan het cruisetoerisme, doordat die met taxi's bij de Beach Hut worden afgezet en ligstoelen huren. Toch zou hij niet willen dat het toerisme nog verder wordt uitgebreid. Hij is ook blij met de regel dat er niet meer bijgebouwd mag worden in het beschermde gedeelte van Lac. Mensen komen naar Bonaire, juist omdat er weinig is, ze komen voor de natuur en het uitzicht. Als er toch veel bijgebouwd zou worden verander je dat.

Vindt het cruise schip Grandeur of the Seas de drukste boot, voor die cruise is Bonaire de laatste stop en de mensen komen dan allemaal naar het strand.

Is voor betere educatie van toeristen. Hij is het ook met ons eens dat het informatie bord van STCB wellicht beter zou staan bij de ingang van de Beach Hut en Windsurf Place, op die manier bereik je iedereen op dat deel van Sorobon, er is maar 1 ingang. Hij zegt zelf dat het bord op de huidige locatie (op het strand waar de ligstoelen beginnen) is geplaatst door STCB zelf. Hij is van mening dat toeristen goed gecontroleerd worden op hun Nature Fee tags, maar vindt dat er meer aandacht besteed mag worden aan erop letten dat men zich aan de regels houdt.

The Beach Hut heeft 2 septische systemen. 1 is net nieuw geplaatst om een oude lekkende te vervangen, deze nieuwe heeft 4 kamers, het eindwater hiervan wordt gebruikt voor bewatering van de planten. De andere wordt gebruikt om keukenwater in op te vangen, deze wordt elke twee weken geleegd. Het afval van The Beach Hut wordt afgevoerd naar de landfill.

29 april 2011

Elly Albers, Mangrove info & activity centre

Geeft al jaren lang kayak tours in het mangrove gebied van Lac, die groene zone (waar kayak en snorkeltours zijn toegestaan) heeft de huidige grenzen door de vaste routes die zij al tijdenlang aanhoudt. Gemiddeld op jaarbasis heeft ze 10 kayakers per dag. Omdat ze activiteiten in Lac houdt moet ze zich aan strike regels houden, er mogen maximaal 8 kayaks per tour mee, waarvan er 1 voor de gids is, dan zouden er maximaal 14 toeristen meer kunnen per toer. De gidsen moeten een cursus bij STINAPA hebben gevolgd om tours te mogen geven, dit houdt in dat ze leren over het gebied, wat er wel en niet mag en uitleg over het zoneringsplan.

Elly en outdoor Hans zijn momenteel de enige die kayak en snorkeltours in het gebied houden. Ze hebben goed contact met elkaar, overleggen over tijden zodat ze elkaar niet in de weg zitten en wisselen gasten uit wanneer een van hen al vol zit voor een tour terwijl de andere nog plek heeft.

Ze is tegen meer ontwikkeling in Lac, maar vindt dit wel onrealistisch, mensen moeten hun geld ergens verdienen. Mensen moeten onthouden dat toerisme op Bonaire is vanwege de natuur. Dit idee zou beter uitgedragen kunnen worden en toeristen zouden beter geïnformeerd kunnen worden over de natuur hier.

Ze vindt dat STINAPA veel werk te doen heeft om het gebied te onderhouden en daar zouden ze meer capaciteit voor kunnen gebruiken om te voorkomen dat punten te weinig aandacht krijgen. Zelf ziet zij nog regelmatig gevallen van zandextractie of mensen die in de mangroves komen terwijl ze daar niet moeten zijn. Het lijkt haar een goed idee om hiertegen continue controle te hebben in Lac, een boot die altijd in de baai ligt bijvoorbeeld. Ze vindt ook dat buitenlanders erg gedreven kunnen zijn met betrekking tot natuurbehoud, als die speciaal aangesteld worden voor een baan om de natuur te controleren zouden ze dit waarschijnlijk zeer gedreven volbrengen. Ze vindt dat de witte zone in de baai onduidelijk is aangegeven. Ze heeft het idee dat de Nature Fee niet genoeg door alle ondernemers even goed verkocht aan toeristen. Iedereen zou hier beter achter moeten staan, of het geld moet al bij de vliegveld douane geïnd worden.

29 april 2011

Harry, Sorobon Beach Resort (SBR)

Is manager van de bar en gedeeltelijk van de appartementen sinds 2010. Sinds 18 december 2010 is SBR geen nudisten resort meer, wat het sinds 1984 geweest is. Deze recentelijke verandering maakt SBR toegankelijk voor meer publiek.

Er kunnen maximaal 60 gasten per nacht verblijven, verdeeld over 25 appartementen. De gemiddelde bezetting is 60%.

Harry geeft aan dat hij geen cruise toeristen op zijn strand wil, die verstoren de rust van zijn gasten. Hij zegt ook dat mensen die naar Bonaire en Lac komen, hier zijn om van de rust en de natuur te genieten. Je hebt dan wel mogelijkheden om faciliteiten te gaan uitbreiden en hier op korte termijn winst mee te maken, maar op langere termijn verniet je het natuur beeld en verlies je de rust. Hierdoor komen er vervolgens ook geen toeristen meer. Door de groei van de bevolking op Bonaire en grotere aantallen toeristen moet ook het beheer hierop aangepast worden met verbeterd management en regels. Het belangrijkste is het gebied in stand te houden, dit blijft immers de attractie waarom de mensen hierheen komen. Zelf is hij wel voor uitbreidingen van zijn resort, zolang het het gebied niet verniet.

Hij vindt dat toeristen meer kan voorzien kunnen worden van informatie en educatie. Over het zonerings plan zegt hij dat de blauwe zone niet helemaal tot aan Cai zou hoeven reiken, zover komen mensen toch niet en zo zou er daar meer ruimte zijn voor het botenverkeer. Over de Nature fee zegt hij dat deze niet verkoopt, dit gaat alleen via de watersport bedrijven. Wel geeft hij al zijn gasten die reserveren via E-mail een aantal bestanden met informatie over het gebied. Hij zou graag van STINAPA ook een pdf document hebben met hierin uitleg over de regels in Lac, zonerings plan en de Nature fee. Dan kan hij deze ook meesturen bij reserveringen. Verder zou hij graag 's nachts controle willen zien in het gebied, hij merkt dan dat er illegale dingen gebeuren zoals zandwinning en Conch stroperij.

SBR heeft 4 ondergrondse septic tanks, die zijn zo oud als het resort zelf, zo'n 30 jaar. Waarschijnlijk lekken ze zegt Harry. Elke 4 a 5 maanden worden ze leeggepompt. Hij gaat samen met DROB een CO₂ neutraal plan voor SBR opstellen. Deze zou binnen 5 jaar gerealiseerd moeten worden.

Als laatste geeft hij aan dat graag meer onderlinge communicatie zou zien tussen de werkzame organisaties en stakeholders. Een werkgroep opzetten? Of elkaar informeren en op de hoogte houden via E-mail groepen?

29 april 2011

Miriam Geerlings en Martin Bekkum, Kontiki Beach Club

Sinds juni 1998 zijn zij eigenaar van deze locatie. Ze hebben het opgericht van wat eerst een verlaten restaurant was. In die tijd was er vooral veel activiteit bij Cai. Ze zijn zich gaan richten op uitbreidingen met als doelgroep windsurfers. Tegenwoordig kunnen ze maximaal 60 gasten per nacht ontvangen, de gemiddelde bezetting is 40, waarvan 70% surfer is. Ze werken veel samen met lokalen, die ook bij het resort werken.

Ze beseffen dat Lac een belangrijk gebied is voor de natuur. Mensen komen om van deze natuur te genieten. Ze hebben vaak terugkerende gasten die de plek erg mooi vinden.

Ze zijn erg begaan met de natuur, ze hadden al plannen voor uitbreiding van het resort en hebben hiervoor een MER procedure gevolgd, die toen nog niet verplicht was. Ze proberen alle uitbreidingen op een zo ecologisch mogelijke wijze te doen. Aan uitbreidingen van meer faciliteiten in het gebied zien ze liever niet zoveel, het gebied zit wel aan z'n top. Wel zouden er meer educatieve dingen moeten komen, zoals een uitkijktoren, trails door de mangrove met informatie borden.

Ze zouden graag zien dat er meer druk wordt uitgeoefend op de overheid voor onderhoud van het gebied en het schoonhouden van stranden. Het strand voor Kontiki is van de overheid, maar dit wordt niet schoongehouden en prullenbakken worden niet geleegd. Openbare toiletten zouden beter onderhouden moeten worden en er kan meer informatie verstrekt worden aan toeristen. Ook vinden ze dat er niet genoeg 1 lijn getrokken wordt, handhaving van regels moet duidelijker en eerlijker. Ze zouden graag hebben dat informatieve folders over het gebied bij hen langs gebracht worden zodat ze deze kunnen verstrekken aan hun gasten, ze willen hier niet zelf achteraan hoeven gaan. Ook zouden ze graag de nature fee verkopen bij Kontiki en hierover meer informatie verstrekken, en ze zouden graag een informatie bord over het gebied bij het resort hebben staan. Ze zouden graag zien dat Lac een soort park idee zou zijn, zoals het Washington park, met rangers die constant aanwezig zijn om informatie te verstrekken.

Ze staan negatief tegenover cruise toerisme. Van hun gasten krijgen ze vaak negatieve uiting over cruise toeristen. Ze geven aan dat deze mensen niet voor de natuur en het gebied komen. Het zou veel beter zijn om deze schepen te weren en juist een soort eco- cruise schepen naar Bonaire te trekken.

Kontiki beschikt over een septic tank uit 1985. Het water uit de eerste kamer wordt regelmatig geleegd en dit gaat naar de landfill. Het grijze water gaat naar kunuks in de buurt die het gebruiken als bewatering voor het land. Kris Kats van PES doet regelmatig metingen in het water voor Kontiki, hij vindt geen resultaten die erop lijken dat de tank lekt.

Ze geven ook aan dat ze veel overlast hebben van loslopende geiten die de tuin vernielen.

29 april 2011

Willem en Christine van Dijk, Jibe City Beachbar

20 jaar geleden is Jibe City heel kleinschalig begonnen. Dit werd steeds verder uitgebreid naar een actieve surfschool en beachbar. In de loop der tijd werden Robert en Monique eigenaar van Jibe, en 3 jaar geleden hebben Willem en Christine de bar overgenomen.

Geeft aan de baai een mooie uitstraling heeft wat de toeristen trekt, ze hoopt dat dit uitzicht niet zal veranderen door meer ontwikkelingen in het gebied.

Christine geeft aan dat ze graag meer zou communiceren met STINAPA over planning en regelgeving. Ze zouden het geen moeite vinden om meer informatie over het gebied te verstrekken of het informatie bord, wat nu uit het zicht bij de toiletten hangt, ergens meer opvallend te plaatsen. Ze vindt dat er niet genoeg 1 lijn wordt getrokken wat betreft toestemming voor activiteiten bij Lac, bijvoorbeeld wel surfwedstrijden, maar geen feesten op het strand, hier zou ze graag meer toelichting over horen. De richtlijnen wat betreft ontwikkelingen in het gebied zijn wel goed duidelijk.

Cruise toerisme is niet bevorderlijk voor de natuur. Zelf ondervingen ze er bij de beachbar geen hinder van, maar de surfers wel wanneer de mensen allemaal in het blauwe gebied lopen.

Jibe heeft een ondergrondse septic tank van 9 m³. Het grijze water uit de laatste kamer wordt een gebruikt om de palmbomen te bewateren. 1 keer per week worden alle kamers geleeegd.

1 mei 2011

Robert en Monique, Jibe City

Jibe City is 23 jaar geleden als windsurf centre opgezet. 8 jaar terug hebben Robert en Monique de beachbar gekocht, en 2 jaar daarna ook de omliggende grond en de surfschool. Nu verhuren ze de bar aan Willem en Christine.

Ze doen hun best om rekening te houden met de natuur. Ze zijn wel ondernemer en uitbreiding hierbij is gewenst, maar ze zien in dat de natuur in stand gehouden moet worden. Het huidige aantal ondernemers in het gebied is goed in evenwicht, hier moet niet meer bijkomen.

Over cruisetoeerisme zeggen ze dat deze het gebied uit balans brengen. Zonder de boten zou het gebied wel goed in balans zijn. Zeggen dat het erop lijkt dat het eiland zijn economie afleest aan het aantal cruiseschepen, dat de overheid het liefst dit aantal uitbreidt. Volgens hen heeft cruisetoeerisme in 10 dagen meer impact dan de surfschool het hele jaar door. Hierdoor hebben ze het gevoel dat hun eigen moeite om de natuur te behouden een te klein effect heeft. Vooral het overmatig gebruik van de toiletten wanneer er cruisetoeeristen aanwezig zijn. Ook krijgen ze klachten van surfers dat er teveel mensen door het water lopen, in het blauwe gebied.

Over STINAPA zeggen ze dat deze met twee maten meet, bij Jibe worden toeristen gecontroleerd op nature fees, terwijl hiernaast, bij de Beachhut en Windsurf Place al die cruisetoeeristen zonder tags lopen. Ze hebben het idee dat lokalen makkelijker tussen de regels doorkomen, beleid moet op 1 lijn liggen. De tags worden bij de surfschool verkocht, maar een betere manier zou zijn om het via de airport te doen. Hierdoor mis je niemand, is er minder administratie nodig en hebben de rangers meer tijd over om andere controles te doen in het gebied. Ook willen ze wel meer informatie over het gebied verstrekken in de vorm van folders, maar initiatief hiervoor moet vanuit STINAPA komen. Ze vinden dat STINAPA een goede uitstraling heeft, ze zijn vriendelijk tegenover toeristen.

Ze vinden het onnodig dat ze moeten betalen om hun afval af te voeren. Een groot deel hiervan komt van het strand af wat aangespoeld is, dit moet toch schoon gehouden worden om het strand representatief te houden. Dit is niet alleen hun verantwoordelijkheid maar ook die van het beheer en de overheid.

Over het zoneringsplan hebben ze het idee om meer afgezette zwemgedeelten te maken vlak voor het strand waar de surfers eerst voorbij moeten. Zo blijven deze groepen recreanten uit elkaars gebieden.

1 mei 2011

Elvis Martinez, The Windsurf Place

In 1986 is hij gestart met de windsurf school, in 1995 kwam hier de bar bij. Tegenwoordig wordt de bar verhuurd aan Maarten en worden er ligbedden verhuurd (\$5), waarvan hij er 200 heeft. Hij doet graag mee aan projecten voor kinderen, zo heeft hij de surfschool opgezet voor de jeugd van Bonaire, die nu zijn uitgegroeid tot professionele windsurfers. Ook geeft hij steun aan de club Jong Bonaire, hij heeft een locatie voor hen geregeld waar surfspullen kunnen worden opgeslagen en hij doneert geld voor surflessen.

Hij geeft aan dat hij het cruisetoerisme nodig heeft om het jaar rond genoeg inkomen te hebben. De surfschool heeft niet genoeg inkomen het jaar door, het verhuur van de ligbedden compenseert dit. Hij zegt dat cruisetoerisme zichzelf vanzelf balanceert, als het te druk wordt gaan mensen vanzelf weg. Wel zegt hij dat hij het met 2 aangemeerde cruise schepen te druk vindt, dan zouden er meer attracties op het eiland moeten zijn waarover de mensen zich kunnen verdelen. Een oplossing hiervoor zou zijn om cruise schepen meer verspreid over het jaar te laten komen, nu heb je een paar maanden hele drukke periodes, en in de zomer komen er helemaal geen cruiseschepen. Zo zou het ook voorkomen kunnen worden dat er 2 schepen tegelijk zijn. Hij zegt dat de cruise toeristen maar weinig impact hebben, ze zijn maar voor een uur of 2 op het strand en zijn daarna weer weg.

In het gebied ziet hij liever niet meer ondernemers, er is niet genoeg geld aan het gebied te verdienen met meer ondernemers, en ook zou dan de druk op de natuur te groot worden. Hij heeft jaren gewerkt aan de Windsurf Place en de Beachhut om deze tot een aantrekkelijke lokatie te maken, maar daarbij wel zo veel mogelijk rekening houden met de natuur. Zijn gebouwen zijn bijvoorbeeld niet geschilderd om beter in het natuurbbeeld te passen. Hij zegt ook de eerste investeerder te zijn in het aanleggen van de zeegraslijnen. Hij vindt dat er ruimte moet blijven voor de lokalen om te genieten van het gebied, niet alles moet uitgebreid worden voor toerisme, de pier moet juist voor de lokalen blijven.

Over STINAPA zegt hij dat ze erg goed werk doen. Zeker als je het vergelijkt met natuurbeheer in andere landen, ligt Bonaire daar erg op voor. Hij vindt wel dat er de laatste jaren steeds meer onnodige regels bij zijn gekomen. Zoals het verbieden van de vangst van bepaalde vissoorten, terwijl het verminderen in aantal van die soorten niet te wijten valt aan vissers, maar door natuurlijke processen. Het succes van STINAPA komt volgens hem vooral doordat er veel lokalen bij werken, die zijn betrokken met de natuur en doordat het lokalen zijn die de regels voorleggen worden deze sneller gerespecteerd.

I Minutes of presentation about data collection on Bonaire

Carrying capacity Lac Bay area, by Carsten Wentink and Astrid Wulfsen

3 May 2011, Sorobon Beach Resort, 3 – 5 pm

Number of participants: ±30

Thanks to Jimmy van Rijn for taking notes

Questions from the participants after the presentation

What was the reason for the timing of this project. Why did you not do it later in the season?

The survey was planned in March and April because this is the tourism high season. When you're doing research on the carrying capacity and recreational pressure on a location it is important to do this when the pressure is expected to be highest.

In response it is stated that it might be interesting to conduct research in the hurricane season as well because during this period locals often leave their boats in the bay to protect them from the stormy reversal winds.

Why were governmental organizations not seen as a stakeholder?

We have chosen to limit ourselves to the ones who are more personally involved, such as local entrepreneurs. In response it is stated that when doing policy supporting research one should first consult policy makers before you start. Dolfi Debrot has added the comment that actually government is owner, not stakeholder. Stinapa is appointed manager, not stakeholder. The purpose was to investigate the ideas of the user public as stakeholders not people and organizations higher up the chain of command.

Comments:

Elvis: I was the First one at Sorobon to open a business. Since then I have seen major changes! The Lac Bay area clogging up which leads to a shallower Lac Bay. The sea grass that we have been protecting in front of our shops is also in my opinion a contributor to this problem, so should we keep protecting it? It might be useful to take a look at the oldest reports about Lac and see what has changed. (Sabine Engel has a link to a digitalized version of this report) Also Lac is a special place for Bonairian culture and I feel that we should not develop Sorobon too much so that local Bonairians have their place as well. Like the pier, I think that should stay a place for locals.

Elly Alberts: In mangrove management and policy there is a discrepancy going on. Because the commercial trips and entrepreneurs are to follow strict rules while locals are free to go into the nesting areas. What I see is that quite a few fishermen and especially people from Surinam with their traditional fishing methods (throwing nets) walk thru these RAMSAR protected nesting areas.

Notes of the discussion

The discussion was based on a number of propositions developed by the interns for the sake of discussion and based on their points of view and personal opinions. They do not represent actual intentions.

#1 Environmental awareness amongst visitors should be improved.

Almost everybody agrees without hesitation. Some people notice that not all visitors pay or know about the Nature Fee. Opinions about this, entrepreneurs should take responsibility and inform people about this.

There are sceptical feelings about how long it will take for people to take action as a follow up on our research recommendations.

Businesses in the area could make a huge difference in awareness creation because they are in direct contact with tourists, and an immediate change will be noticeable. Once you have explained tourists about the special natural values of Lac they immediately are more careful and appreciate their time here more.

We should not only focus on environmental awareness but as well on cultural awareness because that is a big part of Lac as well.

#2 Sorobon needs a visitor centre slagbaai style.

Quite a lot of people have positive reactions, but there is still hesitation about the meaning of this visitor centre, what is it for, what will be possible there?

Positive reactions about the idea that people should get the feeling they enter a special area, like an entrance or striking entrance sign.

Also an information centre is a good idea to follow up on the first discussion point. The next point builds upon this one.

#3 Without nature fee a compulsory entrance fee.

This point of view generates a lot of noise. The idea would be like the entrance at the National Park but then quicker so if you show your nature fee tag you can drive through straight away so it does not clog up. Visitors who do not have a Nature Fee can buy one at the entrance, or they could buy a Lac Bay entrance fee, which could cost about 5 Dollars, which would be like a day pass.

General thought is: why is the Nature Fee not being charged at the airport customs? This way you reach all the visitors to Bonaire, except for the cruise tourists. Disadvantage about this is that it could be too general, and you forget about creating awareness.

#4 There should be a maximum number of visitors allowed access to the area at a time.

The maximum number of people allowed to Lac will have to be corresponding with the carrying capacity. To maintain these levels we should not look at numbers of people alone. Because then tourist businesses and taxi drivers would rush over to Lac to get their clients there early, creating dangerous situations on the roads and irritation and anger. Also there should always be place for the locals to visit the area.

An impression about cruise tourists is that they do not spend a lot of money at Sorobon, and thus they should be the first to be moved out of the area. There are experiences that cruise tourists disturb the atmosphere and they make other people want to leave. So next to environmental and cultural carrying capacity, social capacity must be taken into account as well, the best would be to try and find a balance.

An idea about the maximum number of visitors; if there would be more places people could go you could distribute the people/pressure around the island. Many public beaches slowly become more and more private owned beaches by the hotels. This stops possibilities to distribute pressure over the beaches. A problem is that there are not enough beaches for tourists on Bonaire and we cannot make more beaches to reduce pressure because that would have a negative impact on surrounding reefs.

The idea about not to think only in number management but also in activity management comes up. Reactions on this is that the rentals should not be responsible for this activity management by restriction/maximums. Because by this you can get people that do activities on their own and then they do not get the advice and information about the area, resulting in poor education.

We should think about people/tourist management and not just restrict the number of tourist that visit Lac.

#5 What to do with the pier area?

It is being said that there is too much litter lying around the area, not only at the pier but also around the parking area. The pier area is a place which is primarily being used by local Bonaireans and some find it important to maintain this value in future plans for this specific area. Because there are no businesses adjacent to this part of the beach it is not subject to regular cleaning as is happening at the businesses at the other side of the peninsula. Therefore it is being said that a proper way of garbage disposal should be put in place. Currently there are no trashcans and there is no place to dispose of hot barbeque ashes, which currently often end up on the beach. It is stated that the rawness of the pier area might be something that could also be particularly appreciated. Therefore more development might not be a good idea, maybe the area should be kept the way it is. As a reaction it is stated that indeed development is not particularly necessary but the area should be taken better care of in terms of maintenance and garbage disposal. It is also stated that these points should also count for the parking area adjacent to the pier area. Another point is that there is not a designated place for visitors to park their car. Cars can be found too close to mangrove vegetation and the beach. It is stated that the cars should not be parked so close to the beach so that more suitable space for recreation will be made. Perhaps part of the area would be suitable for sports activities. In the pier area also a large hole filled with old construction debris can be found. Maybe this place should be cleaned up. Perhaps something cultural can be done here, for example about windsurfing which the bay is so famous for.

#6 What is wise use?

It is stated that wise use means that in Lac a harmony should be found between all activities in the area. Nature conservation, tourism, sports, local recreation etc. It is stated that the term sustainable use actually originated from wise use. It is also mentioned that it might be necessary to adjust nature in order to maintain it. In this matter is being aimed at the clogging of the bay which locals are very concerned about. Before talking about solutions it is said that in order to make good decisions elaborate research has to be done.

#7 Creating a new beach on Bonaire in order to reduce pressure on Sorobon is a good idea?

It is brought forward that on Curaçao making an artificial beach turned out devastating for the reef. On Curaçao it destroyed hundreds of meters of reef. In response another project on Curaçao is mentioned, where they successfully made an artificial beach which left the coral reef intact. They made a wooden platform to support a beach above the actual water. Such a beach could be relatively sustainable and could relieve recreational pressure at Sorobon. It is also stated that the recreational pressure could be diverted to Bonaire's other tourist attractions.

Appendices part 2; Lac Bay Catchment Area

J Questionnaire Kunuku owners

Enquete Kunuku eigenaren

Datum:

Interviewer:

Tijd:

Locatie:

Voor onze studie zijn wij momenteel bezig met een stage in samenwerking met STINAPA om een zo volledig mogelijk beeld te krijgen van Lac Baai en het afwateringsgebied hiervan. Hiervoor verzamelen wij gegevens van toerisme en menselijk gebruik in de baai zelf in de vorm van enquêtes afnemen en monitoringen. Voor het afwateringsgebied van Lac, het gebied waarin water afstroomt naar Lac Baai, willen we graag onderstaande gegevens van de Kunukus verzamelen. Wij hopen dat u ons kan helpen met deze informatie.

Algemene informatie

Naam eigenaar:

Naam Kunuku:

Adres Kunuku:

Aantal hectare land:

Veehouderij

Aantallen vee:

Geiten: / geen / weet niet
Schapen: / geen / weet niet
Koeien: / geen / weet niet
Anders:
.....

Waar graast uw vee overdag?

Binnen mijn erf / Buiten mijn erf / Beide

Heeft u last van verlies van vee door diefstal, honden, verkeer of anders?

Ja / Nee

Indien ja: Weinig/soms/veel

Waar gebeurt dit? Thuis, op het erf / “na mondi”(in de bush)

Denkt u dat de nieuwe plannen van LVV voor veehouderij(Vee voortaan binnen de omheining met voer van LVV) een verbetering zullen betekenen?

Ja / Nee / Misschien / Weet ik niet

Waarom?

Akkerbouw

Doet u aan akkerbouw: “planta kunuku?

Ja / Nee

Indien ja:

Hoe vaak? Elk jaar?, elk xx jaren, wanneer is het laatst dat u heeft geplant?

Wat heeft u voor het laatst geplant?

Sorghum / Maishi chiki / Boonchi / Pampuna / anders nl:.....

Ploegen?

Indien u akkerbouw doet, ploegt u machinaal of met de hand?

Watergebruik

Gebruikt u putten op uw Kunuku?

Ja / Nee

Indien Ja, hoeveel?

Heeft u dammen bij uw Kunuku?

Ja / Nee

Indien Ja, hoeveel?

Voor welk doeleinde gebruikt u dit water?

Drinkwater voor vee

Irrigatie land

Huishoudelijk gebruik (kraan/douche/wc)

Anders nl: