Annual report
Carmabi Foundation
2016

CARMABI
Caribbean Research & Management of Biodiversity

CARMABI Annual Report 2016
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FROM THE DIRECTOR

In 2016, the CARMABI Board of Directors was to a large extent renewed. The new Board now consists of President Tom Kok, vice president and Government Representative Kenneth Heidweiller, Secretary Richard Cardose, Treasurer Pieter van den Berg and members Edwin Flameling, Clementine Wallé and Odette Doest. We wish the new Board success and we thank the previous Board Members for their invaluable work.

Friends, associates, partners and the Government have shown considerable support in 2016 which is highly appreciated by CARMABI's Board and staff. It has made 2016 a very successful year. We would also like to thank all the volunteers involved with turtle monitoring, bird monitoring, tree nursery maintenance and terrestrial education and marine education.

CARMABI's Research Department has performed very well. In 2016 a total of 144 scientists visited CARMABI to conduct a wide variety of research projects. Additionally, 88 students participated in the various courses taught at CARMABI. In total, 30 scientific studies were published based on work done at CARMABI. More scientific insight in the ecological processes shaping Curacao's reefs is essential for improving existing and new strategies to ensure the long-term survival of these unique assets of our island.

The Parks Department worked hard to protect nature and promote tourism. A total of 42,058 people visited the Christoffel National Park in 2016, an increase of 6.6% compared to 2015. The total number of visitors to Shete Boka National Park amounted to 82,622 in 2016, a reduction of 1.1% compared to 2015.

Our Nature and Environment Education Department is responsible for the Terrestrial and Marine Educational Programs for primary school children. The Terrestrial Program consists of tours related to the flora and fauna in the Christoffel National Park and in the areas of Daaibooi and the Shete Boka National Park. The Marine Educational Program consists of lectures about the coral reefs, interactive exercises and a visit to CARMABI's Marine Education Center. In 2016, a total of 9,081 school children participated in CARMABI's Educational Program. Both programs were organized by 12 volunteers. In addition to educational programs, this department also visits schools and gives lectures and tours on various topics to high school students.

What do we expect for 2017? On the 2nd of March 2017, a cooperation agreement was signed by CARMABI, The Curaçao Marine Research Center (CMRC) and the Government of Curaçao. A total amount of ANG 8,730,266 has been granted to CARMABI (ANG 3,823,000) and the CMRC (ANG 4,907,266) to upgrade their research infrastructure to further promote Curaçao as an island specialized in marine biological sciences. This project is scheduled for completion by the end of 2019. Carmabi will use these funds for the renovation of the old CARMABI building, construction of a pier, renovation of the wet laboratory (building with aquaria for research purposes), the purchase of a boat and 2 vehicles, purchase of laboratory equipment and of an automated system for monitoring water quality. It is clear that 2017 will be a busy year.

Paul Stokkermans
Director – CARMABI

1. MISSION, VISION AND HISTORY

Mission

Contribute to the sustainable development and management of the natural resources of the former Netherlands Antilles through research, nature management and environmental education.

Vision

Be a leading organization in the Caribbean on applied natural sciences by means of knowledge acquisition, knowledge dispersal and nature management applications, to support the sustainable development of nature.

Short history

CARMABI was founded as a marine biological research station in 1955. His Royal Highness, the late Prince Bernhard of the Netherlands, laid the first stone of the institute. From the start, aside from research, applied nature conservation and education were also important areas of activity brought together in 1962 under the allied National Parks Foundation of the Netherlands Antilles (better known as STINAPA).

In 1996 CARMABI and STINAPA merged into one organization, the Caribbean Research and Management of Biodiversity Foundation, better known under the original acronym CARMABI.

Today CARMABI provides facilities and logistical support to upwards of 200 visiting researchers and graduate students per year, manages nine protected areas on Curacao (the largest of which is the 2300 hectare Christoffel National Park) and runs an educational program reaching about 12,000 school children per year.

2. PARKS AND MUSEUM

3.1 General

The Parks Department had a mixed year in 2016. There was a small increase (6%) of visitors in the Christoffel National Park, but a decrease (17%) at the Savonet Museum and in the number of visitors at the Shete Boka National Park (1%). The decrease in visitors at the Museum and Shete Boka National Park likely reflects the overall decrease of 5.6% stay-over visitors according to the Curaçao Tourism Board (CTB) statistics for 2016 (source: www.curacao.com). However, February, March, July and August 2016 were the best months if we look at the number of people visiting the Christoffel National Park in 2016.

3.2 Visitor statistics

3.2.1 Christoffel National Park

In 2016, a total of 42,058 people visited the Christoffel National Park, while in 2015, this was a total of 39,453 people, an increase of 6.6%, likely caused by the increase of tour operators visiting the Park. We are also proud to report that the number of visitors of 42,058 in 2016, included 11,262 local visitors. In the Christoffel National Park, visitors have the option to join different activities such as jeep safari's, mountain hikes, moon and deer- and bird spotting tours.

We had a total of 2,270 participants of activities in 2016 and a total of 1,687 participants in 2015. Although there was a small dip in the number of activities in February, April, May and October, we managed to achieve a nice result and an increase of activities of 34%. Much marketing effort was put into increasing the activities in collaboration with the Curacao Tourism Bureau (CTB), social media and flyers at hotels and other accommodations.

3.2.2 Savonet Museum

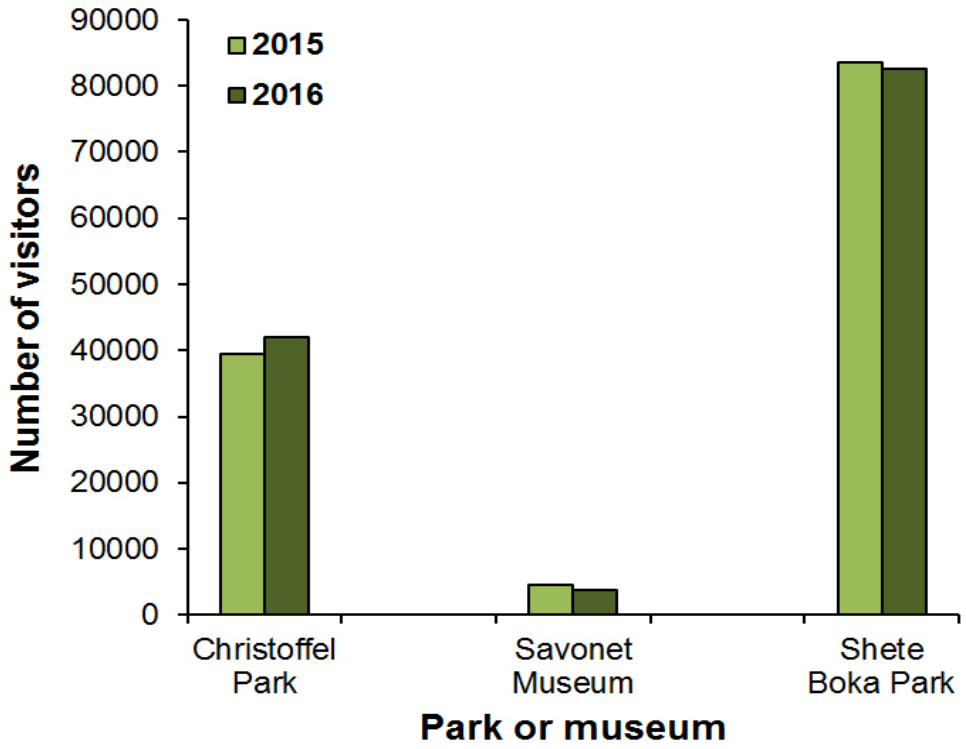
Although much effort was put into promoting the museum (e.g., lowering the entry price and organizing an open day for Savonet and the Museum), there was a 17% decrease in the number of visitors to the Savonet Museum (3,710) compared to 2015 (4,493 visitors).

3.2.3 Shete National Boka

A total of 82,622 people visited the Shete Boka National Park in 2016, compared to 83,576 people in 2015. This is a slight decrease of 954 visitors and in percentage terms represents a fall of 1 % compared to 2015. This number includes the tour buses that visit Shete Boka National Park.

3.2.4 Exposition dedicated to the sea turtles

An exposition about sea turtles, organized in collaboration with the CARMABI Sea Turtle Monitoring Project, started in May in the conference room of the Savonet Museum. By organizing this exposition and



Visitor numbers for the two parks and Savonet museum for 2015 and 2016

combining it with the museum, it was projected to increase the percentage of visitation for 2016. This was not the case, although much marketing energy went into attracting extra visitors by Dushi Deals and updating the Facebook pages.

3.3 Personnel

3.3.1 Learning and development

Ivensley Iltes and Adrion Plantijn participated in the Junior Ranger Program in 2016. The idea behind this program is to train the youth of Bándabou. During the program, they learn about different aspects of nature conservation, responsibilities, and about supplying information to guests of the park. They are guided by Senior Rangers. In addition, we welcomed youngsters from an employment oriented school in Barber Joseph Civilis to do a 2 week on the job training program with the rangers to improve their working skills.

3.3.2 Staff training

A "mystery guest" visited the park to investigate the client service experience. The results have been recorded in a report in June 2016. The overall assessment based on the experiences of mystery guests during their visits over a 3-week timeframe were positive. The employees were client friendly and service minded towards clients.

3.3.3 Staff changes

Two employees, Jurwin Rifaela and Gregory Kasteneer have left the organization. Humphrey Janzen and Dominique Adriaens were hired to replace them.

3.4 Preview for 2017

In 2017, Head of the Parks Department, Sabine Berendse, has decided to leave our organization to dedicate her time and energy to the Sea Turtle Monitoring Project. We welcomed Dominique Adriaens as our new Park Manager as of the 1st of April 2017. We wish them both all the best.

3. NATURE AND ENVIRONMENTAL EDUCATION (NME)

4.1 Educational Programs

The CARMABI Nature and Environment Program (NME) consists of two programs, the Terrestrial Education Program (TEP) and the Marine Education Program (MEP). The TEP includes guided tours within the parks managed by CARMABI and the MEP consists of presentations, interactive exercises and a visit to the CARMABI's Marine Education Center (MEC). A total of 33 schools participated in the educational programs of the Nature and Environment Education Department (NME). The parks visited were Christoffel National Park, Daaibooi and Shete Boka National Park. For the marine program, 14 schools visited the Marine Education Center at Piscadera. In 2016, a total of 9,081 school children participated in the CARMABI educational program. This is a 24% decrease compared to the figures for 2015, when 12,041 school children visited the park. The decrease is partly explained by financial budget cuts. The NME department therefore set a maximum number of schools that could visit the park with the funds received from the Ministry of Health Environment and Nature. Additionally, the schools were offered other excursions for example Exhibit George Maduro and other events involving different celebrations and awareness programs. The last months of 2016 were very rainy, therefore many excursions to the park were cancelled or rescheduled. Fortunately, many schools still consider their visit to the parks important and have it in their compulsory school curriculum.

4.1.1 Terrestrial Education Program

A total of 8,112 school children from 4 to 12 years old visited the Christoffel National Park throughout the year. The activities in the park are focused on different themes such as our local birds, trees, plants, reptiles, agriculture, man-made wells and ruins. Shete Boka National Park was visited by 942 school children from Group 8 (between 11 and 14 years old), which was a decrease compared to last year when 1,155 students visited this area. The decrease of visits was caused by bad weather conditions.

The younger school children (1,377) from Group 1 and 2 visited the parks as an introduction to the natural world around them during the so-called "Mondi Misterioso/ Nos Mondi" activity. The aim of this activity is to teach the children to be more caring for nature in a playful way by recognizing different flora and fauna. A total of 936 children of Group 4 went to the Christoffel National Park for lessons on birds. The bird lessons involved obtaining knowledge about our local birds in theory and through observing birds within the park. A total of 939 children from Group 5 visited Christoffel National Park to learn more about our trees and plants. They also got the opportunity to

practice recognizing trees and plants in the park. Lessons on wells,
agriculture and ruins in the area of Savonet and Zorgvliet in the Christoffel National Park, were visited by 2,059 school children of Groups 6 and 7. All the lessons for Groups 4 up to 8 included a small test. The grade on the test is sometimes part of their school report card for the lessons of "Kennis der Natuur (KDN)".

The Reptile Species Program for Group 3, introduced last year, was a success so it is now a part of the terrestrial program. A total of 1,236 school children visited Christoffel National Park and received information on the different species of reptiles of Curaçao. In addition to this, another program was added to the reptile program, the Sea Turtle Exhibit was set to be temporary but because of its great educational value it is now semi-permanent and it has become a part of the terrestrial program for Group 2. This was done especially for the schools which now have a separate Group 2. The program for the pupils belonging to Group 2 starts with a story told by a Guide about the adventures of Zola the sea turtle. Afterwards they enter the exhibit room and the Guide explains the life of a sea turtle (birth, food, threats) making sure to link the story of Zola to the exhibit. A total of 380 schoolchildren visited the Sea turtle exhibition at Savonet. Because of the interactive character of the program the schoolchildren continue to talk about the adventures of Zola.

4.1.2 Marine Education Program

The Marine Education Center (MEC) has become more and more popular. Due to lack of funds we had to limit the number of school visits. In 2016, 969 schoolchildren visited the Marine Education Center and received in depth information about coral reefs and sharks. The program for the Marine Education Program (MEP) consists of the following:
1. The school children follow some introductory lessons in school with their teacher.
2. The teacher receives a book beforehand and a teacher's guide on the Coral Reef Ecosystem from CARMABI.
3. This is followed by a visit to CARMABI Piscadera, where the children attend a presentation in the Auditorium on the coral reef ecosystem. The focus is on the importance of the coral reef for the island's citizens.
4. After this presentation, the children take a test and the group is divided in two.

The first group attends a presentation about sharks, while the other group visits the MEC, where they can see what they have learned. The MEC is an exhibition room offering a unique view to the underwater world. The MEC consists of three sections. The first section is the reception area, where a photo exhibition can be seen. The second section is about marine life in general. This part shows interesting things that can be seen under water.

Also, a coral skeleton collection is on exhibit and information about "Oostpunt" is provided. In the third part, different research groups exhibit their research; sea turtle monitoring, deep sea research, coral larvae, marine geology of Curaçao, medicine research, mangrove project, information on sharks and underwater research instruments and tools. During the tour through the MEC, the school children sit and watch a video about the importance of the coral reef and coral spawning. They can ask questions and walk around on their own. After the shark presentation, the children take another test and then swap with the group that visited MEC. The activity is organized in this way due to the fact that a maximum of 15 people is allowed in the MEC at one time because of its capacity and safety reasons.

4.2 Save Our Shark (SOS) Project

Sharks have roamed our oceans since before the time of dinosaurs. Worldwide, over 100 million sharks are killed every year as a result of fishing and shark finning activities. Sharks are being driven to the brink of extinction by human ignorance and greed. Most of the sharks in the Netherlands are not found in the North Sea, but in the waters of the Dutch Caribbean. Over thirty species of sharks and rays, from tiger to bull sharks and from the hammerhead to nurse sharks, frequent the coral reefs and coastal waters of Bonaire, Curaçao, Saba and the Saba Bank, St. Eustatius and St.

Maarten.
The Dutch Caribbean Nature Alliance (DCNA) has received funding from the Dutch Postcode Lottery (Nationale Postcode Loterij) to run a three-year project entitled "Save Our Sharks". The objective of this project is to work with local fishermen, scientists and local communities to put an end to the slaughter of sharks in the Dutch Caribbean and to encourage islanders to benefit from their presence as a valuable tourism asset.

The following concrete results are expected from the execution of the project:
- Substantial popular support for shark conservation
- Complete ban on commercial and targeting fishing for sharks
- Establishment of sanctuaries as safe havens for sharks
The organizations involved in this project are:
- Board of the Dutch Caribbean Nature Alliance (DCNA)
- Saba Conservation Foundation
- St. Maarten Nature Foundation
- STENAPA
- STINAPA, Bonaire
- Arikok National Park Foundation
- CARMABI

An overview of activities executed by CARMABI within the framework of this project so far are:
- Shark exhibition in the CARMABI Marine Education Center
- Information and presentation to regular schools on shark conservation
- Information and presentation in an afternoon school program on shark conservation
- Information on shark conservation to all visitors of the Marine Education Center
- Distribution of the book "Shark Stanley"; a book funded by The PEW Charitable Trust
- Organizing activities during Shark Week which ran from June 18th - June 26th, 2016
- Save our Sharks Rare Pride Survey with the local population regarding its perception of sharks
- Assisting Vroege Vogels film crew from Holland with filming the program with focus on sharks.

4.3 Other educational activities

Apart from the regular terrestrial and marine program the Nature and Environment department also worked on the following activities in 2016:

1. Assisting students from different secondary schools with their exam projects, students from Radulphus College, KAP, ISC and MIL on different themes such as: coral reef, coral spawning, mangroves, lion fish, geology and water pollution;

2. Assisting schoolchildren with preparation for school lectures regarding nature themes for example, mangroves, sea turtle and sharks;

3. Visited Radulphus College with Master students from University of Amsterdam to give information about Marine Biology studies and research activities;

4. Organized activities for evening school students and educational themed birthday parties on the subjects of coral reef and sharks;

5. Participated in Student and Career Fair at World Trade Center November 11th with a CARMABI stand giving future students information about studying (marine) biology and
working at CARMABI as park ranger. At the same time, we conducted Save Our Sharks survey among the visitors (pictures can be seen in chapter 6.13);

6. Participated at volunteer's event from Maduro & Curiel's Bank (MCB) on December 18th, giving information to the public about sharks, trees, coral restoration and conducting Save Our Sharks survey during the 100 years' anniversary celebration of the MCB bank. On this day, we also sold local plants and recruited new volunteers for different activities for CARMABI.

4. SCIENTIFIC RESEARCH

2.1 Visiting scientists

A total of 144 scientists visited CARMABI in 2016. In addition, 88 students participated in Coral Reef Ecology courses and workshops delivered by CARMABI and various universities from the Netherlands, Surinam, and the United States. The number of visiting scientists and students in 2016 illustrates a continued positive trend of increasing visitors after the official opening of the new Science Center in 2013 (Figure 1a). The majority of scientists visiting in 2015 were from the United States (49%) followed by the Netherlands (31%). Almost all of the scientists and students that worked at CARMABI stayed at the newly constructed laboratory/ dormitory facilities and the average duration of stays increased significantly in 2016, resulting

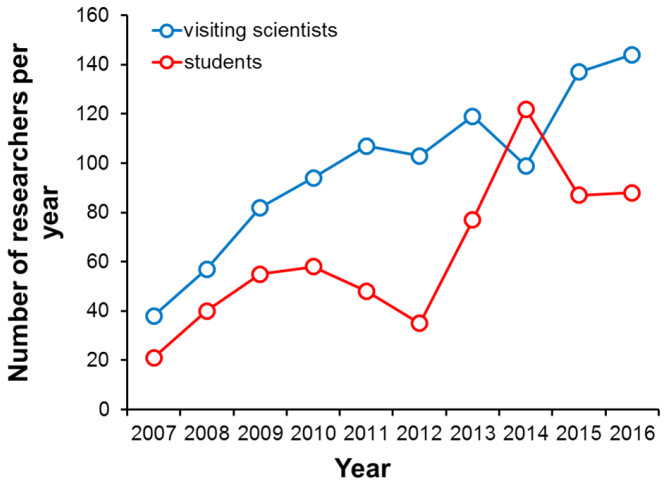


Figure 1a. Increase in reserachers visiting Carmabi between 2007 and 2016

in a total of 6827 (2015: 6536, 2014: 4256) personal working days (i.e. one visiting scientist working one day); this also signals an upward trend over the last few years, i.e., 2013 (4226), 2012 (4329), 2011 (3752) and 2010 (1767 days). The occupation of the new science center increased to 58% (2015: 54%, 2014: 47%, 2013: 28%). An overview of the areas in which all researchers that visited or worked at CARMABI were active is shown in Figure 1b. (See list in appendix A2.).

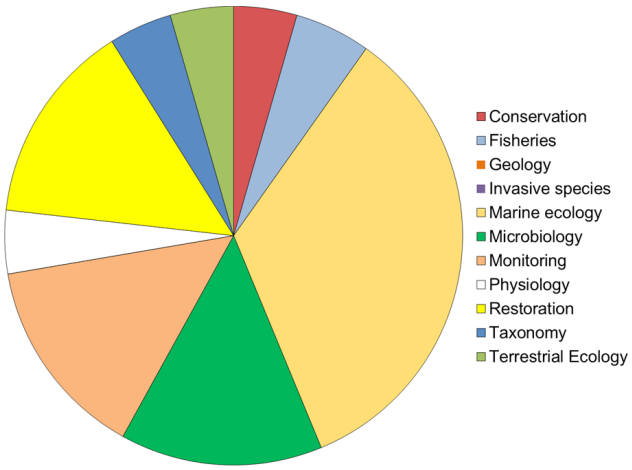


Figure 1b. Areas of expertise of visiting researchers in 2016

2.2 Peer reviewed scientific publications

Thirty publications appeared in peer reviewed scientific journals based on work that was conducted at CARMABI. This makes 2016 one of the most productive years ever in terms of CARMABI's scientific output (Figure 2). The results of some of these studies have been featured in magazines, news programs and educational websites around the world. Furthermore, 22 reports were produced by MSc. students who did

their Master's thesis projects at CARMABI.

An overview of all peer reviewed scientific publications accepted for publication or published in 2016 is shown below:

Barnes DKA, Neutel AM (2016) Severity of seabed spatial competition decreases towards the poles. Current Biology 26.8: R317-R318.

Bernal MA, Floeter SR, Gaither MR, Longo GO, Morais R, Ferreira CE, Vermeij MJA, Rocha LA. High prevalence of dermal parasites among coral reef fishes of Curaçao. Marine Biodiversity 46(1):67-74.

Böhm T, Hoeksema BW (2016) Habitat selection of the coral-dwelling spinyhead blenny, *Acanthemblemaria spinosa*. Marine Biodiversity: 1-9.

Brinkmann BW, Fransen CH (2016) Identification of a new stony coral host for the anemone shrimp *Periclimenes rathbunae* Schmitt, 1924 with notes on the host–use pattern. Contrib Zool. 85:437-56.

Chamberland VF, Petersen D, Latijnhouwers K, Snowden S, Mueller B, Vermeij MJA (2016) Four-year-old Caribbean *Acropora* colonies reared from field-collected gametes are sexually mature. Bulletin of Marine Science 92: 263-264.

Chamberland VF, Snowden S, Marhaver KL, Petersen D, Vermeij MJA (2016) The reproductive biology and early life ecology of a common Caribbean brain coral, *Diploria labyrinthiformis* (Scleractinia: Faviinae). Coral Reefs: 1-12.

Condor-Lujan B, Klautau M (2016) Nicola gen. nov. with redescription of *Nicola tetela* (Borojevic & Peixinho, 1976)(Porifera: Calcarea: Calcinea: Clathrinida). Zootaxa 3:230-238.

Cummings SL, Barbé D, Leao TF, Korobeynikov A, Engene N, Glukhov E, Gerwick WH, Gerwick L (2016) A novel uncultured heterotrophic bacterial associate of the cyanobacterium *Moorea producens* JHB. BMC microbiology 16(1):198.

De Bakker DM, Meesters EH, Bak RPM, Nieuwland G, van Duyl FC (2016) Long-term shifts in coral communities on shallow to deep reef slopes of Curaçao and Bonaire: Are there any winners? Frontiers in Marine Science 3: 24.

de Freitas J, Rojer AC, Nijhof BS, Debrot AO (2016) A landscape ecological vegetation map of Saba (Lesser Antilles). IMARES.

Dornburg A, Lippi C, Federman S, Moore JA, Warren DL, Iglesias TL, Brandley MC, Watkins-Colwell GJ, Lamb AD, Jones A (2016) Disentangling the influence of urbanization and invasion on endemic geckos in tropical biodiversity hot spots: a case study of P*hyllodactylus martini* (Squamata: Phyllodactylidae) along an Urban Gradient in Curaçao. Bulletin of the Peabody Museum of Natural History 57(2):147-64.

Frade PR, Roll K, Bergauer K, Herndl GJ (2016) Archaeal and bacterial communities associated with the surface mucus of caribbean corals differ in their degree of host specificity and community turnover over reefs. PloS one, 11(1).

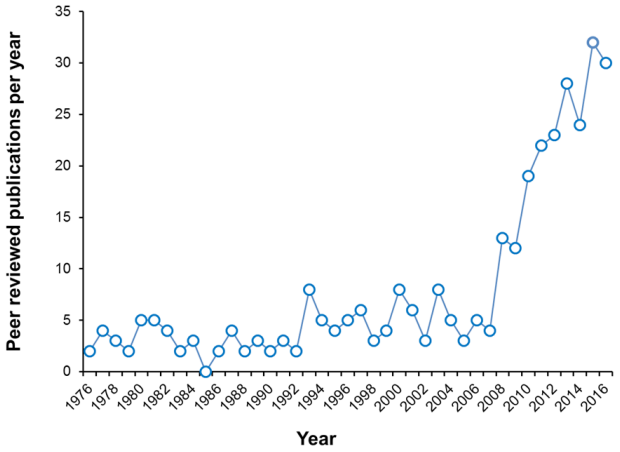


Figure 2. Research outpunt in terms of peer reviewed papers through time

Frade PR, Schwaninger V, Glasl B, Sintes E, Hill RW, Simó R, Herndl GJ (2016) Dimethylsulfoniopropionate in corals and its interrelations with bacterial assemblages in coral surface mucus. Environmental Chemistry 13(2):252-65.

Glasl B, Herndl GJ, Frade PR (2016) The microbiome of coral surface mucus has a key role in mediating holobiont health and survival upon disturbance. The ISME journal 10: 2280-2292.

Hoeksema BW, Bongaerts P, Baldwin CC (2016) High coral cover at lower mesophotic depths: a dense *Agaricia* community at the leeward side of Curaçao, Dutch Caribbean. Marine Biodiversity: 1-4.

Hoeksema BW, Hove HA (2016) The invasive sun coral *Tubastraea coccinea* hosting a native Christmas tree worm at Curaçao, Dutch Caribbean. Marine Biodiversity, 1-7.

Knowles B, Silveira CB, Bailey BA, Barott K, Brainard R, Cantu A, Cobián- Güemes AG, Coutinho FH, Dinsdale E, Felts B, Furby KA, George EE, Green KT, Gregoracci G, Haas AF, Haggerty JM, Hester ER, Hisakawa NG, Kelly LW, Lim YW, Little M, Luque A, McDole-Somera T, McNair K, Quistad SD, Robinett NL, Sala E, Salamon P, Sanchez SE, Sandin S, Silva GGZ, Smith J, Sullivan C, Thompson C, Vermeij MJA, Youle M, Young C, Zgliczynski B, Edwards RA, Nulton J, Thompson F, Rohwer F (2016) Piggyback-the-Winner: Lytic to Temperate Switching of Viral Communities. Nature 531: 466-470.

Lillis A, Bohnenstiehl D, Peters JW, Eggleston D (2016) Variation in habitat soundscape characteristics influences settlement of a reef-building coral. PeerJ 4: e2557.

Miller M, Williams DE, Huntington BE, Piniak GA, Vermeij MJA (2016) Decadal comparison of a diminishing coral community: a case study using demographics to advance inferences of community status. PeerJ 4: e1643.

Mueller B, den Haan J, Visser PM, Vermeij MJA. van Duyl FC (2016) Effect of light and nutrient availability on the release of dissolved organic carbon (DOC) by Caribbean turf algae. Scientific Reports: 6.

Potkamp G, Vermeij MJA, Hoeksema BW (2016) Host-dependent variation in density of corallivorous snails (Coralliophila spp.) at Curaçao, southern Caribbean. Marine Biodiversity: 1-9.

Quinn RA, Vermeij MJA, Hartmann AC, d'Auriac IG, Benler S, Haas A, Quistad SD, Lim YW, Little M, Zgliczynski B, Sandin SA, Smith JE, Dorrestein P, Rohwer F (2016) Metabolomics of reef benthic interactions reveals a bioactive lipid involved in coral defence. Proc. R. Soc. B. 283. No. 1829.

Rogers A, Lorenzen K (2016) Does slow and variable recovery of Diadema antillarum on Caribbean forereefs reflect density-dependent habitat selection? Frontiers in Marine Science3: 63.

Salcedo-Sanz S, Cuadra L, Vermeij MJA (2016) A review of computational intelligence techniques in coral reefs-related applications. Ecological Informatics 32: 107-123.

Steingrover R, Illidge S, Martina C, Virginia-Cova L, Vermeij MJA (2016) Detection and analysis of antibiotic resistance in coliform bacteria in caribbean coastal water. Open Forum Infectious Diseases Vol. 3, No. suppl 1, p. 704. Oxford University Press.

Sumrall JB, Larson EB, Mylroie JE. Dolomite caves within the Seroe Domi Formation on Curacao, Netherland Antilles. Acta Carsologica. 45(1).

Swierts T, Vermeij MJA (2016). Competitive interactions between corals and turf algae depend on coral colony form. PeerJ 4: e1984. .

van der Meij SET, Nieman AM (2016) Old and new DNA unweave the phylogenetic position of the eastern Atlantic gall crab *Detocarcinus balssi* (Monod,) (Decapoda: Cryptochiridae). Journal of Zoological Systematics and Evolutionary Research.

van Tienderen KM, van der Meij SET. (2016) Occurrence patterns of coral-dwelling gall crabs (Cryptochiridae) over depth intervals in the Caribbean. PeerJ 4: e1794.

Wells JV, Wells AC. The significance of Bonaire, Netherlands Antilles, as a breeding site for terns and plovers (2016) Journal of Caribbean Ornithology 19(1):21-6.

2.3 Free advice, outreach and consultation

During the year, several organizations, Government departments, the press and others received free advice and information from the CARMABI Science Department. We assisted in 214 cases, both oral and written (2015: 184, 2014: 157, 2013: 111, 2012: 72). In 2016, the CARMABI Science Department was featured and/or interviewed in 152 times (2015: 144, 2014: 167, 2013: 86, 2012: 57) and in 175 international (known) items for local TV, radio and newspapers

5. ADVISORY AND CONSULTANCY SERVICES

5.1 General

Besides managing parks and conducting marine and terrestrial research, CARMABI also provides advisory and consultancy services delivered by our experts, such as environmental impact assessments, reforestation with indigenous plant species, conducts different types of surveys, develops nature management plans and reviews and much more. In 2016, the Advisory and Consultancy Department did various consultancies for (semi) government organizations and the private sector.

5.2 Native tree nursery

Significant efforts were devoted to the continued upgrading of the tree nursery and further research into the germination and propagation (through cuttings) of several indigenous tree and shrub species. Three students from the HAS Hogeschool of Den Bosch in The Netherlands (Tim van den Hurk, Evelyn Beckers and Dide Starmans) performed germination trials with a number of tree species as part of their internship at CARMABI. Some of the trials with the cuttings were also carried out in the mist room at Vivian's Nursery.

5.3 Consultancies

In 2016, just like in the previous four years, John de Freitas participated in meetings aimed at advancing the idea to develop the mangrove area of Rif (Otrabanda) into a sustainable educational and recreational park. This year the Ministry of Traffic, Transportation and Spatial Planning (VVRP) has taken several concrete steps to realize this project. A project team was set up by the VVRP ministry to work towards the realization of this project: the specifications, and cutlery drawings were made and put out to public tender.

In April, John de Freitas was invited by the Aruban nature foundation Stimaruba to make several public presentations as part of their project 'Expedicion Rescate' in which the Cultural Department of Aruba also participated. This project consisted of an exposition on four important gullies and their surrounding hills in the Arikok National Park, excursions and presentations by Rene Rosalia (role of dams in the landscape) and John de Freitas. The presentation by John de Freitas focused on the status of the terrestrial nature of Aruba and possibilities to improve its condition. The presentations by John de Freitas included public talks as well as interviews and presentations on television and radio stations.

Smaller activities included provision of advices to the ministry VVRP in the process of issuing installation permits, relevant information on indigenous Sabal palm to a US Sabal palm researcher, information on the mangrove Rif project and ecosystem to an international medical entomologist visiting Curaçao upon invitation of the Curaçao government, sale of vegetation map books to Caribbean libraries and help to local secondary school students in the selection and content of small research projects as part of their school curriculum.

Consultancies were done for the Ministry of EL&I (the Netherlands), Ministry of Defence (the Netherlands) and (semi-) governmental organizations.

6. OTHER ACTIVITIES

6.1 Cooperation agreement between the Curaçao government, Curaçao Marine Research Center (CMRC) and CARMABI

On March 2nd, 2017, a Cooperation Agreement was signed for the purpose of further improving the conditions for conducting marine biological research in Curaçao. The agreement was signed between the Government of Curaçao, the Curaçao Marine Research Center (CMRC) and CARMABI and followed from an earlier decision of the Council of Ministers dated 26th of November 2014.

The Government was represented by the Minister of Traffic, Transport and Urban Planning, Mrs. Susanne Camelia-Römer and the Minister of Health, Environment and Nature, Mrs. Zita Jesus-Leito. CARMABI was represented by its Director Paul Stokkermans and its Deputy Director Dr. Mark Vermeij. CMRC was represented by its Director Adriaan (Dutch) Schrier. The signing took place in Fort Amsterdam in the building of the Council of Ministers and was followed by a press conference.

A total sum of ANG 8,730,266 was made available to improve the research infrastructure at CARMABI and the CMRC. This project should be completed by the end of 2019. CARMABI will use the resources allocated for the renovation of the old CARMABI building, the renovation of a pier, the renovation of the wet laboratory (a building with aquaria for research purposes), the purchase of a boat and 2 vehicles, the purchase of laboratory equipment and the purchase of an automated system for monitoring water quality. The CMRC will implement similar projects. A cooperation protocol will be signed by the CMRC and CARMABI at the beginning of 2017. Both CMRC and CARMABI conduct marine biological research on Curacao, though fields of expertise differ between the two organizations. The research at the CMRC focuses on taxonomic studies of deeper reef habitats whereas research at CARMABI studies the ecology of shallow water reef communities.

6.2 Meeting with DCNA 2016 on Saba and Curaçao

CARMABI is a member of the Dutch Caribbean Nature Alliance (DCNA). The directors of the park organizations of the 6 Dutch Caribbean islands are Board members of the DCNA. The office of the DCNA is located in Bonaire. The objective of the DCNA is to safeguard the biodiversity and promote the sustainable management of the natural resources of the islands of the Dutch Caribbean, both on land and in the water, for the benefit of present and future generations, by supporting and assisting the protected area management organizations and nature conservation activities in the Dutch Caribbean. Furthermore, the DCNA manages a trust fund. This trust fund is funded by donors such as the Dutch Postcode Lottery and the Ministry of the Interior and Kingdom Relations. The purpose of the trust fund is to provide core funding to cover the operational costs of the designated marine protected area (marine nature park) and the designated terrestrial protected area (land nature park) on each of the islands of the Dutch Caribbean.

The DCNA holds two Board meetings every calendar year. In 2016, the meetings were held on 5th to 7th of April in St. Maarten and on 24th to 26th of October in Bonaire. Both meetings were attended by CARMABI's Director Paul Stokkermans, who is also Treasurer of the DCNA Board. A special Board meeting was held on 10th to 12th of February in Bonaire. The Sint Maarten meeting focused, inter alia, on the future role

of the DCNA. The decisions made during the Special Board meeting held in Bonaire in February were reviewed. Furthermore, the Trust Fund Committee report and Finance Committee report were presented. President Glenn Thode resigned and Tadzio Bervoets was appointed as acting president.

During the meeting in Bonaire it was decided that the DCNA 2017 budget be reduced. This was necessary because of the end to the funding of the DCNA by the Ministry of Internal Affairs and Kingdom relations in 2017. Treasurer Paul Stokkermans was asked to compile the new reduced budget. During both meetings, the progress made by the Save Our Sharks (SOS) project was discussed. The Save Our Sharks project is an important three-year project which is funded by the Postcode Lottery in Holland. The budget component which will be spent on the six Dutch Caribbean islands amounts to nearly 1 million Euros. The project focuses on research, the involvement of the local communities and fishermen.

6.3 Visit of French Military to the Christoffel National Park

The French Military group took the opportunity to visit the Parks at Bándabou for their annual training. They were very thankful for the collaboration between themselves and CARMABI and gave a good service reference presented by Mr. Cyrill Kooistra (Cyrill Kooistra, Head Ranger and Deputy Head of Department).

6.4 Visit by the former Director of CARMABI

On the 22nd of February 2016, CARMABI was visited by its former Director, Mr. Walter (Wotty) Bakhuis, who was accompanied by his brother Ed Bakhuis. They were shown around by the current Director of CARMABI, Mr. Paul Stokkermans.

6.5 Get together with the new Board of CARMABI

On Friday, the 19th of August 2016, a small get together with the new Board members of CARMABI and the employees was organized at Land house Savonet. The chairman of the Board, Mr. Tom Kok,

held a speech to encourage all employees and to keep up the good work that has been achieved throughout the years. It was a great event where members of the Board had the opportunity to get to know the employees of CARMABI and vice versa. All departments were well represented at the event and there were also some volunteers who came along.

Board members attending were Mr. Tom Kok (President), Mr. Kenneth Heidweiller (Vice President and Government Representative), Mr. Richard Cardose (Secretary), Mr. Pieter van den Berg (Treasurer) and members Edwin Flameling, Clementine Wallé and Odette Doest.

6.6 Safety measures by the rangers

During the rainy season, the Park's rangers were working hard to keep the roads accessible to the visitors and most importantly keep it safe for both visitors and employees of CARMABI itself.

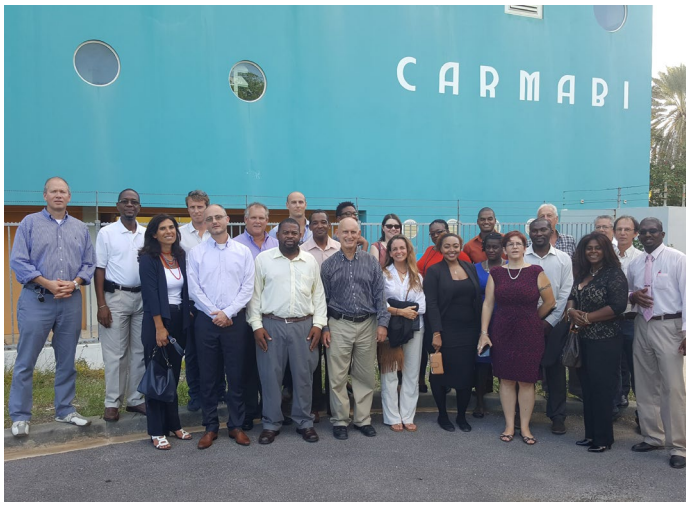
6.7 Dia di Sabaneta

Dia di Sabaneta was held on Sunday August 14th, 2016. It took place at Landhouse Savonet. It was a great event with different stands where one had the opportunity to buy food, drinks or locally made handcraft. The day was filled with music, a nice local dance group and speeches from Mr. Paul Stokkermans (CARMABI's Director), Mr. Echi Cijntje, and from the Prime Minister of Curaçao, Mr. Ben Whiteman.
At that event, Sea Turtle Conservation Curacao was also present and they provided information about the CARMABI's Sea Turtle Conservation Curaçao project. It was in all, a very pleasant day for everybody to enjoy.

6.8 DCNA meeting with Governor of St. Maarten

On the 24th of February 2016, a meeting with Governor Holiday of St. Maarten took place at the office of the Dutch Caribbean Nature Alliance (DCNA) in Bonaire. CARMABI's Director and Treasurer of the DCNA, Mr. Paul Stokkermans, was also present.

6.9 Overseas Countries and Territories (OCT) conference



In September 2016, a conference of the Overseas Countries and Territories (OCT) of the European Union took place in Curaçao. As part of the conference the participants visited CARMABI on the 15th of September for a tour, guided by the Director of CARMABI, Mr. Paul Stokkermans.

6.10 RBC donation

On the photo, a Royal Bank of Canada (RBC) cheque worth $767 was handed over to the Director of CARMABI, Paul Stokkermans, on the 2nd of November 2016. This donation of the RBC to CARMABI is part of the Bank's Blue Water Project.

6.11 Ban selebr'é 100 100

The local bank, Maduro & Curiel's Bank (MCB) recently celebrated on December 18th their 100 years of existence. As a true local financial institution, they wanted to celebrate this memorable moment with the whole community of Curaçao. During this event, the streets and squares in downtown Punda and Otrobanda were transformed into a genuine event venue, freely accessible to everyone, with live music from local and international artists, spectacular entertainment, delicious food and drinks. CARMABI was approached to also take part in this event, where we were well represented by the Advisory and Consultancy Services Department with plants fresh out of our own nursery and providing additional information on the local plants. The Education Department was also present, and they were afforded the opportunity to disseminate questionnaires on measuring the knowledge of the local population on sharks. They also took this opportunity, just as the Sea Turtle Conservation Curaçao, to show their ongoing activities and to provide additional and educational information to the visitors of this event.

6.12 Plantation bell for Savonet

Recently an old plantation bell was donated to the Savonet Museum. Mr. Nanno Nommensen found this bell in the Zevenberg area at the end of the 1960's. He took the bell to The Netherlands, but decided to donate it to CARMABI when he heard that there was a museum in the Landhuis Savonet. From there onwards, the bell can be seen in the Savonet Museum. This bell is a typical cast iron bell from the 19th Century. CARMABI and Christoffel National Park thanks Mr. Nanno Nommensen for the gesture of returning the bell, and Mr. Jacco van den Berg (in the Netherlands) and Mr. Cor Mons (in Curaçao) for transporting this bell free of charge.

6.13 Curaçao Study and job fair

During the month of November, the Education department of CARMABI was approached to take part during this year's study and job fair. This was a three day event held at the World Trade Center (WTC) in Curaçao and where student of different schools had to opportunity to get aquainted with the CARMABI as organization and also they were given the opportunity to know more about what the job possibilities are in such organization. A lot of questions and vacancies and jobs opportunities were asked and clear answers were given in hope to inspire and push these student to not only pursue a job in the scientific direction, but also increase awareness to take care and love our nature.

6.13 Annual Christmas Dinner

On Saturday 17th of December 2016, CARMABI had its yearly Christmas dinner for all the employees and volunteers. A total of 68 people attended this event and also 6 members of CARMABI's Board were present at the event. The dinner took place at Restaurant Fusions in Salina, where a delicious buffet was prepared for all attendees.

A fun raffle took place where all attendees participated, a Birthday song was sang dedicated to one of the employees, and it was nicely decorated by the Marketing team with some fun Christmas-props and Christmas hats, where all had the opportunity to take pictures. The Christmas dinner 2016 was a great event.

7. FINANCIAL OVERVIEW

BALANCE SHEET AS OF DECEMBER 31, 2016
(after proposal of result appropration)

	2016	2015
	ANG	ANG
Assets		
Non-current assets		
Property, plant and equipment	955,543	976,989
Other fixed assets	347,392	388,022
	1,302,935	1,365,011
Current Assets		
Receivables	253,147	244,072
Stock	18,462	20,194
Cash and cash equivalents	504,976	489,642
	776,585	753,908
Total assets	2,079,520	2,118,919

	2016	2015
	ANG	ANG
Equity and liabilities		
Equity		
Capital	106	106
Earmarked reserve	0	11,267
Retained earnings	1,230,481	1,035,491
	1,230,587	1,046,864
Non-current liabilities		
Non interest bearing loans and borrowings	154,000	154,000
Deferred income investment grants	243,877	262,453
	397,877	416,453
Current Liabilities		
Deferred income project grants	240,809	228,621
Pension contribution payable	12,450	-82
Taxes and social security payable	50,875	41,615
Other liabilities	146,922	385,448
	451,056	655,602
Total equity and liabilities	2,079,520	2,118,919

STATEMENT OF OPERATIONS FOR THE YEAR 2016

	2016	Budget 2016	2015
	ANG	ANG	ANG
Income			
Grants	607,686	449,100	607,723
Earmarked grants	81,552	10,000	(2,992)
Admission fees	1,230,564	1,229,400	1,232,730
Rental income	231,131	251,056	225,589
Other income	467,251	715,000	456,064
	2,618,184	2,654,556	2,519,114
Expenses			
Personnel expenses	1,384,502	1,373,755	1,239,149
Depreciation expenses	110,329	121,860	99,184
Other operating expenses	948,024	1,139,149	923,403
	2,442,855	2,634,764	2,261,736
Result for the year	175,329	19,792	257,378
Interest income	8,394	4,237	4,425
Result for the year	183,723	24,029	261,803
Appropriation for the year			
Retained earnings	183,723		261,803
	183,723		261,803

8. BOARD OF 2016

Mr. Tom Kok
President

Mr. Kenneth Heidweiller
Vice president
Government's Representative

Mr. Richard Cardose
Secretary

Mr. Pieter van den Berg
Treasurer

Ms. Odette Doest
Member

Mrs. Clementine Wallé
Member

Mr. Edwin Flameling
Member

9. PERSONNEL

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 Research Department
John de Freitas M.Sc.
Valerie Chamberland, M.Sc., Research Scientist
Ard Vreugdenhil, Coordinator sea turtle project

Parks Management Department
Sabine Berendse, Head of Department
Dominique Adriaens, former Ranger/ Head of Department since 2017
Cyrill Kooistra, Head Ranger and Deputy Head of Department
Rachel Tokaai, Assistant Events and Sales
Humphrey Janzen, Senior Ranger
Briand Victorina, Ranger
Melvin Martinez Estevez, Ranger
Argelijn Cijntje, Ranger
Edwords Alberto, Ranger
Araceli Ersilia, Front Desk Officer
Sharlette Victorina, Front Desk Officer
Merelyn Albertoe, Front Desk Officer
Xiomara Concetion, Janitor

Marketing and Communication
Thessa Fleming, Head of Department until January 2016
Eunice Cijntje, Head of Department since February 2016

Nature and Environmental Education Department
Angela Richardson, Head of Department

Advice and Consultancy Department
John de Freitas M.Sc., Head of Department
Bastiaan Vermonden, Junior Environmental Consultant

Administration Department
Ethline Isenia, Head of Administration Department
Shahaira Martina, Financial Assistant
Larissa Hooi-Fransisca, Administrative Assistant until May, 2016
Roxanne Martina-Martis, Administrative Assistant since August 2016
Rosemary Olivo Busto, Janitor
Magda Inees, Janitor
Carlos Winterdaal, Technician

Left the organization in 2016
Thessa Fleming, Head of Marketing and Communication Department
Emma Alves, Marine Education Center (MEC)
Larissa Hooi-Fransisca, Administrative Assistant
Sue-Endrich Sluis, Junior Ranger

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

SPECIAL THANKS TO THE VOLUNTEERS OF CARMABI

Volunteers Terrestrial Education Program (TEP):
Arien Liberia
Clarette (Retty) Schoop - Coordinator
Charetty Jansen
Sonaly (Naly) Rijnschot
Ruthline (Ruth) Bernadina
Ruthsella Statius

Marine Education Program (MEP):
Angelique Kok
Cees van Houten - Coordinator
Emma Alves
Jonathan Estanista
Sabrine Tapoka
Tessa van de Zande

On-Call Personnel of Savonet:
Alietta Cijntje (Front Desk)
Giovanni Domacassee (Ranger)
Jonathan Hansen (Ranger)
Ronadyne LaCruz (Front Desk)
Richard Davelaar (Cleaning Shete Boka)
Sharlette Victorina (Front Desk)
Sue-Shantely Lourens (Front Desk)

Junior Rangers:
Connie Mingeli
Haydelson Lourens
Vurgell Cijntje

10 . SPONSORSHIPS, PARTNERS AND SUPPORTERS

Partners, Sponsors, Supporters and Donations:

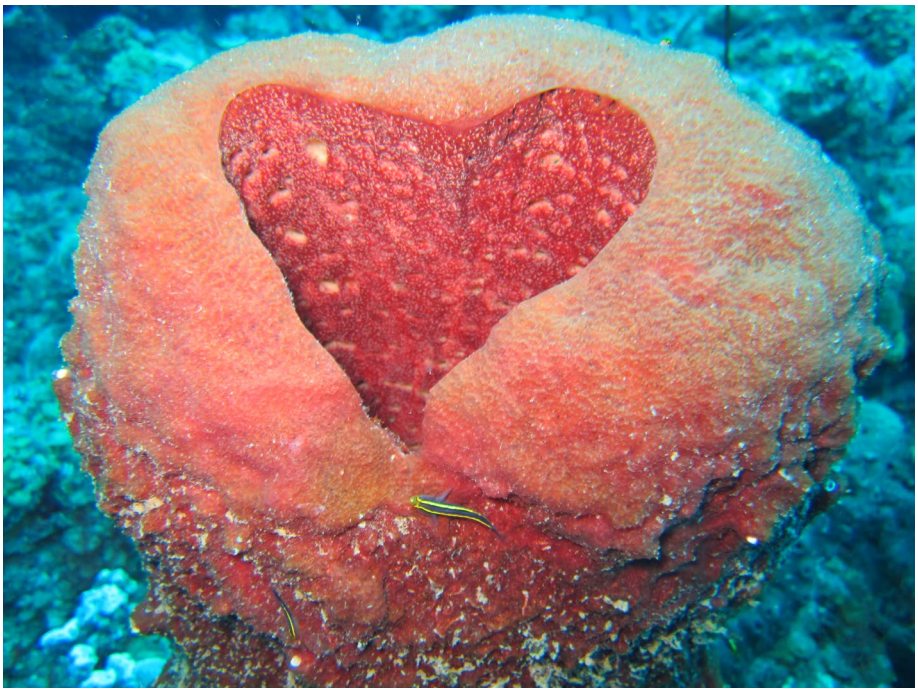
A. Maduro, Barbados Sea Turtle Project, Bellavue Curaçao, BirdsCaribbean, Blue Bay Resort, Carla Daniel (BSTP), Christof, CITRO, CMTC Community Service Foundation, Coastguard, Coca-Cola, Curacao Actief, Curacao Clean Up, CuraDoet,Darren Browne (BSTP), Dutch Caribbean Nature Alliance, Elise Benedictus (DCNA), Emeray Martha-Neuman (DCNA), Familie Finies, F.E. Perret-Gentil, Flip Sluiter, Gielmon Egbrechts (STCB), H. Schepers, IMARES, J. Kwidama, Jeroen Pauw, Julia Horrocks (BSTP), Jurjan van der Zee (RUG), Kailani boattrips, Kalli de Meyer (DCNA), Karen Eckert (WIDECAST), Kim Russel, Kompa Leon Green, Kon. Ned. Akademisch Encology Funds, Kooyman BV, Korpodeko, Lisa Becking (INMARES – WUR), L. Sedney, M. Jonis, Mabel Nava (STCB), Maduro & Curiels Bank (MCB), Marjolijn Christianen (RUG), Mermaid boattrips, Ministery of GMN, Miss Ann boattrips, MRC Rental, Postcode Lotterij - Save Our Sharks, Rijksuniversiteit Groningen, RBC Royal Bank, Rotary Club, Piscadera Harbour Village, St. Percy Henriquez Fonds, St. Prins Bernhard Cultuurfonds Caribisch Gebied, Sea Turtle Conservation Bonaire, Sue Willis (STCB), TRAMIL, Uniek Curacao, Uitgeverij Amigoe, Vivian's Nursery, WIDECAST.

Volunteers Bird Monitoring:

Ans Bronneberg, Robyn Fidanque, Annette de França, Elisabeth van de Kar, Jeltje Maduro, and Eric Newton.
Volunteers Nursery:
Grace Best, Peter van den Broek, Mirella Christiaan, Roger van Daalen, Colin Engels, Sandra Felicia, Filomena Kleinmoedig, Gwendolin Martina, Ingrid Profas, and Frans van Schaik

Volunteers Sea Turtle Conservation Curaçao:

Alyn Kuiper, Andrew Thode, Angela Richardson, Annelies Stoll, Annemieke Klaarbergen, Ard Vreugdenhil, Arjan Vreugdenhil, Babette van Ravenswaaij, Bas Bongers, Bastiaan Vermonden, Briand Victorina, Connie Mingeli, Corinne Senior, Dirk Meij, Edwords Albertoe, Ergelyn Cijntje, Finn Simonetti, Frensel Mercelina, Glenn Fraites, Humphrey Janzen, Ilse Koster, Ineke Gauvin, Jasper Meij, Jeffrey Sybesma, Joes Grimmelt, Joey Wit, Juni Wever, Jurwin Rifaela, Kuko Elisabet, Leonie Nijburg, Marianne van der Meij – Kros, Myung van Leeuwen, Nathalie Slingerland, Peter Bongers, Pieter de Geus, Robert Jan van der Houwen, Ronadyne La Cruz, Rosa de Geus, Sahana Simonetti, Sontje Lourens, Sue Endrick Sluis, Sue Shantely Lourens, Terence Ching, Theo Vreugdenhil, Thijs Giskes, Thijs Vreugdenhil, Ton Kros, Vurgell Cijntje, Willemijn Jussen, Walter Samboe, Yaír Stokkermans.



APPENDIX A: RESEARCH

A1. An overview of visiting scientists (PI name and home institute) is provided below:

Dr. Viktor Brandtneris (University of the Virgin Islands, U.S.V.I.)
Dr. Erik Meesters (IMARES, The Netherlands)
Dr. Fleur van Duyl (NIOZ, The Netherlands)
Didier de Bakker (Wageningen University, The Netherlands)
Dr. Martin de Graaf (Wageningen University, The Netherlands)
Skylar Snowden (Ripley's Aquarium of Canada, Canada)
Dr. Joost den Haan (Max Planck Institute for Marine Microbiology, Germany)
Dr. Ron Eytan (Texas A&M University at Galveston, U.S.A.)
Dr. Ryan McMinds (Oregon State University, U.S.A.)
Dr. Dan Warren (Macquarie University, Australia)
Dr. Michele Pierotti (Smithsonian Tropical Research Institute, Panama)
Dr. Tinka Murk (Wageningen University, The Netherlands)
Dr. Aschwin Engelen (University of the Algarve, Portugal)
Dr. Forest Rohwer (San Diego State University, U.S.A.)
Dr. Patrick Keeling (Canadian Institute for Advanced Research, Canada)
Dr. Martin Kolisko (University of British Columbia, Canada)
Dr. Javier del Campo (University of British Columbia, Canada)
Dr. J. Lukes (Laboratory of Molecular Biology of Protists, Czech Republic)
Dr. Alistair. Simpson (Dalhousie University, U.S.A.)
Dr. Tom Richards (University of Exeter, United Kingdom)
Dr. Camille Poirier (Monterey Bay Aquarium Research Institute, U.S.A.)
Dr. Maria Herranz (University of British Columbia, Canada)
SECORE (Germany, U.S.A.)
Dr. Marieke Verweij (Van Hall Larenstein, University of Applied Sciences, The Netherlands)
Dr. Michael Lesser (University of New Hampshire, U.S.A.)
Dr. Ryan Eagleson (University of Guelph, Canada)
Dr. Tobias Pfingstl (University of Graz, Germany)
Dr. Mireia Alcantara Rodriguez (Utrecht University, The Netherlands)
Dr. Charles Fransen (Naturalis Biodiversity Center, The Netherlands)
Dr. Jasper de Goeij (University of Amsterdam, The Netherlands)
Dr. Bert Hoeksema (Naturalis Biodiversity Center, The Netherlands)
Dr. Ben Mueller (CARMABI, Curacao)
Valerie Chamberland (University of Amsterdam, The Netherlands)
Dr. Nicole D. Fogarty (Nova Southeastern University, U.S.A.)
Dr. Stuart Sandin (Scripps Institution of Oceanography, U.S.A.)

A2. Selected research projects

A2.1 Laboratory-bred corals reproduce in the wild

Researchers of SECORE International (USA, Germany), the University of Amsterdam (Netherlands) and the CARMABI Marine Research Station (Curaçao) have for the first time successfully raised laboratory-bred colonies of a threatened Caribbean coral species to sexual maturity. These findings have been published in the latest issue of the scientific journal Bulletin of Marine Science."In 2011, offspring of the critically endangered elkhorn coral (*Acropora palmata*) were reared from gametes collected in the field and were outplanted to a reef one year later", explains

Valérie Chamberland, coral reef ecologist working for SECORE and CARMABI. "In four years, these branching corals have grown to a size of a soccer ball and reproduced, simultaneously with their natural population, in September 2015. This event marks the first ever successful rearing of a threatened Caribbean coral species to its reproductive age."

Due to its large size and branching shape, elkhorn corals created vast forests in shallow reef waters that protect shores from incoming storms and provide a critical habitat for a myriad of other reef organisms, including ecologically and economically important fish species. An estimated 80% of all Caribbean corals have disappeared over the last four decades and repopulating degraded reefs has since become a management priority throughout the Caribbean region. The elkhorn coral was one of the species whose decline was so severe that it was one of the first coral species to be listed as threatened under the U.S. Endangered Species act in 2006, and as critically endangered under the IUCN Red List of Threatened species in 2008. Consequently, measures to aid Caribbean reef recovery often focus on the elkhorn coral given its major decline and its ecological importance.

While these initial results provide some hope for the restoration of endangered elkhorn populations, restoration cannot perform miracles. "Our techniques can only support natural recovery, which means that conditions have to be appropriate to allow long term survival of outplanted corals and succession by other organisms to restore ecosystem functions. Hence, outplanting efforts have the best chance for success in well managed areas where stress has been reduced, but where, for some reason, no natural recruitment occurs. We don't get around to protect coral reefs and to apply additional management tools to reduce overfishing, pollution and other threats to coral reefs", underlines Dirk Petersen. "So far, any restoration effort is restricted to small areas and involves costly and labor intensive hands-on work. We now need to take the next step forward to apply our findings on a larger scale in Curaçao and elsewhere in the Caribbean.

Source: *Phys.Org (Jan 29, 2016) Photo credit: Paul Selvaggio*

A3.2 Sea Turtle Conservation Curaçao

In February 2014, Curaçao took another step forward in the protection of some of the island's most charismatic and threatened species – sea turtles. On February 18th and 19th the Secretary pro tempore of the Inter-American Convention for the Protection and Conservation of Sea Turtles (IAC), accompanied by the Dutch delegate to the IAC, of the Ministry of Economic Affairs, and the director of Sea Turtle Conservation Bonaire met with the Curaçao Ministry of Health, Environment and Nature, officials from the Ministry of Foreign Affairs as well as CARMABI and

Uniek Curaçao, to start the development of a monitoring program to assess the number of nesting and in-water sea turtles of Curaçao. This information will then be used to determine if sea turtles are increasing or decreasing in number in Curaçao.

Now, with increased protection for sea turtles in Curaçao and the establishment of four new Ramsar sites, the banning of destructive gillnet practices went into effect in May 2014, after a five-year exoneration period. However, it will still take strict enforcement of rules and regulations to control persistent illegal gillnetting. These discussions with the IAC Secretary led to a collaborative agreement to monitor Shete Boka National Parks' beaches throughout the sea turtle nesting season (May–December) and monitor sea turtles at one of the key feeding areas in Curaçao – Boka Ascencion. The data collected will not only track Curaçao's sea turtle nesting trends, but will contribute to a regional dataset that monitors Caribbean population trends.

Sea turtles are long-lived species that reach sexual maturity after 20–30 years of age and migrate great distances at different stages of their lives. These unique features of their life cycle necessitate international cooperation and long-term monitoring programs to best understand and safeguard these endangered species. Once amazingly abundant, Caribbean Sea turtles have seen rapid decline since the time of European expan-

sion in the Americas. Scientists estimate that in the 1600's, over 90 million Green Turtles swam the Caribbean seas. Today the number is estimated at 300,000. Hawksbills have plunged 99.7% from 11 million to 30,000. Both Green Turtles and Hawksbills nest in Curaçao. Today, fishing gear entanglement, illegal harvesting, coastal development, marine pollution and climate change are still putting serious pressure on sea turtle populations, which remain threatened with extinction not only in the Caribbean, but across the globe. To learn more about or get involved with Curaçao sea turtle conservation contact the Ministry of Health, Environment and Nature, CARMABI or Sea Turtle Conservation Curacao (STCC).

Source: *Dutch Caribbean Nature Alliance (Nov 9, 2016)*

A3.3 Will the next big cancer drug come from the ocean?

Pharmaceuticals are derived from a weird, wide range of natural and synthetic sources. Thanks to scientists who probe every inch of the globe, one increasingly common source for discovering natural compounds is the ocean. The anti-tumor drug trabectedin was originally made from extract from a sea squirt. Ziconotide, an analgesic for severe and chronic pain, comes from a cone snail.

Sirenas, a San Diego, California-based company, specializes in discovering marine-based therapeutics. A team from the startup goes out, on average, four times a year to bioprospect, seeking out and harvesting plant and animal species that may contain compounds helpful in treating diseases plaguing millions around the world, including malaria, tuberculosis and a variety of difficult-to-treat and incurable cancers. In the Central Pacific, California and Florida coasts, and the Caribbean, the divers are particularly interested in sea sponges and algae, such as cyanobacteria, commonly known as blue-green algae.

There's a traditional way of doing this work—at Scripps and elsewhere. Researchers go into the field and collect certain organisms, such as sea sponges, and get certain bacteria and grow it in lab. As you progress in your career and information becomes more apparent, you can begin asking which are the organisms that tend to produce good chemistry. Then you focus on those, and it becomes about finding new types of organisms.

What we do is find a way to track every little bit of chemistry. In previous approaches, you'd go out and collect an array of samples and use a cancer or antibacterial test to find something useful for that specific purpose. It was like finding a needle in a haystack and then trying to figure out where the needle is useful for these diseases. We treat that stack of hay as all needles. We look at every single molecule as being important, and we're looking to see what all those different needles are doing. We catalog every little thing we find, test everything, and basically get a fingerprint for every needle. It's sort of like National Security Administration spying, compiling a dossier on every person, and there are no red flags until something weird happens. And maybe it isn't even that weird, but that's when we start paying attention.

Maybe in the traditional way, harvesting was harmful. Collecting tons of sponges didn't seem bad because there was a greater good aspect to it. Researchers would find an anti-cancer compound and simply collect the sponges that make it. That's ancient history. Today, people harvest and cultivate in different ways. Genomic methods allow us to collect a tiny bit of an organism, and we don't have to go back. We need a single sample, a small amount, to make elements synthetically in a lab. The net benefit is that we have a minuscule impact on the environment. We typically work with ocean conservancy Groups and laboratories wherever we go, and we try to support educational or scientific work in those places, sharing what we know or actual financial support with local institutions. In the end, if we can show this incredible health benefit from what's in our oceans, people will respect the environment even more, and that can drive conservation.

Source: *Smithsonian Magazine (8 dec. 2016) Photo*

credit: Barry Brown/Coral Reef Photos

A3.4. Long-term shifts in coral communities on shallow to deep reef slopes of Curaçao and Bonaire

Tropical coral reefs are among the most biologically diverse and economically important ecosystems on earth. Nevertheless, we found dramatic changes in coral communities on the reef slopes of Curaçao and Bonaire since 1973. Cover and abundance declined for virtually all coral species. The data show a shift from communities dominated by framework building species (e.g., *Orbicella* spp.) to communities consisting of small opportunistic, phenotypically plastic, species, including few remaining structural colonies. *Madracis mirabilis*, *Porites astreoides*, *Diploria strigosa*, and *Agaricia lamarcki* are at present modest winners in the coral assemblage, although overall cover declined also for these species. Increased frequency and intensity of events inducing coral mortality and ongoing reduction in suitable hard substratum, provided by the remnants of large colony building species, could reduce the chance of these species to remain winners in the longer run. The observed loss in coral cover and the shift from larger structural to smaller opportunistic species reduced reef carbonate production by 67% and therewith, in combination with a trend toward smaller coral colonies, reef complexity. Alarmingly, reefs at upper-mesophotic depths (30–40 m) did not escape the general degradation of the coral community. The negative effects are larger around densely populated areas where local stressors are adding to degradation caused, for instance, by region wide mass bleaching. Without proper conservation and management this already dramatic degradation will continue and turn more and more coral species into losers.

Source: *Frontiers in Marine Science (Nov 25, 2016)*

A3.5 Successful coral spawning workshop in September

This year's SECORE's coral spawning workshop in Curacao was held in the fall of 2016. It was the seventh workshop as part of our ongoing coral restoration research project in collaboration with the CARMABI Foundation and the Curacao Sea Aquarium. Curacao was SECORE's first study site, aiming at better understanding the sexual reproduction of corals and developing new restoration strategies. Over the last years, the main focus of this workshop was the endangered elkhorn coral. This year, a small team of our experts worked on this species in August and September. During this year's workshop research focused on several new coral species, some of them never described before. A mass-spawning event of *Siderastrea siderea*, a gonochoric species with male and female colonies, was observed for the first time and researchers collected their gametes and accordingly reared larvae. Furthermore, larvae were raised from the broadcast spawners *Montastraea faveolata*, *M. cavernosa*, *Colpophyllia natans*, *Diploria strigosa*, *Stephanocoenia intersepta* and the spawncasters *Dendrogyra cylindrus* and *Eusmilia fastigiata*. Two film teams were also present and all documented spawning events will appear in a German/ French produced nature documentary.

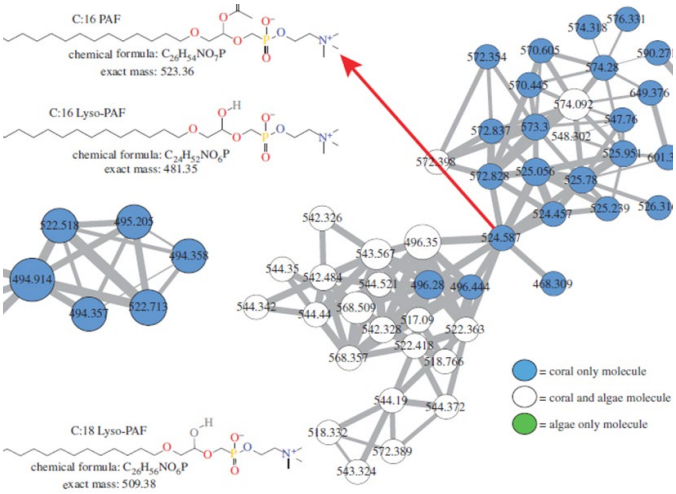
A3.6. Large-scale invasion of western Atlantic mesophotic reefs by lionfish potentially undermines culling-based management

The detrimental effects of invasive lionfishes (*Pterois volitans* and *Pterois miles*) on western Atlantic shallow reefs are well documented, including declines in coral cover and native fish populations, with disproportionate predation on critically endangered reef fish in some locations. Yet despite individuals reaching depths [100 m, the role of mesophotic coral ecosystems (MCEs; reefs 30–150 m) in lionfish ecology has not been addressed. With lionfish control programs in most invaded locations limited to 30 m by diving restrictions, understanding the role of MCEs in lionfish distributions remains a critical knowledge gap potentially hindering conservation management. We synthesized unpublished and previously published studies of lionfish abundance and body length at paired shallow reef (0–30 m) and MCE sites in 63 locations in seven western Atlantic countries and eight sites in three Indo-Pacific countries where lionfish are native. Lionfish were found at similar abundances across the

depth gradient from shallow to adjacent MCEs, with no difference between invaded and native sites. Of the five invaded countries where length data were available three had larger lionfish on mesophotic than shallow reefs, one showed no significant difference, while the fifth represented a recently invaded site. This suggests at least some mesophotic populations may represent extensions of natural ontogenetic migrations. Interestingly, despite their shallow focus, in many cases culling programs did not appear to alter abundance between depths. In general, we identify widespread invasive lionfish populations on MCE that could be responsible for maintaining high densities of lionfish recruits despite local shallow-biased control programs. This study highlights the need for management plans to incorporate lionfish populations below the depth limit of recreational diving in order to address all aspects of the local population and maximize the effectiveness of control efforts.

Source: *Biological Invasions (Dec. 19, 2016)*

A3.7 Corals and humans share similar immune systems



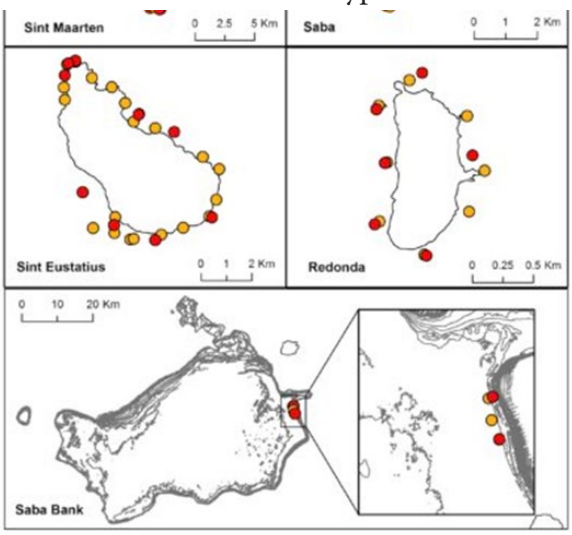
Holobionts are assemblages of microbial symbionts and their macrobial host. As extant representatives of some of the oldest macro-organisms, corals and algae are important for understanding how holobionts develop and interact with one another. Using untargeted metabolomics, we show that non-self-interactions altered the coral metabolome more than self-interactions (i.e. different or same genus, respectively). Platelet activating factor (PAF) and Lyso-PAF, central inflammatory modulators in mammals, were major lipid components of the coral holobionts. When corals were damaged during competitive interactions with algae, PAF increased along with expression of the gene encoding Lyso-PAF acetyltransferase; the protein responsible for converting Lyso-PAF to PAF. This shows that self and non-self-recognition among some of the oldest extant holobionts involve bioactive lipids identical to those in highly derived taxa like humans. This further strengthens the hypothesis that major players of the immune response evolved during the pre-Cambrian.

Source: *Proc. R. Soc. B (Apr. 5, 2016)*

A3.8 Windward Caribbean Expedition

The Waitt Institute, CARMABI and Dr. Stuart Sandin's laboratory at Scripps Institution of Oceanography collaborated to organize an expedition to conduct a rapid scientific assessment of the coral reefs around the windward Caribbean islands, namely Sint Maarten, Sint Eustatius, Saba, Redonda, and a submarine atoll, Saba Bank. To complement these efforts, the expedition was supported by the Government of Antigua and partners in the nearby Dutch-affiliated islands (St Eustatius, Saba, and St Maarten).

The collaboration is part of a larger effort to establish a regional scale perspective of coral reef health, investigating how reefs are structured, how they change over time, and how we can better manage them in the face of global change. The research conducted during this cruise aimed to investigate the independent and interactive effects of oceanography and human activities in affecting the structure and dynamics of coral reef communities. The survey design controls for within-island variables by conducting the core surveys within the same habitat type – forereef habitat



at 7-15m depth. To assess the benthic and reef fish communities, the GCRMN methodology was utilized in conjunction with large-area 'photomosaics'

to quantify the structure and the workings of each coral reef community at 1-2 km intervals surrounding each island.

To complement the ecological data collected, two sea temperature recorders (HOBO Pro v2 Logger) were deployed around each island. The temperature recorders were programmed to record the seawater temperature at an interval of thirty minutes. We expect to retrieve these recorders and download the temperature record in approximately 2 years. Across the 4 islands and submarine atoll, 65 sites were surveyed. This effort resulted in a total of 325 fish and benthic transects, following the GCRMN guidelines. Additionally, 38 photomosaics were imaged: 6 on Redonda, 11 on Sint Eustatius, 11 on Sint Maarten, 8 on Saba, and 2 on the Saba Bank (Figure 6).

A4. Terrestrial Research Projects

Several steps were also taken to increase awareness of benefits using indigenous plant species in landscaping through information and participation in several

Facebook sites (this was also aimed at getting more volunteers). The following filler ad was placed for free in the popular daily newspaper 'Amigoe': Valuable help in the tree nursery was obtained from a number of volunteers: Grace Best, Peter van den Broek, Mirella Christiaan, Roger van Daalen, Colin Engels, Sandra Felicia, Filomena Kleinmoedig, Gwendolin Martina, Ingrid Profas, and Frans van Schaik. Later in the year (after significant rainfall on the island), seeds of the endemic tree species *Myrcia curassavica* were collected from specimens growing on the Seru Gracia (Christoffel National Park). The seeds were put in trays for testing their germination rate and grow specimens for sale and replanting in the northern part of the Christoffel National Park where this species is not found and has a relatively lower biodiversity (compared to the southern part of the Christoffel National Park).

This year the process of getting a second biologist for the department was also difficult and only in September we were able to fill in this position. Bastiaan Vermonden, MSc. started working in the department as of September 12th. Before that he worked as coordinator for the sea turtle conservation project of CARMABI. The lack of a second biologist for a large part of the year of course hampered the output of the department.

A.4.1. Water Bird Monitoring

The two volunteers water bird monitoring groups were also active this year. On the western side of the island the following sites were regularly monitored: The freshwater dam of Malpais, the freshwater areas of Blue Bay, the salina of St. Michiel and the waste water treatment plant of Klein Hofje. In the eastern site of the island the salina of Jan Thiel was visited and monitored at different locations along the edge of the salina. The data collected by both groups of volunteers were uploaded on the eBird site (www.ebird.org) as was also done in 2015. CARMABI obtained also funds from the Prins Bernhard Cultuurfonds Caribisch Gebied to buy two refractometers so that the salinity of the waters in the areas can be measured during each monitoring session. We thank also mr. Yede van der Kooy for granting permission to enter the Blue Bay premises for the monitoring activities. We also thank the Ministry of GMN (Clinton Johans as contact person) for giving us permission to visit the freshwater areas in the LVV area at Klein Kwartier.

A.4.2. Medicinal plants

For the research on use of medicinal plants by the local population of the island the survey data were analyzed and a report is being finalized based on the findings and comparison with other publications on the use of medicinal plants on several Caribbean islands (TRAMIL studies) and in Curaçao.

A.3.3. White-tailed deer

The proposal for an ecological research on the Curaçao white-tailed deer ('Ecology and conservation of the endangered Curaçao white-tailed deer (*Odocoileus virginianus curassavicus*)) that Prof. J. Komdeur (University of Groningen) and Prof. J-M

Gaillard (University of Lyon) wrote in co-operation with the department (J. de Freitas) was submitted to the NWO Caribbean research program for its second round of funding of projects in the Dutch Caribbean. Only nine projects of the 82 projects that were submitted were selected for funding. Despite getting the predicament 'very good' our project did not make it as one of the selected projects for funding. We will keep looking for other ways of funding this important project for Curaçao. The results will be very useful for conservation purposes and spatial planning strategies due to the fact that this animal is the largest mammal and can be considered a keystone species of the nature of the island.

A.4.4. Indigenous Plants

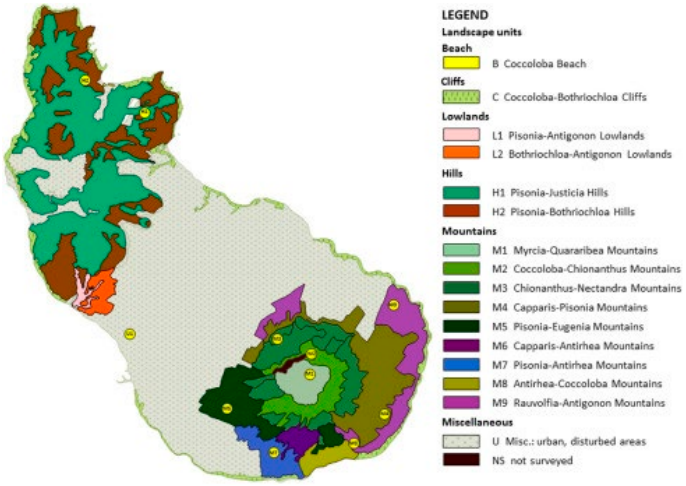
This year further steps were taken to advance the plant phenology project of indigenous tree and shrub species on the three main geological formations in the Christoffel Park (i.e. Curaçao Lava Formation, Knip Formation and limestone formation). The phenology data of over 60 plant species (including tree, shrub, a semi-parasite, *Tillandsia* species and cacti) that were collected (monthly surveys during two and a half years) by John de Freitas and Dolfi Debrot are being analyzed at the University of Puerto Rico with the purpose of making a publication in an international scientific journal. This publication will be important due to the fact that little has been published on the phenology of the vegetation of Caribbean islands.

A4.5. Seed germination trials by students

Seeds of the following indigenous tree species were used in the germination trials by the three students: *Bourreria succulenta, Cordia dentata, Crescentia cujete, Crossopetalum rhacoma, Guaiacum officinale, Malpighia emarginata, Quadrella odoratissima, Randia aculeata, Sabal cf. causiarum*, and *Trichilia trifolia*.

A4.6.Landscape ecological vegetation map of Saba (Lesser Antilles)

This publication gives insight into the relative value and changes in the (semi-)natural landscape and vegetation types of Saba. Similar CARMABI publications for three other Dutch Caribbean islands have been very useful in spatial planning and nature management. For Saba two main and nine different sub-landscape types were distinguished based on geology, geomorphology and nine different vegetation types found. The CARMABI study shows that large vegetation changes have taken place since the only other vegetation survey done five decades ago by the late Prof. Stoffers. The changes appear to be due to three



major forces: hurricane impacts, natural succession following diminished agricultural activity and invasive species and plant pest species. The vegetation continues to be impacted negatively by free roaming goats. Landscape ecological vegetation map of Saba: considerable effort was made this year by John de Freitas, Dolfi Debrot and Anna Rojer to review drafts of this publication. It first appeared in March of this year as an Imares report and at the end of the year it was definitively published in the Dutch Royal Academy of Arts and Sciences series.

A.4.7. Sensitivity map of coastal areas in Curaçao in the event of an oil spill

This study was carried out as a consultancy project and shows the relative sensitivity (based on natural and commercial values present) of the island's coastal areas for the consequences of an oil spill. The report is intended to help increase effective response by stakeholders in case an oil spill occurs.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