Annual report

2010

CARMABI

Caribbean Research & Management of Biodiversity

Caribbean Research and Management of Biodiversity

Pictures on front page:
- Caribbean Flamingo (*Phoenicopterus ruber ruber*) by Bea Moedt
- Crustacean by Mark Vermeij

Carmabi Annual Report 2010

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From our director

Much has happened in 2010 and this annual report provides a detailed overview of the progress made in this year. On behalf of the Carmabi Board of Directors and the Carmabi staff I want to thank all Carmabi friends, associates and partners in research and nature conservation for a very productive year. We hope that collaboration with all our partners will be as productive this year as in 2010. We also thank the government of Curaçao for their ongoing and renewed support, and in particular our new Minister of Health, Environment and Nature, Mrs. Jacinta Constancia, who has been very supportive of Carmabi's work.

Our main event in 2010 was the opening of the Savonet Museum on May 18th in the presence of, amongst others, the Prime Minister of the Netherlands Antilles and the Governor of the Netherland Antilles, Mr. Frits Goedgedrag. The Savonet Museum is now open for everybody and based on visitors' responses ranks amongst the best museums in the Caribbean.

All four departments of Carmabi, i.e., research, park management, nature & environment education and advisory have been very active. Research is booming. A total of 94 visiting scientists came to Carmabi in 2010 to conduct a wide variety of research projects and 19 scientific publications were published in 2010 continuing the rise in research output over the last few years. This information is of great importance to Curaçao and is used to design new and monitor existing conservation measures employed on the island.

Heavy rains that caused damage in many parts of the island also affected the parks during the last months of 2010. The Christoffelpark had to be closed several days because entering the park was no longer safe and as a result the number of visitors was lower than expected during this period. The Hato Caves also suffered because a lot of water entered the Caves through the ceiling and the cave walls. It was literally raining inside the caves. On the sunny side I can report that the activities offered by the Christoffelpark have been expanded, for example with trips to the top of the Christoffel Mountain for cruise tourists. The park entrance has been moved and the entry tickets are now being sold in a brand new building.

The Nature and Environment Education Department is responsible for the guided tours for primary school children in the Christoffelpark and the areas of Daaibooi, Shete Boka and Kabouterbos. In 2010 more than 9000 school children visited the park guided by our 5 volunteer guides.

Advisory work is also on the rise. Environmental legislation on the BES islands has become stricter

and as a result we are receiving more requests for advice. Requests for advice from organizations on Curacao have also increased.

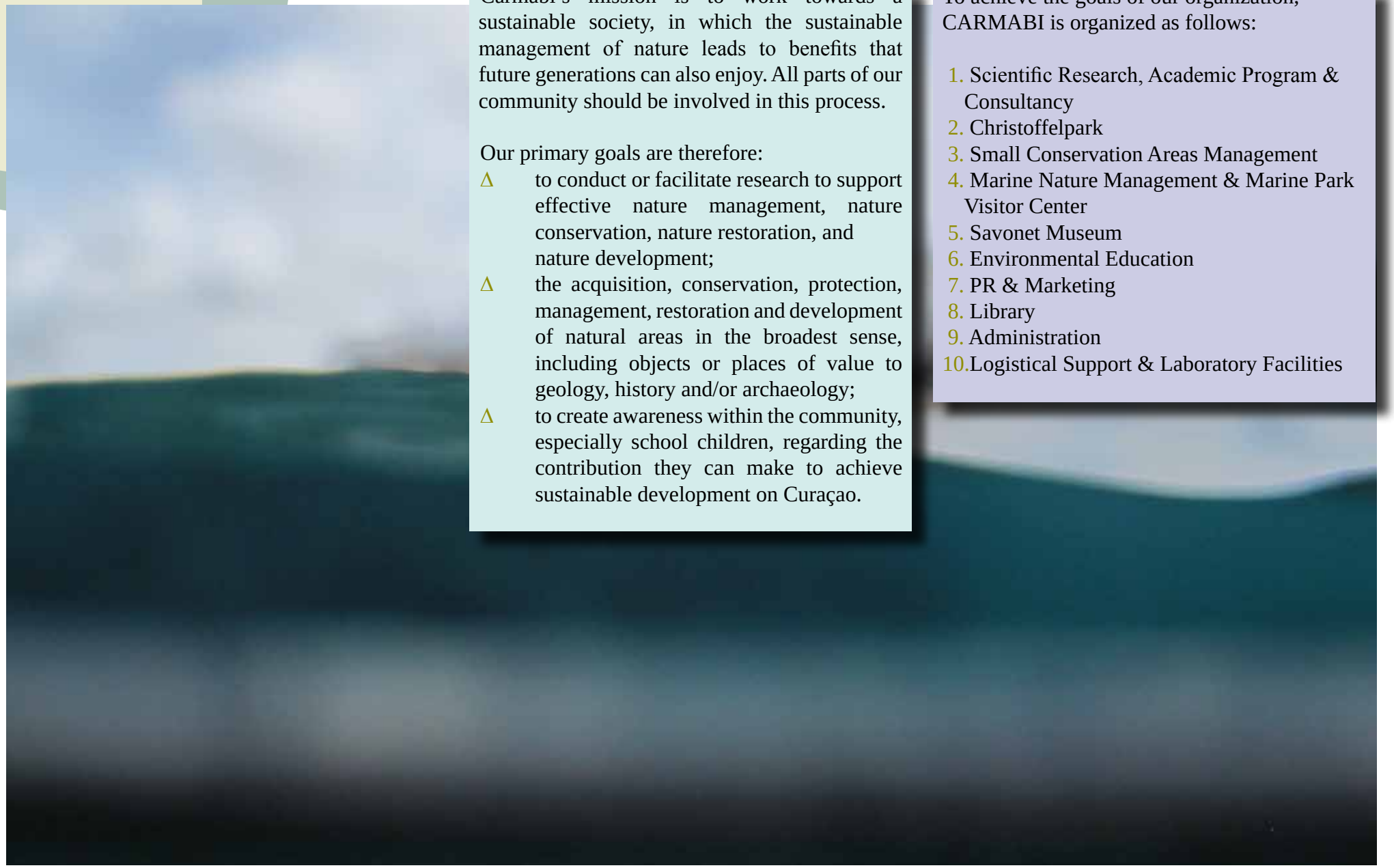
What will Carmabi's future look like? The construction of the new Carmabi Science Center funded by the Social Economic Initiative (SEI) will be phased. With the available funds the frame and complete outside of the building will be constructed as well as the interior of two of the four floors. The interior of the remaining two floors will be constructed when more funds become available. The Science Center will provide lodging for visiting scientists and will offer much-improved laboratory and library facilities.

Carmabi strives to be even more involved within nature conservation in the Caribbean and expand its advisory services to the entire Caribbean. As such we are developing a Caribbean wide network. We therefore participated in a conference of the Caribbean Sea Commission in Barbados which works towards becoming an interface between research and policymakers. This initiative stems from the feeling that research results are not used sufficiently by policy makers to solve the problems of the Caribbean Sea. Furthermore, Carmabi participated in a conference of the International Union for Conservation of Nature (IUCN) in Santo Domingo to create a regional committee for the implementation of the Caribbean Initiative, a regional program for the conservation of nature.

Looking at nature on Curaçao in general I am increasingly worried. Coral reefs at Curaçao are deteriorating. Coral reefs protect our coast against storms and hurricanes and are very important to our fisheries and dive tourism sector. As such the coral reef represents an important economic asset which unfortunately is not always recognized. Coastal development on Curaçao is an important local driver of coral reef deterioration. If our coral reefs would disappear they would be gone forever, as techniques to restore coral reefs do not yet exist. To prevent these reefs from disappearing Carmabi intents to work together with all those on and off island, that strive to protect these unique marine ecosystems. Curaçao's reefs are still among the best in the Caribbean; let's keep it that way!

Ir. Paul Stokkermans
Director Carmabi

C1 General Information



Mission and goals

Carmabi's mission is to work towards a sustainable society, in which the sustainable management of nature leads to benefits that future generations can also enjoy. All parts of our community should be involved in this process.

Our primary goals are therefore:

- to conduct or facilitate research to support effective nature management, nature conservation, nature restoration, and nature development;
- the acquisition, conservation, protection, management, restoration and development of natural areas in the broadest sense, including objects or places of value to geology, history and/or archaeology;
- to create awareness within the community, especially school children, regarding the contribution they can make to achieve sustainable development on Curaçao.

Sections

To achieve the goals of our organization, CARMABI is organized as follows:

1. Scientific Research, Academic Program & Consultancy
2. Christoffelpark
3. Small Conservation Areas Management
4. Marine Nature Management & Marine Park Visitor Center
5. Savonet Museum
6. Environmental Education
7. PR & Marketing
8. Library
9. Administration
10. Logistical Support & Laboratory Facilities

2.1 Visiting Scientists

Ninety four scientists visited Carmabi in 2010. In addition 58 students stayed at Carmabi to participate in Coral Reef Ecology courses that were taught by various universities from the Netherlands and the United States. The number of visiting scientists in 2010 signals a positive trend (i.e. a 14.6% increase) in Carmabi's visitation rate compared to 2009 when 82 scientists visited Carmabi (2008: 57; 2007: 38). Most scientists in 2010 were from the United States (41.2%) followed by the Netherlands (25.9%), Australia (14.1%) and Great Britain (8.2%). Not all scientists and students that came to Carmabi stayed at the Piscadera location due to expected loss of dormitories in September 2010, the supposed starting date for the construction of the new laboratory/ dormitory facilities. The annual occupancy rate was 34.6%, which is an increase relative to 2009 (22.7%). A total of 1767 personal working days (i.e. one visiting scientist working one day) were achieved. An overview of the areas in which all researchers that visited Carmabi were active is shown in Figure 1). An overview of visiting scientists (PI name and project description) is provided below:

1.	Aaron Hartmann (SCRIPPS, U.S.A.)	Physiology of coral larvae
2.	Alexander Wolf (ZMT, Germany)	Coral predators
3.	Alice Rogers (Imperial College London, UK)	Settlement dynamics of *Diadema antillarum*
4.	Bastian Piltz (ZMT/MPI, Germany)	Diversity of benthic cyanobacteria
5.	Ben Greenstein (Cornell College, U.S.A.)	Fossil reefs
6.	Benjamin Mueller (Royal Netherlands Institute for Sea research)	The relationship between dissolved organic compounds and bioerosion
7.	Brendan Biggs (Florida State University, U.S.A.)	Sponge ecology
8.	Brigitte Sommers (University of Queensland, Australia)	Pleistocene and modern day reef community composition
9.	Bruce Fouke (University of Illinois, U.S.A.)	Course: coral reef ecology & geology
10.	Butch Bringelspaugh (Pier Aquarium, U.S.A.)	Ecology of *Acropora prolifera*

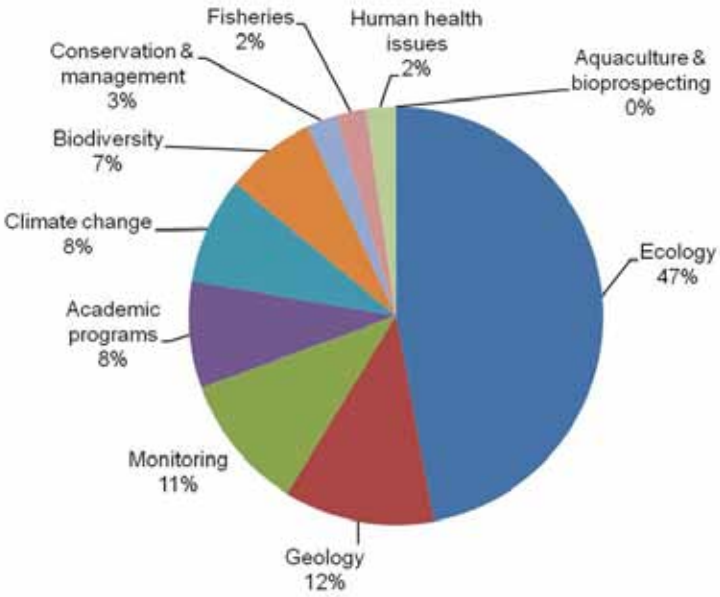


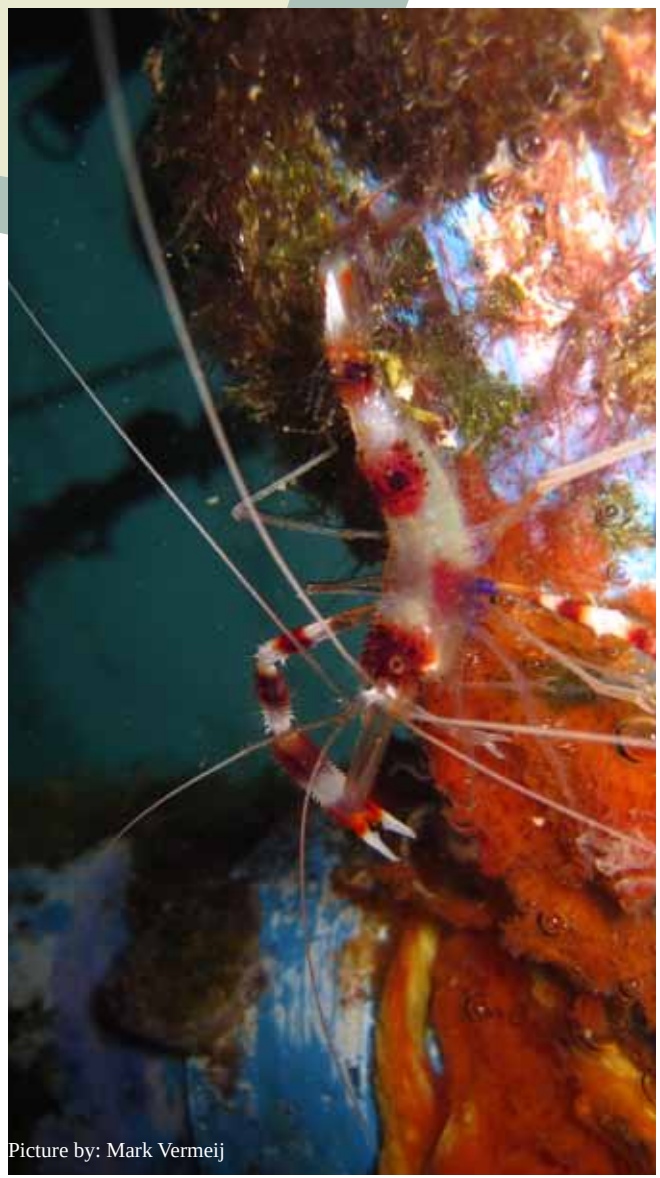
Figure 1: Overview of the areas in which visiting scientists were active in 2010.

Picture by: Mark Vermeij

11.	Camila Granados (University of Louisiana at Lafayette, U.S.A.)	Detection of zooxanthellae on coral reefs
12.	Dan Warren (University of Texas at Austin, U.S.A.)	Island biodiversity
13.	David Meyer (University of Cincinnati, U.S.A.)	Fossil reefs
14.	David Meyer (University of Cincinnati, U.S.A.)	Growth rates of pleistocene corals
15.	Donald Behringer (University of Florida, U.S.A.)	Diseases in Caribbean reef lobsters
16.	Fleur van Duyl (Royal Netherlands Institute for Sea research)	Production of dissolved organic compounds on Caribbean reefs
17.	Gaëlle Quéré (ZMT, Germany)	Spatio-temporal distribution of diseases in crustose coralline algae
18.	Hannah Brocke (ZMT, Germany)	Environmental drivers of cyanobacterial abundance
19.	Iliana Baums (Penn State University, U.S.A.)	Course: coral reef ecology
20.	Jasper de Goeij (Poriforma BV, The Netherlands)	Growth dynamics of tropical sponges
21.	Joan Maloof (Salisbury University, U.S.A.)	Course: coral reef ecology
22.	John Pandolfi (University of Queensland, Australia)	Fossil and modern reef structure
23.	Joost den Haan (University of Amsterdam, The Netherlands)	Nutrient dynamics in coastal waters
24.	Joseph Bump (Michigan Tech, U.S.A.)	Animal-ecosystem interactions
25.	Juan Sanchez (Universidad de los Andes, Bogota, Colombia)	Coral reef ecology class
26.	Juul Olthuis and Roel van der Heijden (University of Amsterdam, The Netherlands)	Dispersal of macroalgae by herbivorous fish
27.	Katie Barott (San Diego State University, U.S.A.)	Coral-algal boundary dynamics
28.	Kristen Marhaver (SCRIPPS, U.S.A.)	The importance of bacteria during the settlement of corals
29.	Maggy Nugues (ZMT, Germany)	Effects of benthic community structure on coral recruitment

30.	Mark van Alfen and Jordy van Vooren (Hogeschool Zeeland, The Netherlands)	Mapping coral communities around Curacao
31.	Mauricio Rodriguez-Lanetty (University of Louisiana at Lafayette, U.S.A.)	Zooxanthellae
32.	Michael Lesser (University of New Hampshire, U.S.A.)	Ecology of mesophotic reefs
33.	Nick Polato (PENN State, U.S.A.)	Effects of rising seawater temperatures on survival and behavior of coral larvae
34.	Niels Gelderland and Roel Maas (Hogeschool Zeeland, The Netherlands)	Effects of predatory fish on damselfish abundance
35.	Petra Visser and Mark Vermeij (University of Amsterdam, The Netherlands)	Course: coral reef ecology
36.	Pim Bongaerts (University of Queensland, Australia)	Distribution of *Symbiodinium* on mesophotic reefs
37.	Rene Severens (The Netherlands)	Flora of Curacao
38.	Rob Schmeider (San Diego State University, San Diego, U.S.A.)	Marine metagenomics and Vibrio studies
39.	Rolf Bak (University of Amsterdam, The Netherlands)	Long term monitoring of Curacaoan reef communities
40.	Sander Scheffers (Southern Cross University, Australia)	Climate reconstruction
41.	SECORE Project (Various countries)	Development of restoration methods for threatened *Acropora* species
42.	The FORCE team led by Peter Mumby (University of Queensland, Australia)	Drivers of coral reef degradation
43.	Valery Chamberland and Caroline Dube (Universite de Quebec a Montreal, Canada)	The effects of inland bays on the abundance of reef fishes on nearby reefs

Picture by: Mark Vermeij



Picture by: Mark Vermeij

2.2 Peer reviewed scientific publications

19 publications appeared in peer reviewed scientific journals based on work that was conducted at Carmabi by Carmabi staff or Carmabi's associated scientists. Nine of those publications were authored or coauthored by Carmabi staff making 2009 a productive year in terms of Carmabi's scientific output. The results of some of these studies (especially the study on larval hearing in corals) have been featured in magazines, news programs and educational websites in approximately 50 countries worldwide. Furthermore, 14 reports were produced by MSc students that did their master's thesis' project at Carmabi. An overview of all peer reviewed scientific publications published in 2010 is given below:

1. Bongaerts P, Ridgway T, Sampayo EM, Hoegh-Guldberg (2010) Assessing the 'deep reef refugia' hypothesis: focus on Caribbean reefs. Coral Reefs, DOI 10.1007/s00338-009-0581-x.
2. Filatov MV, Kaandorp JA, Postma M, van Liere R, Kruszyński KJ , Vermeij MJA, Streekstra GJ, Bak RPM (2010) A comparison between coral colonies of the genus *Madracis* and simulated forms. Proc Roy Soc B. doi: 10.1098/rspb.2010.0957.
3. Frade PR, Reyes-Nivia MC, Faria J, et al (2010) Semi-permeable species boundaries in the coral genus *Madracis*: Introgression in a brooding coral system. Molecular Phylogenetics and Evolution 57: 1072-1090..
4. Gyri C, Felis T, Koelling M, Scheffers SR (in press). Geochemistry and skeletal structure of *Diploria strigosa*, implications for coral-based climate reconstruction. Palaeogeography, Palaeoclimatology, Palaeoecology.
5. Giry C, Felis T, Scheffers SR, Scholtz D (2010). Assessing the potential of Southern Caribbean corals for paleotemperature reconstruction. IOP Conf. Ser.: Earth Environmental Science 9 012021. DOI: 10.1088/1755-1315/9/1/012021
6. Giry C, Felis T, Scheffers SR, Scholtz D. (in press) Assessing the potential of Southern Caribbean corals for paleotemperature reconstruction. Proceedings of the PAGES 1st YSM, Retrospective views on our planet's future, IOP Conference Series: Earth and Environmental Science.
7. Giry C, Felis T, Scheffers SR, Fensterer C (2010). Monthly Holocene temperature variability from Caribbean corals. PAGES news 18: 49
8. Kruitwagen G, Nagelkerken I, Lugendo BR, Mgaya YD, Wendelaar Bonga SE (2010) Importance of different carbon sources for macroinvertebrates and fishes of an interlinked mangrove–mudflat ecosystem (Tanzania). Estuarine, Coastal and Shelf Science 88: 464-472

9. Nagelkerken I, De Schryver AM, Verweij MC, Dahdouh-Guebas F, van der Velde G, Koedam N (2010) Differences in root architecture influence attraction of fishes to mangroves: a field experiment mimicking roots of different length, orientation, and complexity. Journal of Experimental Marine Biology and Ecology 396: 27-34.
10. Pignatelli C, Scheffers A, Scheffers SR and Mastronuzzi G (2010). Evaluation of tsunami flooding from geomorphological evidence in Bonaire (Netherland Antilles). Zeitschrift fuer Geomorphologie
11. Scheffers SR, van Soest RWM, Nieuwland G, Bak RPM (in press). Coral reef framework cavities: Is functional similarity reflected in composition of the cryptic macrofaunal community? Atoll Research Bulletin.
12. Sommer B, Harrison PL, Scheffers SR (2010). Aggressive colonial ascidian impacting upon coral reefs at Bonaire, Netherlands Antilles. Coral Reefs, 29 (1): 245.
13. Toller, W., Debrot, A.O., Vermeij, M.J.A. and P.C. Hoetjes. (2010) Reef fishes of Saba Bank, Netherlands Antilles: Assemblage structure across a gradient of habitat types. PLoS ONE 5(5): e9207.
14. Vermeij, M.J.A., I. van Moorselaar, S. Engelhard, C. Hörnlein, S. M. Vonk and P. M. Visser (2010) The effects of nutrient enrichment and herbivore abundance on the ability of turf algae to overgrow coral in the Caribbean. PLoS ONE 5(12): e14312.
15. Vermeij, M. J.A. (2010) First observation of a nocturnal nudibranch feeding on Caribbean corals. Coral Reefs 29: 1047.
16. Vermeij, M.J.A., K.L. Marhaver, C.M. Huijbers, I. Nagelkerken and S.D. Simpson (2010) Coral larvae move towards reef sounds. PLoS ONE 5(5): e10660 .
17. Vermeij, M.J.A., Barott, K.L., Johnson, A.E. and K.L. Marhaver (2010) Release of eggs from tentacles in a Caribbean coral. Coral Reefs 29: 411.
18. Vermeij, M.J.A., A.O. Debrot, N. van der Hal, J. Bakker and R.P.M. Bak (2010) Increased recruitment rates indicate recovering populations of the sea urchin Diadema antillarum on Curaçao. Bulletin of Marine Science 86: 719-725.
19. Vermeij, M.J.A., M.L. Dailer, S.M. Walsh, M.K. Donovan and C.M. Smith (2010) The effects of trophic interactions and spatial competition on algal community composition on Hawaiian coral reefs. Marine Ecology 31: 291-299.

Picture by: Mark Vermeij

Figure 2: A lionfish of 42 cm.
Picture by: Mark Vermeij

2.3 Free advice, outreach and consultation

Several organizations, government departments and others received free advice and information from the Carmabi Science Department during the year. We assisted in 65 cases, both oral and written. Five consultancy studies were executed for international and governmental organizations on Curaçao or other Caribbean islands. In 2010 the Carmabi Science Department was featured/ interviewed in 27 items for local TV, radio and newspapers. Twelve public and four invited lectures were given on various topics related to coral reefs. Visual materials were provided to numerous organizations, including the ARKKIVE project, NOAA and the New York Times, to illustrate various reef related items. Carmabi further developed its on-line identification guides for Caribbean corals that can be found under publications at the Carmabi website.

2.4 Research

A large, collaborative project was started funded by the European Union's 7th Framework Program. It's entitled; "Future of Reefs in a Changing Environment: an ecosystem approach to managing Caribbean coral reefs in the face of climate change (FORCE)" and will last for four years. In early 2010, all FORCE participants met on Barbados for a kickoff meeting. On Curaçao this project will largely focus on the ecology of microbes and phytoplankton in the water overlying reefs and how these functional groups are important to reef deterioration and health. Furthermore socio-economic studies will be conducted (as well as in a.o. Mexico, Honduras, Costa Rica en Barbados) to weigh the importance of factors such as e.g., poverty, corruption, lack of enforcement relative to "natural" factors when considering reef degradation. In 2010 several projects were started under this overarching research project (see contributions Den Haan, Visser, Hartmann in section 2.5).

The monitoring of the invasive lionfish (Figure 2) that first appeared in Curaçaoan waters in October 2009 was continued. In cooperation with LVV, local information now is available on the basic ecology and occurrence of this invasive species on Curaçao's reefs which has been used to (in cooperation with the Bonaire National Marine Park) design a new eradication program that will start in 2011. The following "facts" are now known with respect to the lionfish on Curaçao:

(1) Lionfish are probably able to grow to a size of 40+cm in one year which makes their growth rates among the fastest reported for fish in the Caribbean;
(2) attempts to promote human consumption of lionfish seem fruitless, active eradication using divers is by far the most effective methodology to reduce lionfish numbers;
(3) the lionfish has dispersed around the entire island of Curaçao in less than one year;
(4) lionfish eat both fish and crustaceans where the proportion of the former increases as the

fish increases in size;
(5) lionfish arrive on reefs as relatively small individuals (i.e., <5cm) in deep waters (i.e., >40m) and move to shallower water as they grow and
(6) several predatory fish, that are now in low abundance as a likely result of overfishing, are capable of eating the lionfish: groupers, snappers, barracuda's, scorpionfish and moray eels.

Currently, there is good hope that the new eradication program, which is also used on Bonaire and will start in 2011, will reduce the numbers of this nuisance species.

In 2010, Curaçaoan reefs were also hit by unusually warm seawater temperatures which caused them to "bleach", i.e., lose their endosymbiontic algae which they need for nutritional purposes (Figure 3). If such elevated sea water temperatures last too long (which they did), many corals die as a result of their lost endosymbionts. In December a survey was conducted to assess the damage caused by this bleaching event, but, at the writing of this report, these data still need to be analyzed.

Carmabi scientists visited the European meeting of the International Society of Reef Studies (ISRS), held every 4 years, in Wageningen to communicate and discuss recent findings and future plans for coral reef research projects on Curaçao. Several researchers working at Carmabi presented their findings to the international audience present at this 4-day meeting.

Science director Dr. M. Vermeij was invited to attend a workshop in Jamaica to talk about the reef restoration techniques used in Curaçao to increase the number of threatened Acropora corals on its reefs. Together with a large number of international collaborators gathered within SECORE (see: www.secore.org), Carmabi actively participates in the discovery of new methods by which the abundance of threatened coral species can be increased around Curacao.

A collaborative project with SCRIPPS Institution of Oceanography and San Diego State University (both U.S.A.) was also continued (for the 3rd year). In this project, active reef restoration methods are being a applied to a degraded reef near Westpunt (Curacao) to experimentally test which techniques and approaches are the most successful management tools to restore degraded Caribbean reefs.

Vermeij also participated in a research expedition to the Northern Line Islands, a group of remote islands between Hawaii and Tahiti, where pristine reefs can still be found (Figure 4). Again, a large group of collaborating scientists spent one month on a research boat while describing the workings of the most important reef processes on degraded and pristine island to better understand the ecological dynamics shaping coral communities before they degrade due to anthropogenic disturbance.

Carmabi continued its membership of the Association of Marine Laboratories in the

Figure 3: A bleached reef near Westpunt.White colonies are corals that have lost their endosymbiontic algae

Figure 4 Pristine reefs like the one shown here on Jarvis Island still have large amounts of large fish swimming over their reefs

Picture by: Mark Vermeij

Caribbean (AMLC, see: www.amlc-carib.org/) and NET-BIOME network (www.netbiome.azores.gov.pt/NetBiome). NET-BIOME stands for "NETworking for tropical and subtropical BIodiversity research in Outermost regions and territories of Europe in support of sustainable development", a new network aimed at overcoming the lack of trans-regional funding and increasing the integration of research on biodiversity.

Carmabi is part of the oil-spill response team on Curaçao (RAC/ REMPTEIC-Carib).

2.5 Selected research projects

Below one finds some examples of some of the projects carried out at Carmabi in 2010. Published findings will eventually become available, but because publishing/ reviewing takes generally 1-2 years, this overview aims to provide a current overview of the type of projects that were carried out in 2010.

2.5.1 Mating system of the bluehead wrasse, one of the most common reef fish species in Curaçao.

Teresa Iglesias, Peter Wainwright, and Dan Warren (Section of Integrative Biology University of Texas at Austin, U.S.A.) are investigating the mating system of the bluehead wrasse, one of the most common reef fish species in Curaçao. These fish are able to change their sex based on social cues, transforming from female to male over a matter of weeks. Some individuals begin their reproductive lives as females while others begin their reproductive lives as males. There are also multiple mating strategies within the species that result in different expectations of sperm competition. They are looking to see whether males who frequently compete with other males for fertilization are capable of producing more competitive sperm, and whether there is some performance penalty incurred by individuals who transition from female to male function late in life. At present it is too early to say what the results of the Curaçao work are, but preliminary results from Panama indicate that individuals that experience greater sperm competition do produce faster sperm.

2.5.2 Competition dynamics of coral- algal interactions

Katie Barott's (SDSU, U.S.A.) research on Curaçao focuses on competition between corals and seaweeds on the coral reef, and her goal is to identify the methods these two types of organisms use to battle each other. In 2010 she measured oxygen levels on the surface of corals and seaweeds that were fighting for space on the reef. Normally, corals have high oxygen levels on their surface, since their symbiotic algae are photosynthesizing. She found that when corals are

next to short filamentous algae and big seaweeds, oxygen levels are really low. Interestingly, oxygen levels were normal when corals were next to encrusting red algae, suggesting that different types of algae have different effects on coral health. She then removed the algae from these same fights underwater to see if corals could recover without the algae there, and found that after only one week, oxygen levels on the surface of the coral returned to normal if the algae were removed. This means that the algae are somehow causing the low oxygen levels on the coral, but we still do not know how. Barott thinks that seaweeds release sugars that feed the bacteria that normally live on corals, which makes them grow out of control and suffocates the coral. To test this, she also labelled sugars released by algae with a chemical tracer, and is looking to see if she will find these labelled sugars in the cells of bacteria that live on corals that were exposed to the algal sugars.

2.5.3 Do "fat" corals make "healthier" babies?

Scripps Institution of Oceanography (U.S.A.) Ph.D. students Aaron Hartmann (Figure 5) and Kristen Marhaver spent two months at CARMABI in the autumn studying coral health and reproduction in collaboration with Science Director, Dr. Mark Vermeij. Corals store certain types of fats (lipids) as energy for everyday use, times of stress (e.g. bleaching) and reproduction. Thus these lipids may be useful indicators of coral health. Hartmann, Marhaver and Vermeij are investigating whether the lipid content of four coral species is different between reefs at East Point and those near Willemstad. In the same four species, they are assessing whether adult corals with high levels of stored lipid produce offspring with high lipid content, and in turn if lipid-rich offspring survive at a higher rate than their lipid-lean counterparts. Collections of adults and brooded and spawned offspring were conducted in August, September and October and lipid analyses are ongoing in San Diego CA, USA. The investigation is examining two spawning species: Montastraea annularis and Acropora palmata and two brooders: Agaricia humilis and Siderastrea radians. This project is funded by the European Union's FORCE (Future of Reefs in a Changing Environment) project, on which Dr. Vermeij is a co-Principal Investigator.

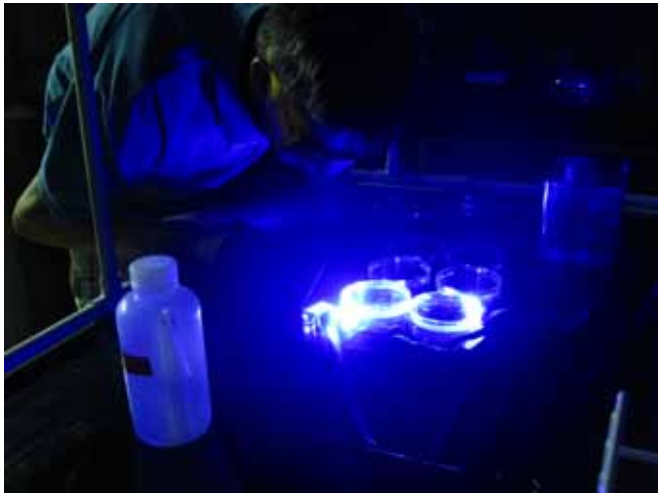


Figure 5: Aaron Hartmann studying the presence of symbiotic algae in coral larvae using blue light

2.5.4 What happens to nutrients when they enter the water overlying the reef?

Joost den Haan and Petra Visser (University of Amsterdam, The Netherlands) investigated the fate of nutrients entering coral reefs. Nutrients are often assumed to be directly available to stimulate the growth of smothering algae that can damage coral reefs, but in reality, many of these nutrients may be taken up by phytoplankton first, and thus not become directly available to organisms living on the bottom. They try to find early warning indicators of nutrient pollution

Picture by: Mark Vermeij

(eutrophication) onto the reefs of Curaçao to effectively protect them. At the moment they are trying to understand the nutrient dynamics of the reefs by looking at current eutrophication along the island, the composition of phytoplankton and algal communities, growth rates etc. They also developed a new system to effectively determine which nutrient limits algal growth. With this research they will gain more understanding of the reef ecosystem and in particular the role of algae in this system. With this knowledge they hope to be able to predict which organisms will be favoured when nutrient concentrations are increasing and to define conditions at which corals can still effectively compete with algae for space on the reef, an indication of coral health.

2.5.5 Long term monitoring of Curaçaoan reefs

Coral reefs are changing over time but it is difficult to say how much they are changed without knowing how reefs looked in the past. The question is then; how did coral reefs look in the past compared with how they look today? Here the difficulty is that the awareness that reefs are changing is something of the last 10, 20 years and it is only in the recent past that scientists started looking for change on reefs, using photographs or other survey methods to compare the past to the present. Many researchers know what coral cover was ten years ago but does that really tell the story of change on reefs? We are so lucky in Curaçao/Bonaire that under the care and with support of Carmabi and other institutions (Netherlands Institute for Sea Research NIOZ and University of Amsterdam) coral reefs have been photographed by Prof. Dr. Rolf Bak since 1973, i.e., 40 years ago. These are repeated photographs of the same areas of reef bottom. Together they represent the longest time series that is internationally available over the depth range of 10 to 40 m. We have a total of 207 m² under observation. These permanent quadrats have again been photographed in 2010. The main conclusions of the analyses show that since the start of the series, in 1973/74 coral cover has dramatically declined, going down from up to 60% to much lower values, in some cases to only 10%. They also show that today coral cover is low and not changing much. There appears to be potential for recovery because a low cover of coral is still present. However, we continue to see a slow decline or at best unchanged low coral cover. The only site where recovery, in terms of increasing coral cover, was recorded was at a site at Oostpunt Curaçao. How the composition of the coral community has changed over time in terms of presence of different coral species is currently analyzed.

2.5.6 Ecology of benthic algae on coral reefs: the crisis for friendly algae and the rise of nuisance algae

ZMT (Leibniz Center for Tropical Marine Ecology, Germany) scientist Dr. Maggy Nugues and her team of PhD students (Alexander Wolf, Hannah Brocke and Gaëlle Quéré), MSc student

(Bastian Piltz) and volunteer (Philipp Kutter) visited Carmabi to begin investigations on the ecology of coral reef algae and macroalgal associated corallivores. Their studies focus on crustose coralline algae (CCA), generally considered as 'coralfriendly', and macroalgae and cyanobacterial mats, generally considered as 'coralunfriendly'. CCA play an important role in the ecology of coral reefs by acting as cues for coral settlement and by contributing to reef calcification and cementation. However, these algae show increased signs of mortality through disease. Disease may reduce the survivorship and growth of CCA and subsequently decrease the recruitment of reef corals. Gaëlle Quéré investigates the ecology and driving factors of disease affecting crustose coralline algae and their effects on reef recovery processes using field surveys and experiments. In contrast, macroalgae and benthic cyanobacterial mats (Figure 6) are becoming widespread on Caribbean reefs. They are often early colonizers of dead coral and disturbed substrates and have negative effects on coral growth, survival and recruitment. Hannah Brocke carries out field surveys to characterize the spatio-temporal dynamics of benthic cyanobacterial blooms in relation to biotic and abiotic parameters in the environment and is planning further field and laboratory experiments to investigate the driving factors of these blooms and effects on the coral reef ecosystem. Furthermore, macroalgae serve as a refuge for a variety of macrofauna, in particular corallivores (coral predators). Thus more macroalgae could mean more predation on corals. Alexander Wolf studies the interactive effects of macroalgae and macroalgal associated corallivores on corals. These projects are financed by ZMT and the EU-funded project FORCE. Their next field trips are planned in March-May and September-December 2011.

Figure 6 Cyanobacterial mat smothering the underlying reef community.

2.5.7 Status of Curacao's reef fish communities

Bsc students Niels Gelderland and Roel Maas from the HZ University of Applied Sciences at Vlissingen performed a research project at the Carmabi institute. They monitored the biomass and biodiversity of the reef fish population around the south coast of Curaçao on 24 different locations during four months. A total of more than 46.000 fish were counted and classified according to species and length. This provides crucial insight on the current status of reef fish communities along Curacao's south-western shore. In particular they took a closer look at the distribution of the threepot damselfish (Figure 7), which destroys coral colonies to create space for the "farming" of algae and thus represents a treat for the reef. These fish especially prefer the coral species *Montastraea annularis* and *Montastraea faveolata*, i.e., the main reef building corals in the Caribbean. Under healthy conditions the threespot damselfish is suppressed by predatory fish, but this study showed that the distribution of the threespot damselfish depended on its preferred

Figure 7 Threespot damselfish with its garden that it created on a Montastraea coral

habitat, i.e., the corals *Montastraea annularis* and *Montastraea faveolata*, when the abundance of predatory fish was low (caused by fishing. Hence, healthy fish populations suppress the abundance of threespot damselfish and thus indirectly help corals, by relieving them from this nuisance species.

Figure 8 A male Curacao deer captured with an automatic camera system.

2.5.8 Ecology of Curacao's deer

How many deer currently live on Curaçao? Estimating the island's deer population is a challenge, but it is a challenge that Carmabi is tackling in collaboration with scientists from Michigan Technological University, USA. Last year, Dr. Joseph Bump, a wildlife ecologist at MI Tech, visited Curaçao to begin to determine feasible ways to estimate the island's deer population and to learn more about Curacao deer. Automatic camera trapping may prove to be a low-cost, non-invasive method to count deer, recognize individuals, and approximate the island's deer population using visual "mark-recapture" methods (Figure 8). Camera traps can also be used to estimate deer occupancy across different island habitats, which can help guide conservation and management efforts. Dr. Bump will also be working with Carmabi's deer skull collection, from which important population biology information can be learned.

Figure 9 Professor Greenstein and his students studying fossil coral reefs.

2.5.9 Effectiveness of the Curaçao underwater park in promoting coral reef health

The beautiful coral reefs that surround Curaçao are very important to the island economy, especially in the form of dive tourism. The Curaçao Underwater Park was established in 1983 to help preserve coral reefs present offshore from the Breezes Hotel to Oostpunt. The purpose of work carried out by Dr. Benjamin J. Greenstein (Department of Geology, Cornell College, Iowa U.S.A.) is to learn whether the park has been effective in protecting the reefs inside its boundaries since they were established more than a quarter century ago. One of the problems with determining the "health" of a coral reef is that many reefs were harmed by human activities before scientists had the opportunity to study them. A solution to this problem is to use the fossil reefs exposed in the cliffs of Curaçao as "ecological baselines" for comparison. The fossil coral reefs exposed in the cliffs (Figure 9) at the water's edge lived 125,000 years ago, long before humans could have disturbed them. They are conducting extensive surveys of several fossil reefs to determine what corals were present and how abundant they were. They are comparing their results to surveys of modern reefs inside and outside the Underwater Park. Their results thus far indicate that the modern reefs inside the park are more similar to the fossil reefs than those outside the park. This indicates that the reefs inside the park closely match what was "natural" along the shores of Curaçao before extensive human occupation occurred. Thus establishment of the

Curaçao Underwater Park seems to have thus far been effective in fostering the development of relatively pristine coral reef communities.

2.5.10 The relationship between inland bays, parrotfish and algal abundance

Valérie Chamberland and Caroline Dubé (Universite de Quebec a Montreal, Canada) investigated the distribution of parrotfish in relationship to two inland bays, Piscadera and Spanish Water. These bays have a nursery function for several kinds of parrotfish that live on the coral reefs around Curaçao. Because of this nursery function they assumed that there are more parrotfish around the bays than far from the bays which likely structure benthic communities differently across space. The main food for the majority of parrotfish is algae that can be harmful to the coral reef, and especially juvenile corals. The hypothesis of the study was therefore to test whether inland bays provided more parrotfish to nearby reefs, which in turn would reduce local algal abundances. This could mean that there are more corals in areas where parrotfish are more abundant, especially juveniles which are necessary to replace adult corals that died due to a variety of reasons (e.g. disease, storms). This study is important because scientists did a lot of research to the relation between of two of these organisms, but never as to whether the herbivore-algae dynamic is to some degree driven by the presence of inland bays.

2.5.11 Spiny Lobsters could be Key to Understanding Disease Dispersal in the Ocean

The Caribbean spiny lobster (*Panulirus argus*) is an important predator on coral reefs and supports a highly valued fishery throughout the Caribbean Sea. However, not long ago Donald C. Behringer, Assistant Professor at the University of Florida's School of Forest Resources and Conservation & Emerging Pathogens Institute (U.S.A.) discovered a virus, named *Panulirus argus Virus* 1 (PaV1), infecting these lobsters. PaV1 is a lethal pathogen, primarily killing the smallest juvenile lobsters, but adults potentially act as carriers – showing no obvious signs of infection. Lobsters can become infected with PaV1 through consumption of infected meat, close contact with infected lobsters, or for very small lobsters just through seawater. PaV1 has remarkable effects on lobster ecology, the most striking being that healthy lobsters can detect when another lobster is infected and avoid it – reducing their risk of being infected. Thus, normally social lobsters are nearly always found alone if infected. The research that brought Dr. Behringer to CARMABI on the beautiful island of Curacao stems from stunning new evidence suggesting that the lobster larvae, which spend 4 – 6 months in the open-ocean plankton after hatching, may also act as carriers of PaV1 and distribute it around the Caribbean! In the Florida Keys (USA) up to 30% of the larvae arriving from other places in the Caribbean are positive for PaV1 but show no signs of infection. This

Figure 10 Lobster sampling Dr. Behringer and Jolanda Wederfoort (Curacao) measure a lobster collected from the reef in Curacao.

indicates they may also be carriers and may have acquired the virus from their parents. Samples from adults around the Caribbean are currently being collected to determine where PaV1 occurs in hopes of determining how it spread, and are conducting mating experiments to determine if adult lobsters can pass PaV1 to their larvae. Curaçao is in the far south of the Caribbean and only receives larvae from a limited number of locations "upstream", so it is important to determine if PaV1 exists there and what proportion of the population is infected. We collected samples from around the island in November 2010 with the gracious assistance of Eric Wederfoort, and Jolanda Wederfoort (Figure 10), and are awaiting analysis of those samples. Most marine animals have life histories that include planktonic larvae, and many are widely distributed. If infected by pathogens, these "larval vectors" could provide an efficient mechanism for distributing diseases at high concentrations directly into habitats where susceptible animals dwell.

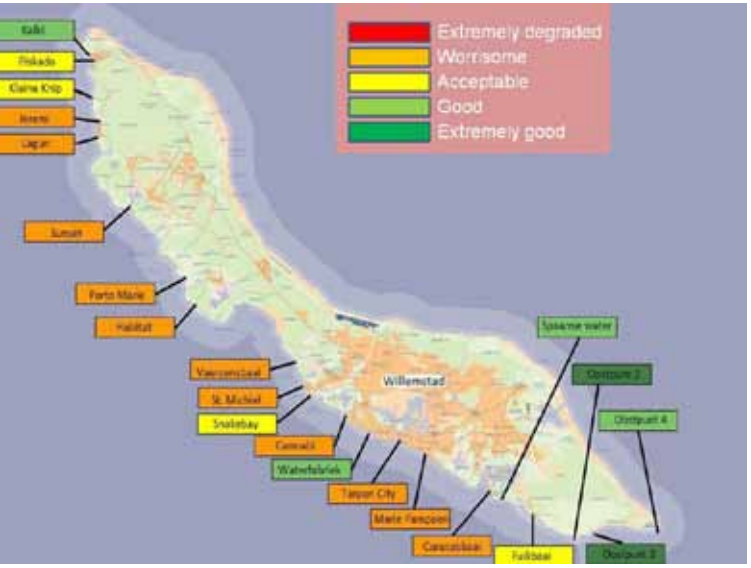


Figure 11 Overview of the state of Curacaoan reefs in 2010.

2.5.12 State of the reefs: reef composition along Curacao's southwestern shore in 2010

There has been no integral survey of Curaçao's reefs since 1985. To conduct a new survey, Jordy van Vooren en Mark van Alfen, both students from the University of Applied Science at Vlissingen (Netherlands) visited 21 locations along the southern shore of Curaçao. At each location a large number of pictures were taken that later could be analyzed to determine the cover of a large number of reef organisms around the island, such as the coverage of corals, macro-algae and gorgonians. All this data was synthesized into an Excel-model which was used to analyse the data. Several different data could be compared to another to search for factors that might explain the patterns observed. Van Vooren en Van Alfen found that the reefs on Westpunt and Oostpunt remained in the healthiest condition, likely due to their remoteness relative to large scale coastal developments and the vicinity to large bodies of relatively clean open ocean water. Near Willemstad and smaller villages the reefs were less healthy. The data shows that most of the reefs are in a worrisome condition (Figure 11).

2.5.13 Unveiling the free-living stage of a keystone species of coral reefs: Symbiodinium

Dinoflagellates are alveolate protists that share several interesting features in the structure of their genome. They are symbiotic with different invertebrate hosts including *Symbiodinium* (so-called zooxanthellae), which engages in symbiosis with reef building corals. The dominance of these corals would depend on healthy growth rates of established corals and on the successful establishment of new coral recruits. This, in turn, will affect the survival and persistence of one of the most diverse ecosystems on the world. Different factors suggest the presence

of these dinoflagellates in the free-living stage, such as a proposed sexual reproduction, mode of acquisition by the host (whether an initial onset of the symbiosis carried out by the majority of corals or a recovery after a bleaching event), and great genetic, physiological, and biochemical variability, among others. Therefore, it is vital to understand the reservoirs of free-living symbionts. It is unknown if free-living *Symbiodinium* populations are also being affected by local and global changes that affect coral reefs, due to natural and anthropogenic stressors. Only few studies have glanced at the reservoirs of free-living *Symbiodinium*, but we still do not know what the actual habitat reservoirs are. Camila Granados-Cifuentes and Mauricio Rodriguez-Lanetty (Laboratory of Integrative Marine Genomics and Symbiosis, University of Louisiana at Lafayette, U.S.A.) aim to expand our knowledge on the ecology of free-living *Symbiodinium*. In order to have a broader understanding of this important stage, they looked at temporal and spatial variables. The spatial component includes the variability seen between and among reef sites. The temporal component consisted of sampling during different times of the year. They employed molecular biology techniques to do their research, such as polymerase chain reaction –PCR–, denaturing gradient gel electrophoresis –DGGE–, high-resolution melting –HRM– and quantitative real-time PCR –qPCR–. They expect that at the end of this study, they will show the free-living *Symbiodinium* reservoirs and match them with any temporal variation. They also expect that their findings will be important for management and conservation purposes since these reservoirs may play other fundamental roles in the coral reef ecosystem e.g. settling substratum of coral larvae. Overall, they will improve our knowledge in the ecology and population biology of the free-living stage of the symbiont of the reef, *Symbiodinium*.

2.5.14 DOM as a possible food source for coral-excavating sponges

Algae and Corals are releasing organic matter in the form of particles (particulate organic matter = POM) or dissolved (DOM) in the water column. Sponges in general are considered to be filter feeders, pumping water through their aquiferous system and clearing it from small particles. Recent research shows that the diet of some cavity sponges and open reef sponges consists to up to 90 % of DOM. PhD student Benjamin Mueller (Figure 12) and his supervisor Dr. Fleur C. van Duyl from the Royal Netherlands Institute for Sea Research (NIOZ) visited CARMABI to investigate the role of DOM as a possible food source for coral-excavating sponges. Those sponges invade dead and life corals and make excavations in the limestone to create themselves a shelter. While doing this they are killing the coral they are living in and they also weaken the structure of the reef framework. In order to identify possible sources of DOM they took and analyzed water samples from the surface of dominant coral species, dominant algal species,

Figure 12 Benjamin Mueller taking water samples to determine DOM gradients on the reef.

cyanobacteria and surface water at 9 selected reef sites along the south coast of Curaçao. Preliminary findings suggest that the reef bottom is a net source of DOC. Concentrations in reef bottom waters were usually higher than in surface waters. Water samples in the boundary layer of sediment surface, turf algae and filamentous cyanobacteria had higher DOC concentrations than other sampled substrates and may therefore be important sources of DOC in reef bottom waters. Furthermore, several techniques were tested to produce limestone grafts with coral-excavating sponges in it which will be used for upcoming DOM-consumption experiments.

Figure 13 The Caribbean long spined sea urchin is an important Caribbean herbivore and currently working on a slow return to Caribbean reefs after a massive die-off 20yrs ago.

Picture by: Mark Vermeij

2.5.15 Understanding recovery patterns of the Caribbean long-spined sea urchin Diadema antillarum in Curaçao

The Caribbean long-spined sea urchin (Figure 13), though a nuisance underfoot is vitally important to coral reef health and resilience. It is the primary grazer of algae on Caribbean reefs and acts to maintain a healthy balance between macroalgae and live coral. Without these urchins macroalgae can quickly grow to dominate reefs making them less attractive to tourists, less productive as fisheries and less resilient to disturbance from storms or coral bleaching events. Following a mass mortality event in the 1980s which reduced *D. antillarum* populations by over 95% across the Caribbean, we are finally beginning to see these urchins returning to Caribbean waters. In Curaçao *D. antillarum* are doing comparatively well but their distribution is extremely patchy and scientists are yet to understand why some locations support large populations where others are completely devoid. Alice Rogers and her research team (Imperial College, U.K.) aim to understand what processes and environmental factors drive *D. antillarum* recovery dynamics, and spent the summer of 2010 at Carmabi surveying current population densities and larval settlement rates of urchins in different habitat types around the coast. They were particularly interested to disentangle effects of exposure and substrate complexity on urchin abundance to explain why more urchins are being encountered in sheltered locations close to inland bays. Their results show that *D. antillarum* larval settlement and adult population densities are favoured in sheltered locations and in locations with high structural complexity. However, they also found that these two factors are not necessarily linked and sheltering is equally important whether or not substrate is complex. Scientists already understand why urchins benefit from structural complexity because they use rocks and corals as refuges to hide from predatory fish but a preference for shelter is something that has not previously been explored. Their results further show that sheltered habitats receive higher rates of *D. antillarum* larval settlement, are home to fewer herbivorous fish and have higher rates of algal growth. Predatory fish abundance is generally low and variable but not directly related to exposure or habitat complexity. In general

terms their study suggests that sheltered locations offer an abundance of food, little competition and no greater risk of predation to *D. antillarum* than exposed reef locations. Mechanisms of larval settlement choice, increased growth and recruitment and possible adult migration are causing populations of *D. antillarum* to favour sheltered habitats. However, as population numbers continue to increase, the researchers expect that urchins can and will reappear in more exposed sites

2.5.16 Climate change and local pollution impacts on Curacao reefs continued….

Last year (2009) Southern Cross University (Australia) researcher Dr. Sander Scheffers and his team (Cyril Gyri from Uni. Bremen, Prof. Malcolm McCulloch (Uni. Western Australia) and 2 research technicians (Paul Kelly & Lea Taylor) visited CARMABI to look at the condition of the reefs from a long term or so-called "palaeo" perspective. In 2010 the team was back to get additional samples from "un-disturbed locations" at East Point and Klein Curacao. Coral reef ecosystems are increasingly under threat due to climate change, warming oceans, and anthropogenic influences, such as sedimentation and eutrophication. Another emerging major concern associated with future climate change is the acidification of the oceans and its influence on coral calcification. A reduction in reef building would be critical for protection of low-lying coastal regions of the world in light of future sea level rise. The adaptive capacity of corals to synergistic multiple stressors is uncertain but will be better understood and projected if the historical context of change is accurately identified. There is therefore an urgent need to improve understanding of causal relationships between historical changes in climate and environmental modification and how it influences adaptation and persistence of coral reefs at site-specific physicochemical environments and on a regional scale. Their dataset is now complete, ranging from very disturbed locations (close to Anna Baai), to "pristine" locations (Klein Curaçao). The next 6 months they will look at differences in growth rates and densities of the four most important reef builders and will also determine climate and pollution change in the last 200 years, measuring a wide range of elements ("proxies") hidden in the coral skeleton. We will do this in cooperation with CARMABI to assist in the development of effective future management plans for Curacao's number one resource: coral reefs.

Picture by: Mark Vermeij

Figure 14 Students of the University of Amsterdam explore the reefs near Westpunt.

Picture by: Mark Vermeij

2.6 Academic programs

2.6.1 'International Excursion Tropical Marine Biology' of the University of Amsterdam 2010

Eight students of the University of Amsterdam attended the MSc field course at CARMABI in April 2010. This course, focusing on the diverse marine life on coral reefs, is the main field excursion of the Master program Limnology and Oceanography of the UvA, but is also open for students from other master programs. The course was taught by Mark Vermeij and Petra Visser with assistance of Joost den Haan. Every day started with a lecture on reef organisms and their ecology. Emphasis was on corals and algae, but the biology and ecology of other reef organisms were also discussed. During the rest of the day, the students were underwater (Figure 14), in the laboratory or studying on the identification of the many coral and macro algal species they observed at the reefs. During the field and lab work, students practiced to make surveys of the benthic community composition, to measure temperature and light profiles, and to determine photosynthetic rates of corals and macro algae using PAM fluorometry. In small groups, students designed their own research plan on a specific topic and performed field and lab work on this topic during one week. This year's topics were: (1) Algal dispersal by herbivores, (2) Feeding ecology of the red lionfish, and (3) nutrient limitation assays for Lobophora variegata and phytoplankton. After three weeks, the students presented and discussed their results. During the last week of the course, they focused on data analysis and writing of their report.

2.6.2 Coastal Biology (Pennsylvania State University)

The Coastal Biology course (Biol482) of the Pennsylvania State University, offers a field trip to Curaçao, where the class experiences the coastal environments they have studied during the semester. During the course, the students develop original research proposals that are evaluated by their peers and performed during the stay in Curaçao. Last year projects included titles such as: "The role of predation on sponge community structure in mangroves and coral reefs" and "Shell size selection of the hermit crab Calcinus tibicen". At the beginning of the week the students have the opportunity to explore the coral reefs, mangroves, seagrass beds, salinas and fossilized reefs of the Island. The rest of the week is devoted to the selected research projects. During their stay at the Carmabi research station the students interact with locals, visiting scientists, and tourists, gaining some insight of Curaçao's society. One of the highlights of the trip has been the safari tour to Christoffel Park. At Christoffel National Park, the students meet Mr. Cyrill Kooistra who shows them the park and teaches them about the nature and history of Curaçao.

2.7 Research: Long term developments

Carmabi is currently actively investing to upgrade its research facilities and capabilities to provide the island of Curaçao with a modern biological station that will support and can improve existing management strategies of the island's natural resources. Recent developments have increased local awareness of the loss of natural areas and the need to protect such areas to preserve the island's identity. As such, the plans to upgrade Carmabi's laboratories and accommodations for visiting scientists (aka "science tourism") have solidified and been approved by all required authorities. This means that construction of the new facilities will start early 2011 (and has occurred when this report went to print). Lastly, one staff member of Carmabi, Dr. M. Vermeij is still (part-time) employed by the University of Amsterdam to oversee research projects of their students and teach the course "Tropical Marine Ecology" in Amsterdam and at Carmabi.

Picture by: Mark Vermeij

"Trunk of Palu di sia korá(Bursera simaruba)."
Picture by: Michelle da Costa Gomez

C3 Christoffel Park

3.1 Management

Heavy rains assaulted the island of Curaçao at the end of 2010, flooding several areas and killing 2 people. In the area of Banda Bou heavy rains caused flooding in several areas including Christoffelpark. For the second year in a row the so called “rooi's” which are normally dry river beds were filled with excess rainwater creating running rivers in the park, flooding of a part of the road to Westpunt for a short while, and destroying parts of the park fence. The power of the water washed trough the northern side of the park to the salt marsh (Saliña) filling it up in a record time and causing the inner bay to break open into the sea, and as such destroying a large part of the beach of Boka Grandi, dislocating the natural sand on the beach and overturning rocks, signs and picnic tables.
Heavy currents on the northern side of the island also caused large amounts of trash to wash up on the shore of the beach consisting of plastic water bottles, deodorant rolls, discarded toys and organic trash such as wood and bamboo. This all took place at the end of the year making it impossible to clean it all up before the end of the year.

The rains caused the park to close a total number of 6 times in November and December and severely influenced the number of visitors at the end of the year. The danger to visitors on the slippery slopes of Christoffel mountain and the roads as well as the difficulty for the rangers to do their work caused the closures. Many trees fell during the rainy period including 6 large Machineel trees in the so called Mahokkenbos. Almost all hiking trails in the Northern part of the park were at the end of 2010, still unmanageable and inaccessible to the public because of its inundation. The picnic area in Mahokkenbos was also flooded as well as a large part of the dirt road leading to Boka Grandi. Rivers were flooding the car route on several spots and as such caused a change of scenery which visitors never expect, but also caused some damage to sides of the asphalted roads.

At the beginning of 2010 the entrance of the park was transferred from its original location to the new location, about two hundred meters before the original one. A new front desk, new booms and a new parking place delivered its own set of challenges for the park personnel.
The opening of the new Savonet Museum, with a soft opening taking place in September 2010, also brought about more changes in the park especially regarding security, control and visitor management. During 2010 we started running a basic version of the new terrace under our own management, providing visitors the opportunity to relax under the new 'palapa's' with a cold drink, ice cream or local sweets.
The new offices, and the new Christoffel shop also became active during 2010. The introduction of the new terrace and shop, as well as the museum, introduced a variety of new personnel in the park. All these new events and locations

“Uprooted large Manchineel tree in Mahokkenbos.”
Picture by: Leon Pors

“The flooded road to Westpoint.”
Picture by: Cyrill Kooistra

changed the way our personnel worked with each other severely, bringing about several communication challenges which needed attention throughout the year. However the positive feedback by our visitors helped to make the changes a little easier.

"Safari with tourists."
Picture by: M. da Costa Gomez

"Ranger checking the state of Boka Grandi where several activities are held each year."
Picture by: M. da Costa Gomez

3.2 Activities and events in 2010

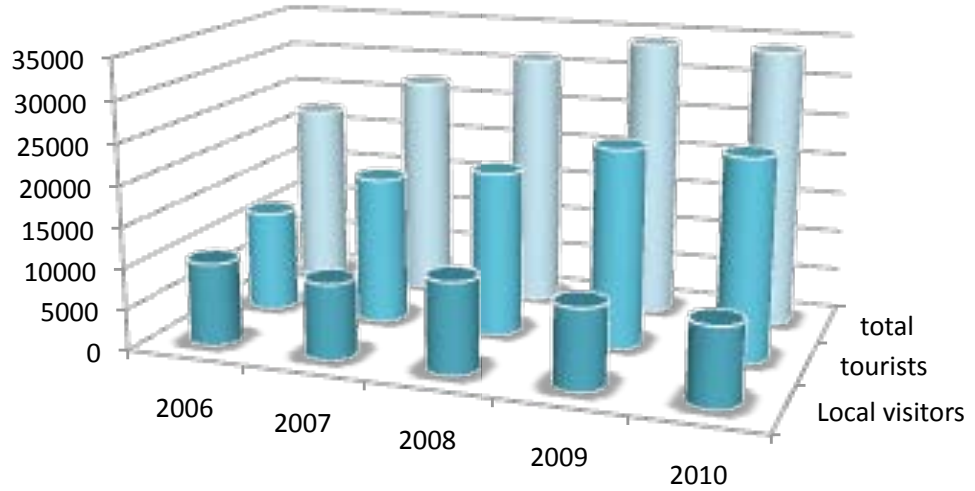
2010 saw an increase in the number of visitors participating in the several activities we organized. Taking into account that the rain disrupted the activity schedule in the months of November and December we can say that 2010 was a successful year. Activities for visiting cruise tourists brought to the park by Funbini Tours were also organized throughout the year, and we are now also including a guided mountain hike in our packages.
On the 27th of June the park organized its yearly Open House, attracting more or less 150 visitors to the park. They participated in several guided hikes and trips and also visited the museum in so-called preview trips.

Activity	# of times organized	Total # of participants
Deer spotting tours	7	77
Camping	3	29
Zevenbergen tour	8	81
Special mountain hike	1	35
Survival trip	1	27
Vacation activities	24	908
Safari trips	n/a	760
Bike rentals	n/a	107
Funbini total	n/a	1069
Open House	1	150

3.3 Visitor Statistics 2010

2010 was a dynamic year for visitors in the park. The months of July and August saw over 4000 visitors each, while January, February and October came second with over 3000 visitors each. However the month of November, with all the rains, saw a large decrease in visitor numbers, crashing the local visitor numbers almost completely. The days the park was closed, because of floods and safety issues, also influenced the number of tourists coming to the park. Overall we saw a decrease in numbers of almost 0.4% compared to 2011. These numbers

do not include the visitor numbers of Savonet Museum (For visitor numbers of the museum, see chapter Savonet Museum).



	2006	2007	2008	2009	2010
Local visitors	10156	9270	11173	9831	9509
tourists	12468	18111	20117	24256	24473
total	22624	27381	31290	34087	33982

3.4 Park upgrading

3.4.1 New logo

After the logo for the new Savonet Museum was developed, it became apparent that the logo for the park also needed a refreshment. Together with Atelier Argos a new logo was designed and a new house style developed. This will be implemented on all publications such as signs, business cards, ad, flyers etc. The logo feautures the most visual landmarks of the park, Christoffel mountain, the endemic white tailed deer and a columnar cactus which are crucial to the local ecology.

"New parking place at the entrance of the park."

"Locally made souvenirs are now for sale in the shop."

3.4.2 Information signs

Several sponsors and funds helped Christoffelpark with a new signage project to provide visitors with information about several sights in the park. Percy Henriquez Fund, ENNIA Insurance and the Nationale Postcode Loterij, all provided us with funds to finally make this project happen. The park's old signs indicating the car and hiking trails as well as sightseeing spots were severely damaged throughout the years they were used (some of them were almost 20 years old). The new house style of the park was implemented in the designs of the new signs which are going to be printed and placed at the beginning of 2011. On these signs the sights are explained in English, Papiamentu and Dutch to cater to almost all the visitors we receive in the park. Atelier Argos, also responsible for the design of the Savonet Museum exhibitions, developed the signs.

3.4.3 New Front desk and parking space

As mentioned before, the new head entrance to the park opened during the year and as such the new front desk office and new parking place were also inaugurated. Several new "Palu di Sia" trees were planted along the entrance road providing shade and a picturesque sight for visitors. We introduced a new computerized cashier system, making the financial exchange with visitors more professional and up to date.
The new large parking space makes it easy for visitors to park the car while visiting the museum or terrace as well as for tour busses and school busses to park and deliver their groups in a safe way, away from the main road.

3.4.4 Terrace

The terrace of the park was carefully reintroduced in June by offering visitors cold drinks, high quality coffee by Cafe Barista, ice cream, and local cakes and sweets. The new palapa's, tables and chairs provide the clients with a comfortable and shady spot to relax after climbing the mountain or exploring the rest of the park. This low key service to the visitors will be further developed in 2011, attracting new personnel, updating the "interior design' of the terrace and expanding the menu with light lunches and other local specialities. We will also start providing catering services to groups and events, like weddings, receptions and others.

3.4.5 Christoffel and Savonet Shop

The former Kas di Vitó was converted to house the new shop and the offices of the park's management. With air-conditioning the shop provides visitors with a relaxing ambience to look around and buy locally made souvenirs and nature-related books. The collection of souvenirs was not yet complete at the end of 2010, but will be expanded in 2011.

3.5 PR & marketing park

In 2010 we continued our marketing and communication efforts based on our 2008 marketing plan, which focusses on social networking, visibility of all special and regular activities and image building. We would like to thank everyone who in one way or another contributed by helping us promoting our National park and Savonet Museum. Your support and contribution played an important role in our achievements. We hope we can continue to count on your support and services.

3.5.1 Brochures and flyers

We continued to use the Christoffelpark brochures designed and printed in 2009 to provide almost all hotels, car rentals and the tourist booth in Punda with information about the park. The brochure was designed specifically to inform potential visitors on the main attractions and special activities we organize in the park throughout the year. Not all hotels accept our brochures, those working with private owned tour desks don't accept the brochures, or only if the park pays commissions. As a non-profit organization, we have to look for other ways to reach such tourists with our information.

"Homepage of www.christoffelpark.org."

3.5.2 Website

The www.christoffelpark.org website proved to be a huge asset in our communication strategy. By providing the URL in flyers, mailings, press releases and advertisements, many potential visitors visited the website and used it not only for bass vacation planning, but also as a reliable source of information about monthly special activities. Many school children also found the website useful for their presentations and projects as it provides relevant information about the protection goals and history of the park.

3.5.3 Social networking

Following the international popularity of social networking and its potential for marketing purposes, Christoffelpark started its own Facebook page (http://www.facebook.com/ pages/ Curacao-Dutch-Caribbean/Christoffelpark-Curacao/107419611605) in September 2009. By the end of 2009, 1250 people were fans of this page. By the end of 2010 about 4050 people were either a friend or fan of Christoffelpark on Facebook. The page is proven to have a profound effect on reservations for special events, As soon as these events are posted on the page, people react and call for reservations. More fans sign up every day, and also post on our page with questions about the park for presentations and projects and also share their pictures made in the park with us and other fans.

"Advertisement in Curaçao Road Map, and Kras vakanties."

"Activity ad's."

3.5.4 Curaçao events

The past two years Christoffelpark and Carmabi were both extensively featured in the well known publication Curacao Events, published once a year and distributed all over the island. In 2008 the Christoffelpark was featured on its own, and in 2009 Carmabi was featured with a part dedicated to the park and the activities organized in it. Savonet Museum is projected to appear in the publication of 2011. We would like to thank Mrs. Susan Campbell for her wonderful writing.

3.5.5 Mailinglist

Our mailing list is now completely automated trough a mailing distributor. It's now possible to sign up or off automatically to receive mailings, newsletters and other relevant information. This service will also be available shortly on our websites.

3.5.6 Flyers and advertisements

About 5 ad's were produced and distributed in 2010 including monthly overviews of regular activities and special activities.
We advertised in local newspapers for the new gift certificates, annual membership opportunities, summer vacation activities and pickup safari's.
We also bought advertisement space in the following publications:

Big Red Restaurant guide
The park advertises in this publication every year which is distributed throughout the year and can be collected for free. We now have a full page advertisement for Christoffelpark, and a quarter page for Savomet Museum in the To do section.

Yellow Visitors Guide
Now also available for Curaçao, this well known European Yellow Visitors Guide format includes publications on cities such as Amsterdam, London etc . The Curaçao publication focuses on people who visit the island as a vacation destination and on people who start living on the island and are looking for practical information on restaurants, car rentals, shops, hotels, tours and other business and tourism related items. Christoffelpark and Savonet Museum are featured with an ad and an article in the section on attractions the island has.

Expedition Paradise
This monthly publication focuses on Dutch visitors interested in inside information on happenings on the island. The Christoffelpark logo is featured on the Curaçao map, which can be found in the center of the publication overviewing the location of attractions and restaurants on the island. We also wrote a special contribution about the deer spotting tours.

Curaçao Road map
We have a yearly advertisement on this map which can be bought at all the major bookstores, and souvenir shops on the island including the Christoffelpark shop. The new advertisement now includes the Savonet Museum.

Island Map
The island map is a free road map on the island which visitors can take along while touring on the island. Both Christoffelpark and Savonet Museum are featured in an advertisement in this publication.

Kras Vakanties
Kras vakanties is one of the largest travel organizations in the Netherlands, responsible for bringing a large number of Dutch tourists to the island. Christoffelpark and Savonet Museum are featured in a joint colorful advertisement in the Winter 2010 en Summer 2011 vacation brochures seen by hundreds of thousands of people.

3.5.7 Other efforts

Tropisch Koninkrijk
The documentary about nature protection on the island was so popular in the Netherlands that we got several positive responses from people who know the organization and the park and also from visitors who saw the documentary on television and visited the park because of it.

Tourism booth Punda
Almost every wednesday morning our PR and marketing assistant spends at the tourism booth in Punda, where lots of tourists come to get information about the island and attractions and locations they can visit. We talk to people personally about the park and provide them with flyers about park and route descriptions. On the other days the booth employee provides visitors with our flyers.

Dolfijn FM magazine
We started writing bi-weekly small articles of no more than 200 words in the popular Dolfijn FM magazine which is published every week on the island.

3.6 Wildlife management

3.6.1 Bird Monitoring workshop

In January 2010 DCNA organized a Bird Monitoring workshop at Carmabi on Curaçao with Christoffelpark staff and future volunteers for the monitoring program. The course also included participants from Bonaire and Aruba and was given by Dr. Adrian Delnevo, a well known ornithologist with ample experience on the ABC islands. Besides theoretical lessons about the technicalities of bird monitoring, the workshop also included practical fieldwork in the areas of Malpais, the Hato plains and Christoffelpark. Bird monitoring is now a recurring part of the wildlife

"Bird monitoring training on the Hato plains."
Picture by: M. da Costa Gomez

"Professor Adrian Delnevo is very visual with his teachings." Picture by: M. da Costa Gomez

management in the park, with the team consisting of mr. Wotty Samboe, mrs. Michelle da Costa Gomez, mrs. Ans Bronneberg, mr. Eric Newton and mr. Frensel Mercelina monitoring the 3 wells on the southerns side of the park to research the importance of such watering spots in all kinds of seasons. The monitoring sessions are done every two months and all results are exchanged with Dr. Delnevo.

"The complete bird monitoring group."

3.6.2 Deer reserve maintenance

The former deer reserve needs maintenance to facilitate observation and subsequent monitoring work of the large number of deer that visit water sources in this area. Before each rainy season, we open up the paths and trails to reach the observation platform, drinking spots and the principal feeding grounds to provide the deer with additional feeding opportunities. A total of 2 dead deer were found during 2010, of which one was found in Pos Monton.

3.6.3 Tree planting

The planting of rare endemic plants is an ongoing initiative of Christoffelpark. In 2010 we planted a total of 30 so called "palu di sia" in the park along the main entrance. The trees are growing nicely and with al the rain they are starting to bloom and grow into a luscious welcome for our park visitors. In 2011 we are going to enhance the center part of the park, where the restaurant and shop are located, with more local trees to make the visitors stay in this part of the park as enjoyable as possible.

"How to handle wild birds."
Picture by: M. da Costa Gomez

3.6.4 Goat management

Goat management is an important part of the basis park management. Goats not only have a huge negative impact on the local rare and vulnerable vegetation, but also cause erosion and are direct competitors of the local endemic white tailed deer. The huge amounts of goats are long gone from the park, due to successful management in the past, and the positive consequences on the vegetation is apparent throughout the park. There are still 2-3 groups of feral goats in the park that stay in the most inaccessible parts of the park. However we do our utmost best to catch these goats. In 2010 we caught 37 goats and 19 billies.

3.6.5 Rubber vine management

Invasive species were a hot topic on the island in 2010, because of the invasion of the feared Lionfish. However we have known about the presence of several invasive plant species on the island for years now, one of them the Rubber vine (*Cryptostegia grandiflora*), once imported to start the production of rubber on the island. The plant produces beautiful lilac-white flowers but is a danger to the fragile local vegetation as it overgrows and kills everything. The plant

can be found all over the island (the seeds are dispersed by air) and can also be found in the Christoffelpark in certain areas. Throughout the year our rangers exterminate the plants with machete's as close to the ground as possible and whenever possible take out the roots. The plants are difficult to kill in one time, tiny pieces of roots remaining in the ground can grow back into full plants, so the work is never done.

3.6.6 Wells and water holes

The semi-arid climate of the island makes the wells and water holes which are located in the park extremely important for the survival of birds, insects and mammals. Regular patrols check out these spots in the park 2-3 times every week. Regular clearing of the shrubs around the wells and holes and cleaning of anything that causes the water quality to diminish is also a priority.

3.7 Sponsors

3.7.1 ENNIA

ENNIA Insurance sponsored Christoffepark in 2010 with Naf.10.000 to update the animal housing of the iguana's and snakes as well as picnic tables to be used throughout the park. The money also covers part of the costs for the new information signs in the park

3.7.2 Percy Henriquez Fund

The Percy Henriquez Fund also sponsored us again in 2010 with an amount of almost Naf.10.000 also to be used for the design an development of new information signs.

3.7.3 Nationale Postcode Loterij

Since 1989 the Dutch Postcode Lottery has been raising funds to support organizations working for a fairer, greener world. The Lottery has grown to become the Netherlands biggest charity lottery and currently supports 75 charitable organizations including, since 2008, the Dutch Caribbean Nature Alliance. Fifty percent of its income is given to charitable organizations such as our own. Since its founding the Lottery has dispensed more than 2.9 billion euros to its beneficiaries.

Thanks to the Lottery's 2.5 million participants, over 256 million Euro was distributed in 2009 alone. With this money, Lottery beneficiaries work to create a better world, for example, by making it possible for Sudanese refuges to return to their homes safely, by providing medical care for the needy and giving young people in Afghanistan their own TV news program. It also allows the barn owl to fly freely in the Netherlands and for us to safeguard the unique biodiversity and promote the sustainable management of the nature on our islands.

Thanks to the Lottery we are better able to maintain our parks, provide outreach and

NATIONALE POSTCODE LOTERIJ

ennia

Percy Henriquez Fonds

"Representatives of ENNIA with the sponsor sign at the outdoor center." Picture by: M. da Costa Gomez

"Interns Anneloes and Marieke helping out at Museum Savonet."
Picture by: M. da Costa Gomez

"Bird watching trip."
Picture by: M. da Costa Gomez

education to visitors and islanders, conduct research and monitoring programs and ensure that our parks are indeed truly protected havens for the rich and fragile nature of our islands.
The Dutch Postcode Lottery gave us a generous amount of funds through DCNA to complete the extensive information sign project in the park. We wish to give our sincere thanks to the Dutch Postcode Lottery for their support.

3.8 DCNA Management Success

In January we sat with Mr. Duncan McRae, consultant for the Dutch Caribbean Nature Alliance (DCNA) for the Management Success of Nature Parks. These sessions are held every year to survey several key criteria and compare them from year to year so the success of the management of the nature parks can be assessed. The strong and weak points in the organization are analyzed and reported in order to improve management decisions in the years to come.

3.9 Interns and volunteers

In 2010 we had the help of 3 Dutch interns in Christoffelpark: Anneloes van Vught, Marieke de Greef and Joyce van der Knaap. Both Anneloes and Marieke worked on the PR and marketing of Christoffelpark and Savonet Museum, organizing several activities and events including the official opening of Savonet Museum.
Joyce worked on the organization and execution of several vacation activities with children and also helped with PR and Marketing of the park.
We'd like to thank all three of the girls for their extensive work and fun times that we spend together and wish them all kinds of luck with their further endeavours.

Christoffelpark would like to thank several volunteers for their work in the park. Many thanks to Ans Bronneberg, Reginald Rosario, Eric Newton and Frensel Mercelina for all the work they did for us!

3.10 Tour Operators

In 2010 we continued our business contract with Fun Bini Tours, a local tour operator operating on the cruise line market, from which the park hardly benefited in the past. Fun Bini is the first tour operator that made the park the main attraction of their tour, called the Natural Wonder tour, offered to cruise lines, which visit the island. As of October we started welcoming the first guests in the new tour called the Mountain Hiking Tour. During this tour we climb the Christoffel mountain with the visitors under guidance of one of our professional rangers.

Other tour operators include the park in their trips but generally focus more on stay-over tourists. These operators are Peter Trips, Curaçao Actief, Yellow Jeep Safari and TMC.

3.11 Miscellaneous

2010 was a happy year for our park staff. Three staff members got married in 2010:

- Ranger Oswald (Wotty) Ricardo got married to his long time love Clarisa
- Ranger Brian Victorina married Jocibeth
- Assistant manager Cyrill Kooistra married Corah

For the first time in years Christoffelpark was blessed with the birth of two park babies:

- Manager Michelle da Costa Gomez and Museum manager Leon Pors gave birth to a beautiful baby girl named Yalena Iliana on the 26th of October and;
- Ranger Brian Victorina and his wife Jocibeth gave birth to their beautiful little girl Norianne Brianna Safira in November.

Picture by: Michelle da Costa Gomez

"Flowering tillandsia (Bromelia humilis)."
Picture by: Michelle da Costa Gomez

C4 Small Conservation Area Management

4.1 Shete Boka National Park

Repairs

Significant repairs and replacements (parking boom, reception facility, toilets and platforms) were carried out in 2010. The platform overseeing Boka Wandomi was completely rebuild.

Road map

This year just like last year 10,000 copies of the Shete Boka park road maps were printed.

4.2 Daaibooi

Renovation of management contract with the Island Governement

In 2010 it became clear that the government of the island of Curaçao was not going to renew the management contract of Daaibooi beach with Carmabi because of the government policy to put all public beaches of the island under the same management by the department of agriculture, animal husbandry and fisheries. There is still the opportunity to apply for the management of the natural area behind the beach however. Efforts to solidify this opportunity will be continued in 2011.

4.3 Hermanus

The management contract of Hermanus with the Island government expired in 2009. A renewal of this contract was requested at the end of 2009. Up till the end of 2010 the renewal of the contract was not finalized.

4.4 Kueba di Yèchi & Kueba di Ratón

Both Kueba di Yèchi and Kueba di Ratón were checked by Carmabi personnel on the state of the bars, which block the entry to the caves for the general public, and also on the presence of the bat species for which the caves are protected. The bars were in place, no recent access by people could be detected and the numbers of the bats are still relatively stable.

"Glossophaga elongata."
Picture by: Leon Pors

"Savonet Plantation house."
Picture by: Michelle da Costa Gomez

5.1 Museum Savonet open to the public

Immense effort in combination with a lot of sweat resulted in a wonderful event on May 18th. During a cozy cultural program, about 140 people, including the Governor of the Netherlands Antilles, Mr. Goedgedrag, and Prime Minister, Mrs. de Jongh - El Hage, were the first to check out the new Savonet Museum. Of course the representatives of the Netherlands as well as Usona were placed in the "VIP"-spot, because without Dutch financial aid this museum would have never been realized.
Mr. Roy Colastica, a well known and popular local artist, recited his poem about Savonet, the place to which his mother and grandmother are tied to.
As one of the highlights of the evening the local artist Eliah Isenia was the one inviting all guests to explore the museum, by means of performing one of her emotional historical songs that have also been incorporated in the TV documentaries within the museum.

The museum implementation team, led by Mr. Felix de Rooy and Mr. René Wissink, did a really professional job. They were able to convert the substantial amount of historical information that was compiled as part of the preparatory phase of the project into a coherent audio-visual experience during which the visitor will get a broad understanding of the way of life on the Savonet plantation over time.

The activity in May functioned as a so called "soft opening", because several essential elements needed to be completed before the public in general could be invited. However, after resolving issues with the sound system and the security cameras the time was there to open the doors for all to enjoy! Since October the museum is open to the public during the same opening hours as the Christoffel Park. The visitor response has been very positive, reinforcing the feeling that the project can be considered "a job well done".

Apart from Mr. Pors, who coordinated the implementation phase and will dedicate part of his time to the daily management, two new personnel members were selected to assist with the maintenance. Mr. Marcpaul Wisman will take care of the technical maintenance aspects. He will also keep an eye on things after opening hours, because he agreed on occupying the new "guard house", together with his partner Helena de Bekker, who professionalized herself in the the art of guiding visitors and started working for the museum on a semi-voluntary basis. Mrs. Xiomara Concecion took on the all important cleaning responsibilities.

"Savonet by night."
Pictures by: Mark Vermeij

5.2 PR & Marketing

New website www.savonetmuseum.org

The Savonet Museum now has its own information website with the url www.savonetmuseum.org.
Information about the opening hours, history of the plantation and the museum project, activities and events and much more can be found on the site as well as a link to the new facebook page.

Social media

The new savonet museum facebook page has gathered 640 fans at to the end of 2010. Trough the page we send messages about activities and events organized at the museum, information about new items in the shop as well as general information about the museum's history and projects.

Brochures

Atelier Argos is the designer of the new museum logo as well as the house style. With these in mind a new Savonet Museum brochure was created which will be used to market the museum at all the hotels and car rentals on the island as well as other important spots. The brochure will be printed in 2011.

Ad's and advertisements

In prepartion for the opening of the museum we started placing ad's in several publications on the island to prepare potential visitors for a visit. Ad's were placed in:
- Big Red Restaurant guide
- Yello Visitors guide
- Kras vakanties Magazine
- Curaçao Road Map
- Island map

(For more information on these publications please take a look at the Christoffelpark chapter.)

5.3 Impressions of Savonet Museum

Pictures by: Helena de Bekker (HB) & M. da Costa Gomez (MDCG)

(HB)

(HB)

(HB)

(HB)

(MDCG)

(MDCG)



(HB)




(HB)




(HB)

(MDCG)

"Crested Caracara (Caracara cheriway."
Picture by: Eric Newton

C6 Environmental Education

6.1 Target groups

- Students in the age range of 4-18 years (school related)
- Teachers
- Parents
- Adults
- Youngsters in general

6.2 Subscriptions

For the fifth year in a row we personally visited all schools on the island to provide the possibility to subscribe to our environmental program.
Mrs. Retty Schoop and Mrs. Sonaly Rijnschot provided information about the different projects to teachers and directors of the schools and presented the schedules and course materials.

6.3 Educational programs and projects for schools

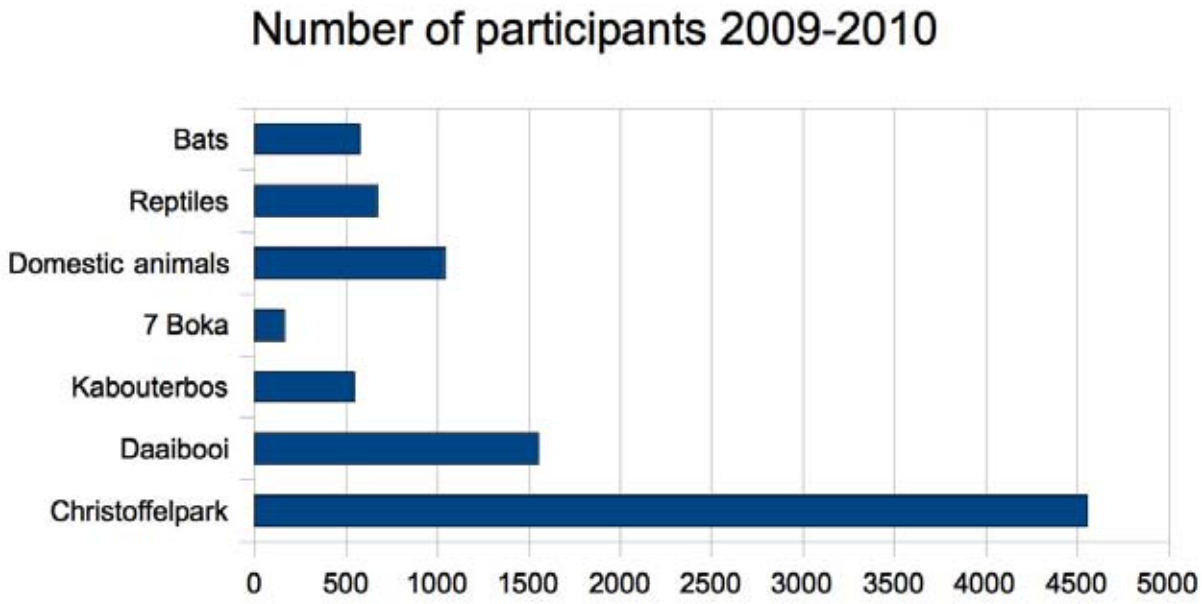
	Theme	Level	Place
1.	Mondi Misterioso (Mysterious Woods)	Foundation Based Education (Former kindergarten and 1st and 2nd grades of elementary school)	Kabouterbos/ Christoffelpark
2.	Nos ta Palunan den Mondi (We are trees in the Woods)	Foundation Based Education (Former kindergarten and 1st and 2nd grades of elementary school)	Kabouterbos/
3.	Domestic animals and care	Foundation Based Education (Former kindergarten and 1st and 2nd grades of elementary school)	School visits
4.	Bats of Curaçao	3rd, 4th and 5th age level of Foundation Based Education (1st, 2nd and 3rd grades of elementary school)	Carmabi
5.	Reptiles	3rd, 4th and 5th age level of Foundation Based Education (1st, 2nd and 3rd grades of elementary school)	School visits
6.	Relationship between nature and culture	4th grade of elementary school	Christoffelpark
7.	Adaptations to climate factors	5th grade of elementary school	Christoffelpark
8.	Coastal ecology	6th grade of elementary school	Daaibooi
9.	Sea Turtles	(on request) 6th grade of elementary school)	Shete Boka

"The scarlet ibis (Eudocimus ruber)."
Picture by: Bea Moedt

C6 Environmental Education

Picture by: Mark Vermeij

The structural school program ran like clock work. The numbers of participating kids appear in the graph below. 7 structural activities have been executed of which 4 are field activities (Christoffelpark, Daaibooi, Kabouterbos and 7 Boka) and the others consist of school visits on the respective topics. During the school year 2009-2010 a total of 9094 kids participated in the Carmabi educational program.



New this year was the addition of a bird (watching) program to the curriculum. Through this program the kids will obtain general knowledge of the physiology of birds and their habitat requirements. The program consists of two parts. After arriving at the park, the kids will receive the theoretical essentials while sitting below the new "palapa's" (thatched roof sheds) at the museum. Then they are taken on a bird watching hike through the "mondi". The number of kids participating in this new program will appear in next years annual report.
In order to get information on the effectiveness of the Carmabi educational programs as well as on the level of knowledge the kids acquire through the regular schooling system a survey is conducted as part of the program. The preliminary results show an alarming lack of interconnectivity between theoretical memorized facts and applied understanding of real world processes. A simple example: most kids are brilliant in memorizing bird names, and will score pretty high on exams, but are unable to identify the same birds in the field. The results of the survey will be analyzed at the end of school year 2010-2011. The results and conclusions will be communicated to the

relevant authorities, and will be applied to fine tune Carmabi's education policy.

6.4 Savonet Museum

The Savonet Museum was added to the "core business" of the educational program. Despite of the fact that the museum primarily focuses on the cultural historical aspects of plantation life (although a natural history extension is in preparation) it was decided to incorporate the museum in the educational program because of it's role within cultural education of the general public. No specific school curriculum has been developed around historical and cultural topics yet but this is certainly the intention for 2011.

6.5 Website

The education department of Carmabi is called or mailed everyday by school children, teachers or other people who are interested in certain nature related issues and themes. To better serve these target groups a brand new education website was launched in October 2010 with access to almost all educational materials the department has produced over the years.
Not everything is digitalized yet or translated into Papiamentu, but everything which is digitally available is now online. The site is innovative as it feautures both a Papiamentu and Dutch version. Students can find info sheets on marine and terrestrial related themes, teachers can find lesson plans, and materials which can be used for teaching. Also photo's and posters can be dowloaded and used for educational purposes. The website will continuously be updated with new material and also offers teachers and other interested people the opportunity to send feedback about themes which should be included.
For the Papiamentu version of the site go to www.carmabi-educatie.org/pap and for the Dutch version go to www.carmabi-educatie.org.

"Learning about climate."
Picture by: M. da Costa Gomez

"Home page of the new website of the education department."

"Corals."
Picture by: Mark Vermeij

C7 PR & Marketing

7.1 Press releases

Type of press release	# in Dutch	# in Papiamentu
Christoffelpark activities	21	21
Christoffelpark other	3	3
Sponsors	2	2
Marine park other	4	4
Savonet Museum	4	4
Articles	18	0
Total	52	34

7.2 New websites

In 2010 3 new websites were established for Carmabi to make information access by target groups easier. The design of the websites, done by Dragonfly Media, is fresh and colorful with lots of pictures of nature both terrestrial and marine. The series of websites www.carmabi.org, www.christoffelpark.org and www.researchstationcarmabi.org is now expanded with the new sites www.savonetmuseum.org, www.carmabi-educatie.org/pap and www.carmabi-educatie.org.
For more information please check the Savonet Museum chapter and Education chapter in this publication.

7.3 Newsletter

Two Biná newsletters were published in 2010.

7.4 Other efforts

Many other PR and marketing efforts were executed in 2010. All are described in the chapters of Christoffelpark and Savonet Museum.
Besides these efforts we also published our Annual Report 2009 in 2010.

Picture by: Mark Vermeij

"Cave."
Picture by: Mark Vermeij

C8 Advisory & consultancy services

The advisory department executed a number of consultancy studies both on terrestrial and marine topics. Clients included governments of several islands in the Caribbean, governmental organizations, private persons and commercial organizations.

Some of the scientific reports published in 2010:

- Van der Velde, J., K.M.A. Hoogenboezem-Lanslots, Y.M. Schenau, R.J. van Leeuwen, M.F.M. Briene & J.A. de Freitas. 2010. St. Eustatius strategic development plan. 60 pp.

- Lammens, M., J. Barrois & J. de Freitas. 2010. Bonaire Strategische Milieubeoordeling. 133 pp.

- Van der velde, J., M. Lammens, J. Barrois. F. Plantinga & J. de Freitas. 2010. Ruimtelijk Ontwikkelingsplan Bonaire 2010. 232 pp.

- Freitas, J.A. de. 2010. Flora en landschapstypen Playa Kanoa. 17 pp.

- Freitas, J.A. de. 2010. De natuurwaarden van de conserveringsgebieden van het E.O.P. Curaçao, hun status en bedreigende factoren. Rapport in opdracht van de DROV Curaçao. 166 pp.

Picture by: Michelle da Costa Gomez

“Conch.”
Picture by: Mark Vermeij

9.1 Design phase Carmabi Knowledge Center

Just before years end, the necessary steps were completed to be able to consolidate the contract with the contractor selected for the construction phase of the new Knowledge Center. Design bureau Broos van Werkhoven transformed Carmabi's space and infrastructural wishes into construction drawings. The new building will provide space for a cafeteria annex presentation room on the ground floor. The first floor will harbor new laboratory facilities as well as a bigger library. Student dormitories will occupy the second floor whereas on the next floor, the space below the roof, the somewhat more luxurious "professor" rooms will be constructed.
The new building will be constructed parallel to the existing Carmabi building at Piscadera. The landscape will change dramatically, though, because the first impression future visitors will get will be the impressive facade of the new building. Construction will commence in February 2012, and the bulk of the construction will be in place by December 2012. Contractors firm Nederlands Antilliaans Bouwbedrijf (NAB) has been selected for the project.
The project is part of the Social Economic Initiative (SEI), a cooperation program funded by the Netherlands. The aim of the project is to attract more foreign scientists as well as students to the Island with two-fold benefits: they will help broaden the knowledge base on the natural processes and resources of the Island, and they will also provide, through room and lab fees, the necessary financial assistance for sustainable exploitation of the center.

9.2 Carmabi participates in conference on Caribbean Sea Commission

After receiving an invitation from the Association of Caribbean States (ACS), Carmabi, represented by its director ir. Paul Stokkermans, participated in a conference on Barbados aimed at operationalizing the Caribbean Sea Commission (CSC). The conference was held at the University of the West Indies from July 7th till the 9th 2010 and financial support was provided by Finland. During the conference participants discussed ways and structures needed to accomplish this goal. Barbados currently acts as chairman of the CSC and the Netherlands Antilles are an associate member. Carmabi received an invitation after the ACS's Secretary General, Fernando Andrade Falla, visited Curaçao earlier that year. The ACS consists of Caribbean countries that strive towards cooperation in areas in which they share a common goal.

The CSC was established in 2008 in response to a resolution of the United Nations calling for the sustainable use of the natural resources of the Caribbean Sea. The resolution mainly intends to promote cooperation among smaller (island) nations. Such cooperation will likely improve local conservation efforts and ensure the long term survival of the islands' marine resources that serve as the basis for local fishing and tourism

Picture by: Mark Vermeij

industries. Marine resources such as healthy fish populations, sea grass fields and coral reef provide economic possibilities in the form of fishing and tourism to islands that often lack other significant sources of economic revenue.

Several examples of well known sources of pollution such as the BP oil spill in the Gulf of Mexico were discussed during the conference, but also less visible sources of pollution were considered. For example, the detrimental effect of land based pollutants (e.g., pesticides and fertilizers) that enter the near shore environment after coastal vegetation is removed, was discussed. Visible or not, the CSC encourages its members to cooperate and share information on how to successfully design and implement management strategies aimed at reversing the negative impacts affecting the islands' marine resources.

The CSC concluded that much of the information needed to design effective management strategies is already available, but is often "too scientific" to be effectively used for designing management strategies and support policy making processes. Therefore the CSC wants to make an inventory of existing information and make it available to policy makers and resource managers after it has been reformatted for use by these particular stakeholder groups. The CSC will initially focus on the living natural resources of the Caribbean region and cooperate with representatives of the fishing and maritime industries to achieve its goals.

9.3 Departure Carmabi director Dr. Adolphe Debrot

On the 28th of February 2010 we said goodbye to Carmabi director Dr. Adolphe Debrot better known as Dolfi. On the 26th of February we celebrated this with a reception on the Carmabi premises. During his speech Dolfi looked back on the many years he has worked at Carmabi. Dolfi started to work at Carmabi on the 1st of April 1989 as chief scientist. On the 1th of October 2003 he was promoted to deputy director of Carmabi. On the 1st of August 2006 Dolfi became director of Carmabi.

Dolfi is a highly motivated person. He was a Carmabi man to the backbone and well known within the Curaçao society. He is an excellent biologist with a profound knowledge of the biology on land and in the sea of Curaçao in particular and the former Netherlands Antilles as a whole. He has many publications on his name. He managed the difficult task to combine his work as a scientist and his responsibilities as director. His work has not been easy. Around the time he became director the Carmabi subsidy was cut with 70%. Dolfi had the ungrateful task to dismiss personnel Carmabi could no longer afford to pay. Nevertheless he managed to keep the Carmabi ship afloat which required a lot of helmsmanship. Furthermore he succeeded in obtaining funds

from the Social Economic Initiative (SEI) for the construction of the Carmabi Science Center. His work is bearing fruit now because the construction of the Science Center has recently started!

9.4 Blue Festival

The United Nations declared May 22nd in 2010 International Day of Biodiversity. In response to this worldwide event, Carmabi organized, in collaboration with their neighbors at Piscadera (i.e., Hook's Hut and DiveVersity) an open day to celebrate this event on Curacao. People were invited to come to Piscadera to enjoy a wide variety of activities such a kayak tours with Ryan De Jongh, free scuba dive lessons, tours around the Carmabi facilities and presentations on Curaçao's biodiversity and nature in general. At the start of the evening Carmabi received a cheque of nafl.15000 from the Maduro & Curiels Bank. The day ended with a spectacular performance of the band Happy Peanuts, DJ Johny Brazao and VJ Ryan Oduber (from Aruba). All in all more than 400 persons attended this first edition of the Curaçao Wild Blue Festival.

Picture by: Mark Vermeij

9.5 Financial department

The financial department of Carmabi consists of 3 people, a financial controller, an assistant financial Controller and an office manager. 2010 was a year of many changes in the financial department. In the first quarter of the year our former financial controller resigned. She was substituted by the actual Financial Controller Ms Isenia. In the third quarter of the year our assistant financial Controller resigned. In November 2010 we welcomed Ms Martina our new assistant financial controller.

We also added the POS system to our financial software/tools at the Christoffelpark. With this system we do not need to use tickets any more but a simple touch on the screen to register the entrance at the park. This software also enables us at the financial department at the head office of Carmabi to access the system remotely what give us the possibility to access and control the figures daily. This is a big improvement because with this system we reduce the manual activities, make better estimates and manage our financials according to our procedures. Despite all changes we managed to close our financial year successfully.

For next year more administrative changes are planned to improve the procedures at our Financial Department.

9.6 Meeting IUCN Dominican Republic

Carmabi director Paul Stokkermans attended on the 10th and 11th of November 2010 a meeting of the International Union for Conservation of Nature (IUCN) in the Dominican Republic.

C9 Miscellaneous

"IUCN meeting participants."

The IUCN helps the world find pragmatic solutions to the most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice. Carmabi is a member of the IUCN

The meeting was organized by the IUCN Regional Office for Mesoamerica and the Caribbean Initiative (IUCN-ORMA/Caribe). It was the first meeting for the insular Caribbean.

The purpose of the meeting was to establish a regional committee. The purpose of the meeting was to prepare and plan for the 2011 regional forum, to organize the affairs and activities of IUCN Caribbean members in preparation for the World Conservation Congress to be held in Jeju Island, Republic of Korea, 6-15 September 2012 and to serve as a first point of contact between members and the regional secretariat.

During the meeting the regional committee was established. Carmabi was elected as a member of the committee. A photo of the newly formed committee can be seen below.

"Fungus in Christoffelpark."
Picture by: Michelle da Costa Gomez

C10 Sponsors

A big thank you to all who helped Carmabi in 2010 by sponsoring.

- Nationale Postcode Loterij
- Percy Henriquez Fonds
- ENNIA Insurance
- Maduro & Curiel's Bank
- Curaçao Tourist Board
- Kooyman B.V.
- Kustwacht
- Selikor
- Floris Suite Hotel
- Friends of Carmabi
- Drukkerij Interpress
- Drukkerij de Curaçaose Courant
- Budget Rent a Car
- Destination Curaçao
- DCNA
- Xerox docucentro
- Prins Bernhard Cultuur Fonds
- Elizabeth Stichting
- Rene Severens
- Mevr. Agatha Gomez
- Bruce Fouke
- Peter Bongers
- Wereldstage
- Island TV
- Expedition Paradise
- Curaçao Road Map

Volunteers and interns

Ans Bronneberg
Eric Newton
Frensel Mercelina
Joanne Rich
Reginald Rosario
Ryan de Jongh
Mark Fraites

Anneloes van Vught
Marieke de Greef
Joyce van de Knaap

C11 Committees & work relations

11.1 DCNA

Carmabi is a member of the Dutch Caribbean Nature Alliance (DCNA). The objective of the DCNA is to safeguard the biodiversity and promote the sustainable management of the natural resources of the islands of the Dutch Caribbean, both on land and in the water, for the benefit of present and future generations, by supporting and assisting the protected area management organizations and nature conservation activities in the Dutch Caribbean. Furthermore the DCNA manages a trust fund. This trust fund is funded by donors such as the Dutch Postcode Lottery. The purpose of the trust fund is to provide core funding to cover the operational costs of the designated marine protected area (marine nature park) and the designated terrestrial protected area (land nature park) on each of the islands of the Dutch Caribbean. Before the parks can receive any funds the trust fund needs to accumulate a target of Euro 24 million.

The DCNA holds two meetings every calendar year. In 2010 the meetings were held 19-22 April in St. Maarten and 25-28 October in Bonaire. Carmabi director Paul Stokkermans participated in both meetings. During the meetings many conservation and organizational issues are discussed. The meetings are usually concluded with a tree planting event in order to compensate for the carbon emissions during the air travel going to and from the meetings. In 2010 the DCNA also organized a GIS course. A geographic information system (GIS), is a system that captures, stores, analyzes, manages and presents data with reference to geographic location data. GIS is therefore a very useful technique for nature management. The head of the Carmabi Advise and Consultancy Department, John de Freitas, participated in this course.

"DCNA meetings on Bonaire and on St. Maarten."

Appendix I Publications & reports

Peer reviewed scientific publications

1. Bongaerts P, Ridgway T, Sampayo EM, Hoegh-Guldberg (2010) Assessing the 'deep reef refugia' hypothesis: focus on Caribbean reefs. Coral Reefs, DOI 10.1007/s00338-009-0581-x.
2. Filatov MV, Kaandorp JA, Postma M, van Liere R, Kruszyński KJ , Vermeij MJA, Streekstra GJ, Bak RPM (2010) A comparison between coral colonies of the genus Madracis and simulated forms. Proc Roy Soc B. doi: 10.1098/rspb.2010.0957.
3. Frade PR, Reyes-Nivia MC, Faria J, et al (2010) Semi-permeable species boundaries in the coral genus Madracis: Introgression in a brooding coral system. Molecular Phylogenetics and Evolution 57: 1072-1090..
4. Gyri C, Felis T, Koelling M, Scheffers SR (in press). Geochemistry and skeletal structure of Diploria strigosa, implications for coral-based climate reconstruction. Palaeogeography, Palaeoclimatology, Palaeoecology.
5. Giry C, Felis T, Scheffers SR, Scholtz D (2010). Assessing the potential of Southern Caribbean corals for paleotemperature reconstruction. IOP Conf. Ser.: Earth Environmental Science 9 012021. DOI: 10.1088/1755-1315/9/1/012021
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8. Kruitwagen G, Nagelkerken I, Lugendo BR, Mgaya YD, Wendelaar Bonga SE (2010) Importance of different carbon sources for macroinvertebrates and fishes of an interlinked mangrove–mudflat ecosystem (Tanzania). Estuarine, Coastal and Shelf Science 88: 464-472
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10. Pignatelli C, Scheffers A, Scheffers SR and Mastronuzzi G (2010). Evaluation of tsunami flooding from geomorphological evidence in Bonaire (Netherland Antilles). Zeitschrift fuer Geomorphologie
11. Scheffers SR, van Soest RWM, Nieuwland G, Bak RPM (in press). Coral reef framework cavities: Is functional similarity reflected in composition of the cryptic macrofaunal community? Atoll Research Bulletin.
12. Sommer B, Harrison PL, Scheffers SR (2010). Aggressive colonial ascidian impacting upon coral reefs at Bonaire, Netherlands Antilles. Coral Reefs, 29 (1): 245.
13. Toller, W., Debrot, A.O., Vermeij, M.J.A. and P.C. Hoetjes. (2010) Reef fishes of Saba Bank,

Appendix I Publications & reports

Netherlands Antilles: Assemblage structure across a gradient of habitat types. PLoS ONE 5(5): e9207.
14. Vermeij, M.J.A., I. van Moorselaar, S. Engelhard, C. Hörnlein, S. M. Vonk and P. M. Visser (2010) The effects of nutrient enrichment and herbivore abundance on the ability of turf algae to overgrow coral in the Caribbean. PLoS ONE 5(12): e14312.
15. Vermeij, M. J.A. (2010) First observation of a nocturnal nudibranch feeding on Caribbean corals. Coral Reefs 29: 1047.
16. Vermeij, M.J.A., K.L. Marhaver, C.M. Huijbers, I. Nagelkerken and S.D. Simpson (2010) Coral larvae move towards reef sounds. PLoS ONE 5(5): e10660 .
17. Vermeij, M.J.A., Barott, K.L., Johnson, A.E. and K.L. Marhaver (2010) Release of eggs from tentacles in a Caribbean coral. Coral Reefs 29: 411.
18. Vermeij, M.J.A., A.O. Debrot, N. van der Hal, J. Bakker and R.P.M. Bak (2010) Increased recruitment rates indicate recovering populations of the sea urchin Diadema antillarum on Curaçao. Bulletin of Marine Science 86: 719-725.
19. Vermeij, M.J.A., M.L. Dailer, S.M. Walsh, M.K. Donovan and C.M. Smith (2010) The effects of trophic interactions and spatial competition on algal community composition on Hawaiian coral reefs. Marine Ecology 31: 291-299.

Scientific reports

- Van der Velde, J., K.M.A. Hoogenboezem-Lanslots, Y.M. Schenau, R.J. van Leeuwen, M.F.M. Briene & J.A. de Freitas. 2010. St. Eustatius strategic development plan. 60 pp.

- Lammens, M., J. Barrois & J. de Freitas. 2010. Bonaire Strategische Milieubeoordeling. 133 pp.

- Van der velde, J., M. Lammens, J. Barrois. F. Plantinga & J. de Freitas. 2010. Ruimtelijk Ontwikkelingsplan Bonaire 2010. 232 pp.

- Freitas, J.A. de. 2010. Flora en landschapstypen Playa Kanoa. 17 pp.

- Freitas, J.A. de. 2010. De natuurwaarden van de conserveringsgebieden van het E.O.P. Curaçao, hun status en bedreigende factoren. Rapport in opdracht van de DROV Curaçao. 166 pp.

Other publications

- Costa Gomez, M. da, Vermeij, M.J.A. and Debrot, A.O. (ed.). 2010. Carmabi Annual Report 2009. - [Willemstad], Curaçao : Carmabi foundation. - 72 bl. : ill. ; 21 x 30 cm. - PDF available from Carmabi.

- Biná : Newsletter of the Carmabi foundation, 7th year number 1 / ed. M. da Costa Gomez, A.van Vught, M. de Greef. - [Willemstad], Curaçao: Carmabi Foundation, 2010. - 16 bl. : ill. ; 30 cm. - PDF available from Carmabi.

- Biná : Newsletter of the Carmabi foundation, 7th year number 2 / ed. M. da Costa Gomez, J. van de Knaap, M. Vermeij. - [Willemstad], Curaçao: Carmabi Foundation, 2010. - 16 bl. : ill. ; 30 cm. - PDF available from Carmabi.

Appendix II Board and personnel

Left/retired
February:
- Adolphe (Dolfi) Debrot, director
- Esmeralda van de Water, financial controller

July
- Djurick Marsera, ranger

August
- Miriam Pieternelle, assistant financial controller

New personnel
April:
- Briand Victorina, ranger
- Ethline Isenia, financial controller
- Xiomara Concetion, janitor Savonet Museum
- Markpaul Wisman, technical assistant Savonet Museum
- Paul Stokkermans, director
- Janine Albert, education guide

August:
- Maria de los Angeles, assistant terrace

November
- Shahaira Martina, assistant financial controller

2010
The board and personnel list as of the 31st of December 2010, is as follows:

Board
- Ir. Dito Abbad, chairman
- MsC. Peter Bongers, treasurer
- MsC. Jeff Sybesma LLM, secretary
- Mr. Erwin Koense, board member

Carmabi ambassador in the Netherlands
- Mr. André Cohen Henriquez

Management
- Ir. Paul Stokkermans, director

Logistical support section
- Mr. Carlos Winterdaal, technical assistant
- Mrs. Sisline Rosalia, janitor

Administration
- Mrs. Ethline Isenia, financial controller
- Mrs. Shahaira Martina, assistant financial controller
- Joanne Rich, office manager

Scientific Department
- Dr. Mark Vermeij, head of the section
- MsC. John de Freitas, senior researcher
- MsC. Leon Pors, researcher

Nature management section
- Mrs. Ing. Michelle da Costa Gomez, manager

Christoffelpark
- Mr. Cyrill Kooistra, assistant manager and activities and events coordinator
- Mr. Wolter Samboe, ranger activities and events
- Mr. Mark Fraites, freelance ranger activities and events
- Mrs. Alice Cijntje, Shop attendant
- Mrs. Rachel Tokaai, assistant PR and marketing

Appendix II Board and personnel

- Mr. Oswald Ricardo, ranger security/ activities
- Mr. Pedro Andrea, Chief ranger
- Mr. Briand Victorina, ranger
- Mrs. Araceli Ersilia, front desk officer
- Mrs. Maria de los Angeles, assistant terrace

Marine Park
- Mr. Ryan de Jongh, volunteer, Honorary Staff Member

Kabouterbos
- Mr. Cyrill Kooistra, assistant manager

Hato caves
Contracted to Indian Caves N.V. (Mrs. M. Vrolijk)

Environmental education section
- MsC. Leon Pors, head of the section
- Mrs. Ing. Michelle da Costa Gomez, education staff member

(Semi) Volunteers education section
- Mrs. Clarette Schoop
- Mrs. Sonaly Rijnschot
- Mr. Reginald Rosario
- Mrs. Ruthlyn Bernadina
- Mrs. Janine Albert
- Mrs. Xiomara Flemming

Consultancy department
MsC. John de Freitas, manager

Appendix II Board and personnel

						
Paul Stokkermans	Mark Vermeij	Leendert (Leon) Pors	Michelle da Costa Gomez	Ethline Isenia	John de Freitas	Clarette (Retty) Schoop
						
Shahaira Martina	Cyrill (Tio Cyrill) Kooistra	Markpaul Wisman	Rachel Tokaai	Syslin Rosalia	Joanne Rich	Pedro (Nini) Andrea
						
Carlos Winterdaal	Alice Cijntje	Mark Fraites	Sonaly (Naly) Rijnschot	Araceli (Celine) Ersilia	Briand Victorina	Ruthlyn (Ruth) Bernadina
						
Walter (Wòti S) Samboe	Oswald (Wòti R) Ricardo	Xiomara Concetion	Reginald (Pietje) Rosario	Janine Albert	Wim van Ginkel	*Mimus gilvus*

Appendix II Board and personnel

			
Dito Abbad	Peter Bongers	Jeff Sybesma	Erwin Koense

Caribbean Research and Management of Biodiversity