Annual report
Carmabi Foundation
2013

Carmabi Annual Report 2013

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CARMABI

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FROM THE DIRECTOR

The year 2013 has been a special year. On the 18th of November King Willem-Alexander has opened the new Carmabi Science Center at Piscadera in the presence of many invited guests and dignitaries. This is a mayor step forward in the expansion of Carmabi's facilities and in this report you can read in which areas and what progress was made. Board and staff thank all friends, associates, partners and the Government for their ongoing support.

Carmabi's research department has done very well. In 2013 in total 119 scientists visited Carmabi, to conduct a wide variety of research projects. In addition, 77 students participated in various courses that were taught at Carmabi. In total 35 scientific publications were published based on work done at Carmabi (2012: 23) of which 13 were authored or co-authored by Carmabi staff. Increased insight in the ecological processes shaping Curacao's reefs is essential for improving existing and new management strategies to ensure the long term survival of these unique assets of our island and also in this area significant progress has been made in 2013.

The number of people visiting the Christoffelpark in 2013 was 32,229 (8,139 local and 24,090 foreign), whereas 72,267 people visited Shete Boka. The Savonet museum was visited by 2,880 visitors. Major improvements to the parks' infrastructure were made, especially at Shete Boka. The curved walls at the entry were painted with a new design and watchtowers were constructed at Boka Wandomi and Boka Kalki to prevent theft from visitors' cars. The watchtowers and the guards were made possible by the Curaçao Tourist Board (CTB).

Our Nature and Environmental Education Department takes primary school children on educational trips to the Christoffel Park and the areas of Daaibooi, Shete Boka and Kabouterbos, but also visits children at schools. In 2013 more than 10,000 school children visited the parks guided by our 5 volunteer guides or learned about the island's nature at school. While the focus of this educational program has been foremost on terrestrial nature, but in 2013 we started with a Marine Education Center (MEC) that will also include Curaçao's marine life into our education program. The new auditorium, which will also be used by the MEC, was completed as well as the MEC school materials.

In 2013, costs to run Carmabi's activities have increased and in 2013the Government has reduced subsidies by 5% for all Curaçaoan foundations, including Carmabi. The introduction of the new medical insurance (BZV) increased labor costs. All of this has posed a severe challenge since the existing revenues are already insufficient to cover the growing number of Carmabi's activities on the island. Like last year, also this year Carmabi will therefore continue to focus on new forms of financial support to avoid that ongoing and planned projects and programs will suffer even more.

Regarding nature on Curaçao, Carmabi is moderately positive about recent developments in this area and will continue to assist decision makers in the future to further ensure that the island's natural resources are managed sustainably. In 2013, Carmabi assisted with the implementation of no-take zones which will increase fish stocks around the island and establishment of four Ramsar sites by the government. These areas are internationally recognized protected areas aimed at preserving wetlands including coastal coral reefs.

With respect to nature we are worried about the developments with regard to the Island Development Plan (EOP). It is very important that urban development remains concentrated in or around existing urban areas to prevent further encroachment into natural areas that are increasingly appreciated by the growing number of (eco)tourists that visit the island. We hope that the actions taken by the government to protect the island's natural resources in 2013 will be continued in 2014 when it comes to issues related to the EOP and the protection of Oostpunt.

Paul Stokkermans
Director Carmabi

In 2013, the results of the largest study ever conducted on the state of Caribbean reefs were presented and showed that the reefs of Oostpunt rank among the top three of "best" reefs left in the Caribbean. *See page 17 for more details.*

1 CARMABI'S MISSION

Missions & 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.

Carmabi's 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.

Departments

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

- Scientific Research
- Park management & Savonet Museum
- Environmental and Nature Education
- Advisory & Consultancy services
- Organizational support

2 SCIENTIFIC RESEARCH

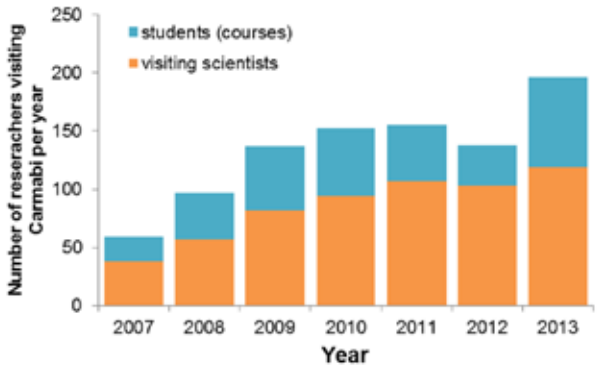
2.1 Visiting scientists

119 scientists visited Carmabi in 2013. In addition 77 students participated in Coral Reef Ecology courses and workshops that were taught by Carmabi and various universities from the Netherlands, Surinam and the United States. The number of visiting scientists in 2013 illustrates a continued positive trend that is probably facilitated by the "unofficial" opening of the new Science Center in the beginning of 2013. Most scientists in 2013 were from the United States (36%; 2012: 40%; 2011: 40%; 2010: 41%) followed by the Netherlands (22%; 2012: 46%; 2011: 22%; 2010: 26%) (Figure 1). Seventy-eight percent of the scientists and students that worked at Carmabi stayed at the newly constructed laboratory/ dormitory facilities. A total of 4226 personal working days (i.e. one visiting scientist working one day) were achieved. This is approximately the same as in 2012 (4329), but signals an upward trend when compared with earlier years, i.e., 2011 (3752) and 2010 (1767 days) indicating that visiting scientists spend longer periods of time on the island. 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 home institute) is provided below:

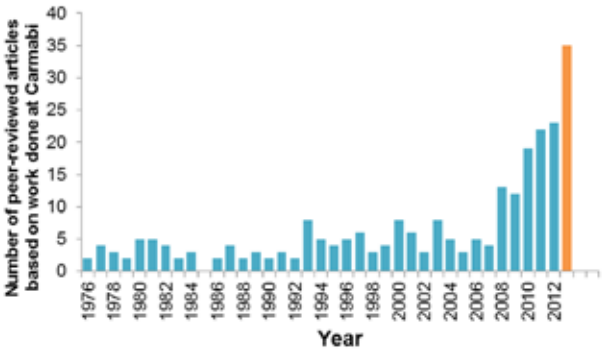
Aaron Hartmann, Scripps Inst. Oceanography, U.S.A.
Aki Ohdera, University of California at Merced, U.S.A.
Andeljean Ho, Florida Institute of Technology, U.S.A.
Anthony Bellantuono, Florida Int'l. University, U.S.A.
Aschwin Engelen, University of the Algarve, Portugal
Ben Mueller, Neth. Inst. Sea Research, The Netherlands
Bob Snowden, Pittsburgh Zoo, U.S.A.
Cara Simonson, Scripps Inst. Oceanography, U.S.A.
Carl koorndijk, Anton de Kom University, Suriname
Chantale Begin, University of South Florida, U.S.A.
Charles Fransen, Naturalis Biodiv. Center, The Netherlands
Colleen Cook, University of Illinois UC, U.S.A.
Dennis de Ruiter, Hogeschool Rotterdam, The Netherlands
Dirk Petersen, Secore Foundation, Germany
Fadilah Ali, CIEE, Bonaire
Forest Rohwer, San Diego State University, U.S.A.
Iliana Baums, Pennsylvania State University, U.S.A.
Jason Macrander, Ohio State University, U.S.A.
Jasper de Goeij, University of Amsterdam, The Netherlands
John Ogden, University of South Florida, U.S.A.
Joost den Haan, Univ. of Amsterdam, The Netherlands
Juan Sanchez, Universidad de los Andes, Colombia
Kenan Matterson, University of Alabama, U.S.A.
Kristen Marhaver, Univ.of California at Merced, U.S.A.
Laurent Delvoye, The Netherlands
Laurie Richardson, Florida Int'l. University, U.S.A.
Manuel Gonzalez Rivero, Caitlin SeaView, Australia
Mark Hay, Georgia Tech, U.S.A.
Mark Warner, University of Delaware, U.S.A.
Mauricio Lanetty, Florida Int. University, U.S.A.
Michelle Gaithern, California Academy of Sciences, U.S.A.
Patrick Keeling, Canadian Inst. for Advanced Res., Canada
Pedro Frade, University of Vienna, Austria
Petra Visser, University of Amsterdam, The Netherlands
Pim Bongaerts, Univ. of Queensland , Australia
Ramon de Leon, STINAPA, Bonaire
Rolf Bak, Neth. Inst. Sea Research, The Netherlands
Sancia vd Meij, Naturalis Biodiv. Center, The Netherlands
Sergio Floeter, Universidade Federal de St.Catarina, Brazil
Sophie Petit, University of South Australia, Australia
Stuart Sandin, Scripps Inst. Oceanography, U.S.A.
Tatyana Gabellone, University of Bristol, United Kingdom
Tim Jonkers, Hogeschool Leiden, The Netherlands
Valerie Chamberland, Univ. of Amsterdam, The Netherlands
Yvonne Sliep, University of KwaZulu-Natal, South Africa

2.2 Peer reviewed scientific publications

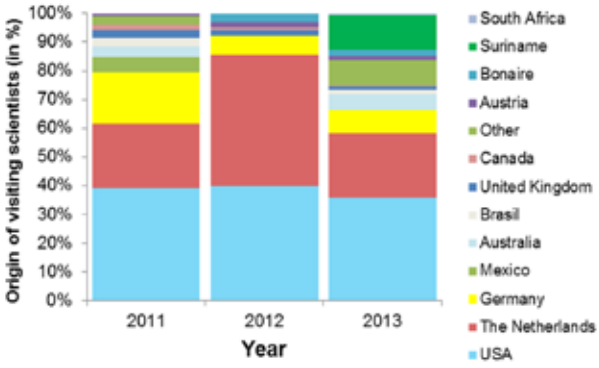
Thirty-five publications appeared in peer reviewed scientific journals based on work that was conducted at Carmabi. Thirteen of these were authored or co-authored by Carmabi staff making 2013 the most productive year ever in terms of Carmabi's scientific output. The results of some of these studies have been featured in magazines, news programs and educational websites around the world. Furthermore, 21 reports were produced by MSc students that did their master's thesis' project at Carmabi.



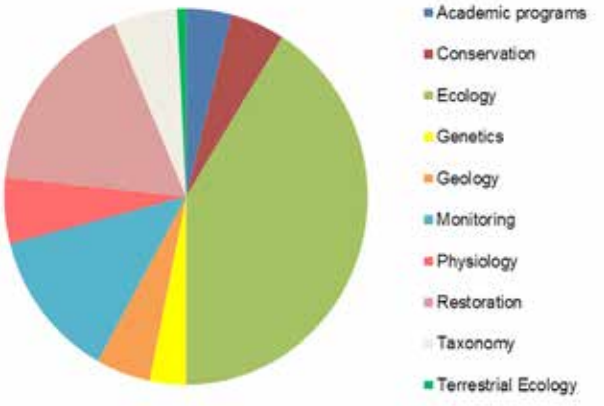
Increase in reserachers visiting Carmabi between 2007 and 2013.



Research outpunt in terms of peer reviewed papers through time



Trends in origin of researchers visiting Carmabi in 2011-2013.



Areas of expertise of visiting researchers in 2013.

An overview of all peer reviewed scientific publications accepted for publication or published in 2013 is shown below:

Ahrens JB, Borda E, Barroso R, Paiva PC, Campell AM, Wolf A, Nugues MM, Rouse GW, Schulze A (2013) The curious case of *Hermodice carunculata* (Annelida: Amphinomidae): evidence for genetic homogeneity throughout the Atlantic Ocean and adjacent basins. Molecular Ecology 22: 2280–2291.

Beek IJM, Debrot AO, de Graaf M (2012) Elasmobranchs in the Dutch Caribbean: current population status, fisheries and conservation. Proc. 65th GCFI, Sta. Martha, Colombia. 12 pp.

Biggs BC (2013) Harnessing natural recovery processes to improve restoration outcomes: An experimental assessment of sponge-mediated coral reef restoration. PLoS ONE 8(6): e64945.

Bongaerts P, Frade PR, Ogier JJ, Hay KB, van Bleijswijk J, Englebert N, Vermeij MJA, Bak RPM, Visser PM, Hoegh-Guldberg O (2013) Sharing the slope: depth partitioning of agariciid corals and associated Symbiodinium across shallow and mesophotic habitats (2-60 m) on a Caribbean reef. BMC Evolutionary Biology 13: 205.

Bright AJ, Williams DE, Kramer KL et al. (2013) Recovery of *Acropora palmata* in Curacao: a comparison with the Florida Keys. Bull. Mar. Sc. 89: 747-757.

Cardoso JF, van Bleijswijk JD, Witte H, van Duyl FC (2013) Diversity and abundance of ammonia-oxidizing Archaea and Bacteria in tropical and cold-water coral reef sponges. Aquatic Microbial Ecology: 68, 215-230.

de Freitas JA, Rojer AC (2013) New plant records for Bonaire and the Dutch Caribbean islands. Caribbean Journal of Science 47: 114-117.

de Goeij J, van Oevelen D, Vermeij MJA, Osinga R, Middelburg J, de Goeij A, Admiraal W (2013) The sponge loop retains energy and nutrients within coral reefs. Science 342:108-110.

Members of the CATLIN Seaview Team visited Curaçao in 2013 and photographed kilometers of reef around the island that can now be viewed online as if one were a "virtual diver" at http://catlinseaviewsurvey.com/surveys/caribbean/curacao.

De Leon R, Vane K, Bertuol P, Chamberland VC, Simal F, Imms E, Vermeij MJA (2013) The effectiveness of lionfish removal efforts in the Southern Caribbean. Endangered Species Research 22: 175–182.

Den Haan J, Huisman J, Dekker F, ten Brinke JL, Ford AK, van Ooijen J, van Duyl FC, Huisman J, Vermeij MJA, Visser PM (2013) Fast detection of nutrient limitation in macroalgae and seagrass with nutrient-induced fluorescence. PLoS ONE 8(7): e68834.

Engene N, Gunasekera SP, Gerwick WH, Paul VJ (2013) Phylogenetic inferences reveal a large extent of novel biodiversity in chemically rich tropical marine cyanobacteria. Applied Environmental Microbiology 79: 1882.

Engene N, Paul VJ, Byrum T, Gerwick WH, Thor A, Ellisman MH (2013) Five chemically rich species of tropical marine cyanobacteria of the genus Okeania gen. nov. (Oscillatoriales, Cyanoprokaryota). Journal of Phycology 49: 1095-1106.

Filatov MV, Frade PR, Bak RPM, Vermeij MJA, Kaandorp JA (2013) Comparison between colony morphology and molecular phylogeny in the Caribbean scleractinian coral genus *Madracis*. PLoS ONE 8(8): e71287.

Foster NL, Baums IB, Sanchez JA, Paris CB, Chollett I, Agudelo CL, Vermeij MJA, Mumby PJ (2013) Hurricane-driven patterns of clonality in an ecosystem engineer: The Caribbean coral *Montastraea annularis*. PLoS ONE 8(1): e53283.

Fricke A, Titlyanova TV, Nugues MM, Bischof K (2013). *Neosiphonia howei* (Ceramiales: Rhodomelaceae)—a common epiphyte of the spreading coral reef alga *Lobophora variegata* (Dictyotales: Dictyotaceae). Marine Biodiversity Records 6: 6 2013e3.

Gartner GE, Gamble T, Jaffe AL, Harrison A, Losos JB (2013) Left–right dewlap asymmetry and phylogeography of *Anolis lineatus* on Aruba and Curaçao. Biological Journal of the Linnean Society 110: 409-426.

Gregg AK, Hatay M, Haas AF, Robinett N, Barott K, Vermeij MJA, Marhaver K, Thompson F, Meirelles P, Rohwer F (2013) Biological oxygen demand optode analysis of coral reef-asso-

ciated microbial communities exposed to algal exudates. PeerJ 1:e107.

Hartmann AC, Marhaver KL, Chamberland VF, Sandin SA, Vermeij MJA (2013) Large birth size does not reduce the negative latent effects of harsh environmental conditions across early life stages. Ecology 94: 1966-1976.

Huijbers C, Nagelkerken I, Debrot AO, Jongejans E (2013) Movement across ecosystem boundaries: source-sink population dynamics of a coral reef fish. Ecology 94: 1859-1870.

Hunting ER, Franken O, Knopperts F, Kraak MH, Vargas R, Röling WF, van der Geest HG (2013) Substrate as a driver of sponge distributions in mangrove ecosystems. Marine Ecology Progress Series 486: 133-141.

Hunting ER, Ubels SM, Kraak MH, van der Geest HG (2013). Root-derived organic matter confines sponge community composition in mangrove ecosystems. Ecological Processes 2: 1-4.

Johnston L, Miller MW, Baums IB (2012) Assessment of host-associated genetic differentiation among phenotypically divergent populations of a coral-eating gastropod across the Caribbean. PLoS ONE 7(11): e47630.

Lace MJ, Mylroie JE (2013) Coastal cave and Karst resource management. In: Coastal Karst Landforms (pp. 127-143). Springer Netherlands.

Marhaver KL, Vermeij MJA, Rohwer F, Sandin SA (2013) Janzen-Connell effects in a broadcast-spawning Caribbean coral: Distance dependent survival of larvae and settlers. Ecology 94: 146-160.

Meesters EH, Mueller B, Nugues MM (2013) Caribbean free-living coral species co-occurring deep off the windward coast of Curaçao. Coral Reefs 32: 1.

Prada C, Hellberg ME (2013) Long prereproductive selection and divergence by depth in a Caribbean candelabrum coral. Proceedings of the National Academy of Sciences, 110: 3961-3966.

One of the largest hawksbill seaturtles ever measured laid her eggs on the beach at Lagun in August 2013.

Rodriguez-Lanetty M, Granados-Cifuentes C, Barberan A, Bellantuono AJ, Bastidas C (2013) Ecological Inferences from a deep screening of the Complex Bacterial Consortia associated with the coral, *Porites astreoides*. Molecular Ecology 22: 4349-4362.

Smith JE, Price NN, Nelson CE, Haas AF (2013) Coupled changes in oxygen concentration and pH caused by metabolism of benthic coral reef organisms. Marine Biology 160: 2437-2447.

Stephen CL, Reynoso VH, Collett WS, Hasbun CR, Breinholt JW (2013) Geographical structure and cryptic lineages within common green iguanas, *Iguana iguana*. Journal of Biogeography 40: 50–62.

Teichberg M, Fricke A, Bischof K (2013) In-

Research on the Southern Line Island allows one to get a glimpse of what (Caribbean) reefs might have looked like in the past before regionwide degradation started decades ago.Photo: B. Zgliczynski

creased physiological performance of the calcifying green macroalga *Halimeda opuntia* in response to experimental nutrient enrichment on a Caribbean coral reef. Aquatic Botany 104: 25-33.

Vermeij MJA, Frade PR, Bak RPM (2013) Zooxanthellae presence acts as a settlement cue for aposymbiotic planulae of the Caribbean coral *Montastraea faveolata*. Caribbean Journal of Science 47: 31-36.

Vermeij MJA, van der Heijden RA, Olthuis JG, Marhaver KL, Smith JE, Visser PM (2013) Survival and dispersal of turf algae and macroalgae consumed by herbivorous coral reef fishes. Oecologia 171: 417-425.

Welicky RL, Cheney KL, Coile AM, McCammon A, Sikkel PC (2013) The relationship between lunar periodicity and activity of fish-parasitic gnathiid isopods in the Caribbean. Marine Biology 160: 1607-1617.

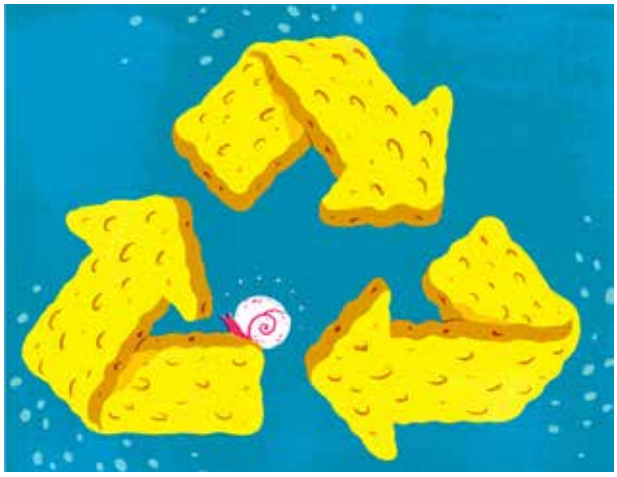
Wolf AT, Nugues MM (2013) Predation on coral settlers by the corallivorous fireworm *Hermodice carunculata*. Coral Reefs 32: 227–231.

Wolf AT, Nugues MM (2013) Synergistic effects of algal overgrowth and corallivory on Caribbean reef-building corals. Ecology 94:1667-1674.

2.4 Free advice, outreach and consultation

Several organizations, government departments, the press and others received free advice and information from the Carmabi Science Department during the year. We assisted in 111 (2012: 72) cases, both oral and written. Four consultancy studies were executed for international and governmental organizations on Curacao or other Caribbean islands. In 2012 the Carmabi Science Department was featured/ interviewed in 86 (2012: 57) (known) items for local TV, radio and newspapers, whereas the publication of the Science paper (DeGoeij et al. See above) caused widespread international recognition for work conducted at Carmabi.

Pieces about this work appeared in e.g., The New York Times and were picked up by the BBC. Five public and seven invited lectures were given on various topics related to coral reefs during conferences and workshops, such



Graphic published in the New York Times to accompagnie their piece on the discovery of the "sponge loop" on Curaçao.

as the 36th Association of Marine Laboratories in the Caribbean's (AMLC) Scientific Meeting sponsored by the Discovery Bay Marine Laboratory from June 17-21 in Jamaica, where multiple people that conducted their research at Carmabi gave presentations for the international coral reef community. In 2015 this same meeting will be hosted by Carmabi and bring approximately 150-200 reef researchers to Curaçao. Assistance was provided to produce a new documentary on Curaçao's extraordinary flora and fauna: Curaçao's True Nature. The episode on Curaçao's marine life, mangrove lagoons and limestone formations is now available via YouTube (www.youtube.com/watch?v=D9jI6w9l-Vk).

2.4 Research

A large, collaborative project was continued in 2012 funded by the European Union's 7th Framework Program 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 continue for another year. On Curacao this project largely focuses on the ecology of microbes, coral larvae 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 that contribute to reef degradation. For more information on the FORCE project led by Prof. Dr. P. Mumby, see: http://www.force-project.eu/

The monitoring of the invasive lionfish that first appeared in Curaçaoan waters in October 2009 was continued and a comparative study was done to determine whether on-going eradication efforts are successful. In cooperation with the Bonaire National Marine Park the number of lionfish was counted on Bonaire and Curacao. On Bonaire, a removal program based on volunteers using spear guns was started immediately after the first lionfish was sighted in 2009 and a similar program was started on neighboring Curaçao two years later. To determine the effectiveness of these removal efforts, differences in the density and biomass of lionfish were compared between areas from which lionfish were directly targeted during removal efforts (i.e., "fished") and areas where they were not. Lionfish biomass in fished locations on Bonaire was 2.76 times lower than in unfished areas on the same island and 4.14 times lower than on Curaçao, that was still unfished at the time of this study. While removal efforts are effective at reducing the local number of lionfish, recruitment from unfished locations, i.e., those too deep for recreational diving and at difficult to access dive sites, will continuously offset the effects of removal efforts. Nevertheless, our results show that the immediate start and subsequent continuation of local removal efforts

Juveniles of the lionfish are extremely beautiful, but small and transparent and consequently hard to spot. Photo: Steven Kovacs.

using volunteers is successful at significantly reducing the local density and biomass of invasive lionfish on small Caribbean islands. This study was published in the international scientific journal "Endangered Species Research" in 2013 (see De Leon et al. in 2.2)

Carmabi contributed to and aided with the compilation of the largest dataset ever compiled on the changes in Caribbean reef communities between 1970 and 2012, an initiative led by Dr. J. Jackson in collaboration with the Global Coral Reef Monitoring Network (GCRMN). The study takes an new approach in separating local drivers of community change to yield a more insightful perspective to ask questions like, for example, do all reefs decline equally? Where do the best Caribbean reefs occur? What local factors foremost contribute to reef decline. In the end, data for corals, macroalgae, sea urchins and fishes from a total of more than 35,000 quantitative reef surveys from 1969 to 2012 were collected and compiled. This is the largest amount of quantitative reef survey data ever compiled and greatly exceeds that used for earlier Caribbean assessments. Preliminary analyses have indicated that parts of Curaçao (Oostpunt especially) are now ranked among the best three reef systems left in the Caribbean in addition to coral reefs on Bermuda and the Flower Garden Banks (USA).

Together with a large number of international collaborators gathered within SECORE (see: www.secore.org), Carmabi actively participated in the design of new methods by which the abundance of threatened coral species can be increased around Curacao by raising the larvae of these endangered species. A marine biologist (Valerie Chamberlan[d) continue]d to work at Carmabi with external funds for another 3 years to further expand the knowledge base to further improve coral restoration techniques and better understand the earliest life stages of corals. A collaborative project with SCRIPPS Institution of Oceanography and San Diego State University (both U.S.A.) was also continued (for the 5th year) on a degraded reef near Westpunt (Curacao) to better understand the processes acting on degraded reefs that will hopefully lead to better management tools to restore these reefs.

During the coral spawning, Carmabi researchers collaborated with various US universities to investigate which factors contribute to the survival of the earliest life stages in corals. Successful survival ensures that coral reefs can basically regrow and adult corals that died due to natural or human-induced causes are replaced. Preliminary findings illustrate that both microbes and algae contribute to higher mortality and less successful settlement compared to historic baselines. It was also found that corals from the Eastpoint area produce approximately 4 times more coral larvae than corals elsewhere on the island and that these larvae (i.e., from Eastpoint) also survive and settle better. In 2013, the research team mentioned above was for the

first time able to raise and settle larvae of the pillar coral (Dendrogyra), in addition to the already existing capacity to raise and out plant larvae of the endangered *Acropora* species.

In April 2013, Carmabi researchers aided to gather information to guide management decisions on Barbuda by participating in the "Blue Halo" Initiative which was initiated by the Waitt Foundation. This Initiative is a collaborative partnership between the Barbuda Council (island government), Codrington Lagoon National Park, Barbuda Fisheries Division, the people of Barbuda, the Office of the Prime Minister of Antigua and Barbuda, and the Waitt Foundation. The goal is to manage ocean resources sustainably, resulting in more and bigger lobster, conch and fish, healthier ecosystems, improved fishing catches, and strengthened ocean-based livelihoods through zoning, implementation, monitoring, financing, and enforcement plans for the waters within 1 league (3.45 miles) of shore that are under jurisdiction of the Barbuda Council. This can accommodate a variety of activities, while supporting ecological integrity and productivity, and working to ensure sustainable fishing for future generations of Barbudans.

In August 2013, scientific director of Carmabi, Mark Vermeij, addressed Parlatino, the Latin American Parliament, in Panama-City to make a case for collective protection of the coral reefs, mangroves and sea grass areas. Vermeij was invited by Curaçao parliament representatives that want to put Curaçao on the map as knowledge center in marine biology. A model law was proposed and supported by various countries to protect the coral reefs and coastal areas in Latin and South America. This law is currently being drafted.

In the fall of 2013 Carmabi participated in a 40 person research expedition to the pristine reefs of the Southern Line Islands in the middle of the Pacific Ocean. These islands are all uninhabited and therefore ideally suited to gain insight how the composition and dynamics of coral reefs uninfluenced by direct human influences vary across natural conditions. By

Cover of the new GCRMN report showing that Curaçao ranks among the top 3 locations in the Caribbean harboring healthy Caribbean reefs.

studying the effects of natural variability in environmental factors on ecosystem processes connecting all layers of community organization (i.e., from viruses to sharks), this expedition set out to develop effective conservation targets and management strategies across natural gradients in oceanography in the absence of people. An enormous amount of data was collected and is being processed at the moment.

In 2013, Dr. Kristen Marhaver conducted her research full-time at Carmabi, with funding from the U.S. National Science Foundation and the University of California at Merced. In 2014-2015, Dr. Marhaver will be formally affiliated with Carmabi as a postdoctoral fellow and visiting scientist, with funding from a U.S. National Science Foundation Postdoctoral Research Fellowship in Ocean Sciences. In her application, Dr. Marhaver cited Curacao's healthy and accessible reefs as a major asset to her proposed research project. With this fellowship, Dr. Marhaver will be serving as a mentor and supervisor for visiting students at Carmabi while bringing in new equipment to improve the research capabilities of the laboratories.

Carmabi continued its membership on the boards of the IUCN National Committee of the Netherlands, Dutch Caribbean Nature Alliance (DCNA), the collaborative coral research network AcroporaNet, SECORE Board of Scientific Advisors, Executive Board of the Association of Marine Laboratories in the Caribbean (AMLC) and is part of the oil-spill response team on Curacao (RAC/ REMPTEIC-Carib).

Vermeij is still a topic editor for the journal Coral Reefs, the journal of the International Society for Reef Studies.

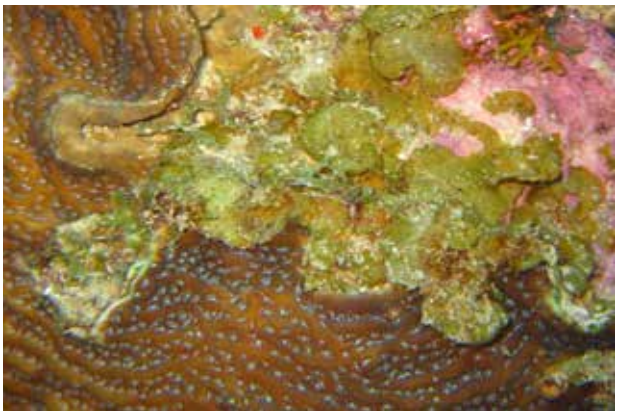
2.5 Selected research projects

Below one finds some examples of some of the projects carried out at Carmabi in 2013. 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 2011.

2.5.1 Coral-seaweed competition on the reefs of Curaçao

Mark E. Hay (School of Biology, Georgia Institute of Technology, USA), Guilherme O. Longo (School of Biology, Georgia Institute of Technology, USA, Programa de Pós-Graduação em Ecologia, Universidade Federal de Santa Catarina, Brasil)

Given the decline in coral cover and increase in macroalgal cover throughout the Caribbean, competition between seaweeds and corals has become more frequent. Seaweeds can use different strategies to compete with corals, including shading, abrasion, and producing chemical compounds that are toxic to corals. Outcomes of these interactions may vary with coral and seaweed species, resulting in variable impacts to reef structure and dynamics. Because the reefs in Curaçao still have considerable coral cover in comparison to other places



Increasingly more often corals (bottom) have to face the consequences of overgrowth by faster growing algae.

in the Caribbean, it is important to assess the frequency of coral-seaweed contacts and how they might be compromising the health of these reefs. We video recorded approximately 500 coral colonies on several reefs in Curaçao (WestPunt, Playa Largo, Port Marie, Snake Bay, Sea Aquarium) to investigate the frequency of coral-seaweed contacts, the seaweeds and corals involved, and whether corals appeared to be damaged by these contacts. We also set-out video cameras from which we can acquire data on fish densities, species composition, feeding rates and the abundance of corals and seaweed

cover at each site. Data from Curacao will be contrasted with similar data we are collecting along a latitudinal gradient from southern Brazil through the Caribbean and north to the mid-Atlantic states of the USA. Our goal is to assess how fish feeding guilds and herbivorous fish feeding patterns change geographically and how this may be related to seaweed-coral interactions. A preliminary assessment indicates that most coral colonies in Curacao are in contact with chemically rich seaweeds. For example, the lettuce coral (*Agaricia agaricites*) and the yellow pencil coral (*Madracis mirabilis*) are frequently in contact with chemically rich seaweeds such as the green alga *Halimeda opuntia* and the brown alga *Dictyota*; with a considerable portion of these contacts resulting in coral bleaching. By consuming seaweeds, herbivorous fishes and sea urchins can play an important role in decreasing the frequency and extent of coral-seaweed contacts. Thus, maintaining healthy fish communities in the reefs of Curaçao could suppress seaweeds, benefit corals, and enhance the resilience, health, and function of reefs in general.

2.5.2 What is the condition of the coral reefs in Curaçao and Bonaire?

Rolf Bak (NIOZ/ University of Amsterdam, the Netherlands)

Coral reefs are changing over time but it is difficult to say how much they are changed without knowing how they looked in the past. In Curaçao/Bonaire we run a program under the care and with support of Carmabi and other institutions (NIOZ, IMARES and University of Amsterdam) to understand the development on the reefs of the islands. Coral reefs in Curaçao/ Bonaire have been photographed for 40 years, since 1973. There are repeated photographs of the same areas of reef bottom. Together this photographic record presents the longest time series that is available on the planet and that over a great depth, ranging from 10 to 40 m. We had a total of 207 m^2 under observation but the area has been expanded in 2012 with an additional 45 m^2. The main conclusions of the analyses show that since the start of the series, in 1973/74 coral cover has dramatically

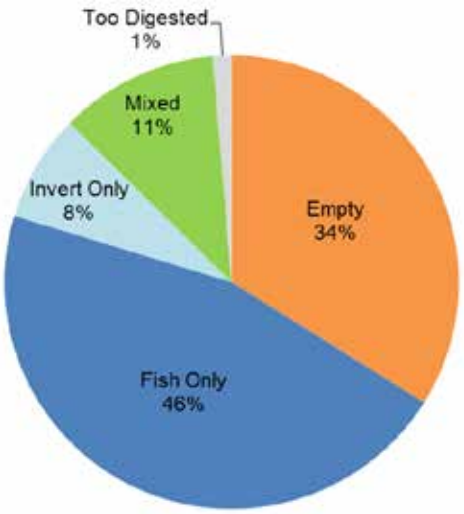
Healthy reefs are still found around Curaçao, especially near Oostpunt, the island's North Coast and Klein Curaçao.

declined, going down from up to 60% to much lower values, in some cases to only 10%. The photographs also show that coral cover is low in the last years and not changing much. There is potential for recovery because a low cover of coral is still present. However, we continue to see still a slow decline or at best unchanged low coral cover. There is an important exception; at Oostpunt Curaçao we measured the only positive development. Here we have the only site where recovery, in terms of increasing coral cover, was recorded. Positive development here is important when we realize that the Oostpunt reefs are a source of larvae of corals (and other reef organisms, fish etc.) for the whole south coast of Curaçao.

2.5.3 The diet of invasive lionfish on Curaçao and Bonaire

Fadilah Ali (University of Southampton, United Kingdom)

The invasive lionfish (*Pterois volitans*) is a venomous, voracious predator native to the Indo-Pacific Region. It's generalist diet along with



Diet composition of invasive lionfish caught on Curaçao based on more than 2000 sampled fish.

its high growth and reproductive rate has aided its successful and rapid colonization of the North Atlantic and Caribbean Region. Lionfish were first confirmed in the ABC islands in late October, 2009 and since then varying management programs have been employed in the various islands. Extensive ecology studies (mostly feeding and reproductive ecology and to a smaller extent parasitism) have been undertaken at Bonaire and Klein Bonaire but there was great interest to see how this compared to Curaçao. Furthermore, this was facilitated through a grant from the Association of Marine Laboratories of the Caribbean (AMLC) which encouraged comparisons and collaboration among AMLC institutions. To analyze sufficient specimen, I attended two lionfish tournaments and also accompanied the team from STINAPA Bonaire when they were conducting their annual lionfish density comparison between Bonaire and Curacao. From the 2026 fish analyzed in Curacao (ranging in size from 16mm to 420mm in total length) there was great general similarity to Bonaire and Klein Bonaire. Like Bonaire, lionfish in Curacao possessed a majority 'fish only' diet (see above) with the most frequently found species in their stomachs being bicolor damsel fish (*Stegastes partitus*), brown chromis (*Chromis multilineata*) and masked gobies (*Coryphopterus personatus*).

2.5.4 The effects of bats on cactus populations

Sophie Petit (University of South Australia, Australia)

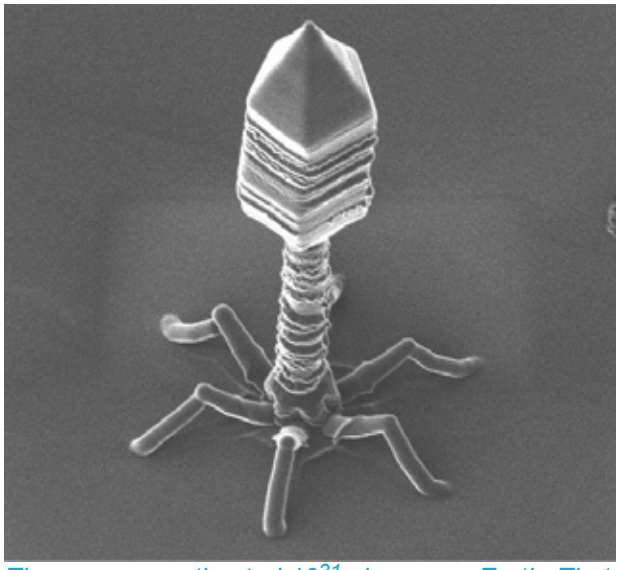
I was back on Curaçao in 2013 to continue the research that Leon Pors, Anna Rojer, and I started several years ago. 2013 was all about cactus fruits and cactus growth. Cacti provide essential resources to wildlife, including two bat species. Fruits open at maturity, so that bats may access the flesh and disperse the seeds. Thanks to Anna's meticulous work, we found out, however, that few fruits make it to maturity because of predation by birds, but we needed to determine what birds. Their impact on bat carrying capacity and cactus recruitment is likely to be significant and we will be crunching the data in the near future. We also needed to check our cactus growth rate estimates against

Cactus germlings used in Dr. Petit's experiments are awaiting translocation.

cacti of known ages. Our detective work started with the scrutiny of many old photographs at the library, and led us to track across the landscape the cacti featured on the photos. All of this exciting work will continue. We also monitored Anna's cherished cactus seedlings (the products of previous experiments) and designed a translocation experiment; it

is important to identify what factors affect cactus survival at an early age and, therefore, their establishment. The seedlings will be used for this purpose. I thank my colleagues from CARMABI and outside organizations for their wonderful support. It was another rewarding trip to Curaçao."

2.5.5 Coral versus Algae: A viral, microbial and chemical perspective



There are an estimated 10^{31} viruses on Earth. That is to say: there may be a hundred million times more viruses on Earth than there are stars in the universe.

Forest Rohwer (San Diego State University, USA)

Corals and algae compete for space on the coral reef. Human-derived stressors, like overfishing and nutrification, appear to favor algae over the corals. We are interested in learning the mechanisms by which algae can kill corals. Working in Curacao, we have developed techniques to determine most of the viruses, microbes and biologically important chemical at the interfaces between coral and algae. This work has shown that algae feeds energy to the microbes on coral surface. These microbes then overgrow the coral and kill it. This means that anything that favors more algal growth will cause bacterial blooms that negatively impact corals. Practically, this means that it is important to keep grazing fish that eat algae and stopping excessive nutrient flow onto reefs. Research in Curacao has been key to this research because of the easy access to both human-impacted reefs around the Water Factory and healthy reefs such as East Point.

2.5.6 Synchronous changes in coral chromatophore tissue density and skeletal banding as an adaptive response to environmental change

Ryanne Ardisana, Carly Miller, Mayandi Sivaguru, Bruce Fouke (Department of Geology and Institute for Genomic Biology, University of Illinois Urbana-Champaign, USA)

Corals are a key reservoir of biodiversity in coastal, shallow water tropical marine environments, and density banding in their aragonite skeletons is used as a sensitive record of paleoclimate. Therefore, the cellular response of corals to environmental change and its expression in skeletal structure is of significant importance. Recently, decimation of corals reefs has created an urgency for scientist to turn their attention to potential issues associated with global climate change and anthropogenic stressors. However, the first essential step to do this is to characterize a healthy coral. Particularly, a better understanding of the complexity of the coral holobiont, is necessary to better evaluate changes to corals because it is hypothesized that disturbing any single component of the holobiont may cause physiological changes that can result in increased susceptibility to disease or death. To effectively do this, each part of the coral must be broken apart and individualistically studied to a create a quantitative and qualitative baseline for what a healthy coral is, based of cellular density and distribution, essential for comparative standard. Chromatophores, which reside within the ectoderm of hermatypic corals, have been hypothesized to serve to both enhance the pho-

tosynthetic activity of zooxanthellae symbionts by both enabling the absorbance of the probiotic part of the short waveband and scattering and reflecting photos to enhance light supply reaching the zooxanthellae, as well as protect the coral animal from harmful UV damage from short-wavelength UV radiation. However, because chromatophores have not been intensively studied and remain not well understood, questions remain regarding the host corals ability to regulate the density of chromatophores in response to changes in water depth and photosynthetically active radiation. The goal of this experiment was to determine adaptive physiological relationship between corals, host pigment-bearing cells called chromatophores, and coral skeletons in healthy corals that can be used as a comparative standard for studying complex environmental issues affecting corals such as ocean acidification, increase in sea surface temperature, disease, and nutrient and sediment loading.

2.5.7 Healthy coral reefs disproportionately contribute to reproductive output on island-wide scales

Aaron C Hartmann (Scripps Institution of Oceanography, USA)

Visual metrics of coral health such as live coral abundance are highly valuable, yet can fail to detect ecosystem degradation until it is well underway. With coral abundance of more than twice the region-wide average, the Eastpoint region of Curaçao is one of the healthiest coral reefs remaining in the Caribbean. Given this, we used Eastpoint as a model to examine subtle physiological differences in coral health among reefs. We measured storage lipid content and reproductive output of visually healthy colonies of four species collected at Eastpoint and on "degraded" reefs near the urban center of the island. Our multi-year dataset shows that individuals from Eastpoint (of multiple species) store greater amounts of energetic lipids and can produce more than three times as many offspring as visually healthy conspecifics near the urban center. The combination of higher adult coral abundance coupled with greater per-adult fecundity suggests that Eastpoint reefs are likely a disproportionately large source of offspring on the island. Currently, plans to develop 50% of Eastpoint await government approval. Given that reef degradation has accompanied development elsewhere on Curaçao, Eastpoint will likely meet a similar fate. By revealing that visually healthy corals can differ dramatically in their reproductive output, our work highlights that more than just Eastpoint corals stand to be lost, making conservation of this area of critical importance to the island as a whole.

The Elkhorn coral (Koral kachu grandi, Acropora palmata*) was killed by an unknown disease in the early'80's. On Curaçao healthy populations can still be found.*

2.5.8 Restoration of Critically Endangered populations of the Elkhorn coral (Acropora palmata)

Valerie Chamberland (CARMABI/ University of Amsterdam, The Netherlands)

Prior to the 1980s, the Elkhorn coral (Koral kachu grandi, *Acropora palmata*) was a dominant shallow-water reef building species that provided shelter for a large variety of other reef organisms and significantly contributed to coastal

protection during storms and hurricanes. In the early 1980s their abundance declined by >95% caused by a white band disease outbreak and has remained at low densities without noticeable recovery since then. As a result, A. palmata was listed as "critically endangered" under the IUCN Red List. To facilitate this species' recovery, the SECORE Foundation, in collaboration with CARMABI and the Curaçao Sea-Aquarium, launched a restoration program in Curaçao in 2010 aimed at developing the techniques required to assist the recovery of depauperate *A. palmata* populations throughout the Caribbean. In contrast to more commonly used methods that depend on the production of offspring by fragmenting existing colonies, SECORE uses sexually produced offspring (i.e., more genetically diverse offspring) which are reared in nursery conditions at the Sea-Aquarium prior to their reintroduction to the reef. Since the beginning of this project, SECORE has succeeded in developing methods to reintroduce large numbers of offspring to the reef.

Between 2012 and 2013, SECORE carried out an experiment at the Curaçao Sea-Aquarium to investigate the following questions: (1) Do young corals grow and survive better if nursed over extended periods of time in an aquarium system compared to corals grown under natural conditions? (2) What are the cost benefits of introducing corals shortly after settlement compared to nursing them over extended periods of time? To address the aforementioned questions, two weeks old and one year old A. *palmata* were introduced to the reef in August 2012 while a third population of young corals remained in the SECORE nursery at the Curaçao Sea-Aquarium. All corals were monitored regularly for 1 ½ year and the results show that survival and growth are both greatly enhanced in natural conditions. Indeed, the corals placed on the reef after 2 weeks survived 5 times better compared to those that remained in aquaria. The individuals that were placed on the reef at the age of one year quickly increased their growth rate and were over 6 times larger and 4 times higher than their counterparts nursed in aquaria over an extended period of time. A cost-calculation exercise further showed that keeping corals in aquaria generates excessive costs which increase exponentially through time due to monthly system maintenance expenses and low coral survival. Overall, these findings indicate that when given the appropriate conditions to develop and settle, young *A. palmata* are capable of coping with natural conditions, and (2) that extended nursing periods in aquaria is sub-optimal, both from biological and financial standpoints.

Gnathophylloides mineri photographed by C. Fransen, that lives in symbiosis with a sea urchin.

2.5.9 New biodiversity records for Curaçao

Sancia van der Meij, Bastian Reijnen and Charles Fransen (Naturalis Biodiversity Center, The Netherlands)

Exploratory marine biodiversity research in the Caribbean, and Curaçao in particular, has been carried out extensively in the early and mid-20th century. These historical collections from the Dutch Caribbean (now housed in Naturalis) were generated by trawling and dredging from large research vessels, shore collecting, and to some extend by using SCUBA. In the last three decades, however, the research focus shifted

from biodiversity to ecology, behavior and conservation among others. In October-November 2013 three members of the Naturalis Marine Biodiversity Team performed fieldwork on the reefs of Curaçao investigating crabs, shrimps and mollusks living in association with various invertebrate groups. Sancia van der Meij studied coral-gall crabs, a family of small crabs that live in obligate symbiosis with stony corals. The Dutch carcinologist L.B. Holthuis recorded one species from Piscadera Baai in 1957. No other gall crab records are available for Curaçao or, in fact, any other of the Dutch Caribbean islands. During the fieldwork period at Carmabi three gall crab species were recorded from 21 different coral hosts, of which eight are new associations. One of the newly recorded gall crab species constitutes a range extension from Brazil to Curaçao. Bastian Reijnen studied gorgonians and soft corals as well as members of the gastropod family Ovulidae. Like gall crabs, most ovulid snails live in obligate symbiosis with Cnidaria. During the fieldwork possibly three new species of gorgonians were discovered, as well as new host species for a number of Atlantic Ovulidae. Charles Fransen studied a group of symbiotic shrimp, which form associations with various reef organisms such as sponges, anemones, echinoderms, sea squirts and mollusks. From Curaçao, only seven shrimp species were previously recorded in the scientific literature. The recent survey recorded a total of 25 species. The three scientists also made a submersible dive with the 'Curasub' from Substation Curaçao, exploring the deep reefs. This resulted in the second record of a shrimp species previously only known from 244-309 meters of Grand Bahama Island.

2.5.10 Bacteria alter larval behavior of corals

Kristen Marhaver (Medina Lab UC Merced (now at Penn State University, USA)).Work supported by NSF Grant#IOS1146880 – Animal Behavior

Dr. Kristen Marhaver conducted research at Carmabi on the role of bacteria in coral larval behavior and settlement. Dr. Marhaver conducted settlement trials with the principal study species (*Montastraea faveolata*) and various components of the reef benthos, including crustose coralline algae (CCA), to identify those most attractive to coral larvae and therefore most likely to harbor bacteria that would trigger changes in larval behavior. CCA species and other benthic samples that induced significant increases in larval settlement were then subjected to bacterial culturing and a bacterial isolate library was constructed. For long-term preservation, replicate glycerol stocks of these isolates are stored at Carmabi and the Medina Lab at Penn State University. Over 200 bacterial isolates were produced for the library so far with over 90% of these isolates remaining viable after storage in glycerol. These methods were repeated using the corals *Diploria labyrinthiformis* and *Favia fragum*.

M. faveolata *larva (foreground) and early-stage settlers (background) shown on the underside of a crustose coralline algae (CCA) chip that was used in settlement trials to determine which species of CCA should be subjected to bacterial culturing and bacterial strain subculturing.*

For each of the bacterial isolates, behavioral bioassays were conducted to identify those bacteria that trigger changes in larval behavior. In general, the bacteria tested had little to no effect of settlement behavior. However, in a

small number of cases, there were noticeable and measurable changes; a subset of bacterial isolates triggered increases in settlement rates, changes in swimming behavior, and/or changes in morphology in *M. faveolata* larvae. Each of these isolates was used in one to four additional trials to test for repeatability. These isolates are currently being identified with DNA sequencing (16s rDNA gene).

2.5.11 Bioeroding sponges feed on dissolved organic matter

Ben Mueller and Fleur van Duyl (Netherlands Institute for Sea Research, The Netherlands)

Sponges are important components of coral reefs. They come in various shapes and sizes, ranging from 1 mm thick sheets growing on the surface of caves to large barrel-like forms which are as large as a diver. Some other sponges, the so-called bioeroding sponges excavate themselves in corals and dead coral rock. By doing so they weaken the foundation on which the coral reef is built on and make it more vulnerable to damage by storms. Bioeroding sponges are increasing in abundance on reefs throughout the Caribbean. This increase is believed to be partly due to an increase in food availability. Sponges pump large amounts of water through their bodies and remove microbes and small algal cells from it. Apart from these particular food sources some reef sponges have been shown to take up dissolved food sources like water soluble sugars. However, little is known about the contribution of dissolved food to the diet of bioeroding sponges. Therefore, Benjamin Mueller and Dr. Fleur van Duyl of the Royal Netherlands Institute for Sea Research (NIOZ) investigated the food uptake of bioeroding sponges on Curaçao and Bonaire. They revealed that the two tested species feed mainly on dissolved organic matter and that particulate food only contributes 20% to their total food uptake. On coral reefs dissolved organic matter is mainly derived from benthic algae. Since the abundance of algae is also increasing, bioeroding sponges may benefit from an increased release of dissolved organic matter by algae.

Red bioeroding sponge growing in and out of a living coral colony.

2.5.12 Advancing development of a model system in the upside-down jellyfish

Aki Ohdera (Medina Lab UC Merced (now at Penn State University, USA))

Advancing development of a model system in the upside-down jellyfish *Cassiopea xamachana* – Ph.D. student Aki Odhera from the Medina Lab at PSU visited Carmabi in June 2013. Aki is currently developing the upside-down jellyfish *Cassiopea xamachana* into a model system for studies of symbiosis and development. In Curacao, he collected embryos and larvae from gravid female jellyfish, and successfully reared and settled jellyfish larvae in the laboratory. He also collected adult jellyfish to house in the flow-through system at Carmabi and worked on methods for culturing bacterial isolates from one source of settlement cues for this species, degrading mangrove leaves. A main goal of Aki's work is to identify culturable bacterial isolates that trigger reproducible behavioral and/or developmental responses in Casseopeia larvae. The result will be a set of two-species study systems that can be investigated in greater

depth to determine the mechanisms and consequences of animal-bacteria interactions.

2.6 Academic programs

University of Amsterdam (The Netherlands)
Petra Visser and Mark Vermeij

The 'International Excursion Tropical Marine Biology' of the University of Amsterdam visited Carmabi in January 2013 with 25 students. 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 and Valerie Chamberland. 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, 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) The effect of reef structure on reef fish abundance, (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.

Penn State University (USA)
Iliana Baums

Every year, students from rural Pennsylvania in the north-eastern US come for a week to CARMABI as part of the class "Coastal Biology". Coastal Biology is a combination lecture and intensive field course designed to introduce participants to the Caribbean coral reef biome and other near-shore environments such as rocky shores, mangroves and sea grass beds. Students learn how environmental and biological factors interact to sustain near-shore ecosystems. We discover and describe the amazing diversity of coral reef, sea grass and mangrove systems, explore the physiological and behavioral adaptations that enable organisms to live in these environments and deduct the basic ecological principles that underlie the function of near-shore ecosystems. During our trip to Curacao, students get the chance to visit healthy coral reefs, mangroves and seagrass beds that are easily accessible from shore. For many students, this is the first time they have been abroad and their trip to Curacao is the experience of a life time as evidenced by one of their quotes: "Up to this point in my college career, when people ask me what the best thing I've done at Penn State is I've always

A student from Penn State University during a course in the mangroves.

said THON [a charity event for children with cancer], which is still true. But, now I'll have sometime else to add to that: Curaçao with my BIOL 482: Coastal Biology class. This experience helped develop my science skills in the field, learn about the process of developing and submitting proposals, gain a deeper understanding of the world environment as a whole, and most importantly develop into, what I believe is, a little bit better of a person."

2.7 Research: Long term developments

Carmabi is finished upgrading its research facilities and capabilities to provide Curaçao with a modern biological station that will support and improve existing and new management strategies to safeguard 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. The new facilities will triple the amount of laboratory space previsouly available at Carmabi and provide accommodations for up to 30 people. The upgrading of Carmabi's laboratories and accommodations for visiting scientists has been made possible primarily through financial support of from the Dutch Government through the SEI initiative, the Curaçaoan Government, the Dutch Ministry of Education, Culture and Science (OCW) and Carmabi itself.

Students from different universities "on the Carmabi pier for beers on Friday afternoon.

3 PARKS AND MUSEUM

The Savonet Museum in the middle of the Christoffel Park.

3.1 General

The parks department started 2013 with a vacancy for the position of park manager. The first month the assistant manager took the responsibility for the daily management. The first of February Sabine Berendse started as the new park manager. Her primary focus was to take control of the financial situation in the department. Several efforts were made to increase the income, lower the costs and improve the procedures.

3.2. Developments toward financial stability

To heighten the amount of foreign visitors to the Carmabi parks, an advertisement was places at the airport where the international travelers wait for their luggage. On the add the slogan "Discover the other Curacao" is shown, with pictures of Christoffelpark, Shete Boka, Savonet museum and the Hato caves. It shows visitors Curacao has more to offer than white sandy beaches alone. In the luggage area Carmabi also places the folders of the parks.

To attract more visitors, Carmabi used facebook to promote the parks and the special activities. Special activities were also promoted by press releases. Different reviews were placed on the tripadvisor webpage and our activities are mentioned in the Amigoe express. Also the Christoffelpark and Savonet Museum joined the DushiVIP card promotion program and the

pick-up safari was promoted in a Dushi Deal in combination with a meal in the restaurant. In comparison to 2012 the park were promoted more.

To increase the number of visitors to the Savonet Museum a combination ticket was introduced. Visitors of the Christoffelpark are asked if they are interested in also visiting the museum. It seems a lot of people don't even know that there also is a museum, so the offering of a combination ticket is a great direct sales opportunity. Also for regular visitors we introduced the annual subscription.

To increase the additional income from the daily activities in the Christoffelpark, the selection of souvenirs offered in the shop was widened. Locally produced souvenirs, in different price ranges, are now offered in the shop where you buy your entrance ticket to the museum and the Christoffelpark. A guideline for sales prices in the shop is to put at least 40% on the purchase price. Using this guideline the Christoffelpark souvenir prices are slightly lower than other shops on the island, which makes it more attractive for visitors to buy souvenirs in our shop.

At the Christoffelpark restaurant we experimented by offering different products, to see if the dishes offered affected the turnover. We tried popular 'easy' dishes, sandwiches and local meals. Also special activities where organized in which a meal would be included in the price. The restaurant employee received a hospitality training offered by the CTB and intensive guidance on how to approach visitors. Unfortunately all efforts that were made had little effects on the restaurant sales.

To improve the financial situation of the Shete Boka National Park the entrance fee was raised from 3,- ANG to 10,- ANG for tourists on the 11th of June. The entrance fee for local residents remained 3,- ANG and the tour operators had to pay 5,- ANG from that day on. An exception was made for tour operator fun bini, because they work with long term contracts in which price agreements were made long in advance. The raising of the entrance fee improved the Shete Boka turnover significantly.

At the Shete Boka National Park additional efforts were made to attract more visitors to the park by making the entrance more visible and attractive for passer-by's, so that they are stimulated to come and visit the park. A decorative illustration was designed by Sander van Beuenkom, to match the restaurant at Shete Boka which is very popular with the visitors of the park.

Cultural events at the Savonet Museum.

The restaurant at Shete Boka used to be sublet only in the weekends. To generate more income and to give visitors a better service it was decided to sublet the restaurant completely. This ensures a steady monthly income.

Carmabi approached different suppliers of products used in the park, to compare the prices and ask for better deals. This resulted in lower purchase prices per unit.

Several companies were approached with the request to sponsor or donate materials or

The new advertisement of Carmabi's parks and museums at the airport..

money for specific projects. Jonka Tuincentrum and AON donated new working materials for the Christoffelpark. Kooyman donated paining materials for the entrance wall of Shete Boka National Park. For the painting and the design Orco Bank, Giro Bank and Avanti Financial Services donated money. And Napa donated four new tires for the Toyota landcruiser. Also the Junior ranger project was introduced at the end of 2013.

3.3. Junior Ranger program

The basic idea of the Junior Ranger project is that youngsters from neighbourhoods close to the Christoffelpark will get the opportunity to work and be educated about the different aspects of nature conservation. This will take place in weekends and during holidays. The youngsters will be supervised by experienced park rangers and nature guides. In the beginning the participants will also help with the maintenance. Depending on where their interests and talents lay, they will be trained in, for example: How to work with different tools/materials, plant life on Curacao, social skills, crime prevention training, first aid, plantation history, culture, English etc. They will be rewarded based on the hours they put into the project and their results. Besides the standard maintenance work, the participants of the "Junior Ranger project" will be involved in several studies that Carmabi currently conducting. This includes an international bat monitoring program and the mangrove reforestation project. The "Junior Ranger Project" will support the Carmabi parks and research greatly. But besides that there are also some strong benefits for the participants and their families. Banda abou, the area in which the Christoffelpark is located, is one of the poorest areas on Curacao. There is little employment and quite a few households are below the poverty line. Because the youngsters are financially rewarded, they are able to support their family. This will ensure a very strong support from the local community, which is one of the most important things to ensure the conservation of species and nature

in general.The Junior rangers will get some valuable work experience, knowledge and skills, which will help them greatly in their future careers. Companies have the opportunity to 'adopt' one of the junior rangers, by donating 5.000,- NAFL. This will ensure a yearlong participation for a ranger. So far four Junior Rangers were adopted. The MCB Bank adopted one junior ranger, the rotary adopted two rangers, and one ranger was adopted through an anonymous donation.

3.4 Christoffelpark Activities

The activities department used to offer pick up safari's every weekday at the beginning of 2013. Because very often only two people joined a pick up safari, it was decided to only offer the jeep safari three times a week as a standard activity. Monday, Wednesday and Friday. This way the number of people participating in a tour will be higher and there are less costs involved. With at least six participants, reservations can be made on other days. Besides the standard pick up safari, different activities were organized. Camping trips, sunset safari's, sunrise safari's, jungle tours, holiday plans, guided mountain climbs, bird watching tours and afternoon guided hikes.

3.5 Christoffelpark vehicle fleet

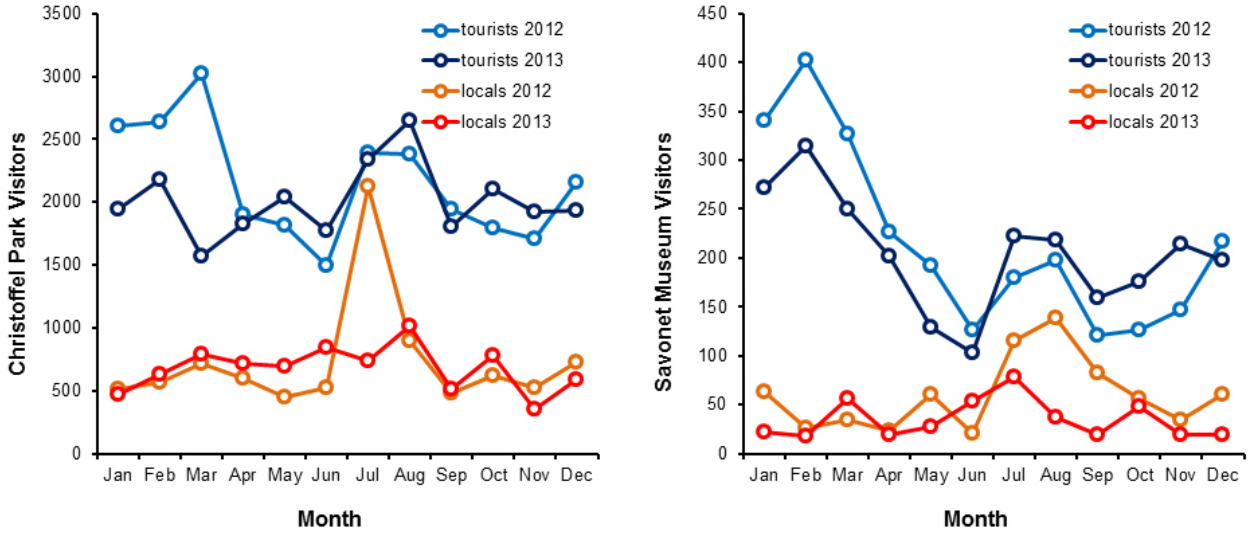
Christoffelpark started 2013 with five cars and one motorcycle. During the year one of the cars was sold and the motorcycle was stolen. The car that was sold had not worked for over a year. The Christoffelpark vehicle fleet counted four cars at the end of 2013, which is the absolute required minimum. Two of the four are really old and underwent major repairs to pass the car inspection. Both these two old cars should be replaced as soon as possible.

3.6 Park maintenance Christoffelpark

The main focus of the maintenance has been on the main road for quite some time. The main roads were fairly well maintained, but to keep them that way is a constant endeavor. The hiking trails on the north side of the park were nearly inaccessible and the hiking trails on the south side were closed to the public. During 2013 we were able to do some catching up on the overdue maintenance. The hiking trails on the north side of the park, as well as the south side of the park and the non-paved roads on the south side of the park were made accessible again, with the help of interns and the introduction of the junior ranger program. Because of this program we also were able to clean the area behind the ticket office. That was really important, because that used to be the path for the disabled visitors of the Savonet museum.. There are still some areas of great concern. The road to the top of Seru Gracia is in a very bad state, the hiking trail to the top of the Christoffel mountain is heavily eroded, the parking lot at the foot of the mountain is also badly eroded and the fence around the Christoffelpark really needs to be replaced. But these are all costly projects, for which Carmabi did not find sufficient funding in 2013.

3.7 Park maintenance Shete Boka

There were two big improvements made concerning the infrastructure of Shete Boka National Park. Fist the road to the right of the park entrance going up the first terrace has been paved. This part was heavily eroded. After we paved it, cars could enter without difficulty. Secondly the hiking trail from Boka Tabla until Boka Wandomi was repaired. With the help of CTB Carmabi was able to place to watchtowers in the Shete Boka park. One was placed at the parking lot of Boka Wandomi and the other was placed at the parking lot at Boka Kalki. CTB also made sure that the watch towers are



Visitor rates for the Christoffel Park and the Savonet Museum in 2012 and 2013.

manned with security guards during weekdays. This was a real improvement, because after that no more incidents of theft took place during the weekdays.

3.8 Park maintenance Hato Caves

Monica Vrolijk had some wishes for the maintenance of the Hato Caves. For safety reasons the cave floor was made less slippery. The renovation of the bathroom facilities and the entrance remain to be done.

3.9 Lightning strike

On the 6th of May there was a terrible storm above the Christoffelpark. A thunderbolt struck the plantation house where the Savonet Museum is located. The thunderbolt which caused great damage to the building and all the electrical devices in all the buildings surrounding the former plantation house. The top of the side wall of the plantation house collapsed, which damaged the roof on several places. The security system including the camera's, lighting in different buildings, cash registers, server, UPS's and the gates were fried. This had a great impact on the daily operations. The museum had to close for 13 days, because it wasn't safe to enter and the documentaries weren't working. It took quite a while before all the damages was assessed and necessary repairs were made.

3.10 Christoffelpark Statistics

In comparison to the first quarter of 2012 the number of tourist park visitors was lower. After the first quarter the number of tourist visitors of 2013 was comparable to the number of visitors in 2012. The number of locals that visited the Christoffelpark in 2013 was lower than the number of locals that visited in 2012.

3.11 Christoffelpark Shop Statistics

The ticket office at the Christoffelpark functions as an information center and a souvenir shop simultaneously. At the beginning of 2013 the shop was nearly empty and the assortment was rather limited. Therefore effort was put in the extension of the assortment. By offering souvenirs from different suppliers and in different price classes the chance that people will buy souvenirs in our shop was raised. At the end of May the shop was amply sorted and shop turnover enhanced in comparison to 2012.

3.12 Statistics Savonet Museum

In the first half of 2013 the number of tourists that visited the museum was somewhat disappointing in comparison to 2012. From July onward the number of visitors was slightly better than 2012 with the exception of December. The introduction of the combination ticket had a positive influence on the number of visitors to the museum. The number of local visitors to the Savonet Museum in 2013 was lower than in 2012. The content of the Savonet museum hasn't been changed since the opening. That is an important reason why local people haven't come to visit the museum again. To again appeal to locals changing expositions are planned.

3.13 Savonet Conference Center

In 2013 two events were held in the conference room, both times the room was rented by a chorus 'Orfeon Alegro'. Although the Savonet Conference Center offers a unique product compared to other conference centers on the island, with the unique historic an natural environment, it proved hard to get people interested in renting the conference facilities.

3.14 Visitors Shete Boka

Until the 11th of June there was only one entrance fee for Shete Boka. From the 11th of June there is a price differentiation between locals, tourist and visitors that come with a tour operator. There are no numbers available about the number of visitors in previous years. In comparison to the number of visitors to the Christoffelpark, the number of visitors for Shete Boka is much higher. People that visit Shete Boka are mostly tourists. Tour operators also bring a lot of people to the park, especially during the last three months of the year.

3.15 Christoffelpark preview for 2014

In 2014 efforts will be made to renovate the road up to Seru Gracia. At this time it would seem that the Dutch ministry of defense will play a major role in the renovation of this road. Digicel and UTS also stated that they were willing to help out financially. Very high on the priority list is the highly eroded parking lot at the foot of the Christoffel Mountain. We have a permit to place permeable pavement, but the costs involved with the purchase are currently

Visitors look at the Christoffel moountain, the highest point on the island..

too high. Efforts will be made to find funding for this very important project, so that hopefully the parking lot can be renewed in 2014. Designs have been made to place information boards with information about the animals that were traditionally held at the Savonet plantation. This will add value to the Christoffelpark as well as to the museum. The required permit for the consolidation of the Zevenbergen ruins was acquired, so the consolidation will take place in the first half of 2014. The Junior Rangers and the future techno school will be involved with this project.

3.16 Savonet Museum preview for 2014

In 2014 a new folder will be designed to promote the museum. We will also try to convince the tour operators to include Savonet Museum in their program. It is the intention to organize at least one temporary exposition, to attract more visitors to the museum.

3.17 Shete Boka preview for 2014

The restaurant of Shete Boka will finally be connected to the electricity. The subcontractor will then be able to give better service and to extend the offered products. In 2014 a new toilet facility will be placed at Shete Boka. This will be integrated with a new entrance building to save costs. There will be 3 restrooms for ladies, one for men, 3 urinals, and one restroom for disabled persons.

3.18 Hato Caves preview for 2014

The toilet facilities at the Hato Caves need to be renovated in 2014. There also is a very strong wish to renew the entrance of the park, but since the toilet renovation will ben a costly project, it is unlikely that both van be done in the same year.

4 NATURE AND ENVIRONMENTAL EDUCATION (NME)

The school program consists of park visits and school visits. The parks were visited by in total 52 schools. The visited parks included the Christoffelpark, Daaibooi, Kabouterbos and Shete Boka. In total 15 schools were visited for classroom teaching. The number of schools is dropping because of the clustering of schools. In 2013 in total 10,122 kids participated in the Carmabi educational program of which you find the specification below.

The Christoffelpark was visited by 4,189 students from groups 6 and 7. Shete Boka was visited by 729 students from group 8 and Daaibooi was visited by 653 students from group 8. A total of 1,319 pupils of groups 4 and 5 went to the Christoffelpark for lessons on birds and a total of 2,493 of groups 1, 2 and 3 went to the Christoffelpark for lessons on nature. 346 pupils of group 4 go to the Christoffelpark for lessons on trees.. The groups 1,2 and 3 went to the Kabouterbos previously, but this is not possible anymore because the Kabouterbos unfortunately is largely inundated by water. The bird lessons involve obtaining knowledge about our local birds in theory and by observing birds within the park. Through the school visits 393 students of group 4 were reached for lessons on "the Micro World".

In 2013 a number of preparations for the Marine Education Center (MEC) were realized. The MEC aims at balancing the education program with a marine component that has been lacking so far. The program for the MEC will exist of three parts. First the students will follow some introductory lessons on school. The school introduction is followed by a visit to Carmabi. In the auditorium the students will attend a presentation on the coral reef where the focus will be on the importance of the coral reef for the ordinary citizen. After this presentation the MEC information center will be visited. At this point in time the auditorium is ready to receive students and is equipped with an audio-visual installation. The books for the introduction lessons at school are completed as are the powerpoint presentations that will be presented during the Carmabi visit. Only the information center still has to be realized.

5 ADVISORY AND 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. Examples of some scientific reports published in 2013 are shown below:

5.1 Free advisory services

The department of advisory and consultancy services has offered free advisory services to a number of persons, entities and projects in case of small requests. Small free advisory services include: the determination of plant and animal species, information on the local flora and fauna on the island, information on seasonal patterns of the local biodiversity and information and advice on ecosystem dynamics, services and values.

In 2013 the advisory and consultancy department gave a substantial contribution to a plan to develop the mangrove area of Rif (Otrobanda) (located between the Holiday Beach Hotel and the Benny Leito swimming pool) into a mangrove park that can be used for recreational and educational purposes. Carmabi, together with Amigu di Tera and Defensa Ambiental, was approached by the owner of the local company Gold Investment Curaçao to provide advice in the realization of the mangrove park.

Aerial photograph of the mangrove area of rif (green area). The megapier and renaissance complex (top and bottom left) and the Holiday Beach Hotel & Casino (top right) are also visible in this photo.

The company is working on the development of a hotel in the direct vicinity of the area. In 2013 biologist and wetland specialist Eric Horstman MSc (PhD student University of Twente) came to Curaçao to study the mangrove area in order to gave recommendations on how to improve water circulation and prevent further silting of the area. The study of Mr. Horstman was possible through a request of Amigu di Tera and Defensa Ambiental to the Dutch Foundation Stichting ABC Advies and the co-operation of Carmabi. The resulting report (English translated title: Development of the Rif mangroves in Otrobanda; the creation of a healthy, educational and recreational city park) is now being used to guide the planning and research phases for the realization of the mangrove park. The advisory and consultancy department of Carmabi has met several times with the initiator of the project (Gold Investment Curaçao) and is involved in providing input with respect to ecological and nature management issues that come up.

5.2 Consultancy assignments

Besides offering free advice on ecology and natural resources management issues the department also sells its expertise through consultancy services. The following consultan-

cy assignments have been conducted by the department throughout 2013.

5.2.1 Bird and Bat Monitoring Playa Kanoa Wind Farm

The wind farm at Playa Kanoa was built in 1998-1999 and consisted originally of 18 wind turbines with a capacity of 0.5 MW each. In

2009 the company NuCapital took the wind farm over from DELTA Windparken N.V. (a Dutch utility company). NuCapital, the current owner of the Playa Kanoa wind farm, is also the owner of the Tera Kòrá wind farm. Since 2012 after a thorough renovation of the park, the old wind turbines were replaced with five bigger wind turbines, each with a capacity of 3 MW.

The objective of the consultancy assignment was to conduct a baseline study on the avifaunal and chiropteran presence and dynamics within the area of the wind farm in order to determine the possible impacts of the wind park on those animals. For the assessment of the possible impact of the wind farm on the avifauna of the area, a collision risk and species importance determination has been conducted for the birds.

For the analysis of the chiropteran presence within the study area an acoustic monitoring has been conducted. The sound recordings have been analyzed on genus/species-specific characteristics. This research was necessary as a condition for the fulfillment of the government permit obtained in order to install the new wind turbines and manage the wind park.

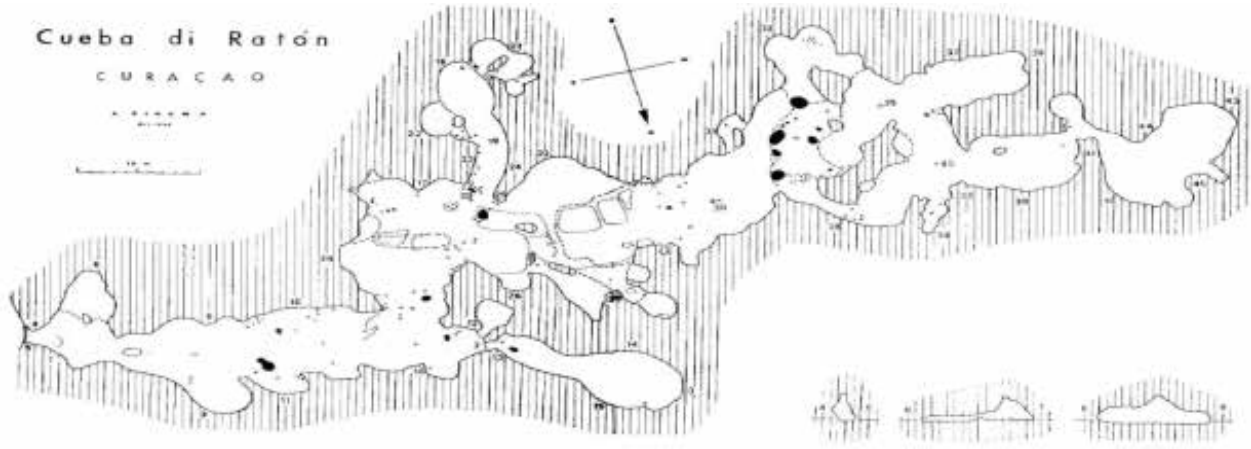
5.2.2 Bat Population Research Tera Kòrá and Playa Kanoa Wind Farm Dry Season 2013

This consultancy assignment is part of the post-construction bat & bird mortality research conducted by EcoVision. The mortality research can be seen as a follow-up assignment following the renovation of the wind farms which took place in 2012. The post-construction research study was divided into two consultancy assignments, namely one in the dry season and one in the wet season to take into account possible seasonal variations with respect to the use of the area by bats. The results of this assignment combined with the mortality study done will help to determine the real impact of the wind farms on the bat populations that use the area of the wind park.

The following research questions were addressed:

(1) Which bat species occur in the caves near the wind parks and what is their population size during the mortality research conducted by EcoVision?

(2) Which species occur in the area of the wind farms and which species occur in direct vicinity of the wind turbines?



Cave map of one of the important bat caves on the island visited for visual counting of bats. This cave is located on the Hato Plains where the Tera Kòrá wind park has been constructed.

This assignment consisted of two parts:

(1) A series of acoustic monitoring sessions on pre-fixed transects in the direct surroundings of the turbines and in areas further away from the turbines but still in the area of the wind parks.

(2) Visual bat population counts in roosting caves near the wind farms. The acoustic data has been analyzed for genus/species-specific characteristics.

5.2.3 Bat Population Research Tera Kòrá and Playa Kanoa Wind Farm Wet Season 2013/2014

This assignment is replica of the Bat Population Research Tera Kòrá and Playa Kanoa Wind Farm Dry Season 2013. The fieldwork activities were started in December 2013 and will continue until the end of January 2014.

5.2.4 Landscape ecological vegetation map of the island of St. Eustatius

Vegetation mapping at a semi-detailed scale is a very useful tool in spatial planning and nature conservation and management. The color semi-detailed landscape ecological vegetation map of the island of St. Eustatius is to be published in January 2014.

The map will be accompanied by a 60 page book in which the research and data analysis methodologies used will be described as well as the presentation of the results, discussion and conclusions. The study is the first quantitative study of the vegetation of the island since Stoffers' 1956 vegetation map of the island. Stoffers' study was largely based on qualitative data of the vegetation of the island.

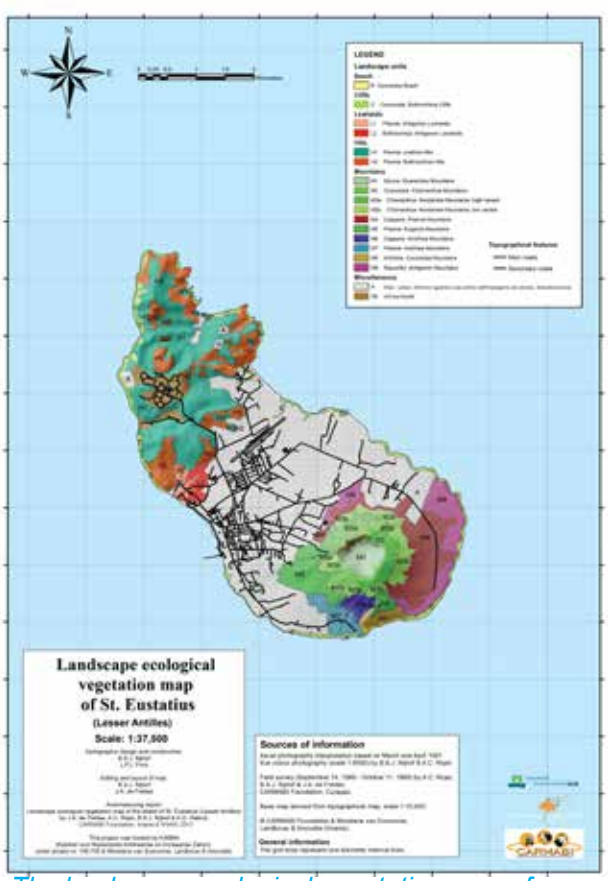
The project is a co-production of Carmabi, Imares and KNAW (Royal Netherlands Academy of Sciences). The Dutch Ministry of EL & I and the Prins Bernhard Cultuurfonds Caribisch Gebied provided the funds for the completion and publication of the map and book.
Analysis of the sampling data resulted in the distinction of 13 (semi-)natural vegetation types. Five well-developed vegetation types were found in and around the Quill and represent primary climax communities. A comparison of the vegetation types described in the present study with those of Stoffers(1956) showed that only one vegetation type closely resembles one in Stoffers' study.

Noticeable is the absence in the present study of vegetation types comparable to the valuable elfin woodland vegetation on the rim of the Quill crater and the 'Montane thickets' (Stoffers' study). We speculate that these losses may

be most directly attributable to the impact of recent hurricanes and/or grazing by introduced livestock. On the lower slopes of the Quill some regeneration has taken place (abandoned farmlands).The vegetation of the Mountains area showed some recovery since the 1950s. There were more evergreen bushes, and less Acacia and Leucaena than Stoffers described. The vegetation Stoffers described for the lowlands had more Acacia than found in the present study, but the invasive Antigonon has since dramatically increased as an ubiquitous and often dominant species. The former importance of Opuntia prickly pear cacti in disturbed vegetations has dramatically declined since the 1950s. We ascribe this to the likely effect of the invasive parasitic insect Cactoblastis cactorum (in the 1980s and 1990s).

Field data of the present study show that all wilderness areas of St. Eustatius remained heavily affected by grazers. This reduces the resilience of natural vegetations and interferes with natural succession by imparting heavy losses to hardwood seedlings and saplings, by reducing plant biomass (which increases exposure to wind and sun), and by favoring hardy invasive plant species. In Curaçao, large scale reduction in densities of feral grazers in the Christoffelpark since 1993 has led to rapid recovery of several rare plant species and vegetation types. The problem of feral livestock remains severe. Therefore the number one priority for terrestrial conservation in St. Eustatius will be to reduce feral grazer densities and impacts in key wilderness areas.

The project is a co-production of Carmabi, Imares and KNAW (Royal Netherlands Academy of Sciences). The Dutch Ministry of EL & I and the Prins Bernhard Cultuurfonds Caribisch Gebied provided the funds for the completion and publication of the map and book



The landscape ecological vegetation map of the Lesser Antillean island of St. Eustatius on a semi-detailed scale (adequate for use in spatial planning and nature management).

5.3 CITES Advices Ministry EL&I

Advices were given to the CITES Bureau of the Dutch Ministry of EL&I concerning the:

(1) Export of tissue samples of three species of sea turtles from Bonaire to the Netherlands for research purposes.
(2) Export of *Strombus gigas* tissue samples for genetic research in the Netherlands.
(3) Export of specimens of exotic *Chelonoidis carbonaira* from Bonaire to the Netherlands.

5.4 Seed germination methods for native Dutch Caribbean trees and shrubs (with emphasis on species relevant for Bonaire)

This is consultancy project that is being carried out in co-operation with Imares and Plant Research International (Wageningen University).

As a first part of this project a literature research will be done in order to gather data on the best germination methods for important indigenous trees of the ABC islands. Several indigenous tree species are known to have very low germination rates, e.g. *Bourreria succulenta* (watakeli), *Guaiacum sanctum* (wayaka shimaron) and *Zanthoxylum* spp. (bosua, kalabari). Also regional (and international) botanical centers will be approached for availability of data on best germination methods for specific tree species. Carmabi will also be carrying out experiments in order to determine the best germination methods for specific tree and shrub species. The experiments will be carried out by a student of the faculty of Tropical Forestry and Nature Management of the Van Hall Hogeschool (university of Wageningen).

5.5 Survey of the vegetation communities that occur on the limestone terraces in the central part of Bonaire ('Terrassen Landschap Midden Bonaire)

This area is considered an important conservation area of the island. Past Carmabi research ('Landscape ecological vegetation map of Bonaire') has indicated the area to contain valuable evergreen woodland vegetation. The present survey research therefore focused on the occurrences of rare and protected plant species. Bonaire has an island ordinance and accompanying resolution ('Eilandsverordening & Eilandsbesluit Natuurbeheer Bonaire') that lists a number of protected plant species. The rare plant species on the list were used as a starting point for the survey and were completed with a number of species that are considered rare on the sister island of Curaçao, but are not the list of protected plant species of the Bonaire ordinance.

Remarkable findings in the TLMB were: (1) the occurrence of a few trees of *Ficus brittonii* (mahawa, mahok di mondi) a species previously thought extinct on Bonaire, (2) the first record of *Cyrtocarpa velutinifolia* for Bonaire. This species has also been found in recent years in Curaçao, but was never found before in botanical surveys, (3) the first record of *Tillandsia balbisiana* for the ABC islands and (4) the relatively frequent occurrence in the area of the orchid *Myrmecophila humboldtii* (banana di mondi). Other rare and protected (tree) species that occur in the area are: *Amyris simplicifolia*,

Evergeen woodland vegetations in the TMLB area

Celtis igaunaea (beshi yuana), *Croton niveus*, *Guaiacum officinale* (wayaka), *G. sanctum* (wayaka shimaron) *Guapira pacurero* (macobari), *G. fragrans* , *Krugiodendron ferreum* (koubati), *Matyenus versluysii, M. tetragona, Samyda dodecandra, Schoepfia schreberi, Ximenia americana* (kashu di mondi), *Zanthoxylum monophyllum* (bosua) and *Z. flavum* (kalabari).

5.6 Sale of indigenous plants for reforestation of Klein Bonaire

On Klein Bonaire and in the Washington-Slagbaai National Park, STINAPA and Carmabi have been planting on several occasions (in

the rainy season) since 2006 nearly extinct and ecologically important native tree species. The focus in these efforts has been on rare and endangered plants on Bonaire (e.g. native palm 'kabana' and other species like *Maytenus* spp.).

With respect to the second category the selection is for native plant species that play a significant ecological role as a fruit or flower

Part of the plants brought from Carmabi ready for transportation from the wharf on Bonaire to Klein Bonaire

source for birds or other fauna (e.g. 'watakeli', 'manzaliña bobo', 'palu di huku' and 'palu di rambèshi'). These efforts can be considered successful because these and other introduced indigenous plant species ('lumbra blanku' and 'huñagatu' trees) were found reproducing (flowering and carrying fruits). These trees enrich the vegetation and produce food for endangered bird species during the dry season. In the past, the Scaly-naped Pigeon (P*atagioenas squamosa*) and the Yellow-shouldered Amazon Parrot (*Amazona barbadensis*) occurred on the island, but they have disappeared over the decades. Since the reforestation efforts ended in 2009, some Scaly-naped Pigeons have started to return to the islet. In the month of November (rainy season on the ABC islands) STINAPA bought 115 plants from Carmabi's nursery in order to continue with the reforestation of Klein Bonaire with species that are important native fruit trees in nature.

5.7 Research on use of medicinal plants by local inhabitants

For 40 years the TRAMIL study (Traditional Medicine of the Islands) has been conducted on numerous Caribbean islands and Caribbean littoral countries. The purpose of the TRAMIL research program is to identify and standardize the use of traditional medicinal herbs to promote greater use of them among the Caribbean population to alleviate strain on the health care systems of the countries and promote greater self-sufficiency of the people to handle minor medical complaints.

The present research is an initiative of Carmabi (Drs. John de Freitas) and takes place in co-operation with the Faculty of Social Sciences and-Economics of the University of Curaçao

The windblown dividivi tree (Caesalpinia coriaria) and specimens of the shrub welensali (Croton flavens). These are locally used native medicinal plants.

(Dr. Mark Hawkins, Associate professor of Research Methods).The research on Curaçao is based on the research protocol of the TRAMIL research center in the Caribbean. 107 UoC students of the Faculty of Social Sciences and Economics of the University of Curaçao made about 3,000 phone calls and five students entered the data in the SPSS Program for analysis. A total of 1249 screening question

naires has been collected. The process is currently underway to select several hundreds of the individuals called for home visits in order to collect what herbs are used and also more detailed information on preparation and usage of the plants.The study has been made possible by subsidies from the Maduro & Curiel's Bank and the Prins Bernhard Cultuurfonds Caribisch Gebied.

5.8 Reports

The Advisory and Consultancy Department furthermore produced the following reports:

Freitas, de, J. & C. de Lannoy. 2013. Inventarisatie vegetatie Terrassen Landschap Midden Bonaire (Caribisch Nederland). CARMABI Rapport. 45 pp.

Lannoy, de, C. & J. de Freitas. 2013. Bird & Bat Monitoring Survey Wind Park Playa Kanoa. CARMABI and Ecovision Report 57 pp.

Freitas, J.A. de. 2013. Herbeplanting: een conditie voor herstel in door exotische grazers verstoorde gebieden. Carmabi. 2 pp.

Lannoy, C. de & J.A. de Freitas. 2013. Populatieonderzoek grotvleermuizen van Curaçao (tussenrapportage droogseizoen (mei-augustus) 2013). 28 pp.

Lannoy, C. de. 2013. Impact mortaliteit op overleving van vleermuizensoorten op Curaçao. 4 pp.

6 ROYAL OPENING OF CARMABI'S NEW SCIENCE CENTER

On the 18th of November 2013, King Willem-Alexander of the Netherlands opened the newly built Carmabi Science Center, located on Curaçao. The opening of the science center became official after the unveiling of a special plaque, marking the occasion. The event was applauded by the Carmabi board, staff, and over 100 guests invited for the official opening.

With growing local and international interest in Carmabi and the important scientific works being done since Carmabi's origins in the 1950's, it was decided that a new science center was needed to improve the capabilities of steadfast research. Thus, the construction of the new building began in 2011 and was finished November of this year, 2013.

The recent opening of Carmabi by King Willem-Alexander follows a royal tradition stretching back to when the first stone of the Carmabi building was laid in 1955 by the late Prince Bernhard, grandfather of the present King Willem-Alexander. The second wing of the building was opened by Queen Juliana, grandmother of the current king in 1965. The mother of the King, former queen Beatrix, visited Carmabi in 1958.

On the 18th of November, the long awaited day finally arrived, and once again the royal tradition was upheld. Many public spectators dressed in orange gathered in front of the Carmabi building. The King and Queen and their entourage arrived by bus and police escort and were greeted by the President of the Carmabi Board, Peter Bongers, and Carmabi Director Paul Stokkermans. After unveiling the plaque, the King and Queen toured the building. In the library a photo exhibition was dedicated to the royal history of Carmabi. In the laboratory, Carmabi students provided information about coral larvae research and the King and Queen were invited to view different stages of coral larvae development through various microscopes. Along with the Carmabi opening, King Willem-Alexander and Queen Maxima toured the other Caribbean islands of the Kingdom including St. Maarten, Saba, St. Eustatius, Curaçao, Bonaire and Aruba for the first time as King and Queen.

Numerous other visiting researches and graduate students from around the world are found in the Science Center. On a yearly basis, Carmabi is visited by 200 students (masters and PhD) and scientists from universities abroad to do re-

search. Most students come from universities in the United States followed by universities from Europe and Australia. Visiting students and scientists usually stay for one to six months. Courses usually last a few weeks.

The newly opened four story Science Center holds a brand new state of the art laboratory, a library, multiple working spaces, and has accommodation for up to 30 guests. Kitchen and laundry facilities as well as numerous patios and balconies allow visitors to also enjoy the tropical sea side location during their visit. The ground floor contains an open space auditorium, allowing for information to flow freely between visitors and scientists in the form of meetings and

presentations. Although Carmabi has provided laboratory and accommodation facilities since 1955, the new building greatly increases Carmabi's capacity towards public outreach and supporting existing scientific investigations.

Before leaving the new research center, the King and Queen were given presents by three children of Carmabi's staff intended for their daughters, the princesses. As time passes and tropical research on Curacao continues to grow, perhaps one day the princesses will also visit to unveil the future of tropical research at the Carmabi Science Center.

The new Science Center can now be used as accommodation and research facility by visiting scientists and students. From June 2013 the facilities were open to everyone interested in staying at Carmabi for research or courses. The new building consists of four layers. The bottom houses a kitchen, a dining room which doubles as a presentation room capable of seating up to 50 people. The second floor of the 60m long building is entirely devoted to a several research labs and a library containing a large number of unique books and journals on the ecology of marine and terrestrial Caribbean ecosystems. The third layer consists of ten spacious rooms that can house up to 2 people each. The 4th and top floor consists of ten "deluxe" rooms that each have their own bathroom, shared balcony and air-conditioning. These rooms provide room for one or two people each. The large number of rooms was specifically included in the design of the new building to support large groups such as those visiting the island for courses and small conferences. The new building oversees the old Carmabi building build in 1955 and the Caribbean Sea and its construction was made possible by funds made available from the Curacao Government through the SEI program, the Dutch Ministries of ELI and OCW and Carmabi's own contribution.

7 OTHER ACTIVITIES

7.1 Bat Conservation Program of the ABC islands (PPRABC) Curaçao division

The PPRABC is the Papiamento abbreviation (Programa pa Protehá Raton di anochi di Islanan ABC) for the collaborative Bat Conservation Program of Aruba, Bonaire and Curaçao, which focuses on research, conservation and education. The Curaçao division of the PPRABC was established in May 2012. In the same month a bimonthly monitoring research in the four main bat caves of the island was started and continued in 2013.

The PPRABC Curaçao team consists of two scientific members (John de Freitas MSc MBA (biologist), and Clifford de Lannoy MSc (biologist and Island Coordinator for Curaçao) and about 30 freelance volunteers with a core volunteers group consisting of a veterinarian (Dr. Odette Doest), 2 volunteers from the VKC and 5 other volunteers working in (eco)tourism sector. Because of the fact that the research takes place during four nights in a week we regularly searching for new volunteers to have a large as possible group of volunteers that can help with this project. All volunteers were trained on all aspects related to the tasks of the baseline research (set up of mist nets, handling of bats at the net and processing table, data recording, etc.).

In 2013 the research activities concentrated on cave mist netting sessions to gather basic census data for the baseline study of the bat populations of the ABC-islands. During the mist netting sessions, data on species, gender, life stage, weight, reproductive condition, parasites and overall health condition and physical anomalies were recorded. The species of focus in the research is *Leptonycteris curasoae* species (long-tongued bat) because of its (presumed) inter-island travel. The animals of this species are tagged with a very light weight metallic ring whereby each animal receives an individual numeric sequential code. For Curaçao this numeric codes are preceded by the letters JNC. JN is an abbreviation of one of the initiators of the ABC-islands' bat conservation program (Dr. Jafet Nassar) and C represents the first letter of Curaçao. E.g. the first ringed bat on the island of Curaçao was tagged with a ring coded: JNC0001. The four caves in Curaçao that are used for the monitoring research are: Kueba di Noordkant (north-eastern part of the island),

Example of a ring on a bat's wing.

Kueba di Yèchi, Kueba di Raton (both on the Hato Plains in the central part of the island) and Kueba Bosá 3 (in the north-western part of the island).

The mist netting efforts in the four major caves of the island yielded valuable data incl. the confirmation that, individuals of *L. curasoae* species travel between Bonaire and Curaçao as well as between Bonaire and Aruba. At the end of 2013 data on 2118 bats (consisting of *Leptonycteris curasoae, Glossophaga longirostris, Mormoops megallophylla, Myotis nesopolus* and *Natalus tumidirostris*) had been collected. At the end of 2013 total of 710 *Leptonycteris curasoae* had been

ringed in Curaçao. Five of these were recaptured in the same caves (on Curaçao) in which they were originally ringed. Additionally, three *Leptonycteris curasoae* originally tagged on Bonaire were caught during the mist netting sessions in January.

Several activities were held on the island to promote bat conservation, education and in general about the work of the Curaçao division of the PPRABC in particular. The presentation at Carmabi was also aimed at obtaining more volunteers which is critical for the continuation of a successful bat research program in the caves. These efforts resulted in more publicity for the program and have yielded more than 10 new volunteers. Efforts were also made to promote more sustainable cave tourism on the island, by approaching tour operators that provide cave visits and present information on caves and bats in their itinerary. These efforts will be continued in 2014.

Impression of the nightly work involved with bat research.

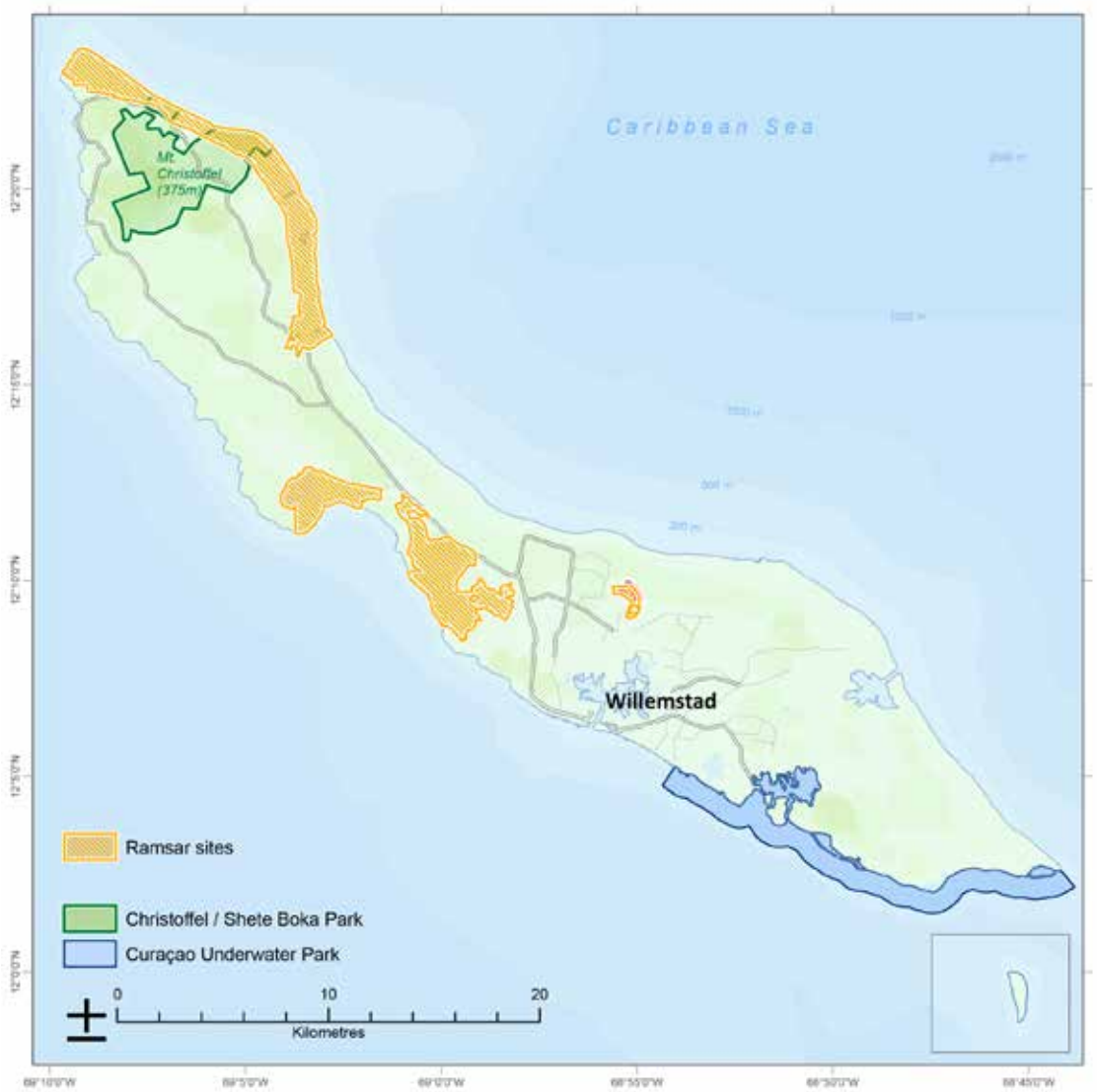
7.2 Ministry of GMN and Carmabi successful in creating protected areas on Curaçao under RAMSAR Treaty

In 2013, the marshland sites recommended by the government of Curaçao as protected areas under the Ramsar-convention, have been approved by the Ramsar-secretariat in Geneva, Switzerland. The countries that have signed this convention commit themselves to protect the marshlands (saliñas). The areas run from Malpais to St. Michiel, from Shete Boka Park to Ascencion and from Jan Kok to Rif St. Marie, and an area near Muizenberg. In addition to protect the island's local biodiversity, a local Ramsar-site aid to improve the international reputation of Curaçao.
The international agreement, the Ramsar-convention, was signed at the time of the former Netherlands Antilles. The purpose of the convention is 'conservation and wise use of all marshlands by means of local, regional and national actions and international collaboration'. Curaçao was the last of the ABC-Islands to recommend areas to be protected. Bonaire has five Ramsar protected areas and Aruba one.
The approval is the result of the efforts of Valérie Chamberland, who is working on her doctoral research at Carmabi and the University of Amsterdam, GMN-policy maker Faisal Dilrosun, research director of Carmabi, Mark Vermeij and others. Preparatory research was conducted between November 2011 and March 2012 to prepare the recommendations. This involved considering which marshlands were potentially valuable and required protection and whether such areas met the criteria for Ramsar nomination.
The team succeeded in identifying nine potential Ramsar sites. Of the nine criteria they met three to seven. If an area meets at least one of these criteria it can qualify for a Ramsar nomination. Malpais to St. Michiel meets four criteria; Jan Kok to Rif St. Marie three; Shete Boka to Ascencion five; and Muizenberg four. Another proposed area (Oostpunt) met 8 of the Ramsar criteria, but was not put forward by the government to the Ramsar office in Switzerland. These areas are very important for the water bird populations. Some areas were already nominated as 'Important Bird Area (IBA)" in 2007. These areas house over 1 percent of the

global population of one species or subspecies and for these reasons are significant. The areas are now officially installed and in the near future management plans will be developed for all these areas to ensure they remain in their current state or even improve.

The brief Annotated List site descriptions below were compiled by Ramsar's Assistant Advisor for Europe, Ms Laura Máiz-Tomé, based on the Ramsar Information Sheets.

Malpais/Sint Michiel. 05/02/2013; Curaçao; 1,100 ha; 12°10'N 069°00'W. Important Bird Area. Malpais is a former plantation just to the north of Sint Michiel. There are two freshwater lakes and the hyper-saline St. Michiel lagoon connected to a bay in which coral reefs are found, surrounded by dry deciduous vegetation and a well-developed woodland habitat. The area provides refugee for many birds, such as the IUCN Red Listed Caribbean coot (*Fulica caribaea*). The lagoon also supports a significant fraction of the global population of the Common tern (*Sterna hirundo*) and is part of a regional network of foraging sites for the Carib-



Overview of areas that receive some form of protection to safeguard plants and animals that occur in these areas..

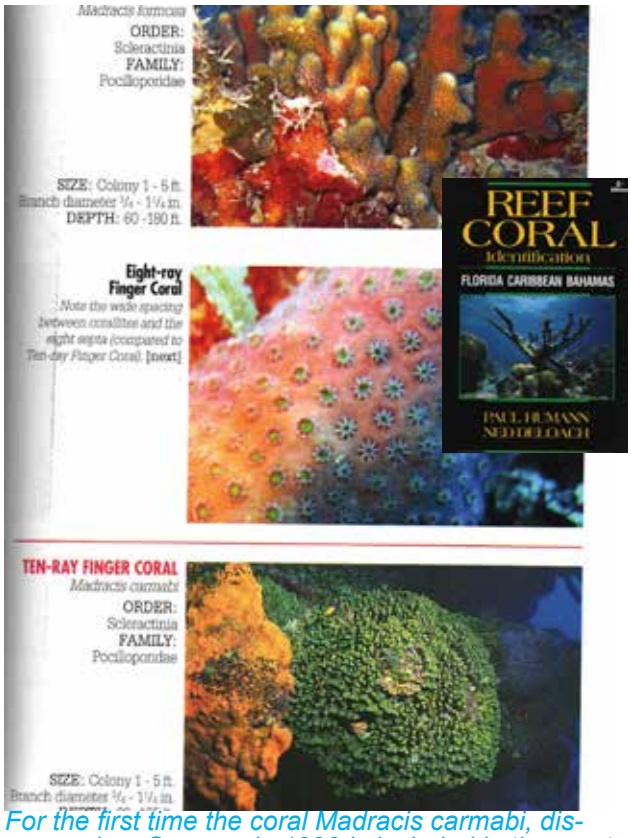
Boka Grandi situated in the Christoffel Park is now also part of the Ramsar area "Northwest Curaçao.

bean flamingo (*Phoenicopterus ruber*), protected under the Convention of Migratory Species. Freshwater is scarce in Curaçao and therefore of great ecological, social and economic value. The dam of Malpais is located downstream. Freshwater infiltrates into the soil, recharging groundwater reservoirs which allow woodlands to grow in the area. Some of the current threats which may affect the ecological character of the site are the landfill and runoff from a pig farm situated only 1km away. Ramsar Site no. 2117. Most recent RIS information: 2013.

Muizenberg. 05/02/2013; Curaçao; 65 ha; 12°09'29"N 068°55'07"W. Important Bird Area; Natural Park. Muizenberg comprises an intermittent shallow lake created by the damming of a stream that drains the surrounding low hills. Periodically inundated grassland and shrubland surround the wetland. A separate small pond, Kaya Fortuna, is situated 200m to the west. This area is internationally significant for its population of the Caribbean coot (*Fulica caribaea*), near-threatened under the IUCN Red List, and the Caribbean flamingo (*Phoenicopterus ruber*) conserved under the Convention of Migratory Species, but it also supports many other waterbirds, both residents and migrants. The Muizenberg dam was built by Shell Curaçao in 1915 to collect freshwater for industrial cooling purposes; with a capacity of 650,000 m3, it represents the largest freshwater reservoir on the island. The area was designated as a Natural Park for the improvement of the urban living conditions of the nearby population and is mainly used by hikers for recreational purposes. Illegal dumping of garbage, pollution, drainage of surrounding wetlands, and recreational disturbance are seen as the main potential threats. A general environmental education program is being implemented. Ramsar Site no. 2118. Most recent RIS information: 2013.

Northwest Curaçao. 05/02/2013; Curaçao; 2,441 ha; 12°21'11"N 069°05'00"W. Important Bird Area, Natural Parks. The area comprises a great variety of ecosystems such as coral reefs, coastal lagoons with sea grass beds and mangroves, coastal limestone terraces, inland hills supporting evergreen woodland, freshwater dams, natural springs and dry deciduous shrublands. The Ramsar site includes parts of Shete Boka and Christoffel Natural Parks. The wetland covers approximately 20 km of the rocky,

wave-exposed north coast of Curaçao, including 10 pocket beaches (bokas) and 3 inland bays that are used as nesting and foraging sites for threatened sea turtle species as *Dermochelys coriacea* and *Eretmochely imbricata*. There is also a breeding colony of more than 500 individuals of Least Tern. Moreover, the northwestern coast of Curaçao locally harbours a fringing coral reef, characterized by more than 50% coral cover and the presence of such critically endangered coral species as *Acropora palmata* and *Acropora cervicornis* as well as endangered fish species like the *Epinephelus itajara*. Some of the caves in the area were used for spiritual rituals in the past, and Indian drawings can be



For the first time the coral Madracis carmabi, discovered on Curaçao in 1999 is included in the most commonly coral identification book in the Caribbean.

found estimated to be more than 5,000 years old. Numerous man-made dams in the area retain freshwater for several months after the wet season has passed. Subterraneous groundwater reservoirs in turn sustain local vegetation types year-round which are used by several bird species, pollinating bats and mammals to survive during Curaçao's dry season. Ramsar Site no. 2119. Most Recent RIS information: 2013.

Rif-Sint Marie. 05/02/2013. Curaçao; 667 ha; 12°12'16"N 069°03'16"W. Conservation Area, Important Bird Area. The area of Rif-Sint Marie is relatively undisturbed and undeveloped and comprises a salt mash surrounded by mud flats, shrub land, and forests. The marsh is a strategic feeding habitat for flamingos and several waterbirds. The coral reef of Rif-Sint Marie is well developed and shelters several threatened coral species such as *Acropora palmata* and *Acropora cervicornis*, as well as such endangered turtle species as *Dermochelys coriacea* and *Eretmochely imbrica* and threatened fishes like Goliath grouper *Epinephelus itajara*. Dense thickets of Elkhorn coral sustain major ecological processes such as gross community calcification and nitrogen fixation; dense populations of this branching species dissipate wave energy and thus protect the coast. The area is currently used for recreational purposes like hiking, biking and guided eco-tours. The major threats to the site are uncontrolled access of visitors with dogs disturbing flamingos and potentially unwise development of touristic infrastructures in the surrounding area. Ramsar Site no. 2120. Most recent RIS information: 2013.

7.3 New study shows that lionfish removal efforts on Bonaire and Curaçao are effective

Lionfish have spread rapidly throughout the Caribbean Sea since 1985, where they negatively impact native fish communities and therefore are considered by some as the most damaging invasive species in the Caribbean to date. To combat further population growth and spread of lionfish and to protect native fish communities, various Caribbean islands have started control efforts. On Bonaire, a removal

program based on volunteers using spear guns was started immediately after the first lionfish was sighted in 2009, and a similar program was started on neighboring Curaçao 2 yr later. To determine the effectiveness of these removal efforts, differences in the density and biomass of lionfish were compared between areas in which lionfish were directly targeted during removal efforts (i.e. 'fished' areas) on Bonaire and areas where they were not (i.e. 'unfished areas') on both Bonaire and Curaçao. Lionfish biomass in fished locations on Bonaire was 2.76-fold lower than in unfished areas on the same island and 4.14-fold lower than on unfished Curaçao. While removal efforts are effective at reducing the local number of lionfish, recruitment from

Lionfish erradication in progress at Oostpunt..

unfished locations, such as those too deep for recreational diving and at dive sites that are difficult to access, will continuously offset the effects of removal efforts. Nevertheless, our results show that the immediate start and subsequent continuation of local removal efforts using volunteers is successful at significantly reducing the local density and biomass of invasive lionfish on small Caribbean islands.

7.4 Scientific Conference of the Association of Marine Laboratories of the Caribbean (AMLC)

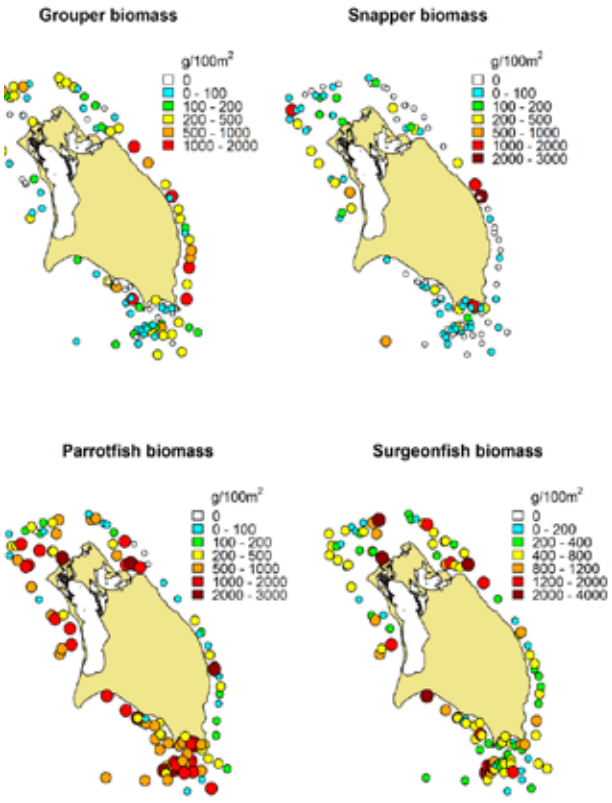
The 36th Scientific Conference of the Association of Marine Laboratories of the Caribbean (AMLC) was hosted by the Discovery Bay Marine Laboratory, University of the West Indies, in Jamaica from June 17-21, 2013. Three people working at Carmabi present their work at this conference, that will be held on Curacao in 2015. The AMLC Scientific Conference is held every 2 years and is attended by international scientists, managers, professionals, and students whose interest is focused on marine resources and the related issues relevant to the greater Caribbean region. Activities include a complete science program, poster exhibits, social events and field trips. A unique feature of this year's meeting were the two Panel Discussions that focused on themes including changing the paradigm of coastal zone management in the Caribbean, Principles of interconnectivity, the challenge of translating scientific knowledge into effective management practices, Trans-boundary marine science as a vehicle for improving International partnerships and Caribbean challenges related to Coastal Restoration. The meeting hosted a presentation by GCRMN Science Director, Jeremy Jackson discussing findings from the analysis of quantitative data of the Caribbean tied to the GCRMN and the IUCN Project:. This project's findings also pointed out that the reefs around Oostpunt are among the best three reef systems left in the Caribbean.

7.5 Blue Halo Research Expedition to Barbuda

The Barbuda Blue Halo Initiative led by Dr. A. Johnson is a collaborative partnership between the Barbuda Council (island government), Codrington Lagoon National Park, Barbuda Fisheries Division, the Office of the Prime Minister of Antigua and Barbuda, the people of Barbuda, and the Waitt Institute. The goal is to ensure sustainable, profitable and enjoyable use of ocean resources. To achieve this goal, the

Blue Halo Initiative will develop fisheries policies, ocean zoning and monitoring, financing, and enforcement plans for Barbuda's waters

To enable Blue Halo ocean management decisions to be based on the best scientific data, the Waitt Institute gathered a team of marine scientists, including two from Carmabi, to conduct a comprehensive ecological assessment of the marine resources around Barbuda. Such an assessment had never been conducted on Barbuda, and existing ecological data was limited. In April 2013, this team conducted 12 days of surveys for lobster, conch, fish, corals, and algae at 234 sites around the island, including several sites in Codrington Lagoon. They also collected water samples from around the island to assess water quality. Many of the threats facing other Caribbean island nations are present on Barbuda. Overfishing has occurred; lobster, conch, and commercially important fish species are



Maps illustrating the abundance of important fish species around Barbuda

less abundant in nearshore waters than they once were, such that fishers report needing to go further from shore and to fish in deeper water to make fishing trips worthwhile.

The total amount of live coral has declined around the island. Many other Caribbean islands have experienced similar declines in fish stocks and coral populations but failed to act; their marine ecosystems are in poor condition, their fisheries have collapsed, and recovery will be long and difficult, if recovery is possible at all (Gardner et al. 2003, Paddack et al. 2009).Our data show that some marine resources around Barbuda may be at a tipping point.
Sound, science-based management strategies have the potential to stabilize and restore marine ecosystems around Barbuda, but bold action is required soon. A report was made describing the major findings from the ecological assessment of the Barbuda Blue Halo Initiative, including maps documenting the distribution of a variety of organisms. These data allow all stakeholders to learn about and visualize the current status of their marine resources, and we hope this information will be used in the help them design a Sustainable Ocean Policy for the island. We describe the methods and results for each broad ecosystem feature that we surveyed (lobster, conch, fish, corals, and water quality), and we provide suggestions for management actions and future research that will improve the sustainability of the use of marine resources around Barbuda, enabling the ocean ecosystems to remain productive for Barbudans for years to come.

7.6 New bird identification cards for Curaçao

The Dutch Caribbean Nature Alliance (DCNA) in cooperation with CARMABI Foundation and Stichting Uniek Curaçao has developed a series of identification cards containing basic information and illustrations of bird species

Example of one of the pages in the new bird ID guides.

that occur on the island of Curaçao. A series of 3 separate ID cards were created in 2013, dividing the occurring species in Marine & Coastal species, Freshwater species and Terrestrial species. Of each bird species, illustrations are shown based on sex and/or life stage. Migratory birds and birds of special conservation interest are also indicated. A map of Curaçao, indicating the important bird areas on the island, (IBA's) is also included as part of the series of bird ID cards. These cards are available in English, Dutch and Papiamentu and are a very useful and reliable research and educational tool.

7.7 2013 Expedition: Journey to the Southern Line Islands

Based on previous work from our teams at Scripps Institution of Oceanography (UC San Diego) and San Diego State University, we began to learn about so-called 'pristine' coral reefs. Reefs without fishing have more fish (no surprise here!), more corals and calcifying organisms, fewer fleshy seaweeds and fewer microbes. In this absence of human manipulation, coral reefs appear to have tremendous capacity to thrive and rebound from disturbance. But also without human impacts, we still see quite a bit of variability in the composition and abundance of species inhabiting these coral reefs. Even in the absence of human activity, we have begun to learn that physical and chemical characteristics of the environment can have a profound influence on coral reef structure and dynamics. The five islands of the southern Line Island archipelago provide for us an invaluable natural experiment. Based on the local oceanography of the equatorial central Pacific, there is a strong gradient of water temperature and nutrient concentration across latitude. The goal of this expedition was thus to test how the

Group picture of the participants of the 2013 Southern Line Islands Expedition.

ecology of coral reefs is linked to variability in oceanographic conditions in the absence of human activities, such as fishing and pollution. Do more nutrient-rich reefs support more fish growth? More production of invertebrates? More algal growth? More microbiological growth? We know that reefs look different in

this part of the central Pacific. However, we don't really know the nature of the linkages between biology and oceanography, let alone how oceanography can drive how these reefs are structured and how they function for organisms at every level of the food web. During this month-long expedition studies were done to

Construction of the new dive facilities.

study these questions.

7.8 Start construction of new divecenter at Carmabi

In June of 2013 Carmabi partnered up with PADI 5 Star Dive Center DiveVersity Piscadera as their primary dive partner. In January of 2014 constructions started on a brand new facility which will host the dive center and allows up to 40 visiting researchers to store their dive equipment. The new facilities are due to be opened June 2014.

DiveVersity Piscadera is a dive center with an outstanding reputation. It is the first, and up to the date of writing, the only dive center on Curacao to be awarded a PADI Green Star Award for their environmental awareness efforts and is a Project Aware 100% Aware partner. In addition to their environmental efforts DiveVersity Piscadera has been selected as PADI World Wide Dive Center of the Month twice.

The dive center will and is providing all researchers, students and Carmabi staff with all their diving needs. By taking care of all logistics, training and safety precautions related to diving, they reduce the workload on researchers, students, supervisors and Carmabi staff allowing them to spend more time on their primary tasks. DiveVersity has been our partner in diving for several years. Opening a dive center on the premises of the research station was a logical next step for both parties.

8 BOARD

The Carmabi Board changed in 2013: Mr. Erwin Koense stepped down as a board member and was replaced by Mr. E. Flameling.


Peter Bongers
President


Alvin Francisco
Treasurer


Jeff Sybesma
Secretary


Edwin Flameling
Board member


Olga Lodowica
Board member

9 SPONSORS & VOLUNTEERS

Sponsors: AON, Avanti financial services, Bellevue Curaçao NV, Caribbean Nautical, Curaçao Tourism Board (CTB), European Union, Giro Bank, Go West Diving, International Union for Conservation of Nature (IUCN), Jonka Tuincentrum, Kooyman Maduro & Curiels Bank (MCB), Ministerie Gezondheid, Milieu en Natuur (GMN) Curacao, Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (BZK) Nederland, Ministerie van Onderwijs, Wetenschap en Cultuur (OCW) Nederland, NAPA, Nationale Postcode Loterij, Ontwikkelingsbank Nederlandse Antillen, Orco Bank, Percy Henriquez Fonds, Porifarma NV, Prins Bernhard Cultuurfonds Caribisch Gebied, Rabobank, Reefcare, Royal Bank of Canada (RBC), Selikor, Substation Curacao, UNESCO, Vrienden van Carmabi, World Wildlife Fund

Volunteers: Alexander Thoma, Anita de Moulin, Anna Rojer, Ans Bronneberg, Bas Bongers, Bob Snowden, Carel de Haseth, Chris Richards, Dirk Ooms, Eddy Baetens, Eric Newton, Fernando Simal, Francois van der Hoeven, Frensel Mercelina, Gerard van Buurt, Gerda Gehlen, Helma Maduro, John Dohmen, Micheal Newton, Nienke Eshuis, Odette Doest, Otto Bongers, Paul Selvaggio, Reginald Rosario, Ryan de Jongh, Thelia Lieuw Sjong, Yvonne Losano

Volunteers bat research: Adiella Adamus, Aldo Silvano, Alexander de Rooij, Andy Loefstok, Angelo Kramers, Anne van Melis, Bert Switters, Carl Vinck, Chantal van Langeveld, Chinka Olario, Chris Richards, Clifford Martina, Connor Doest, Darcy Weber, Diandra Angelica, Ferry Leenman, Gabriëlle Allee, Gilliard Bonifacio, Giselle Kraal, Jennifer Nisbeth, Jonathan Cremona, Jurmarly Angela, Kevin Maria, Kimberly Zijlstra, Luz Maria, Margaux Carmichael, Marijke Hoos, Miriam Bleeker, Odette Doest, Papito Jules, Quincy Jules, Randolph de Lannoy, Savine Boersema, Shakur Bernadina, Therese Eustatia, Ulisses Bonifacio

10 FINANCIAL OVERVIEW

	2013 ANG	2012 ANG
Assets		
Non-current assets		
Property and plant	705,637	268,079
Other fixed assets	284,103	257,229
	989,740	525,308
Current Assets		
Receivables	223,551	156,231
Stock	14,921	19,454
Cash and cash equivalents	357,248	1,016,160
	595,720	1,191,845
Total assets	1,585,460	1,717,153

	2013 ANG	2012 ANG
Equity		
Capital	106	106
Earmarked reserve	36,982	459,732
Retained earnings	605,796	181,021
	642,884	640,859
Non-current liabilities		
Non interest bearing loans and borrowings	154,000	154,000
Deferred income investment grant	9,033	-
	163,033	154,000
Current Liabilities		
Deferred income projects grant	146,989	65,128
Pension contribution payable	15,572	16,304
Taxes and social security payable	60,593	53,403
Other liabilities	556,389	787,459
	779,543	922,294
Total equity and liabilities	1,585,460	1,717,153

STATEMENT OF OPERATIONS FOR THE YEAR 2013

	2013 ANG	2012 ANG
Income		
Grants	449,467	464,700
Earmarked grants	76,218	107,355
Admission fees	894,522	680,361
Rental income	171,252	103,591
Other income	633,916	597,770
	2,225,375	1,953,777
Expenses		
Personnel expenses	1,332,756	1,343,810
Depreciation expenses	75,233	42,141
Other operating expenses	822,591	712,427
	2,230,580	2,098,378
Result for the year	(5,205)	(144,601)
Interest income	7,230	26,669
Result for the year	2,025	(117,932)

11 PERSONNEL

Board
Peter Bongers, President
Jeffrey Sybesma PhD, Secretary
Alvin Francisco, Treasurer
Edwin Flameling, Board Member
Olga Lodowica, Board Member

Patron
Professor Jaime Saleh, Former General Governor of the Netherlands Antilles

Carmabi ambassador in the Netherlands
André Cohen Henriquez

Management
Paul Stokkermans M. Sc. , Director
Mark Vermeij PhD, Deputy and Scientific Director

Research Department
Mark Vermeij PhD, Head of Department
Valerie Chamberland, M.Sc., Researcher

Parks Management Department
Sabine Berendse, Head of Department
Cyrill Kooistra, Head Ranger and Deputy Head of Department
Oswald Ricardo, Senior Ranger (Security)
Wolter Samboe, Senior Ranger (Events)
Pedro Andrea, Senior Ranger
Briand Victorina, Ranger
Roëlley Juliana, Ranger
Araceli Ersilia, Front Desk Officer
Merelyn Albertoe, Front Desk Officer
Rachel Tokaai, Assistant Events and Sales
Shudeska Eisden, Senior Assistant Restaurant
Xiomara Concetion, Janitor
On Call Staff: Alietta Cijntje (Front Desk), Sharlette Victorina (Front Desk), Mairine Djaoen (Front Desk), Sue-Shantely Lourens (Front Desk), Rivienca Albertoe (Restaurant)
Junior Rangers: Giovanni Domacassee, Jonathan Hansen, Giomar Francisco, Richandal Davelaar, Raishelon Doran, Edword Albertoe
Stagiaires: Bert Switters, Adiella Adamus

Hato Caves
Contracted to Indian Caves N.V. (Monica Vrolijk)

Nature and Environmental Education Department
Paul Stokkermans M. Sc.
Clara Schoop, Volunteer Guide Nature Education / Coördinator
Sonaly Rijnschot-Jamanika
Ruthlyne Bernadina
Arien Liberia
Charetti Jansen
Soraida Martis

Advice and Consultancy Department
John de Freitas M.Sc. Head of Department
Clifford De Lannoy, Jr. Environmental consultant

Administration Department
Ethline Isenia, Head Administration Department
Shahaira Martina, Assistant Financial Administration
Larissa Hooi-Francisca, Office Manager
Sisline Rosalia, Janitor
Rosemary Olivo Busto, Janitor
Carlos Winterdaal, Technician

Left the organization in 2013
Ingerelli Francois, Administration Assistant
Erquiles Albertus, NME

Paul Stokkermans
Director

Arien Liberia
(NME)

Sislyn Rosalia
Janitor

Ethline Isenia
Head administration

Charetti Julia Jansen
Volunteer nature education guide

Sabine Berendse
Head parks department

Carlos Winterdaal
Technician

Larissa Hooi-Francisca
Office manager

Xiomara Concetion
Janitor

Valerie Chamberland
Researcher

Soraida Martis
(NME)

Clara Schoop
Volunteer guide nature education / coördinator

Wolter Samboe
Senior Ranger (Events)

Cyrill Kooistra
Senior ranger / Deputy head parks department

John De Freitas
Head advice & consultancy

Rachel Tokaai-Redan
Assistant events and sales

Clifford De Lannoy
Jr. Environmental consultant

Oswald Ricardo
Senior Ranger (Security)

Pedro Andrea
Senior Ranger

Ruthlyne Bernadina
Volunteer nature education guide

Shahaira Martina
Financial Administration assistant

Sonaly Rijnschot-Jamanika
Volunteer nature education guide

Araceli Ersilia
Frontdesk officier

Rosemary Olivo Busto
Janitor

Merelyn Albertoe
Frontdesk officer

Shudeska Eisden
Senior assistant restaurant

Briand Victorina
Ranger

Mark Vermeij
Head research & Deputy director

Roëlley Juliana
Ranger

CARMABI


CARMABI
Caribbean Research & Management of Biodiversity