Baseline survey of anthropogenic pressures for the Lac Bay ecosystem, Bonaire

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Terms of reference

The mangrove and seagrass lagoon of Lac Bay on Bonaire covers an area of roughly 700 ha. It is home to endangered green sea turtles, *Chelonia mydas*, and the Caribbean queen conch, *Strombus gigas*, and is an important roosting site for birds. Other endangered species include the threatened corals *Acropora palmata* and *A. cervicornis* and the rainbow parrotfish, *Scarus guacamaya* and some other IUCN vulnerable species. Based on its nature values this 7km^2 bay has been designated as a legally protected Ramsar site (Stinapa Bonaire 2003) and identified as a Birdlife International IBA (Important Bird Area) (Wells and Debrot 2008). The area falls under the management responsibility of the National Parks Foundation of Bonaire STINAPA Bonaire which tries to address several based on a 2009 management plan. Lac Bay is under increasing development pressure for recreational use and more-effective management is clearly necessary.

As a Ramsar area, several international obligations need to be met, including the documentation of changes, management according to wise use and regular reporting. Based on concerns about Lac and the international commitments, in 2010 the then Ministry of LNV, The Netherlands, commissioned IMARES to assess the situation (Debrot et al. 2010a) and come with a shortlist of action points (Debrot et al. 2010b) that address the principal information gaps. This ministry (today the Ministry of Economic Affairs, Agriculture and Innovation, or EL&I) continues to actively exercise its mandate with respect to the biodiversity of the Caribbean Netherlands and commissioned this study.

One of the identified information gaps was the need to quantitatively document and assess the current level of user pressures on the Lac ecosystem and such is the subject of this contribution.

We like to thank the following people for their generous assistance, information and cooperation:

Frank van Slobbe from the Department of Environment and Natural Resources (DROB) for assistance with the required permits, and Dr. Rita Peachy from CIEE Bonaire for allowing us to use her laboratory. Ton Akkerman and Hayo Haanstra of EL&I arranged the funding required for our work. This work was done under auspices of and in close cooperation with Stinapa Bonaire. We particularly thank Bonaire Marine Park Manager, Ramon de León for his all-around support and assistance. Washington-Slagbaai Park Manager, Juny Janga and the rest of the staff and personnel at STINAPA Bonaire are thanked for their advice and help. Geoconsult generously provided us their 2011 traffic data for Kaminda di Sorobon, while Domeinbeheer gave information on the distribution of kunuku's, and Mr. R. Emers provided information on animal husbandry. Sabine Engel, Paul Hoetjes, Ramon de León, Diana Slijkerman and Mabel Nava, are thanked for providing supplemental information and valuable reviews. Dr. Erik Meesters assisted with the software with which the catchment area was estimated. Alwin Hylkema and Willem Vogelaar helped collect beach litter data. Finally, Peter Smit and François Perreau of the van Hall-Larenstein College are thanked for fulfilling their role as student advisors for Carsten and Astrid.

Summary

Lac Bay of Bonaire is a shallow non-estuarine lagoon of about 700 hectares, separated from the open sea by a shallow coral barrier-reef. It possesses the only major concentration of seagrass beds and mangroves of the island. It is a designated Ramsar wetland of international significance, an Birdlife International IBA (Important Bird Area) and also fulfills a critical fish nursery function for the reefs of the island. The bay has consequently been designated as a protected area and is managed by Stinapa-Bonaire. The bay has been losing effective seagrass nursery habitat surface and quality as a consequence of mangrove-driven land acclamation. This in-turn is potentially being exacerbated by human-mediated eutrophication and erosion caused by agricultural and animal husbandry in the wider watershed, as well as other factors.

The number of visitors to Bonaire and to Lac has been increasing dramatically over the last decades particularly from cruise ships. Yet little has been done to document and map the various types of human use that occur on and in the vicinity of the bay which might affect the ecological carrying capacity of the bay and the critical roles it plays. In this survey we do preliminary mapping and analysis of the level and distribution of human activity in and around Lac and discuss what possible threats these may entail for the environment of the bay.

The Lac catchment area was mapped using satellite imagery combined with field verification and gave a preliminary estimated size of about 22.6 km^2 of surrounding lands. This area consists of a mix of semi-natural deciduous and dry-evergreen vegetation types and at least 213 small part-time farms (for seasonal planting and animal husbandry). Fresh water surface-flow from the hinterlands to the bay is also affected by approximately 54 dams, and groundwater extraction by many (uncounted) wells.

A review of local sources as supplemented by field observations indicate that extensive livestock husbandry (goat and sheep), occurs at densities higher than 1 animal per hectare. Such densities well exceed densities (as found from practice in Curaçao) that permit ecological recovery (0.1 animal per hectare). Therefore, in the natural areas surrounding Lac measures to reduce livestock densities are recommended.

The major recreational activities at Lac are sunbathing, windsurfing and swimming or wading. Other aquatic activities include kayaking, snorkelling and fishing. Beach visitor distribution, densities and activity were monitored for 31 days at Lac during the spring tourist season of 2011 (March – April). In addition we interviewed beach visitors, taxi drivers and recreational part-time farmers that plant and keep livestock in the greater Lac watershed area to assess their level of understanding, concerns and potential support for various measures.

The majority of recreational use of Lac is concentrated on and around the Sorobon Peninsula. While Lac stands out for its international biodiversity value and its legal status as a Ramsar wetland, relatively little current use was directed towards nature activities (such as snorkelling, diving, hiking, sportfishing, kayaking, birding etc.).

Visitor numbers present on the Sorobon beach at different times of the day differed depending on whether a cruise ship was in port or not and whether it was a week- or weekend day. Average peak visitor numbers at Sorobon on days with cruise ships in port was 359 people. On week days it was 187 people while on weekends it was 260 people. Usage patterns and awareness differed importantly between the four different user-categories of cruise tourists, stay-over tourists, foreign residents and inhabitants born on Bonaire. The effect of crowding had negative effects on the quality of experience of the beach visitors, and the majority of businesses operating at the bay believe that the large and growing number of cruise ship visitors needs to be curtailed. While only 9.7% of respondents felt that more hotel capacity at Lac was to be desired, this was almost fully compensated by 8% who felt that less hotel capacity would be better.

Notwithstanding high awareness of the purpose of marker lines placed by the Sea Turtle Club of Bonaire to protect the near-shore seagrass beds of Sorobon, the inner borders of the seagrass exclosures

displayed much bare space due to trampling. The problem of seagrass trampling had been documented by others before and clearly remains an issue. Trampling of the seafloor in the shallows of Sorobon outside of the seagrass-exclosures is intensive and may strongly limit seagrass coverage in these shallow areas. Also, some 7% of windsurfers make incursions into surfer-excluded areas near mangroves and over the seagrass shallows, while some 14% further state to have seen one or more sea turtles while on the water. Based on our own observations, and as confirmed by M. Nava (pers. comm.), sea turtles in the bay generally react strongly to boats and surfers. The possibility that disturbance, along with other factors such as habitat selection and food density, affect the distribution of turtles in the bay cannot be excluded.

Interviews with entrepreneurs indicate that many of the used septic tanks are of old age and leaking. Untreated nutrient- and bacteria-rich septic water is being used for irrigation of ornamental gardens. As there is no sewage treatment and as the available toilets and cesspits are generally defunct, beach visitation definitely result in nutrient enrichment in the waters of the bay where Slijkerman et al. (2011) have already documented eutrophication as a problem.

Beach litter contamination is a matter of concern in two areas within Lac. These are the areas down-wind from the entrance of the bay which have high concentrations of beach litter along mangrove shores and the lagoon-bottom immediately off the public beach of Sorobon. The mangrove area has the most serious litter contamination problem, where its source is largely distant (drifts in) and more household in character. At Sorobon the source of the submerged beach litter is local, and its nature is recreational. Submerged litter densities at the public beach of Sorobon is at levels comparable to unmanaged beaches in Curacao.

Additional data on the apparently reduced level of fishing and negative effects of vehicular traffic are presented and discussed. From this and other studies it is clear that the combined levels of anthropogenic impact on the bay currently exceed sustainable levels. Additional problems, possibly exacerbated by the cumulative effect all the different anthropogenic stressors, are the rapid invasion of the exotic seagrass, *Halophila stipulacea* and a bloom of an encrusting (possibly invasive) calcareous alga (*Ramicrusta* sp.) that is smothering live corals at the seaward side of the bay.

Based on the ecological importance of the bay, its legal status as designated Ramsar site, the various ecological problems that have been fairly documented, as well as the negative effect of current peak crowding levels on the visitor experience itself, it is recommended to develop beach options for cruise ship tourists elsewhere on the island and/or to create or better-promote other activities for the cruise tourist to engage in. Also, roaming livestock levels in the vicinity of the bay should be reduced, either structurally by introducing husbandry management in the surrounding areas or locally by grazer exclusion (fencing).

In addition, various measures (most of which have already been recommended by others) can be taken on-site to reduce visitor impacts, and enhance visitor experience. Firstly, the user facilities and infrastructure at Lac need to be upgraded. These would include the toilets and septic systems, garbage disposal, organized parking, availability of shade, signage and marker buoy-lines for the various management zones. Implementing a Lac Visitor Centre to provide visitor service (products and added-value information) and enforcement, could also contribute to visitor's awareness of the unique natural values of the Lac area and of the zoning plan. We list additional management suggestions with which to address specific issues and identify several knowledge gaps meriting further study.

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1 Introduction

Lac Bay is a designated Ramsar wetland of international significance (Ramsar Convention 2011) and a Birdlife International IBA (Important Bird Area) (Debrot et al. 2010a). In this non-estuarine, clear-water bay 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). The mangroves of Lac show clear zonation and succession with principal seaward zone of *Rhizophora*, and principal landward zone of *Avicennia* and depending on the location, an intermediate mixed transitional zone (Davaasuren and Meesters 2012). A large part of the sandy seabed of the bay is covered by seagrass. The turtle seagrass, *Thalassia testudinum*, is an important food source for the protected Green Turtle (*Chelonia mydas*). It is also a habitat for the endangered Caribbean Queen Conch, *Strombus gigas*. Also the Rainbow Parrotfish (*Scarus guacamaya*) can be found here, as well as some other IUCN red list species. Lac Bay is one of the most important natural areas on Bonaire as it serves as nursery habitat for many economically and ecologically important coral reef species. Rather extensive background studies and inventories for Lac have been provided by Moorsel and Meijer 1993 and Lott 2001).

Tourism is one of the most important driving forces behind the Caribbean economy (Goodwin 2008). However, 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 2011), but over the past decades the number of visitors has been increasing (Bonaire Tourism Corporation 2009). Most cruise tourists wishing to spend time on a beach are taken to Lac and the large increase in tourists visiting the bay is expected to influence the ecology of the bay and the quality of the experience for the visitors.

As mangrove ecosystem health and development is greatly determined by salinity and nutrient fluxes, and by freshwater streaming into the system from afar, a “watershed perspective” is needed in managing and limiting anthropogenic impacts on the bay ecosystems. For this reason we not only studied activities on the bay itself but also mapped the watershed and provided an initial assessment of activities that take place farther away from Lac but which still likely or potentially affect its ecology.

2 Objectives

The objectives of this study were document through observation the kinds of use, number of users, and where these activities are taking place in relation to the present nature values and the current zoning plan. We also used questionnaires to assess the level of awareness, perceived needs and willingness to cooperate of various groups using the bay or the hinterlands. While we do comment on the potential effects these activities might have on the biota of the bay, we did not measure or compare these effects, as doing such would require much more extensive and in depth study.

3 Area description

Lac Bay is located along the eastern coast of Bonaire and covers an area of roughly 700 hectares. The bay is largely 0-3 m deep and protected from the waves of the wind-exposed eastern coast by a shallow coral barrier-reef. The main channel connecting the bay to the sea and the luxuriant fringing reef that surrounds the island is about 5 m deep. Apart from the sediment-ridden, murky backwaters, various levels of seagrass and algal development can be found throughout the different sectors of the bay. The semidiurnal tidal amplitude in this part of the southern Caribbean averages about 30 cm (de Haan and Zaneveld 1959), which, along with the shallow depth of large sections of the bay, translate into low circulation. The bay forms part of the Bonaire National Marine Park which extends to a depth of 60 meters surrounding the whole island, and which also includes the island of Klein Bonaire (STINAPA 2009).

Fig. 1. Map of Bonaire showing the location of Lac (STINAPA, 2003)

The area around the bay is often used for seasonal agricultural purposes and extensive animal husbandry. At the Sorobon peninsula (Fig. 2) a large sandy beach is found which makes a suitable place for sunbathing and swimming. Lac is also a popular place for windsurfing, snorkelling and kayaking. Two hotels are located at Lac. These are Sorobon Beach Resort and the Kontiki Beach Club. Next to Sorobon Beach Resort there are two beach bars, Jibe City Beach Bar and The Beach Hut. Also two windsurfing

centres are located here; The Windsurf Place and Jibe City. Over the past years Bonaire has seen a large increase in visitor numbers. From 2001 to 2008 stay-over tourism grew from about 50,000 to 74,000 visits annually, while cruise tourism grew from 40,000 to 176,000 visits annually (Bonaire Tourism Corporation 2009). The tourism sector hopes to see continued growth in visitor numbers in the future (Bonaire Tourism Corporation 2009) and many hotel projects remain to be completed. The Sorobon peninsula is especially visited by many cruise tourists, who are dropped-off at the beach and only stay for a fewl hours. Also, foreign residents and locals from Bonaire visit the place for work or recreational purposes. All these visitors to greater or lesser extent interact with nature by disturbing the wildlife and touching, collecting or walking over seagrass and coral reefs or leaving litter or other forms of pollution behind (Kats 2007).

Fig. 2. The Sorobon peninsula of Lac, showing the location of the user facilities mentioned in the text.

4 Methods

Mapping the watershed and land-use at the landscape level
Field data collection on Bonaire principally took place in the period April – May 2011. The catchment area of Lac 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 topographic heights can be determined. These heights were used in determining the directions of surface water flows in the area. The combination of heights and the directions in which water flows provided the information needed to determine the actual catchment area.

Aerial photographs and cadastral maps provided a starting point for mapping of human land use in the catchment area around Lac. Particular focus was on structures meant for water extraction (wells) and water diversion or catchment (irrigation dams), fields and enclosures (often cleared or ploughed for planting), presence of livestock etc.

Businesses centered at the bay
Private businesses, such as dive schools, windsurf centers and hotels not only facilitate visitor use of the Lac area, but in and of themselves represent important anthropogenic pressure to the Lac area. The main businesses operating and causing potential environmental pressures in the area were listed and discussed.

Surveying recreational user distribution and densities
Monitoring of the number of people engaged in different activities in the bay was done for a 31 day period, from March 4 - April 27, 2011. Cruise ships were in port for 14 of the 31 days, and 12 of these concerned weekdays. We compared and contrasted beach visitor numbers between cruise-ship days (N = 14) versus ordinary week days (N = 9) and ordinary weekends (N = 8). An overview of the monitoring days and the cruise schedule can be found in Appendix A.

Every 1.5 hrs, from 9 am to 6 pm, the number of people engaged in different activities in different parts of the bay were recorded and mapped in relation to the various management zones. Monitoring took approximately 5-15 minutes a time, depending on the number of visitors. This data was recorded on monitoring sheets (Appendix B).

No structural monitoring was carried out at Cai due to the relatively low and generally predictable level of recreational use as established during several visits. Apart from limited fishing activity, practically all water based recreation originates from the Sorobon peninsula. For this reason it was decided that Sorobon is most suitable for carrying out monitoring and survey activities. In this, Sorobon provided the best vantage point from which to oversee almost all of the bay (except the mangrove creeks on the north side of the bay).

Man-made litter in Lac Bay
One key anthropogenic impacts in the marine environment is contamination. This may take various forms, one important one of which is marine litter pollution. Marine litter contamination affects ecosystems and the provision of ecosystem services in various ways, among which deleterious effects on wildlife, habitat quality, economy, aesthetics, human health and even safety (UNEP 2006). It is a wide-spread problem and is considered to be one of the most serious threats to sustainable use of the region's marine and coastal resources (UNEP 2006). To assess this issue for Lac, in October 2011 we sampled litter pollution at three mangrove beach sites at Punta Kalbas opposite and down-wind from the entrance of Lac Bay, and two submerged transects directly off the public beach at Sorobon.

The beach transects sampled in mangrove forests were 5 meters wide and extended seawards from the last terrestrial vegetation (as is standard methodology for beach litter sampling (e.g. Debrot et al. 1999), straight out towards the sea and into the mangroves. Because the mangroves were difficult to penetrate for sampling, the three transects differed in the extent to which the mangroves were sampled. Transect lengths were, respectively: 2 m beach and 5 m mangroves, 4 m beach and 15 mangroves, and 5 m of beach (all 5 m-wide). All three transects were placed in areas of the bay with a relatively narrow mangrove fringe. Data on submerged beach debris were collected on October 4, 2011, in two 4-m wide x 25-m long transects parallel to the shore at 2-3 m depth in front of the Lac public beach at Sorobon (to the north side of the fishing pier).

All material was collected and removed from the site for cleaning, counting, sorting, measuring and weighing in the lab. Results are expressed as number or weight of objects or materials per stretching meter of beachfront.

Vehicular traffic in the mangrove zone of the bay

Available data on traffic levels on the road that runs along the Lac mangroves generously provided by Geoconsult who had collected these data in 2010 for consultancy purposes. The traffic counts using pneumatic road tubes were made by Geoconsult in 2010 in front of the Kontiki Beach Club on one day with cruise ship traffic (09-03-2010) and one day without (08-03-2010).

Index of fishing levels

A survey of fishing boat abundance at Lac provide an index of fishing activity to be compared with data from the early 1990s by Moorsel and Meijer (1993). Seven bay-wide daytime boat counts of small open fishing boats were conducted by BNMP staff over a period of 3 weeks in May and June, 2012.

User and stakeholder feedback

Aside from collecting and recording various forms of data on anthropogenic stressors operating in the Lac watershed and bay area, we also designed and conducted opinion surveys among three categories of users to be able to better describe the users and assess their level of awareness, perceived needs for various facilities and management measures. These were a) beach visitors, b) taxi drivers and c) subsistence farmers.

Beach visitors: The beach visitor surveys were conducted in the months March and April 2011. This is the peak of the cruise season, whereas May – September no large cruise ships dock at Bonaire (Bonaire Tourism Corporation 2009). During March and April, approximately 14400 people visit Bonaire, (Bonaire Tourism Corporation 2009). A total of 614 beach visitors were interviewed using the Lac visitor questionnaire by taking 2-3 visitor questionnaires immediately after each scheduled activity survey to be able to link opinions to different user densities (Appendix C).

Taxi drivers: Taxi drivers play an important role in transporting tourists from the cruise pier in Kralendijk to Sorobon. Upon request of the RCN, a taxi driver questionnaire was set up. Taxi's driving to Sorobon have two possibilities for which road to take, one road leading close along the mangroves (Kaminda di Sorobon), and the road from Belnem, crossing the area called Lima. Traffic on Kaminda di Sorobon can be expected to cause more impacts to Lac through noise, disturbance, exhaust and traffic casualties than the road via Lima. We principally aimed to determine which road the taxi drivers used, and whether the drivers would be willing to provide their clients with some form of supplemental information about the nature values of Lac (e.g. a brochure). A total of 18 registered taxi drivers that shuttle tourists between Kralendijk to Lac were spoken to at the main pier in Kralendijk, and 15 questionnaires were filled (Appendix D).

Part-time seasonal agriculture and animal husbandry: Information on agrarian land-use in the catchment area of Lac was gathered by interviewing 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 water management infrastructure they have on their land, such as dams and wells. A total of 17 kunuku owners were interviewed based on the questionnaire. Reaching these respondents was particularly difficult because the owners were rarely present on their land (Appendix E).

Stakeholder interviews: Aside from the three groups queried via questionnaires, we also obtained feedback from various stakeholders by means of open interviews and a stakeholder meeting. Stakeholder feedback is not discussed separately in this report but the main points made by the stakeholders have been synthesized into our discussion and recommendations. Minutes of the interviews can be found in Appendix F. Stakeholders included were: 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 several fishermen (Appendix F).

Analysis and presentation of results: Due to limited funding we were only able to provide elementary descriptive analysis and presentation. No full statistical assessment of the results are given here.

5 Results

5.1 Lac watershed catchment area

The catchment area (drainage basin) of Lac Bay can be defined as the area around Lac in which superficial run-off is eventually drained towards the bay. An estimated surface of 22.6 km^2 was determined, in which the bay itself and the mangroves are excluded. Through geo-referencing a satellite-based map of flow vectors (Fig. 3) was overlaid with a satellite photograph of the area, resulting in Fig. 4, which maps the borders of the catchment area. It must be kept in mind that the topography of southern Bonaire is quite flat. This makes it more difficult to accurately identify watershed boundaries. As the watershed boundaries were not all checked and verified in the field, the current estimate should only be considered preliminary.

In the 22.6 km^2 catchment area (Fig. 4), which ultimately drains water, nutrients, contaminants and sediment into Lac Bay from the hinterlands, the majority of human activity takes place in the northern sector. Land in this area is mainly used for keeping livestock such as goat, sheep and chickens and for seasonal agricultural purposes. It is unclear up to what extend activities in the catchment area influence Lac Bay. Livestock frequenting the area mainly concern goats and sheep but also donkeys. 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 (Slijkerman et al. 2011). Wells and dams for fresh water extraction and diversion probably contribute to elevated salinity in certain parts of the bay. Prior to this study, the size of the catchment area was undocumented as were the magnitude and nature of human activities throughout the Lac drainage basin.

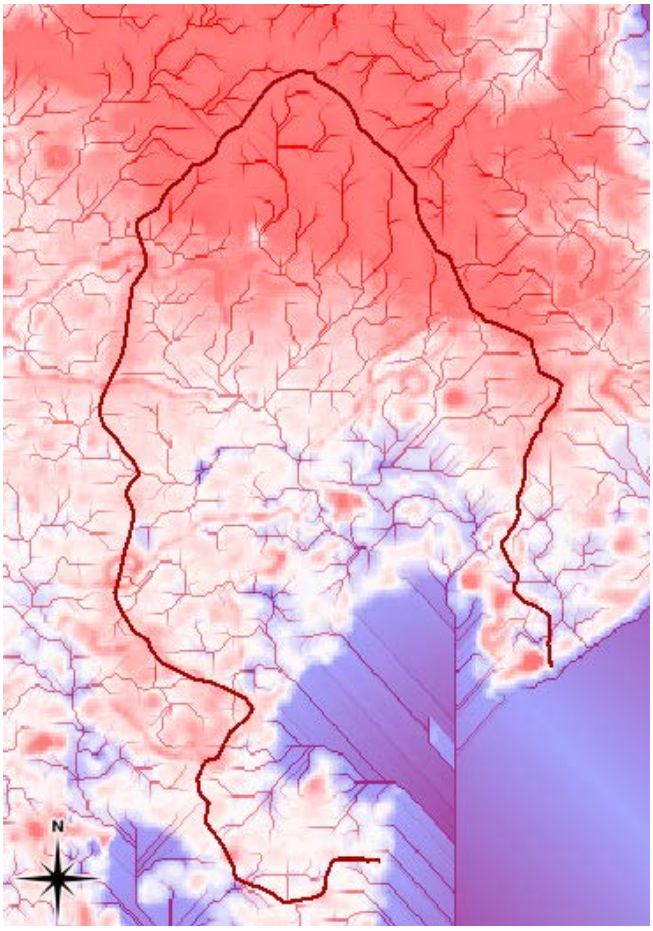

Fig. 3. Surface water flows from high to low, and a map of flow vectors allows the catchment area to be mapped.

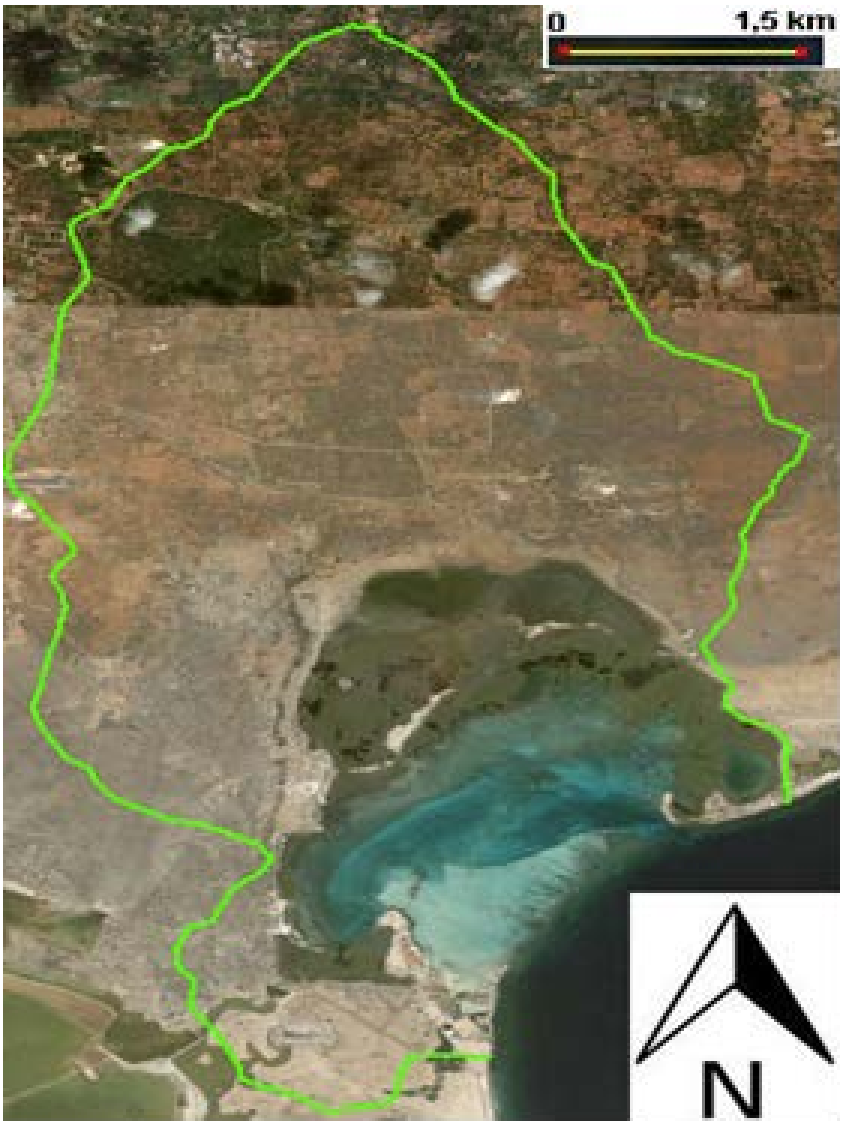

Fig. 4. Map of 22.6 km^2 Lac drainage basin showing the size of the catchment area.

5.2 Activities in the wider watershed area

The majority of human activity takes place in the north of the watershed area. Land in this area is mainly used for the small-scale keeping of livestock such as goat, sheep and poultry and for agricultural purposes. Such a farm on Bonaire is called a 'kunuku'. Practically no one is primarily or even importantly dependent on such agriculture for their income. Farming is largely at the hobby-level. In contrast to many third-world nations, nobody is dependent on farming for income purposes in Bonaire. The term "subsistence farming" would, therefore, not be appropriate.

Wells and dams

Wells (Fig. 5) and dams (Fig. 6) serve to supply water for the kunuku's. This water is mainly used for agricultural purposes. With these structures the original water flow towards Lac Bay, is interrupted, and less fresh water reaches the mangroves.

Fig. 5. Well driven by a windmill.

Fig. 6. Dam collecting rainwater.

Figure 7 maps the distribution of man-made structures in the watershed area which affect surface run-off and groundwater extraction. Herein it should be noted that more dams and wells are present in the area as this survey is incomplete. Fresh water surface-flow to the bay is affected by a minimum of 54 dams, and groundwater is affected by extraction by many (uncounted) wells. 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 that were present in 1984 according to the Cadastral map. Based on satellite photographs and field verification we conclude that all dams which were documented by Cadaster in 1984 are still all present. An increase of dams is highly probable as several new dams were also found that were not shown on the 1984 Cadastral map. The wells indicated are found next to the road and are available for public use. Some are driven by a windmill (Fig. 5). Of 17 interviewed kunuku owners, 4 stated that they have a well on their own land. Eight respondents stated that they have dams on their parcel, ranging up to 4 dams per individual respondent. Consequently, while this overview should be considered preliminary, the results indicate the presence of a large number of man-made structures that can influence freshwater flows in the Lac catchment basin.

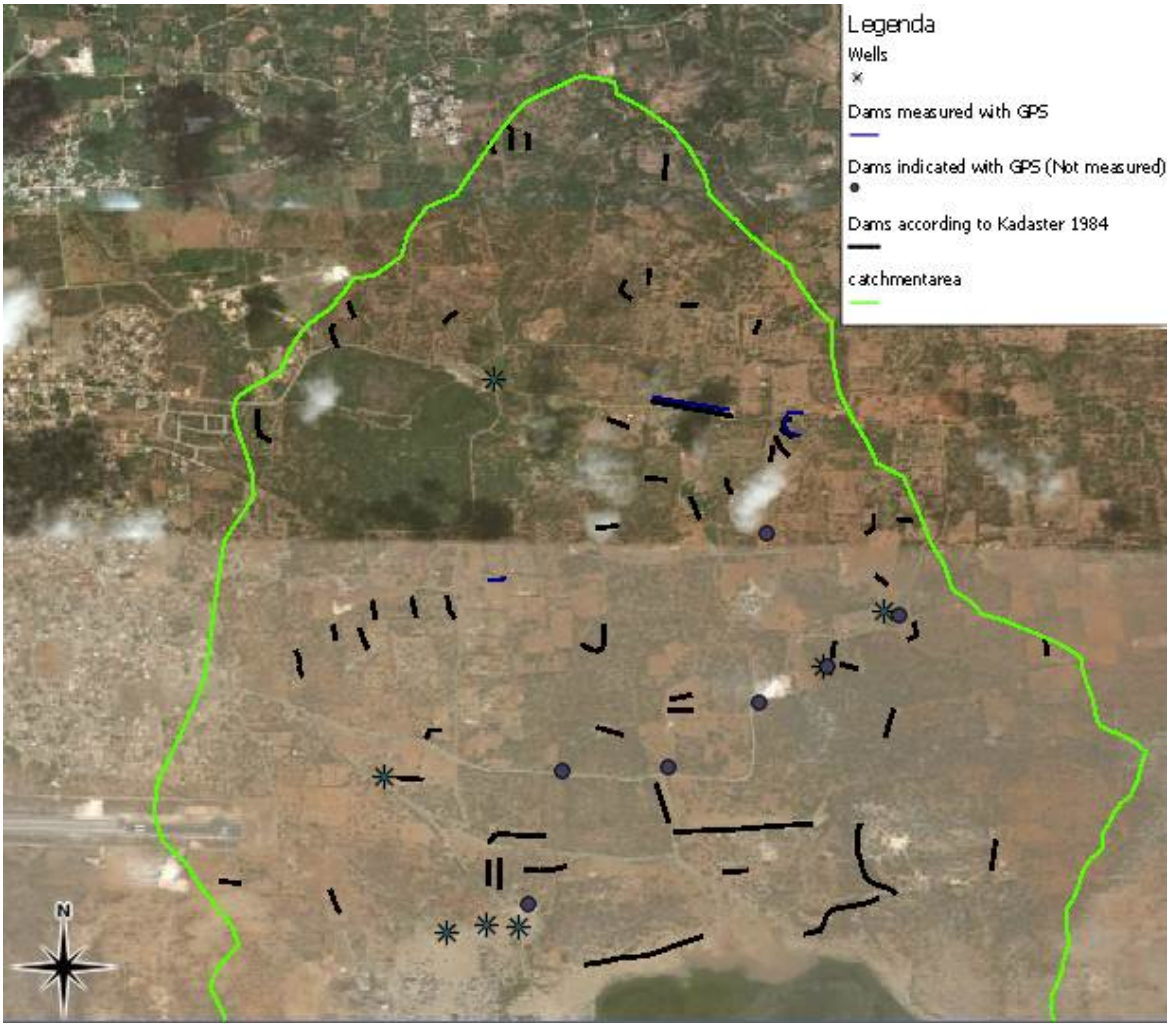

Fig. 7. Locations of structures for water management and extraction in the Lac watershed area.

Livestock

The main activity at the kunuku's is keeping livestock. This livestock mainly consists of goats and some sheep. Feral donkeys also occur in (comparatively) low numbers in the area. 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 and Veen 2009). The donkeys do not have owners and can be considered feral. Livestock is generally let loose to roam freely during the day.

For many Bonairean's, goats are an interesting investment as they require little care and can subsist on very little. According to many interviewed kunukero's as well as Nolet and Veen (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. The owners are rarely held responsible for the damage, costs and risks these animals represent. Letting goats roam freely to the detriment of private gardens, public nature and traffic safety is officially forbidden but not being enforced (Mr. Rocky Emers, director of Dienst LVV (service for agriculture, livestock and fishery).

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 rainy season and only 1 goat per hectare in the dry season on suitable pasture-lands. Livestock abundance for Bonaire was

estimated at 30.000 head of livestock and suitable grazing land at 7.000 hectares (Nolet and Veen 2009). This translates to a capacity of 7.000 goats in the dry season (for the whole of Bonaire). 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, island-wide (Nolet and Veen 2009).

Research in the Washington Slagbaai National Park by Debrot (Anonymous, 2009) gave density estimates of 1 goat per hectare in rough and accentuated terrain. Based on the degraded state of the vegetation in the park and results from grazing exclosures, it is clear that under the climatic conditions of Bonaire this number still leads to degradation of the vegetation. In contrast, results from goat eradication in the Christoffelpark on Curaçao, shows that general vegetation and rare species recovery are successful at goat densities of 1 per 10 hectares. (However, the climatic conditions in Curaçao are more favourable than at Lac, and for Lac this number might consequently be too high).

The northern sector of the Lac catchment area has some of the highest goat densities of Bonaire (as the heart of pastoral Bonaire). For these reasons and based upon our field observations, the average densities of livestock certainly exceed 1 animal per hectare and are unsustainable. The total area of the catchment area encompasses about 2260 hectares. Based on information from Domeinbeheer (the government service of public lands), at least 213 kunuku's (small plots of land where part-time recreational farming and animal husbandry is pursued) are found in this area, of which many are holding livestock, either roaming free or on the parcel. This number is known to be incomplete and the total number of kunuku's is more likely around 300 for the entire catchment area. Seventeen 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 several parcels, high numbers were counted as well, sometimes ranging over a hundred goats and sheep.

Although an accurate count of the number of livestock in the catchment area cannot be given, the number of grazers is certainly higher than densities that can allow ecological recovery and minimize erosion.

Agriculture

Some kunukero's use their land for agricultural purposes, to grow sorghum, fruits and vegetables. In order to make the land suitable for this purpose, ploughing needs to be done. This makes the land prone to erosion (Fig. 8) and during rainfall topsoil will flow towards the bay (Awa di Lodo di Bakuna and Awa di Lodo di San Jose).

Fig. 8. Ploughing of bare dry land can contribute to dust problems and cause sediment and nutrient run-off during rains.

Information on agricultural activities was obtained by means of the developed questionnaire. From the information which has already been found with the 17 respondents no conclusions were drawn because of the small sample size.

Fig. 9. Tank for collecting used oil from the fishing vessels docked at Sorobon, Lac.

5.3 Businesses operating at Lac

At Lac several recreation and tourism-oriented businesses have permanent facilities. These businesses are concentrated on the Sorobon peninsula. These include; Sorobon Beach Resort, Jibe City, The Windsurf Place and the Kontiki Beach Club. Other businesses operating with facilities at the bay include the Mangrove Info and Activity Center and the bar at the Cai peninsula. In addition one dive operator (East Coast Diving) organizes dives on the east coast of the island outside the bay and uses the slipway at the fishing harbor as a launching site. This company was not considered a "user" of the bay and was not listed here or consulted through interviews (Appendix F). We also indicate the fact that several small, typical trolling vessels (which target migratory pelagic species like wahoo and dolphin on a part-time basis outside of Lac) also dock at Sorobon, where there is a "fisherman's" pier providing some 15 berths for such vessels. This pier at Lac is in part used seasonally depending on weather and fish abundance, and occupancy varies. Many fishermen that have berths at Lac, moor mostly at Kralendijk (S. Engel, pers. comm.). For 16 July, 2012, the count was 7 vessels in port and four at sea fishing. While these fishing vessels were not regarded as "business" users of Lac, potential impacts from this group in terms of contamination (Fig. 9), littering and disturbance, should not be overlooked.

Hotels/ resorts

In Lac 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, and manages 24 apartments. The average occupation rate of these apartments is 60%.Kontiki Beach Club (KBC) also has room for 60 guests. The average occupancy per night is 40, of which about 70% are windsurfers. The owners of KBC are planning to expand their business. Before constructions on the expansion starts, an environmental impact assessment needs to be conducted.

Windsurf centers

At the Sorobon peninsula there are two windsurf centers: Jibe City and The Windsurf Place. Jibe City started in 1988 and The Windsurf place started in 1986. In an interview (Appendix F) 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.

Bars/restaurants

Three bars are located at Lac. At the Sorobon peninsula there are Jibe City and The Beach Bar. These bars attract visitors throughout the week. At Cai there is the "Lac Bay Weekend Bar". Here visitors only come in the weekend when the bar is open (mid-day- afternoon). Apart from the occasional fisherman or lost sightseer, during weekdays Cai is largely deserted.

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 (Fig. 15). Throughout the year an average of around 10 people participate in the tours daily with a maximum of 8 kayaks per tour in accordance with the management plan. Tours are also carried out by Outdoor Bonaire on a smaller scale. In an interview (Appendix F) the owner of MIAC states that there is good communication between her and Outdoor Bonaire so that the maximum permissible kayakers present in the area is never exceeded. MIAC is planning to broaden its activities to include snorkel trips to the coral patch reefs on the barrier reef separating Lac from the sea.

5.4 Activities around the bay

Locations where recreational is concentrated are shown in the circled areas in figure 10. The yellow area refers to the beach in front of the Kontiki Beach Club. Driving by this location on a daily basis showed that there was almost no recreational activity on this beach. and no structural monitoring was carried out at this location. The red circle refers to the Mangrove Kayak and Info Center. Throughout the year on average 10 kayakers participate in the tours on a daily basis (A. Albers, pers. comm.). Data on how many people visit the mangroves is structurally recorded by the Center. The green circle refers to the Cai peninsula. Initial monitoring during the week showed that almost no recreational activity took place here. During the weekends some activity took place during the afternoon when the local bar was open. At these times a few visits showed that around 50 visitors are present on this location during weekend peak hours. Small horseback riding excursions also take place at Cai several times a week. The tour has a short break at Cai and participants enter the water with the horses. During the week some fishermen are active from Cai. No structural monitoring was carried out here due to the relatively low and generally predictable extent of recreational use.

Fig. 10. Locations with concentrated recreational activity.

Visitor nationalities and age-classes

Fig. 11 shows the breakdown of nationalities for the beach visitors of Sorobon. The majority of cruise tourists were from the UK and the USA, together accounting for 53% of cruise tourists visiting Lac. These were followed by Colombian and german nationals, representing a respective total of 9 and 11% of cruiseship visitors. The two main groups encountered during such censuses were stay-over tourists and foreign residents, respectively accounting for 61.3% and 21.9% of the respondents. Amongst foreign residents the majority (79%) originated from the Netherlands. Stay-over tourists also show a high proportion of Dutch nationality (40%) followed by tourists from the USA (26%). The category of native

Bonaireans amounted to only 7.6% of the people interviewed at Sorobon. This suggests that Sorobon is especially popular with stay-over tourists and foreign residents. The comparatively low number of cruise tourists in the opinion surveys was due to the fact that this group only was on-island for a short period when in port and on a limited number of days.

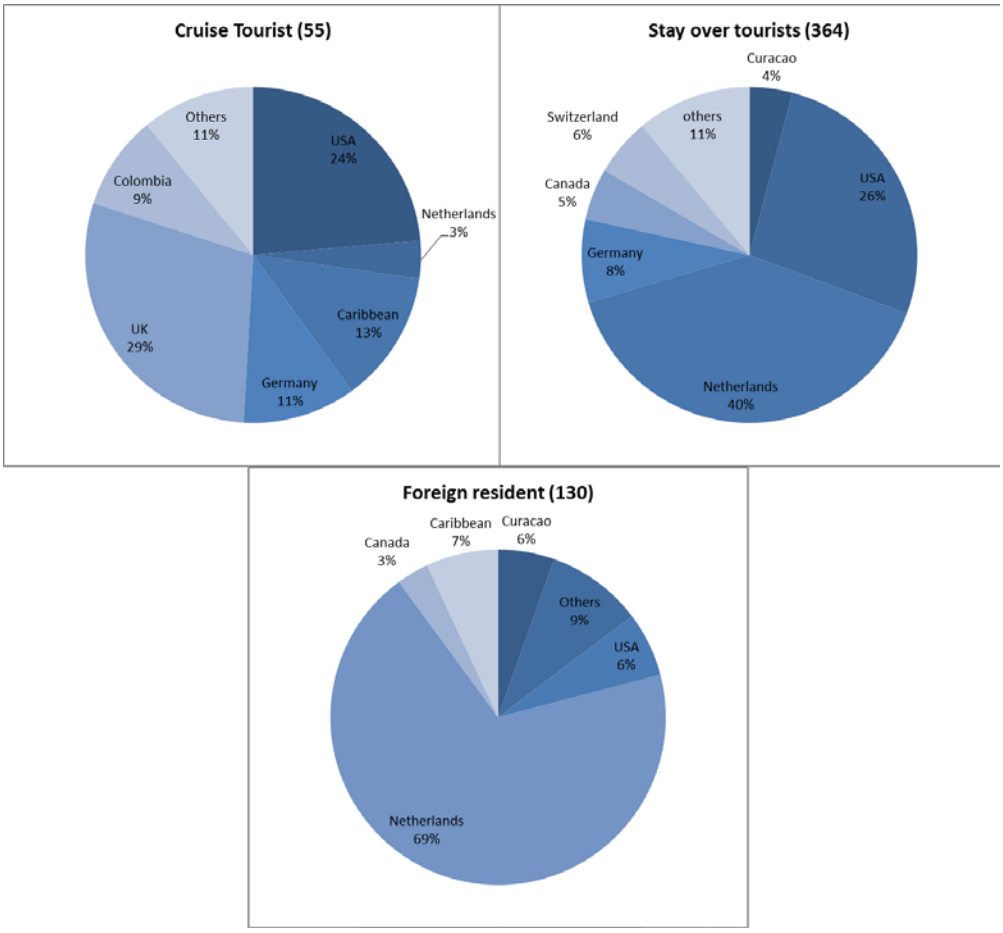

Fig. 11. The national breakdown of different Sorobon beach visitor classes.

The age structure of the visitors to Lac differed depending on whether they were cruise tourists, stay-over tourists, foreign residents or native Bonaireans. Cruise tourist were relatively older, showing 33% belonging to the oldest age category (over 60 years of age). Stay-over tourists showed a peaked at intermediate ages (31-40 years), whereas amongst foreign residents a large number of relatively younger people visited the beach. (Fig. 12).

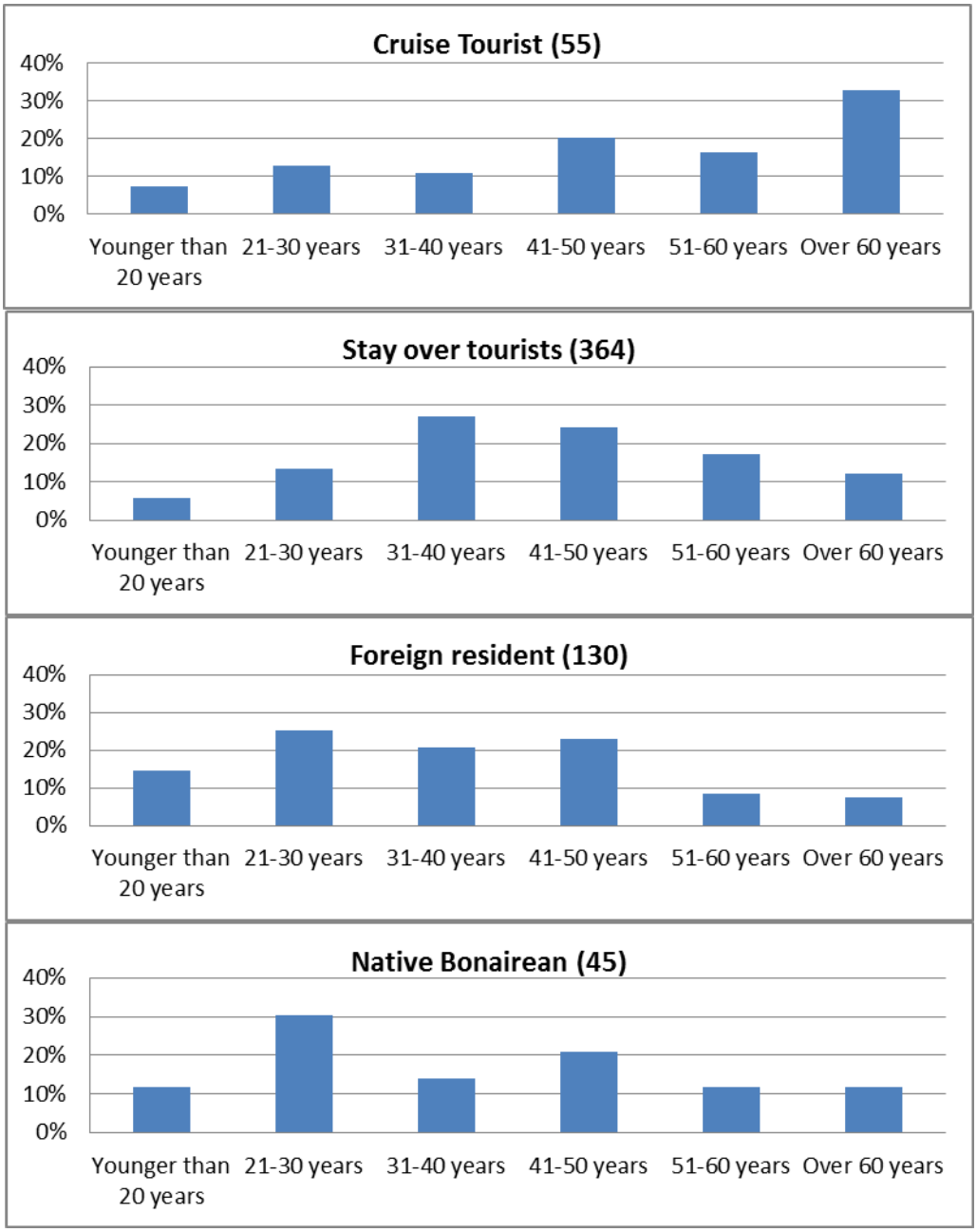

Fig. 12. Age-class distribution among different beach visitor categories at Sorobon. (The first age-class was not as wide as the others, and in practice entailed intwerviewees between 15 and 20 years of age.)

Amongst native Bonaireans a higher proportion of young people came to Sorobon and some 30% were between 21 and 30 years of age.

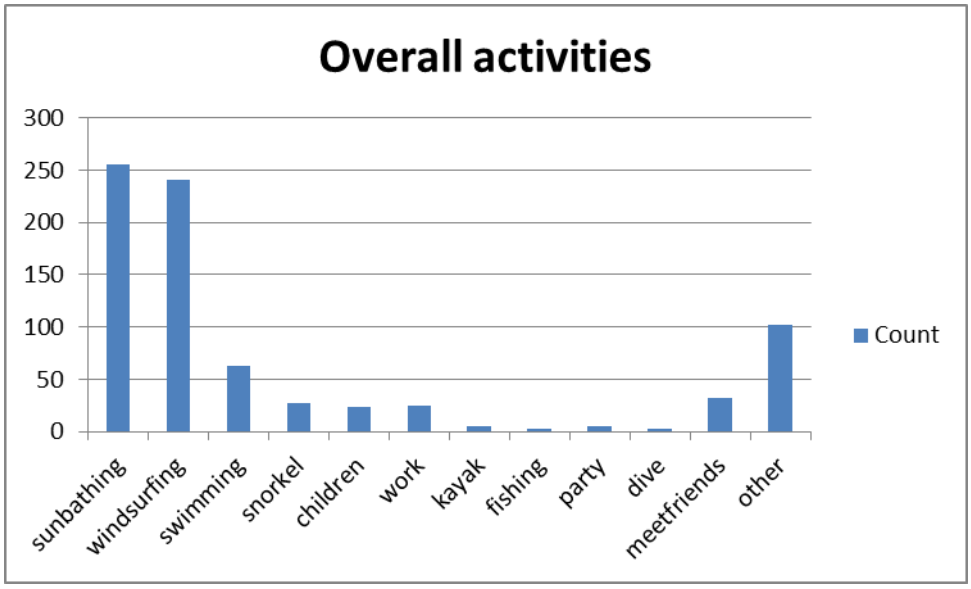

Fig. 13. Stated reasons why the respondent came to Lac.

The majority of respondents visited Lac for sunbathing (32%) and windsurfing (31%) (Fig. 13). The results show that despite its special natural values, Lac generally not visited for activities with the main purpose of a nature-related experience (e.g. snorkelling kayaking, diving, or hiking). Instead Lac is principally visited for sports (windsurfing) and sunbathing.

An important difference however can be seen between the reasons the different user groups visit Sorobon (Fig. 14). Almost 80% of the cruise ship tourists indicated that they visited Lac for sunbathing. Foreign residents follow indicating sunbathing as the main reason in 40% of responses. In contrast, stay-over tourists primarily visit Lac for windsurfing (50%). Native Bonaireans show a large peak on activities classified as 'other'. Their specification on this answer mainly shows general answers such as relaxing and hanging out, and very specific answers which could not be meaning fully grouped. More specific answers mostly imply having a barbeque in the pier area.

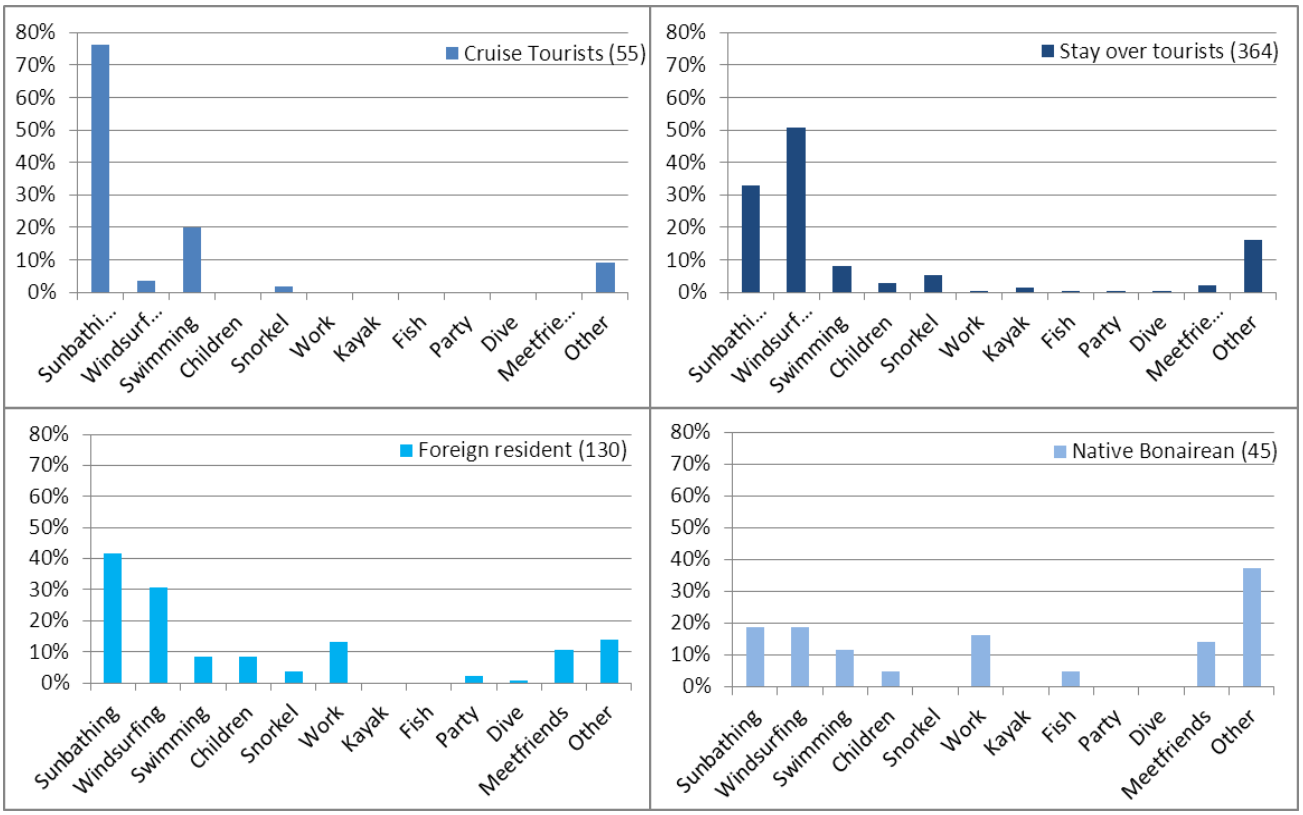

Fig. 14. Principal stated reason for visiting Lac at Sorobon, per beach visitor category.

Locations of activities

The location of activities noted during the surveys was mapped according to the current zoning plan for the bay (Fig. 15). At present, the zoning plan has six areas designated for different kinds of use (Table 1). During the user surveys, we scored the each user according to activity and the zone in which this activity was taking place.

Fig. 15. Lac Bay zoning plan (source: STINAPA brochure on Lac).

Table 1. Overview of usage zones in 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

In addition, part of the zoning plan are the seagrass beds in front of the beach at Sorobon which are marked with buoy-lines to prevent people from walking over them (an initiative of the STCB since 2008 and now in cooperation with the “Conch Project”). Seagrass beds are found all over the bay. The patches that lie away from the beach are not marked since they lie in deeper water and are (maybe) less vulnerable to trampling.

Figure 16 shows what proportion of various aquatic activities takes place in different zones. The different colours refer to the corresponding zone in the zoning plan (Fig. 15). Most activity is focussed on the blue zone (designated only for windsurfing and kayaking) which is situated in front of the Sorobon beach.

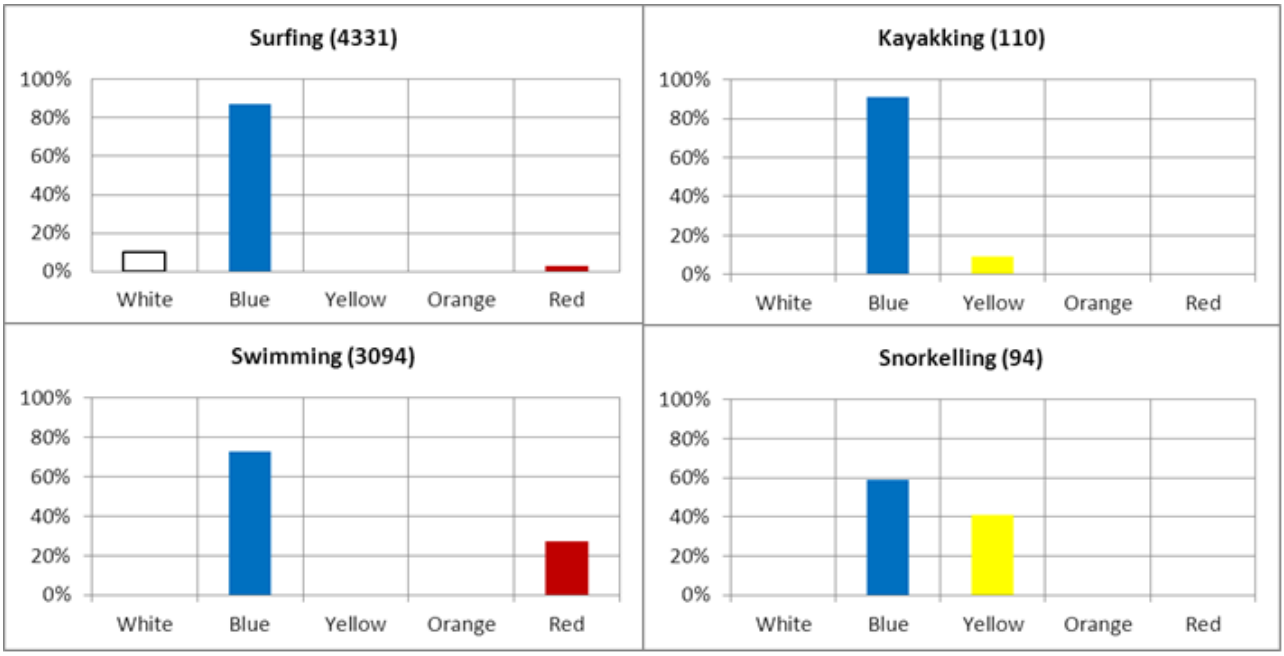

Fig. 16. Distribution of aquatic use of Lac in relation to the zoning plan.

Snorkeling

Monitoring snorkelling activities around the distant patch reefs along the barrier reef was particularly difficult due to long distances and poor visibility. A total of 39 people snorkelling in the yellow zone were recorded on the 31 monitoring days. It can be concluded that that the number of people snorkelling in the area was relatively low since only 4% of the questionnaire respondents mentioned that he or she visits Lac for snorkelling. Fifty-five (55) snorkelers were seen in the blue zone.

Kayaking

During the 31 monitoring days, 110 kayakers were documented during the scheduled monitoring intervals. Of these, only 10 individuals were seen in the yellow zone where the barrier reef lies. Ninety-seven (97) individuals were seen in the blue zone, mainly close to the beach. Most kayakers were children who tend to stay close to the beach. Three kayakers were seen in the seagrass beds, whereas no kayakers were seen in the white zone, nor close to the mangroves at scheduled monitoring's. These observations exclude the kayak tours of the Mangrove Info and Activity Centre in the green zone, as they are poorly visible from Sorobon (most of the tour takes place hidden in mangrove channels at the other side of Lac).

Windsurfing

The vast majority of the windsurfers were found in the blue zone. We documented 7% of the surfers in the white zone, and 2% in the red zone. In total, two individuals were seen in the yellow zone once. 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 shallow seagrass beds and it is less crowded. This is a problem that needs to be addressed as recreation in these shallows located close to the mangroves certainly leads to associated trampling of seagrass, disturbance of roosting birds and sea turtles seeking to feed in the lush shallow seagrass beds. However, the majority of the surfers in Lac are beginners or people taking lessons, and stay in the relatively wide and spacious blue zone.

One of the principal concerns with windsurfing activity is its potential disturbance of sea turtles that feed in the bay. On all occasions that we encountered sea turtles during fieldwork in Lac (AOD, pers. obs.),

they exhibited a startle reaction and pronounced fleeing behaviour. Windsurfers who had already been on the water when they were interviewed were asked whether or not they had seen any sea turtles that day. Of 121 respondents that had windsurfed, 15 had noticed one or more sea turtles (14%).

Observations of sea turtles surfacing for air by STCB indicate that most sea turtles can be found at the locations indicated in white in figure 17. These areas are therefore chosen by STCB as netting locations for research purposes. The area around which the most nets are typically set is located too far upwind for most windsurfers to go to. Some respondents mentioned that they do see turtles near Kontiki Beach Club when they are surfing in the white zone (Fig. 15). Nevertheless, the turtles not only concentrate in the deeper areas; they are also regularly found in areas of seagrass beds near the mangroves and appear scattered in the bay (M. Nava, pers. comm.). Since the average depth of the bay is relatively shallow turtles can't fill their lungs with air when their feeding (otherwise they would not be able to stay in the bottom) and they have to come to the surface to breath more often than when they are in their resting habitat (outside the reef). This makes them more vulnerable to boat and windsurf strikes when inside the bay in their feeding habitat (M. Nava, pers. comm.). Encounters between windsurfers and sea turtles result in disturbance of foraging and resting behaviour.

The highest concentration of sea turtles appears to be located well away from the area with the highest concentration of windsurfing. Given that the animals generally react strongly to boats in Lac, it cannot be excluded that disturbance may influence their distribution in the bay and their access to feeding areas.

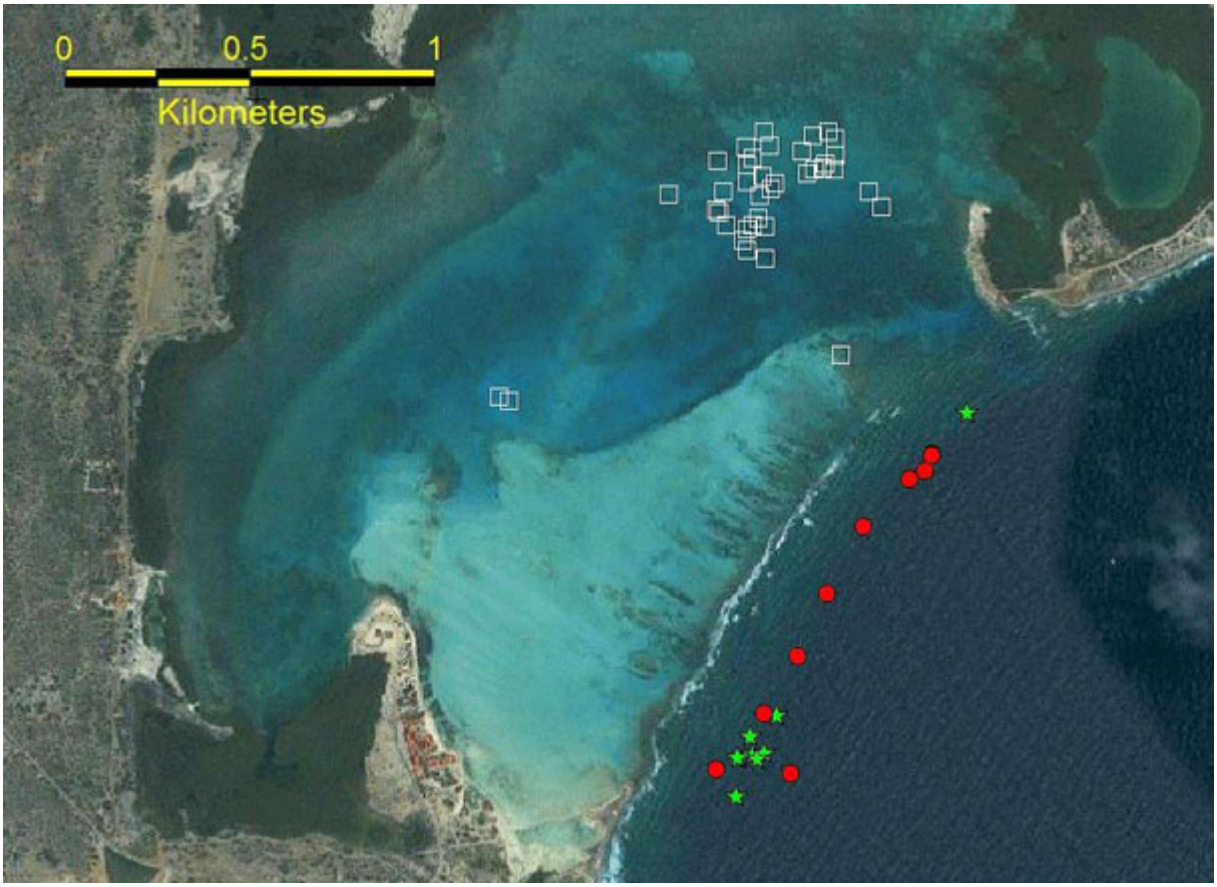

Fig. 17. Sea turtle netting locations inside Lac (white boxes) (green stars and red circles refer to sea turtles hand-caught on the reefs outside Lac…of no relevance to this report). (STCB 2009)

Anecdotal accounts from several windsurfers indicate that collisions between windsurfers and sea turtles have occurred in which fins of the surfboard were broken. Several instances of such collisions are known (M. Nava, pers. comm.), but most people answer that 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 seem to be flourishing. Behind the barrier reef of Lac a relatively high number of these animals can be found due to the foraging opportunities in the bay. The number of Green Turtles has been increasing during the last years (STCB 2009).

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 barrier reef is situated were highly uncommon. People renting their equipment are generally instructed not to surf in the yellow zone.

Figure 18 shows the development of the number of surfers over time. The number of windsurfers is dependent on several factors but showed a general bimodal distribution during the course of the day. Apparently significant numbers of windsurfers take a break around noon. The mean total number of surfers active on the water lies between 7 and 30 whereas the highest recorded number was 91.

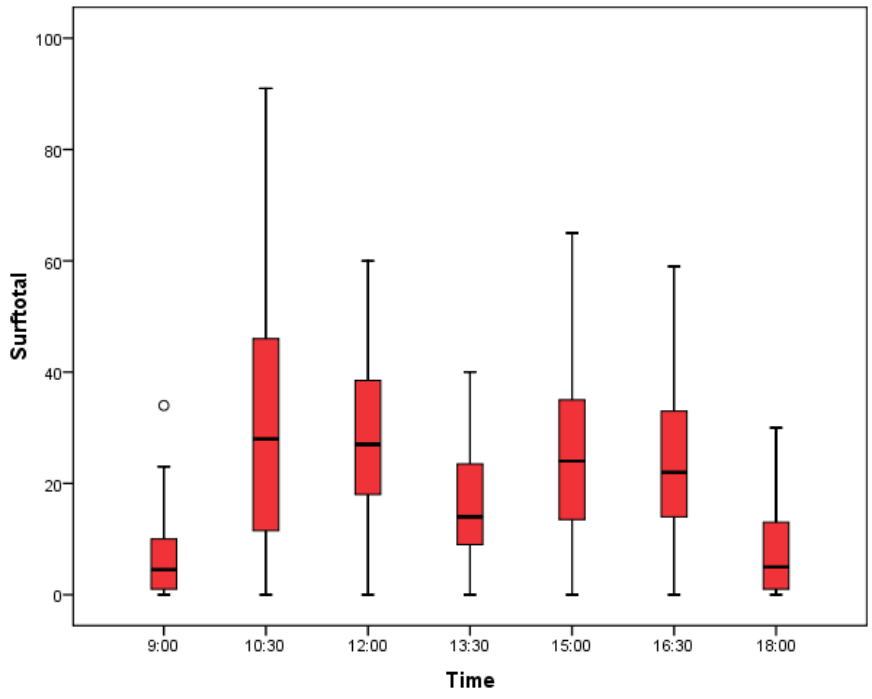

Fig. 18. Number of windsurfers on the water at different times of the day.

Swimming / wading

Figure 19 shows the number of swimmers and waders recorded in the water at different times of the day. Peak abundance was generally around midday (13:30) and peak numbers on days with cruise visits (65) was roughly more than 3 times higher than peak numbers of visitors on weekends (17). The highest number of swimmers recorded simultaneuosly in the water was 260 people.

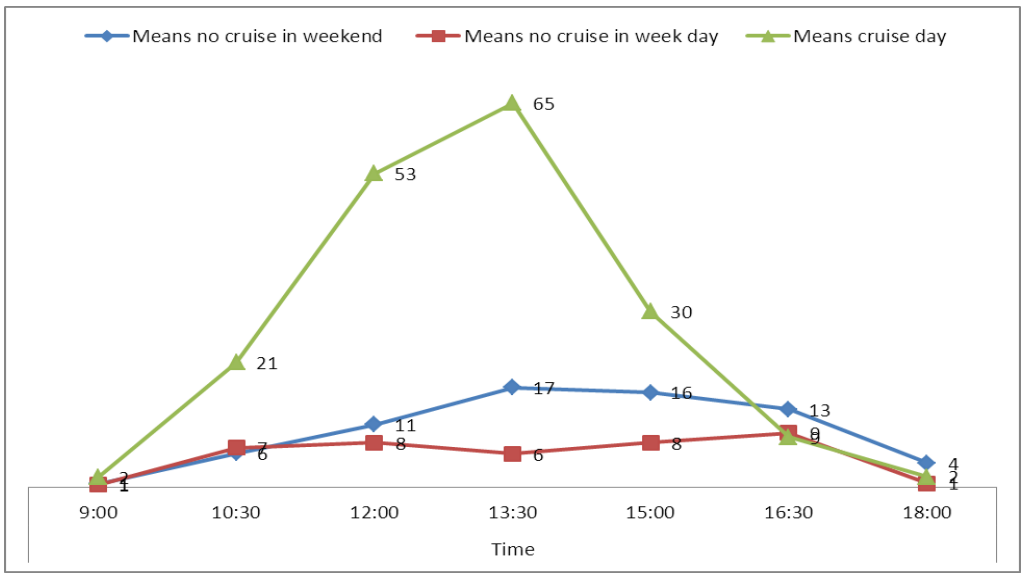

Fig. 19. The mean number of swimmers (and waders) in the water at Sorobon at different times of the day.

Most swimming and wading activity takes place in the blue zone along the beach, and at the beach bars in particular. In this respect, the seagrass areas marked-off for exclusion of waders were of particular concern.

Engel (2008) concluded that seagrass coverage appears to have largely decreased in Lac Bay as a whole, while Giardini (2008) documented trampling as a problem. Kalke et al. (2010) pointed to increased trampling activity due to increased user pressure in the seagrass beds of Sorobon where damage also was occurring due to scarring by windsurf equipment. In 2010 Sea Turtle Conservation Bonaire monitored seagrass trampling in which they found the following: During 40:39 hours of survey time, they observed 134 windsurfers going inside the seagrass beds, 92 people walking across them, 18 people swimming, snorkelling or resting inside the beds, and one person kayaking inside the seagrass beds (Kalke et al. 2010). This led to the placement of seagrass protection-lines in cooperation with Progressive Environmental Solutions (pers. comm., Nava 2011).

During our 31 monitoring days a total of 37 people were seen walking across the seagrass during 16 of the 217 (7.4%) separate 10 min (5-15 depending on user density) survey instances (37 persons seen in 16 instances, equals an average of 37/16 persons per observation interval). With trampling occurring at 7.37% of the observation time, this would translate to a daily average of 40 minutes of trampling (by the average of more than two …37/16…. persons) per day, between 9-6 pm. This amounts to more than 80 person minutes of trampling per day. Almost all along the inner borders of the seagrass-exclosures a band, of 50-100 cm of bare sand is visible that appears to be the result of trampling. In other words, trampling of seagrass inside the zones marked off for seagrass protection is relatively high (as measured) and appears to be having a detrimental effect on seagrass coverage (the dead sand zone along the inside borders of the exclosures).

A large fraction of the recorded trampling occurs by visitors who wade from the Sorobon Beach Resort to Jibe City because of a fence between these establishments. More importantly, trampling of the seafloor in the shallows of Sorobon outside of the exclosures is evidently very intensive (Fig. 20) and might strongly limit seagrass coverage in these shallow areas as well.

Fig. 20. Cruise ship tourists walking inside the seagrass protection zones (Wentink, 2011)

Total visitor numbers present throughout the day.

The mean total visitor numbers present at Sorobon and on Lac at different times of the day are shown in Fig. 21. Both water and land based visitors were included. On cruise days a larger average number of visitors were documented than on non-cruise days (Fig. 21). Visitor numbers during cruise days have their peak around 13:30 pm whereas the peak on non-cruise days occurs around 15:00 (when resident mothers tend to bring their children to the beach for afternoon swimming). The highest recorded simultaneous number of visitor documented on or at the shores of Lac from the Sorobon vantage point was 760 persons (but this excluded the visitors to Cai which on weekends peaks at 50 people).

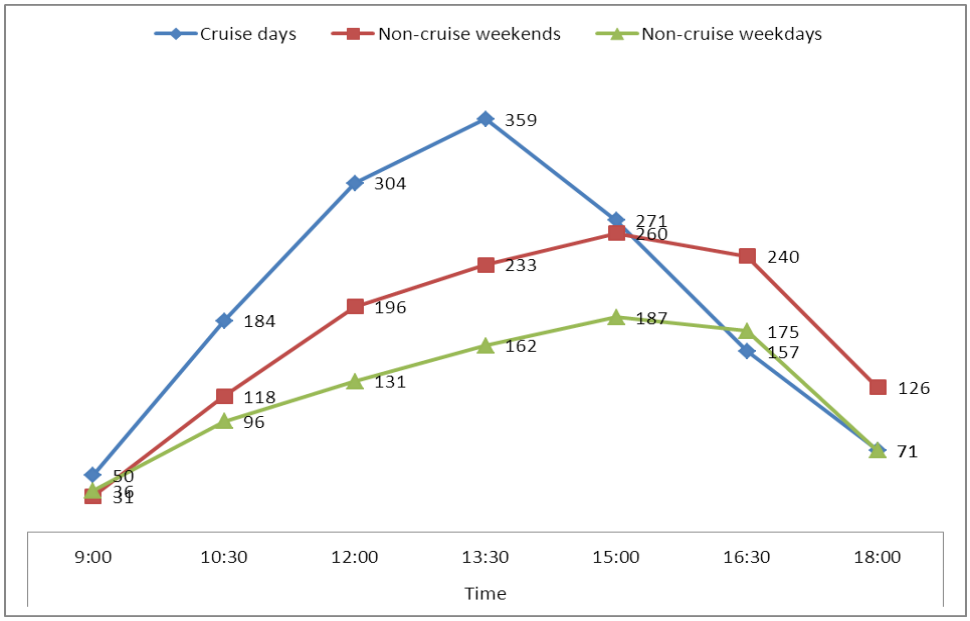

Fig. 21. Mean visitor numbers (ie. swimmers, surfers, plus all other user groups) at Lac as observed from Sorobon at different times of the day.

5.5 Man-made litter in Lac Bay

Mangrove beach litter

Contamination levels: The results show that areas downwind from and directly opposite the entrance of Lac Bay are subject to major litter contamination. Contamination levels are in the order of magnitude observed almost 20 years earlier (1992-1993) for Curaçao (Debrot et al. 1999). In this respect the problem of man-made debris in the environment of Lac remains as critical as ever. The positioning of the Bay on the east coast of Bonaire means that the bay acts as a considerable debris trap in which there is a continuous stream of man-made flotsam entering the Lac Bay. Due to the predominant wind direction, this material is concentrated roughly in a zone stretching from Pta. Kalbas to Isla di Pedro.

Table 2. Abundance of debris in terms of weight and numbers for the three Lac Bay mangrove beach transects sampled in October 2011.

Site name	Length of beach (m)	Plastic	Wood	Glass	Foam	Metal	Cloth	Paper	Rubber	Total
Weight of beach litter (g m-1)										(g m-1)
Pta. Kalbas 1	5	10,250	12,500	800	400	200	-	100	700	4990
Pta. Kalbas 2	5	12,200	13,900	4,900	700	-	100	-	1,200	6600
Pta. Kalbas 3	5	7,500	4,100	2,300	100	400	2,800	-	1,400	3720
	Total (%)	39.12%	39.84%	10.45%	1.57%	0.78%	3.79%	0.13%	4.31%	
Number of beach litter items (m-1)										(m-1)
Pta. Kalbas 1	5	153	13	5	39	3	-	1	8	44.4
Pta. Kalbas 2	5	382	35	24	92	-	2	-	19	110.8
Pta. Kalbas 3	5	443	21	12	80	4	7	-	12	115.8
	Total (%)	72.18%	5.09%	3.03%	15.57%	0.52%	0.66%	0.07%	2.88%	

Debris composition: In terms of weight, the two main components of the collected debris were plastics and wood (Table 2). In terms of numerical abundance, the two most important debris components were

plastics and polystryrene. Compared to earlier data from Curaçao, the contribution of plastics and polystyrene appear to have increased in relation to metals wood, paper and other materials.

Table 3 shows the main debris size-categories for the various man-made materials. Plastics and polystyrene tended to be concentrated in the smaller size categories, whereas wood was predominantly large (i.e. > 30 cm). Rubber debris items were largely shoes and slippers and these peaked in size at the main shoe sizes used (25-29.9 cm). Glass debris comprised largely beverage bottles, in which the principal size category was dictated by the current size of beer bottles (20-24,9 cm).

Table 3. Percent size-frequency distributions for all items collected from three Lac Bay mangrove beaches sampled in October 2011.

Size class (cm):	5-9.9	10-14.9	15-19.9	20-24.9	25-29.9	≥30
Plastic (N=862)	25	24	14	16	5	16
Wood (N=69)	1	7	13	14	10	54
Glass (N=41)	7	12	17	46	17	-
Foam (N=211)	58	22	13	4	1	1
Rubber (N=39)	-	5	15	33	38	8

The results also show that mangrove forests act as both a trap and filter for debris, and show a high accumulation of debris that also get lodged amongst the mangrove roots. Plastic bags and rope appear to be trapped up front and large pieces of wooden flotsam also. Smaller objects penetrate deeper into the mangrove forest, being driven by wind and tidal forces. Curiously, no oil or tar balls were collected at the mangrove sites, while these are common (though patchy in distribution) at coastal sites elsewhere on the island. The possibility that tar is broken down or assimilated more quickly in mangrove mud systems than on sandy beach systems cannot be excluded.

The numerically predominant man-made material found in the mangrove beach debris was plastic. The composition of these plastics in terms of utility is shown in table 4. Compared to earlier debris data from Curaçao, the results stand out for a lower contribution in terms of fragments and a higher contribution in terms of beverage and household bottles. The cause for these differences cannot be explained here without comparative data from control sites. The relatively higher abundance of plastic bottles (particularly beverage bottles) may reflect the local generation of recreational litter in Lac (discussed separately below) or even a general worldwide increase in the use of plastics for every-day use in recent decades. The generally lower importance of fragments may be partially due to the sheltered nature of mangrove-fringed beaches, where plastic objects may break less quickly into fragments than on (wave and sun)-exposed sandy shore beaches.

Table 4. Percent frequency composition of plastic debris items collected at Lac Bay mangrove beaches in October 2011.

Plastic debris items	Lac Bay (%)
Fragments	24
Caps	17
Toys	1
Beverage bottles	18
Household bottles	11
Cups	9
Bags (household + garbage)	11
Buckets	-
Ropes	3
Misc. food containers	3
Combs	-
Drinking straws	1
Other	3
Utensils	-
Fishing materials	-
Pens	-
Medical waste	-
Roller	-
Cigarette lighters	-
Hoses	-
Child care	-
Total:	100

Figure 22 shows the current manufacturing source for the observed debris items that had labels attached or embedded in the objects (all bottles). Of these 75% were found to have been manufactured in Venezuela. Compared to earlier results for Curaçao (Debrot et al. 1999), the contributions of objects manufactured locally or in the USA appeared relatively less, whereas items manufactured in Venezuela were more abundant.

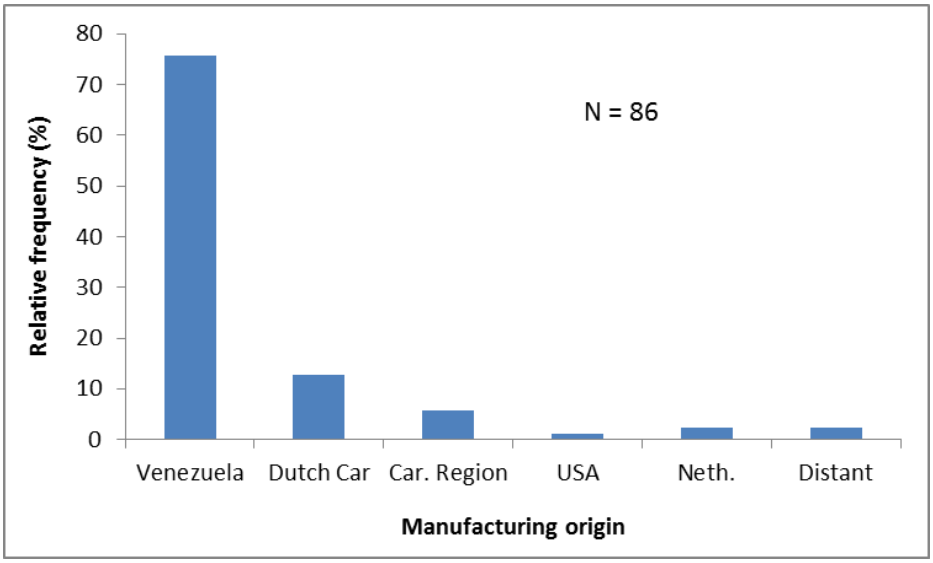

Fig. 22. Relative frequency histograms indicating country of origin for debris collected on mangrove-fringed beaches of Lac.

Submerged beach debris

The two transects of the recreational beach of Sorobon had respectively 26 (0.5 kg) and 71 (3.6 kg) pieces of man-made litter. The nature of the litter collected was fully recreational and plastic beverage cups amounted to 71% of all items. These densities are comparable to available results from unmanaged public beaches in Curaçao (Nagelkerken et al. 2001).

5.6 Traffic densities along the mangrove route (Kaminda di Sorobon)

The recreational activities in Lac inevitably lead to traffic moving from and to the bay, and to the Sorobon peninsula in particular. One of the roads to Sorobon (Kaminda di Sorobon) leads closely along the mangroves of Lac. Traffic data collected by Geoconsult on the Kaminda di Sorobon on two days in 2011 indicate average traffic densities of some 16 vehicles per hour during daytime (6 am-12 am) and 9 vehicles per hour during the first half of the night (6 pm to 12 pm). This makes traffic a constant source of potential disturbance and risk to birdlife in the mangroves and mortality to lizards, iguanas, birds (Fig. 23), hermit crabs and land crabs (Fig. 24) that cross the road. All of these species were observed dead on that road during a brief field visit in October 2011. The other road of the Lac area (the road to Cai), likewise is a source of mortality to native fauna of the bay, but traffic levels there are considerably lower. Traffic tends to move fast on all Lac roads. Mandatory speed reduction (using speed bumps) might be part of the solution for mortality to birds and iguanas, but, for instance, not for crabs or hermit crabs which react to slowly or inappropriately to traffic. Fortunately, such species, are most active at night, when traffic densities are lowest.

Fig. 23. A yellow-billed cuckoo, Coccyzus americanus*, killed by traffic on the Kaminda di Sorobon at the Lac mangroves on October 1, 2011 (Photo: A. Debrot)*

Fig. 24. A kangreu di mondi, Gecarcinus ruricola*, struck dead on the road by traffic (Photo: A. Debrot)*

Of the 15 taxi respondents, the majority of taxi traffic occurs on the southern Belnem route and not along the Lac mangroves (Fig. 25). The limited traffic data collected in 2011 by Geoconsult indicate that during daytime, taxi-related traffic amounts to about 19% of the traffic on the Kaminda di Sorobon and 16% at night (Fig. 26). The results further suggest that taxi traffic was not higher on the mangrove route during cruise ship presence than on non-cruise week days. Cruise tourism taxi busses indeed appear to consistently take the alternate faster route across Belnem. Sixteen of the 18 taxi respondents stated to be willing to offer their tourist clients additional information about Lac.

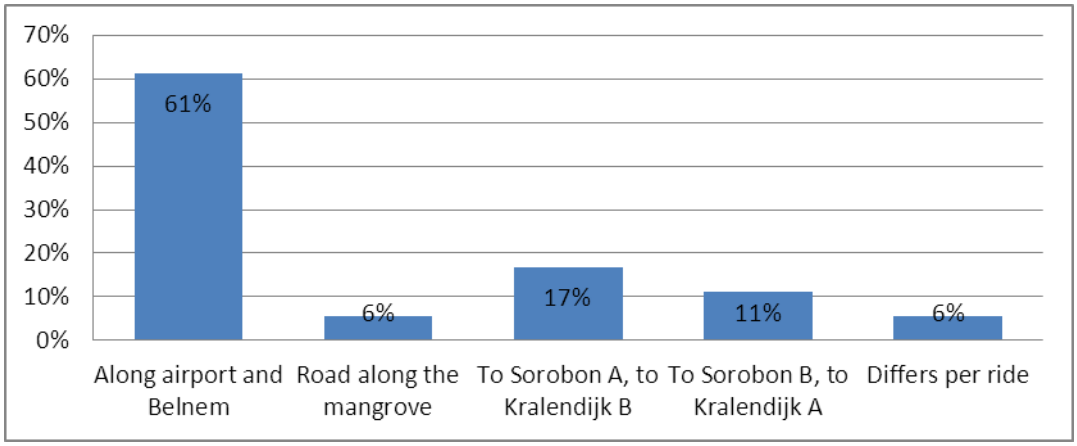

Fig. 25. The use of the two possible routes to Sorobon as stated by taxi drivers.

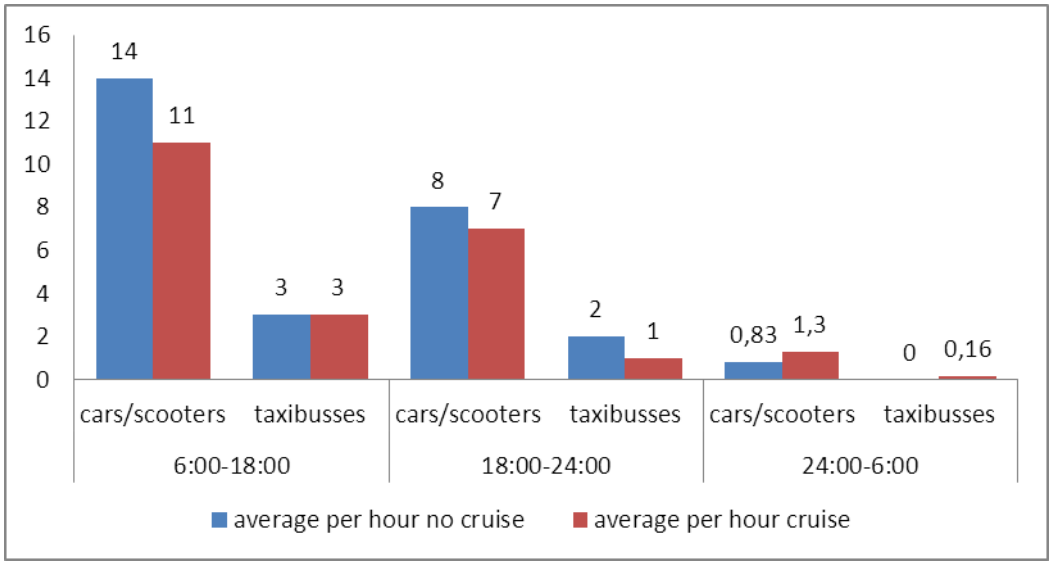

Fig. 26. Hourly traffic densities on the Kaminda di Sorobon along the Lac mangroves as monitored by Geoconsult in 2010.

5.7 Other disturbance in the mangrove-zone

As indicated above, currently two entrepreneurs 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 (Kats, 2007). Despite the fact that these tours are legal, they cause some disturbance to the mangrove environment as the tours lead through areas with foraging, resting and breeding birds. Nesting birds are scared off their nest, leaving behind their eggs which get exposed to the elements (Fig. 27). 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 only visit a small part of the total area of mangrove vegetation in accordance with the zoning plan. Therefore, the net detrimental impacts of kayaking at current levels, should be relatively minor.

Fig. 27. Heron egg exposed due to disturbance in the mangroves (Photo: A. Debrot 2010).

5.8 Fishing activity

Fishing can have heavy impact on an ecosystem, due to its extractive nature (killing and removal). According to the Lac Bay Management Plan, no activity is permitted in the mangroves situated in the white zone, but fishing is exempted based on the attitude that it is a kind of “traditional” activity. According to a fisherman from Mangel Haltu, 19 different “fishermen” frequent the mangroves on a regular basis. However, another fishermen at Cai claimed that there alone some 30 men tended to fish occasionally. It is difficult to exactly tell how many “fishermen” are active in the bay since many Bonaireans tend to see themselves as fishermen even though 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. Two fishermen mentioned that they mainly fish on mangrove snappers, jacks and barracuda. Occasionally anglers can be seen on the barrier reef around Punta Mewchi and across the bay at Cai.

For the Lac fishing boat count, an average of 6.78 small functional fishing boats were seen on or along the shores of the bay. The number of boats actually fishing on the water varied between 2 to 4 boats at the same time. In the discussion, these data compare quite low with data from the early 1990s (some 36 small boat form fishing in Lac; Moorsel and Meijer 1993), allowing us to conclude that fishing pressure inside the bay has apparently decreased in recent decades to some 16% of what it used to be in the early 1990s.

5.9 How Sorobon beach goers experience crowding

The “social carrying capacity” at Sorobon beach can be determined by how this crowding affects visitor perceptions on the quality of their experience at different visitor densities.

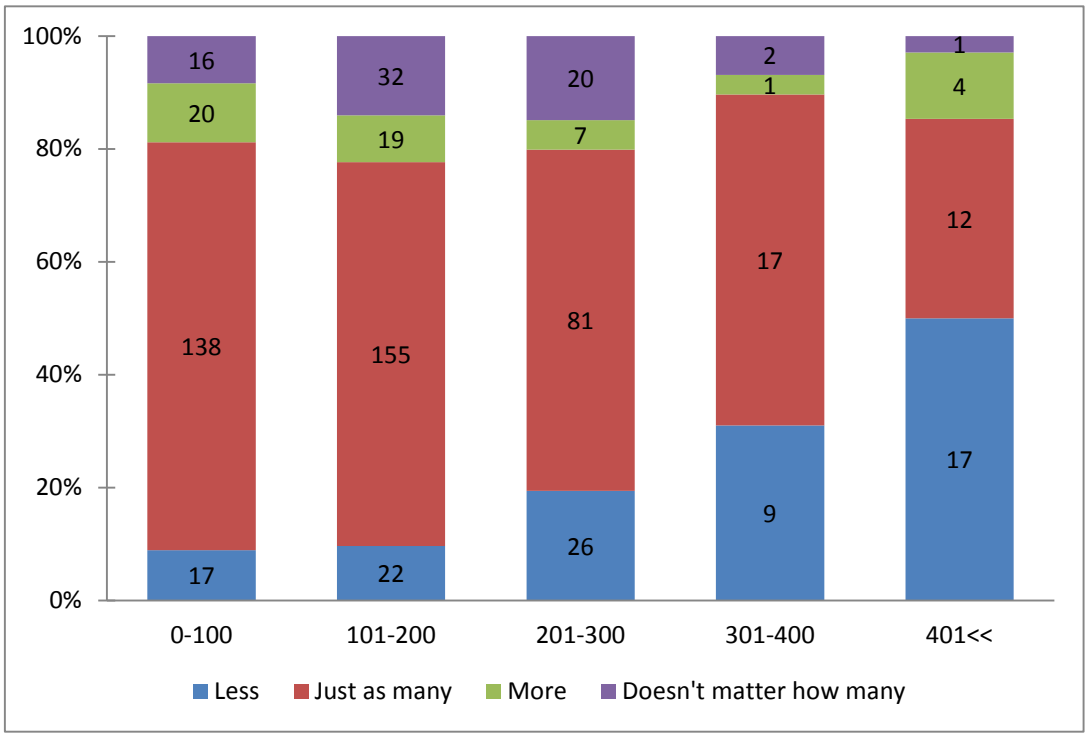

Fig. 28. Relative frequency (%) of preference of beach visitors for more or less people than were present on the beach at that moment as a function of total beach visitors present. Numbers in the bars give actual counts per category of response.

Figure 28 shows the response of beach visitors to how they experience crowding at different levels of visitor densities at Sorobon. The number of people who wanted "more" beach visitors and/or to whom crowding "doesn't matter" were consistently low. The categories of response that show trends are those of respondents that either were "satisfied" with the level of crowding or those who prefered "less" crowding. The line for respondents satisfied with "Just as many" is inversely related to the response for respondents preferring "less" crowding. The negative effect of crowding on the response of beach visitors was statistically highly significant (Chi-square = 58.63, *df* = 9, *P*<< 0.01) and already begins at levels of 2-3 hundred visitors present and consistently increases as densities of beach goers increases. Average peak density on days with visiting cruise ships lies midway between 3 and 4 hundred persons, and means that at those levels some 30% of the visitors are experiencing the crowding on the beach as negative for their personal enjoyment. In other words, our results document how current crowding at Sorobon is decreasing the experience of a large number visitors to the beach.

Availability of facilities

When asked about what additional facilities the visitor might like to see at Sorobon, the majority of respondents (61.7 to 75.5 %) indicated no critical need for additional facilities. However, the three facilities that were most needed according to the respondents were more access to: shading (30.3% of respondents), toilets (18.9%) and shops (18.0%) (Fig. 29). A net 8.1% (= 11.8 minus 3.7) of visitors felt the need for additional restaurants or bars for food services to the visitors, While 9.7% of respondents felt that more hotel capacity at Lac was to be desired, this was almost fully compensated by 8% who felt that less hotel capacity than at present was better, resulting in a scant 1.7% (9.7 minus 8.0) higher number of visitors that wanted to see more hotel facilities at Lac. This indicates that visitors hardly see Lac as a place for more hotel development.

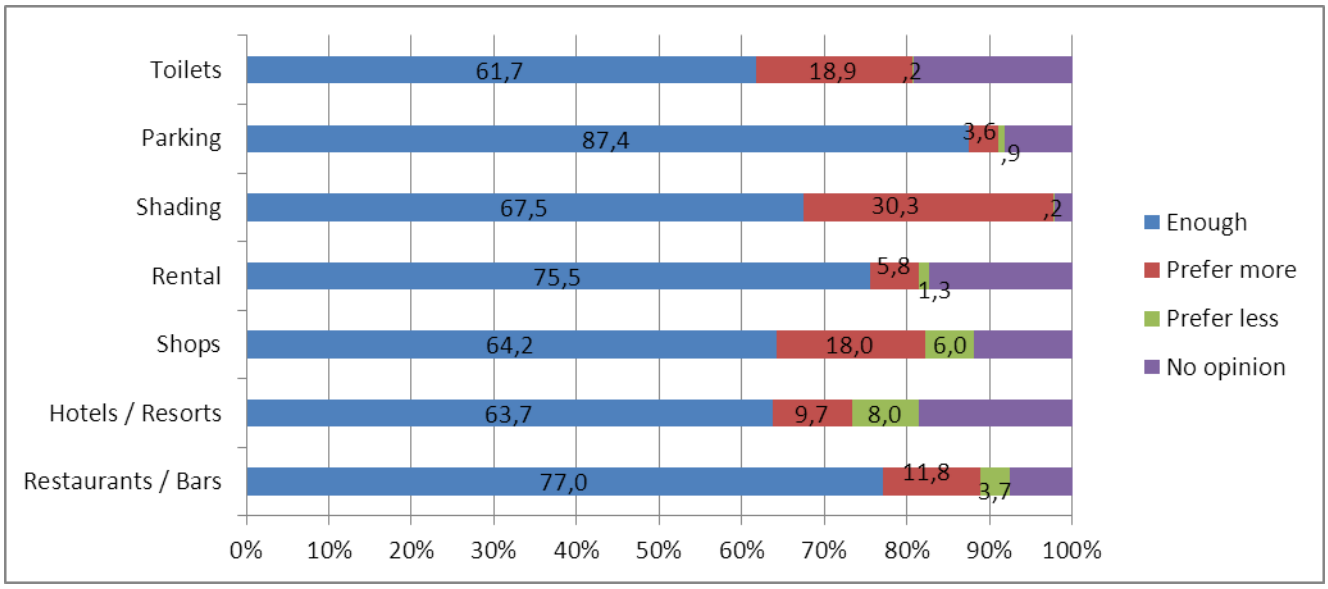

Fig. 29. Opinion of visitors regarding the current availability of different facilities at Lac.

5.10 User awareness

When asked whether the respondent felt that the current level of visitors at Lac was (or was not) a threat to its environment (question 10), the majority answered "no" (398) while 152 answered with "yes" (Fig. 30).

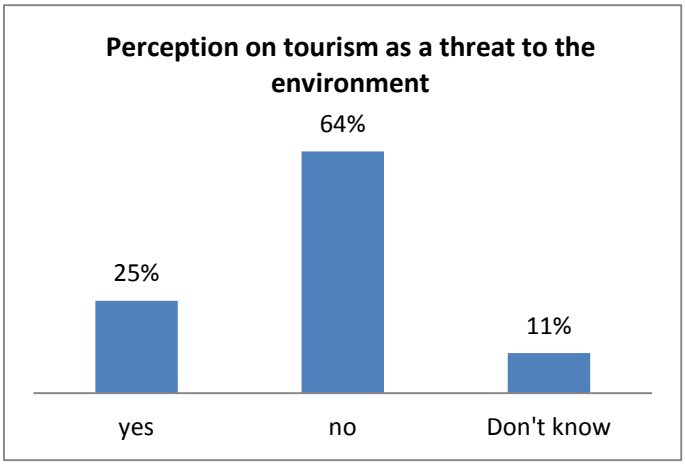

Fig. 30. How the visitors of Sorobon beach perceive the potential ecological danger of current user densities to the ecology of Lac.

Awareness of zoning measures

Figure 31 shows up to what extend different visitor types are aware of the existence of a zoning plan for Lac. As might be expected, cruise tourists knew the least about the zoning plan. Only 15% of these respondents were aware of the zoning plan. Visitors who stay on Bonaire for a longer time were more aware of the zoning plan with 37% of the stay-over tourists answering that they knew about the zoning plan. Of the foreign residents 45% and of the native Bonaireans 47% answered that they were aware that activities at Lac are zoned by area.

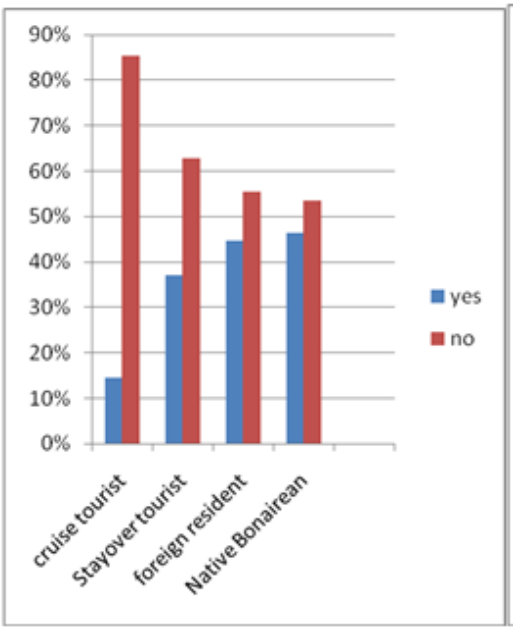

Fig. 31. Awareness of the zoning plan amongst different visitor groups.

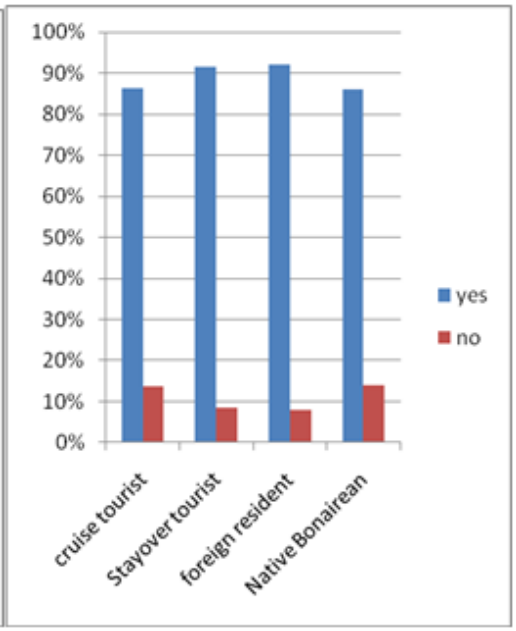

Fig. 32. Awareness of seagrass lines amongst different visitor groups.

Fig. 32 shows that the majority of the visitors was aware that they are not supposed to cross the seagrass lines. The consistently higher level of awareness was likely due to the better visibility of the seagrass exclosures (located close to shore) and the associated signage. An overall 91.2% of the respondents answered that they knew that they should not cross the seagrass marker lines. Notwithstanding these encouraging indications, in practice trampling by an average of (more than) 2 persons occurs during about 7% of the daytime hours and even at these low levels appears to limit seagrass growth inside the current protection-zones.

6 Discussion

Anthropogenic effects coming from afar

When this study was commissioned there was no indication of the size of the Lac drainage basin. However, as mangrove growth and health are importantly affected by freshwater input, a “watershed approach” was deemed valuable. Therefore, the first step we chose, was to use satellite topography to provide an initial map of the Lac watershed area. The surface of the Lac watershed area is estimated to amount to about 22.6 km^2. All activities and processes in the watershed may potentially affect the bay in various ways through ecological connectivity.

Freshwater extraction and diversion in the watershed area are particularly important parameters to know. Our initial assessment indicates the presence of at least 52 dams that obstruct or retard water flow and many wells from which groundwater can be or is being extracted. This is only a preliminary indication of the magnitude of potential effects on freshwater input quantity and quality into Lac. Further mapping and estimation of diversion and extraction and its effects on surface and groundwater flows and fresh water quality would be valuable.

Much of the land in the watershed area is barren and devoid of vegetation due to past felling of trees, agricultural activity and/or due to past and current overgrazing. While no data was specifically collected, a review of sources and field observations show that current densities of livestock in the watershed and in the vicinity of the bay exceed 1 animal per hectare. From observations elsewhere on the island (Washington-Slagbaai) and Curaçao (Christoffelpark) it can be concluded that these densities do not allow vegetation recovery. As mentioned earlier, it is not legally allowed to let livestock roam free. Enforcing this law, would require kunuku’s to keep their livestock within the fenced boundaries of their properties. However, most kunuku’s currently have more livestock than their own parcels can sustain (Nolet and Veen 2009). Adhering to this law would force some people to reduce their herd size and/or to purchase or produce supplemental feed and fodder. The names of the owners of almost all kunuku’s can be found at the government service of Domeinbeheer, where they are registered. Most of the land is government land given in long-lease (“erfpacht”) and not actual private ownership (“eigendom”). Although much of the available information seems to be out of date, it can be a starting point in determining who to contact. Cooperation with the agricultural services of LVV and KriaBon (where food for livestock is sold) could be of great help in establishing contact with agriculturalists active in the Lac watershed area. Roaming livestock levels in the vicinity of the bay could be reduced, either structurally by introducing husbandry management in the surrounding areas or locally by grazer exclusion (fencing).

Effect from users at and on the bay

When this study was commissioned there existed no quantitative information on the numerical density of different users in Lac. Our results provide exactly such data and show that the Lac lagoon is intensively used for recreation. From 9 in the morning to 4:30 pm practically every day (but also depending on the exact time and whether it is a weekend, week, or cruise ship day) anywhere from 100 - 400 people are present on or along the shorelines of the bay at any given moment.

Such numbers of people throughout the day have multiple effects. For instance, interviews with entrepreneurs indicate that many of the used septic tanks are of old age. Some are leaking and need to be replaced or repaired. Nutrient and pathogen-rich “grey” water is often used for watering plants, subsequently causing nutrients to end up in the ecosystem. Under normal conditions, humans produce an average of 1-2 litres of urine per day containing an average of 9.3 g of urea per litre. Increased urination is a known physiological response in response to cool water immersion. This is caused by a reduced blood flow to the skin and extremeties (to help conserve heat) which results in a higher blood

pressure. This in turn is compensated by the kidneys excreting more water in the urine. As there is no sewage treatment and as the toilets and cesspits are generally defunct, all urine from the Lac visitors generally can be assumed to end up in the bay water. With the data we present (along with other variables such as average daily human urine production) it would be possible to model the urea input into the Lac system by these numbers of people.

Doing so is particularly relevant as Slijkerman et al. (2011) have already documented eutrophication as a problem in Lac. In that study they did not measure DON (dissolved organic nitrogen) or pinpoint whether the cause was due to human sewage, nutrients from run-off, from the birds that roost in the mangroves or from a combination of sources. However, with the numbers of visitors that we document here, it is all the more likely that human use may figure importantly in the eutrophication. Urea is an important form of DON on the reef (Crandall and Teece 2012) and is readily taken up by both corals and algae (Grover et al. 2006; Larned and Stimson 1996). It is generally only present in tropical oceans and reefs at very low concentrations (of 5–20 lmol N l^{-1}; Crandall and Teece 2012). Elsewhere, pollution with anthropogenic urea has been pinpointed as a worldwide problem for coastal eutrophication (Glibert et al. 2006).

Other potential effects that can come into play with such large numbers of people concentrated in a small bay include the cumulative toxic effects of suntan lotion (Danovaro et al. 2008). Some 25% of sun tan lotion is washed off within 20 minutes of entering the water and even at low doses stress to corals can occur within 18-48 hrs. According to Danovaro et al. (2008) some 10% of reefs worldwide are threatened with bleaching caused by suntan lotion. When more information becomes available on suntan lotion use, water circulation and the effects of different lotion concentrations on bay organisms, the impact on the dying coral fauna of the bay (e.g Eckrich et al. 2011) can be assessed. For now these effects remain unclear but clearly deserve to be more thoroughly assessed.

The results of our limited sampling distinguish two areas within Lac where litter contamination is a problem. These are the areas down-wind from the entrance of the bay which have high concentrations of beach litter along the shores in the mangroves and b) the lagoon-bottom immediately off the public beach of Sorobon. The first area has the most serious litter contamination problem. At Sorobon the source of the documented submerged beach litter problem is local, and its nature is recreational. In contrast the source for the contamination in the mangrove forests opposite the entrance of the lagoon is external to Lac and more household in character.

Environmental contamination with litter at the levels documented for Lac cannot be considered “sustainable”. Plastics and foam particles in particular carry contaminants into the bay and break down and enter the ecological system where they may accumulate and spread and have long-lasting and complexly interactive impacts. They can also choke and entangle fauna such as crab, birds or sea turtles. Entanglement of turtles in fishing line is a problem in Bonaire and also in Lac where discarded fishing line is especially concentrated in the channels of the bay (M. Nava, pers. comm.) http://www.bonaireturtles.org/what-we-do/fishing-line-project/. In this baseline study we did not assess contaminant concentrations in either environment or biota, nor were the potential biological or ecological effect of contaminants studied. Such data are exceedingly rare in the Caribbean and are highly recommended.

As for the recreational litter problem at Sorobon we noted the scarcity of trash bins for the public to deposit trash into. Placement of more bins may help in and of itself. Policies focussing upon awareness may also help, as would be policies to further limit or prohibit the use of throw-away plastic cups and packaging at Lac. Regularly scheduled clean-ups could also help limit litter accumulation. To address the flotsam drifting the Lac from the wider Caribbean it may be possible to use floating booms and catcher-nets positioned in shallow and calm seagrass areas seawards from the mangroves to herd and

concentrate the litter for periodic removal. Mangrove forest clean-ups, though tedious, are clearly not impossible and could also help address the problem. The issue of flotsam drifting in from open sea should ideally also be addressed at a joint regional level whereby the focus should be to reduce or eliminate the input of man-made debris into the sea. To this end UNEP's Caribbean Environmental Programme (CEP/UNEP) has developed a regional action plan to address the matter (UNEP 2008). Active participation by Caribbean Netherlands representatives can be recommended.

The effects of trampling on seagrass seem apparent (but granted, are not proven). Observations on the density of juvenile fishes reveal high concentration of juvenile fishes (and queen conch) in the shallow sea-grasses at Sorobon, so the protection of these seagrass beds remains important. Our estimates indicate that the seagrass exclosures were subjected to a daily average of 80 person minutes of trampling per day and the borders of the seagrass exclosures showed evidence of the negative effects of trampling (reduction of seagrass coverage). Trampling of the seafloor in the shallows of Sorobon outside of the exclosures is even more intensive and may strongly limit seagrass coverage. Based on our observations, the placement of additional exclosures in the shallows off the beach of Sorobon might greatly increase seagrass coverage in these areas and should be experimented with. Elsewhere the short to longer-term effects of trampling on seagrass and infauna of sandy bottoms have been well-documented (e.g. Chandrasekara and Frid 1996; Skilleter *et al.* 2006).

Several activities in or in close proximity to the mangroves were documented. Windsurfers often enter the white zone throughout the day, often coming 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 causes disturbance to birds and mortalities among birds, lizards, crabs, iguanas and hermit crabs. Mangrove tours lead to disturbance as well, but only in a small part of the mangrove forest. Our results indicate that fishing effort in the bay has decreased since the 1990s.

Disturbance of sea turtles appears to be frequent in the bay due to (principally) windsurfing and other boating activity. 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 (STCB 2009). Sea turtles typically display flight reaction. Disturbance by windsurfers and other forms of recreation can affect their metabolism, food uptake and stress levels. At present the turtles seem to be most concentrated away from the most windsurf intensity in the deeper part of the entrance to the bay. The factors affecting habitat suitability and distribution of turtles in the bay are not well understood and deserve further study, but their concentration in an area well away from Sorobon may in part have to do with disturbance due to recreational intensity.

We document and describe the various user groups of Lac in terms of age structure and nationality. These groups use the beach differently and at different times of the day. The current heavy usage level at Sorobon not only affects nature in this important Ramsar area, but also the quality of visitor experience. As visitor numbers increase, the number of visitors indicating a preference for less people for their maximum enjoyment also increases notably. The awareness of various groups about the importance of Lac and the zoning plan differs significantly. Even though awareness of the exclosures to protect seagrass was high, trampling of seagrass amounted to on the order of 80 person minutes of trampling per day and appear to cause damage. Hence, notwithstanding awareness, such levels of trampling remain a likely problem and should be further investigated. Visitors further indicate their desire for more shade, toilets and shops to buy goods and services on the beach. Interviews with visitors and the various stakeholders identified several issues that need to be addressed. These are:

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

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

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

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

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

7 Conclusions and recommendations

Lac Bay is experiencing a long-term decline in productive habitat area (Debrot et al. 2010a), all the while non-sustainable grazing of vegetation (by extensive livestock husbandry) (this study), eutrophication (Slijkerman et al. 2011), seagrass trampling (Giardini 2008, Kalke et al. 2010, and this study) and high levels of litter contamination (this study) have been documented. Additional problems, possibly exacerbated by the cumulative effect all anthropogenic stressors, are the rapid invasion of the exotic seagrass, *Halophila stipulacea,* (Debrot et al. in prep.) and a bloom of an encrusting (possibly invasive) calcareous alga that is smothering live corals (Eckrich et al. 2011). In addition, the distribution of sea turtles in the bay (as documented by STCB 2009) may suggest these animals are being hindered by human disturbance. It seems clear that the combined levels of anthropogenic impact on the bay currently exceed sustainable levels, but it is very difficult to convincingly prove any principal culprit or to find any "silver bullet" solution.

Recreational beach visitor levels have been documented as high, and our questionnaires also establishes that most visitation has little to do with the specific nature values of the bay. Most experiences sought by the Lac beach-goers could probably be found elsewhere if only offered elsewhere. The effect of crowding further has demonstrable effects on the quality of experience of the users, and the majority of businesses operating at the bay would particularly like to see the massive and growing number of cruise ship visitors curtailed. While only 9.7% of respondents felt that more hotel capacity at Lac was to be desired, this was almost fully compensated by 8% who felt that less hotel capacity than at present was better.

In light of the ecological importance of the bay, its status as a legally designated Ramsar site, the ecological problems that have been fairly documented, and the documented negative effect of current crowding on the visitor experience itself, it would seem to be a priority to develop beach options for cruise ship tourists elsewhere on the island and/or to create or better-promote alternative activities for the cruise tourist to engage in. In addition, various measures can be taken on site to reduce visitor impacts, and enhance visitor experience.

We finalize with recommendations directed either towards management action or research needed to address remaining knowledge gaps.

Recommended management actions

- Develop sunbathing and water sport possibilities elsewhere on Bonaire to distribute user densities away from Lac.
- Upgrade user facilities and infrastructure at Lac. These include toilets and septic system, garbage disposal, organized parking, shade, signage and markers for the various management zones.
- Implement a Visitor Centre to provide visitor service (products and added value-information) and enforcement.
- Reduce grazer densities in the watershed and/or around the bay.
- Discourage/prohibit the use of throw-away food and beverage packaging at Lac and participate actively in the regional Marine Litter Action Plan developed by UNEP
- Design a boom system to herd and trap contaminants entering Lac before they penetrate the mangrove fringes.
- Organize regular beach clean-ups in Lac.

Recommended research to address knowledge gaps

- Further map and quantify anthropogenic effects in the watershed area (pollution, water diversion and extraction, forestation, grazing, farming, erosion) and their effects on Lac (in terms of sedimentation, reduced freshwater influx, nutrient loading).
- Document traffic levels on Kaminda di Sorobon and its effects in terms of disturbance, road-kills and littering.
- Study the concentration and effects of litter-derived contaminants on the environment and biota of the bay.
- Study the distribution and habitat selection of sea turtles in the bay as related to diet, food availability, water temperature, disturbance and other factors.
- Study the use of more and/or larger exclosures to improve seagrass coverage in the Sorobon area.

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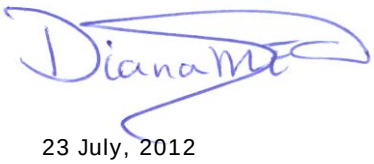
Quality assurance

IMARES utilises an ISO 9001:2008 certified quality management system (certificate number: 57846-2009-AQ-NLD-RvA). This certificate is valid until 15 December 2012. The organisation has been certified since 27 February 2001. The certification was issued by DNV Certification B.V. Furthermore, the chemical laboratory of the Environmental Division has NEN-AND-ISO/IEC 17025:2005 accreditation for test laboratories with number L097. This accreditation is valid until 27 March 2013 and was first issued on 27 March 1997. Accreditation was granted by the Council for Accreditation.

Justification

Report C092/12
Project Number: 430.87010.03

The scientific quality of this report has been peer reviewed by a colleague scientist and the head of the department of IMARES.

Approved:	Dr. D.M.E. Slijkerman researcher
Signature:	
Date:	23 July, 2012

Approved:	F.C. Groenendijk, MSc. Head of Department
Signature:	
Date:	24 July, 2012

Appendix A. Cruise schedule and monitoring days

	2010/2011 CRUISE SEASON AS PER NOVEMBER 23RD 2010									
CALLS	DAY	DATE	NAME	ARR/DEP	AGENT	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	Leponant		????					
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

Appendix B. 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				

Appendix C. Questionnaire for Lac Bay beach goers

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?

Appendix D. Questionnaire for Taxi drivers

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. Randolf 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

Appendix E. Questionnaire for Kunuku owners

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: ……

Appendix F. 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 verniel 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 vernielt.

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 CO_2 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 m^3. Het grijze water uit de laatste kamer wordt een gebruikt om de palmbomen te bewateren. 1 keer per week worden alle kamers geleegd.

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 cruisetoerisme 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 cruisetoerisme 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 cruisetoeristen 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 cruisetoeristen 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 natuurbeeld 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.