CARMABI

Caribbean Research & Management of Biodiversity

Annual Report

2011

Carmabi Annual Report 2011

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Contents

From our director

I am proud to present this annual report 2011 which provides a detailed overview of Carmabi's activities and accomplishments this year. The Carmabi Board of Directors and Carmabi's staff would like to thank all Carmabi's friends, associates and partners involved with education, research and nature conservation for a very successful 2011. We are confident that cooperation with all our partners will be as successful this year. We are also grateful to the government of Curaçao for their ongoing support.

The main event of 2011 was the start of the construction of Carmabi's new Science Center, that will house new laboratories and facilities for visiting scientists. On July 22nd, Minister Constancia laid the first stone and on December 2nd the highest point of this new building was reached which was celebrated with the traditional "Spantenbier". In this regard, we would like to thank the government of the Netherlands, more specifically the Ministry of Internal Affairs and Kingdom Relations and the Ministry of Education, Culture and Science for their help to accomplish the new Science Center. We would also like to thank the government of Curaçao for their generous contribution, in particular the Minister of Health, Environment and Nature, Mrs. Jacinta Constancia. The Science Center should be completed end of August 2012.

Carmabi's research department has done very well in 2011. Hundred and seven scientists came to Carmabi in 2011, compared to 94 in 2010, to conduct a wide variety of research projects. In addition, 48 students participated in various courses that were taught at Carmabi. Twenty-five scientific publications were published based on work done at Carmabi compared to 19 in 2010. More scientific insights in the ecological processes shaping Curaçao's reefs are essential for improving existing and designing new management strategies to ensure the long term survival of these unique assets of our island.

Park management has seen some changes. After the departure of park manager Michelle da Costa Gomez, the parks were left without a manager for a few months until Antoine Solagnier, a former Lt. Governor of Saba, was hired as the new manager of all parks managed by Carmabi, on October 1st, 2011. Integration of the Shete Boka Park and the Christoffel Park including the Savonet museum, is planned for next year, so that all parks and the museum are managed by Mr. Solagnier, which will reduce overhead cost and increase efficiency. In order to stimulate the local population to visit the parks we are currently negotiating a contract with the government to further subsidize local entry fees.

Our Nature and Environment Education Department is responsible for guided tours for primary school children in the Christoffel Park and the areas of Daaibooi, Shete Boka and Kabouterbos. In 2011 over 12,000 school children visited the parks guided by our five volunteer guides or learned about the island's nature at school. In 2011, a start was made with the establishment of the Marine Education Center (MEC), were school children will be able to learn why the coral reef is so important.

The increase in advisory work also continues. Environmental legislation on the BES islands has become stricter and as a result we receive more requests for advice. Requests for advice from organizations on Curaçao have also increased.

Carmabi, as a regional institute, strives to be even more involved within nature conservation in the Caribbean and expand its advisory services to the entire Caribbean. In 2011 we participated in 7th IUCN Regional Mesoamerican Forum and the 1st IUCN Caribbean Forum in the Dominican Republic.

What does Carmabi's future look like? The construction of the new Carmabi Science Center will be a major step forward to expand our science program. The plan to expand our Advisory and Consultancy Department with a junior consultant has already resulted in the recruitment of biologist Mr. Clifford de Lannoy, who will reinforce this department next year. This is urgently needed because requests for assistance are presently more than we can absorb. The coming year park management will focus more on income generation and the parks will be run on a more commercial basis. The current government subsidy is simply not sufficient for adequate park and museum management. The new Marine Education Center (MEC) should be completed in 2012 which will enable us to include the underwater nature of Curaçao and more specifically the importance of its coral reefs into our education programs.

Last year I expressed my worries with respect to the ongoing and accelerating deterioration of Curaçao's coral reefs. Unfortunately my worries have not decreased since (see: http://tinyurl.com/cpvjefm). Coral reefs protect our coast against storms and hurricanes, are very important to our fisheries and dive tourism sector and our health. As such the coral reef represents an important economic asset which is not recognized by many at present. Damage to the coral reef, on many places along our coast, is still ongoing and coastal development on Curaçao remains a very important cause of coral reef deterioration. To stop this process of gradual deterioration of the coral reef Curaçao needs to decide where it stands when it comes to coral reef conservation, which is basically a political decision. On our part, we will continue to disperse information on the island's reefs, and more specifically on their (economic) benefits and factors responsible for damaging them, in order to facilitate a broad nationwide discussion on the coral reef and sound political decision making.

Paul Stokkermans
Director Carmabi

Ch1 General Information

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.

Our primary goals are therefore:
• To conduct or facilitate research to support effective nature management, nature conservation, nature restoration, and nature development;

• The acquisition, conservation, protection, management, restoration and development of natural areas in the broadest sense, including objects or places of value to geology, history and/or archaeology;

• To create awareness within the community, especially school children, regarding the contribution they can make to achieve sustainable development on Curaçao.

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

Ch2 Science Department

2.1. Visiting scientists

107 scientists visited Carmabi in 2011. In addition 48 students stayed at Carmabi to participate in Coral Reef Ecology courses and workshops that were taught by Carmabi and various universities from the Netherlands and the United States. The number of visiting scientists in 2011 illustrates a continued positive trend **(Figure 1)** despite the fact that many facilities were unavailable while the construction of the new lab is ongoing. Most scientists in 2011 were from the United States (39.3%; 2010: 41.2%) followed by the Netherlands (22.4%; 2010: 25.9%), Germany (17.8%) and Mexico (5.6%) **(Figure 2)**. Not all scientists and students that worked at Carmabi stayed at the Piscadera location due to the loss of dormitories in March 2011 and the construction of the new laboratory/ dormitory facilities. Because of the loss of our former dormitories early in the year, occupancy rates could not be calculated for 2011. A total of 3752 personal working days (i.e. one visiting scientist working one day) were achieved is than a doubling of the work carried out in 2010 (1767 days) because 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 3 on page 10**. An overview of visiting scientists (PI name and home institute) is provided below:

- Aaron Hartmann, SCRIPPS Institution of Oceanography, USA
- Alex Dornburg, Yale University, USA
- Alexander Wolf, ZMT, Germany
- Allison Gregg, San Diego State University, USA
- Andy Haas, SCRIPPS Institution of Oceanography, USA
- Benjamin Mueller, Royal Netherlands Institute for Sea Research, The Netherlands
- Brigitte Sommers, University of Queensland, Australia
- Carlos Prada Montoya, Louisiana State University, USA
- Caroline Dubé, Universite de Quebec a Montreal, Canada
- Dan Warren, University of Texas at Austin, USA
- David Reed, University of Florida, USA
- Dirk Petersen, Blijdorp ZOO, The Netherlands
- Eduardo Hajdu, Museu Nacional/UFRJ, Brasil
- Erik Meesters, IMARES, The Netherlands
- Ernesto Weil, University of Puerto Rico, Puerto Rico
- Fleur van Duyl, Royal Netherlands Institute for Sea Research, The Netherlands
- Forest Rohwer, San Diego State University, USA
- Gaëlle Quéré , ZMT, Germany
- Hannah Brocke , ZMT, Germany
- Iliana Baums (Penn State University, U.S.A.) , Penn State University, USA
- James Wetterer, Florida Atlantic University, USA
- Jasper de Goeij, Poriforma BV,, The Netherlands
- Joost den Haan, University of Amsterdam, The Netherlands

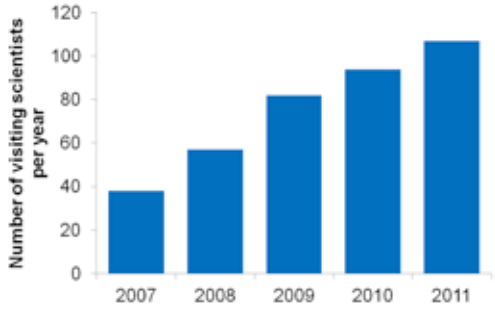


Figure 1: An increasing number of scientists is visiting Carmabi each year

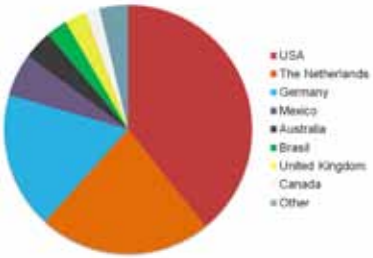


Figure 2: Overview of countries where scientists originated from that visited Carmabi in 2011

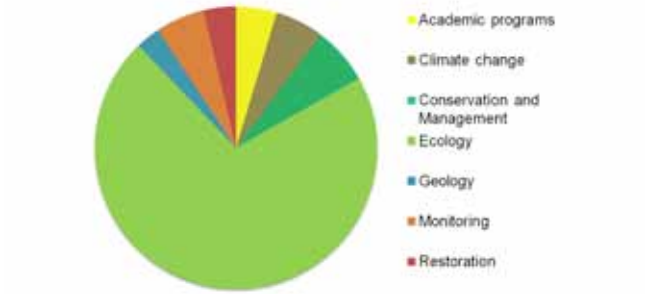


Figure 3: Overview of the areas in which visiting scientists were active in 2011

- Joseph Pawlik, University of North Carolina Wilmington, USA
- Juan Pablo Carricart, Universidad Nacional Autónoma de México, Mexico
- Katie Barott, San Diego State University, USA
- Kristen Marhaver, UC Merced, USA
- Maggy Nugues, ZMT, Germany
- Manu Buschiazzo, UC Merced, USA
- Margaret Miller, NOAA, USA
- Matt Brandley, University of Sydney, Australia
- Mauricio Rodriguez-Lanetty (, U.S.A.) , University of Louisiana at Lafayette, USA
- Monica Medina, UC Merced, USA
- Oded Yarden, Hebrew University of Jerusalem, USA
- Pedro Frade, University of Vienna, Austria
- Petra Visser , University of Amsterdam, The Netherlands
- Richard Hill, Michigan State University, USA
- Roger Portell, Florida Museum of Natural History, USA
- Rolf Bak, University of Amsterdam, The Netherlands
- Rudy Jocque, Royal Museum for Central Africa, Belgium
- Steve Newman, Newcastle University, United Kingdom
- Stuart Sandin, SCRIPPS Institution of Oceanography, USA
- Tim White, Penn State University, USA
- Valérie Chamberland, Universite de Quebec a Montreal, Canada
- Valerie Paul, Smithsonian Marine Station, USA
- Volker Mauerhofer, United Nations University Institute of Advanced Studies, Japan

2.2. Peer reviewed scientific publications

Twentyfive publications appeared in peer reviewed scientific journals based on work that was conducted at Carmabi (2010: 19). Ten of those publications were authored or co-authored by Carmabi staff making 2011 a productive year 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, 12 reports were produced by MSc students that did their master's thesis' project at Carmabi. An overview of all peer reviewed scientific publications accepted for publication or published in 2011 is shown below:

1. Barott KL, Rodriguez-Brito B, Janouškovec J, Marhaver KL, Smith JE, Keeling P, Rohwer FL (2011) Microbial diversity associated with four functional groups of benthic reef algae and the reef-building coral *Montastraea annularis*. Environmental Microbiology 13: 1192–1204.

2. Barott KL, Rodriguez-Brito B, Youle M, Marhaver KL, Vermeij MJA, Smith JE, Rohwer FL (in press) Microbial to reef scale interactions between the reef-building coral *Montastraea annularis* and benthic algae. Proceedings of the Royal Society B.

3. Debrot AO, van Buurt G, Vermeij MJA (2011) Preliminary overview of exotic and invasive marine species in the Dutch Caribbean. IMARES Report number C188/11. 29pp.

4. Dornburg A, Warren DL, Iglesias T, Brandley MC (2011) Natural History Observations of the Ichthyological and Herpetological Fauna on the Island of Curaçao (Netherlands Antilles). Bulletin of the Peabody Museum of Natural History 52(1):181-186. 2011

5. Foster NL Paris CB, Kool JT, Baums IB, Stevens JR, Sanchez SA, Bastidas C, Agudelo C, Bush P, Day O, Ferrari R, Gonzalez P, Gore S, Guppy R, McCartney M, McCoy C, Mendes J, Srinivasan A, Steiner S, Vermeij MJA, Weil E, Mumby PJ (in press) Connectivity of Caribbean coral populations: complementary insights from empirical and modelled gene flow. Molecular Ecology.

6. Fricke A, Titlyanova TV, Nugues MM, Bischof K (2011) Depth-related variation in epiphytic communities growing on the brown alga *Lobophora variegata* in a Caribbean coral reef. Coral Reefs. DOI 10.1007/s00338-011-0772-0

7. Fricke A, Teichberg M, Beilfuss S, Bischof K (2011) Succession patterns in algal turf vegetation on a Caribbean coral reef. Botanica Marina 54: 111-126.

8. Huijbers CM, Nagelkerken I, Govers LL, van de Kerk M (2011) Habitat type and schooling interactively determine refuge-seeking behavior in a coral reef fish throughout ontogeny. Mar. Ecol. Prog. Ser. 437: 241–251. Open access.

9. Hultgren KM, MacDonald K, Emmett D (2011) Sponge-dwelling snapping shrimps (Alpheidae: Synalpheus) of Barbados, West Indies, with a description of a new eusocial species. Zootaxa 2834:1-16.

10. Grimsditch G, Arnold S, de Bey H, Brown J, Engel S, de Leon R, Vermeij MJA (2011) Coral Reef Resilience Assessment of the Bonaire National Marine Park, Netherlands Antilles. IUCN. Open access.

11. Grol MGG, Nagelkerken I, Rypel AL, Layman CA (2011) Simple ecological trade-offs give rise to emergent cross-ecosystem distributions of a coral reef fish. Oecologia 165:79–88.

12. Grol MGG, Nagelkerken I, Bosch N, Meesters EH (2011) Preference of early juveniles of a coral reef fish for distinct lagoonal microhabitats is not related to common measures of structural complexity. Mar. Ecol. Prog. Ser.: 432: 221–233.

13. Kelly LW, Barott KL, Dinsdale L, Friedlander AM, Nosrat B, Obura D, Sala E, Sandin SA, Smith JE, Vermeij MJA, Williams GJ, Willner D, Rohwer F (2011) Iron induced phase-shifts on coral reefs. ISME Journal. doi:10.1038/ismej.2011.114.

14. Kimireia IA, Nagelkerken I, Griffioen B, Wagner C, Mgaya YD (2011) Ontogenetic habitat use by mangrove/seagrass-associated coral reef fishes shows flexibility in time and space. Estuarine, Coastal and Shelf Science 92: 47-58.

15. Marhaver KLM (2011) Bleaching corals of two species appear to feed from neighboring algal turfs. Coral Reefs DOI: 10.1007/s00338-011-0782-y

16. Muller E, Vermeij MJA (2011) Day time spawning of a Caribbean coral. Coral Reefs. doi: 10.1007/s00338-011-0814-7.

17. Petit S (2011). Effects of mixed-species pollen load on fruits, seeds, and seedlings of two sympatric columnar cactus species. Ecological Research 26: 461-469.

18. Petit S (in press) Bataille pour sauver les cactus de Curaçao. Terra Seca.

19. Polato NR, Vera JC, Baums IB (2011) Gene discovery in the threatened Elkhorn Coral: 454 Sequencing of the *Acropora palmata* transcriptome. PLoS ONE 6(12): e28634. doi:10.1371/journal.pone.0028634

20. Rassweiler A, Rassweiler T (2011) Does rapid scavenging hide non-predation mortality in coral-reef communities? Marine and Freshwater Research 62: 510-515.

21. Reygel PC. Willems WR, Artois TJ (2011) Koinocystididae and Gnathorhynchidae (Platyhelminthes: Rhabdocoela: Kalyptorhynchia) from the Galapagos, with the description of three new species. Zootaxa 3096: 27-40.

22. van Duyl FC, Moodley L, Nieuwland G, van Ijzerloo L, van Soest RWM, Houtekamer M, Meesters EH, Middelburg JJ (2011) Coral cavity sponges depend on reef-derived food resources:stable isotope and fatty acid constraints. Mar. Biol. 158:1653–1666.

23. Vermeij MJA, Frade PR, Bak RPM (in press) Zooxanthellae presence acts as a settlement cue for aposymbiotic planulae of the Caribbean coral *Montastraea faveolata*. Caribbean Journal of Science.

24. Vermeij MJA, Bakker J, van der Hal N, Bak RPM (2011) Juvenile coral abundance has decreased by more than 50% in only three decades on a small Caribbean island. Diversity 3(3), 296-307. Open Access.

25. Vermeij MJA, Dailer ML, Smith CM (2011) Crustose coralline algae can suppress macroalgal growth and recruitment on Hawaiian coral reefs. Marine Eology Progress Series 422: 1-7. (Featured Article). Open access.

All these publications can be requested electronically (in pdf format), by sending an email to: camabilog@gmail.com

2.3. 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 66 cases, both oral and written. Four consultancy studies were executed for international and governmental organizations on Curaçao or other Caribbean islands. In 2010 the Carmabi Science Department was featured/ interviewed in 33 items for local TV, radio and newspapers. Nine public and four invited lectures were given on various topics related to coral reefs during conferences in Curaçao (UNA SIDS conference, CSA), Costa Rica (AMLC) and Barbados (UNEP). Visual materials were provided to numerous organizations to illustrate various reef related topics. In addition a 160 page book **(Figure 4)** was finished on the reefs of Curaçao that will be available in 2012. Carmabi further developed its on-line identification guides for Caribbean corals that can be found under publications at *www.researchstationcarmabi.org.*

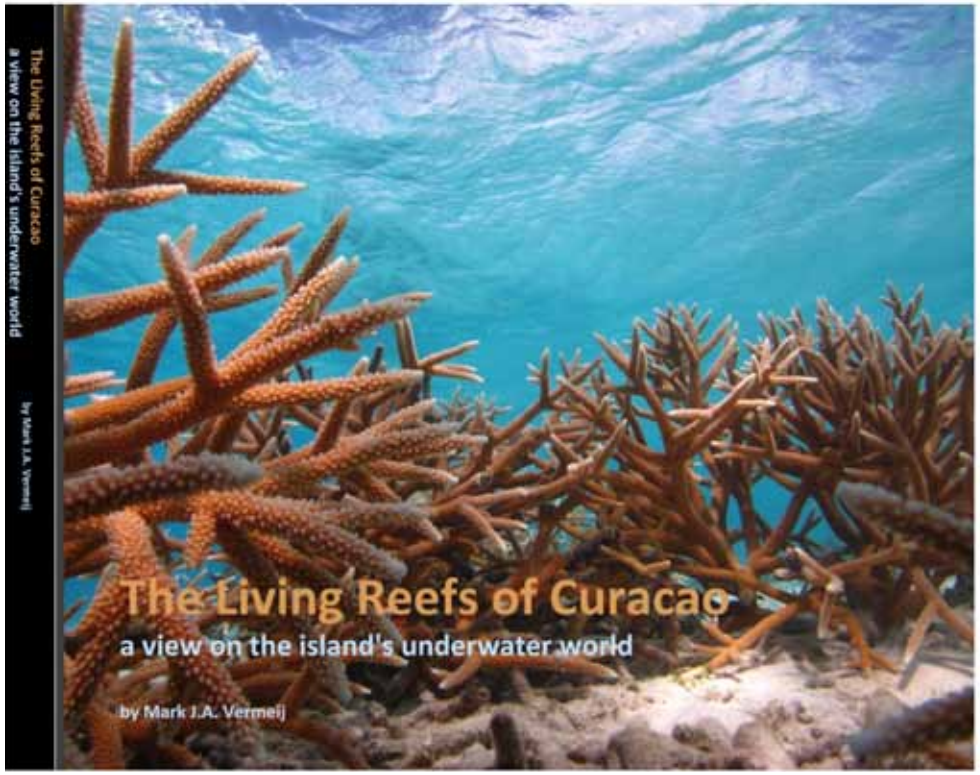


Figure 4: The new book made by Carmabi about the marine life found around Curaçao

2.4. Research

A large, collaborative project was started in 2010 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 last for four years. In early 2011, many FORCE participants met on Curaçao **(Figure 5)** for a meeting to discuss the progress of the project. On Curaçao this project will largely focus 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/*

Figure 5: Participants of the FORCE meeting on Curaçao made a dive at Watamula

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 ongoing eradication efforts are successful. In cooperation with the Bonaire National Marine Park. The number of lionfish was counted on Bonaire and Curaçao. On Bonaire the ELF eradication tool has been used for a year and this corresponded to a 4-8 fold reduction in lionfish biomass when compared to Curaçao where such eradication efforts have only recently started. While this method surely does not represent a final solution for the lionfish problem, these results clearly indicate that the local abundance of lionfish can be controlled to some degree through active eradication efforts.

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 Curaçao by raising the larvae of these endangered species. A collaborative project with SCRIPPS Institution of Oceanography and San Diego State University (both U.S.A.) was also continued (for the 4th year). In this project, active reef restoration methods are being an applied to a degraded reef near Westpunt (Curaçao) to experimentally test which techniques and approaches are the most successful management tools to restore degraded Caribbean 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. Succesful 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 four times more coral larvae than corals elsewhere on the island and that these larvae (i.e., from Eastpoint) also survive and settle better.

Carmabi continued its membership of the Association of Marine Laboratories in the Caribbean (AMLC, see:

www.amlc-carib.org/) and NET-BIOME network (www.netbiome.azores.gov.pt/NetBiome). An AMLC meeting was attended in Costa Rica to discuss the latest research findings relevant to Caribbean reef systems. NET-BIOME stands for “NETworking for tropical and subtropical Biodiversity research in Outermost regions and territories of Europe in support of sustainable development”, a new network aimed at overcoming the lack of trans-regional funding and increasing the integration of research on biodiversity. Carmabi is part of the oil-spill response team on Curaçao (RAC/ REMPTEIC-Carib).

Vermeij became 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 2011. 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. Studies on the dynamics during early life stages in Caribbean corals

Dr. Kristen Marhaver (UC Merced, USA)

Dr. Kristen Marhaver (UC Merced, California, USA) visited CARMABI from August to November 2011. In collaboration with Dr. Emmanuel Buschiazzo and Dr. Monica Medina from UC Merced, she conducted experiments to examine the the role of coral symbionts in the early development and gene expression of coral larvae **(Figure 6)**. In addition, she conducted experiments to identify microbes that attract coral larvae to the reef. Follow-up studies will be conducted in 2012 to identify bacteria that can be used for reef restoration and for coral propagation in general. Dr. Marhaver also conducted studies on the early development of gorgonians, the effects of antibiotics on larval swimming behavior, and the role of ciliates in grazing on reef surfaces. In collaboration with researchers from Scripps Institution of Oceanography, San Diego State University, and CARMABI, Dr. Marhaver helped to conduct a study of the effects of algae and microbes on survivorship of coral larvae.

2.5.2. Testing the Expensive Tissue Hypothesis

Dr. Dan Warren (University of Texas at Austin, USA)

In September 2011, Teresa Iglesias and I visited Carmabi in order to conduct research on the Expensive Tissue Hypothesis. This hypothesis says that, in order for an animal to invest heavily in one metabolically costly organ, it must take that investment away from other organs. This is manifested in a negative relationship between the mass of one organ and the mass of another. This hypothesis has previously been used to explain many diverse patterns seen in many animal groups, including the evolution of the human brain and its relationship to changes in our diet over evolutionary time. We set out to look for these tradeoffs in the bluehead wrasse, *Thalassoma bifasciatum*, a beautiful and common coral reef fish found throughout the Caribbean. The bluehead wrasse has a phenomenally variable mating system, and as a result of this males have enormously variable sizes of testes - varying far more than, for instance, brain sizes across all primates, or gonad sizes across all species of bats! We set out to examine what, if any, changes in investment in other tissues allowed this unusual level of variation. Analysis of this research is still in progress, but we expect to submit something very soon.

Figure 6: A star coral (Montastraea annularis) releasing its gametes during the annual coral spawning in the fall. Gametes are collected and reared to new coral recruits that can be out planted on the reef for restoration or research purposes.

2.5.3. Long term changes in coral communities on Curaçao

Prof. Dr. Rolf Bak (University of Amsterdam, Netherlands)

Throughout the Caribbean people ask the same question: How are the coral reefs on our island doing? What is their condition now compared with the past? In our research we ask the same question for Curaçao. How are the coral reefs doing on Curaçao? What is their condition along the coast of the island? Are there more or less corals now than there were before? Are there still the same species of corals? This question is for most islands difficult to answer: there is a lack of qualitative and quantitative data that go back more than 10, 15 years. Recently (the last 15-20 years) scientists are looking for change on reefs, using photographs or other survey methods to compare the past to the present. But to say more about the condition of our reefs we should have a real long time perspective. In Curaçao/Bonaire we have the best data of the whole Caribbean. With the support of Carmabi (and other institutions such as the Royal Netherlands Institute for Sea Research NIOZ and University of Amsterdam) coral reefs have been photographed since 1973, that is close to 40 years. The result is a series of repeated photographs of the same areas of reef bottom. Together they represent the longest time series that is internationally available over the depth range of 10 to 40 m. We have a total of 207 m^2 under observation. These permanent quadrats have again been photographed in 2011. The main conclusions of the analyses show that since the start of the series, in 1973, coral cover has dramatically declined, going down from up to 60% to much lower values, in some cases to only 10%. They also show that today coral cover is low and not changing much. There appears to be potential for recovery because a low cover of coral is still present. However, we continue to see still a slow decline or at best unchanged low coral cover. The only site where recovery, in terms of increasing coral cover, was recorded was at a site at Oostpunt Curaçao. How the composition of the coral community has changed over time in terms of presence of different coral species is currently analyzed.

2.5.4. Benthic community and fish surveys on the coral reefs off Curaçao

Prof. Dr. Joseph Pawlik, Dr. Tse-Lynn Loh, Dr. Steve McMurray, Dr. Tim Henkel (University of North Carolina Wilmington & Valdosta State University, USA)

As part of a Caribbean-wide study of coral reef communities, the benthic community and spongivorous fish abundance were surveyed in April 2011 at two sites off Curaçao—Snake Bay and Daaibooi. Sponge populations are strongly regulated by fish predators in the Caribbean; however, certain sponge species are chemically defended and avoided by predators. Palatable sponges get eaten and are thus hypothesized to have faster growth and reproduction rates to compensate for the biomass loss from fish grazing. Overfishing lowers spongivorous fish density, which can affect sponge community structure. In the benthic surveys, all sponges observed were identified to species level, and the occurrence of scleractinian coral overgrowth by sponges was also recorded. The total abundances of spongivorous fish within a 2000m3 volume at Snake Bay and Daaibooi were 74 and 87 respectively, confirming that reefs off Curaçao are subject to relatively low fishing pressures. Congruent with the high densities of spongivores, sponges surveyed at Curaçao were mostly chemically defended. Scleractinian coral cover at 26.72% was higher than our Caribbean average of 16.38%, but sponge cover was very low, only 4.48% compared to the Caribbean average of 18.41%. Macroalgae levels were comparable with other Caribbean sites. Rates of coral overgrowth by sponges at both sites were low; less than 5% of the observed coral colonies had any interactions with sponges. This contrasts with results from overfished sites, where palatable sponges are more abundant and corals experience more overgrowth by sponges.

2.5.5. Designing conservation efforts on small tropical islands

Volker Mauerhofer (United Nations University Institute of Advanced Studies, Japan)

I was staying as a lecturer of the University of Vienna/Austria for three weeks in February/March 2011 with CARMABI. This contributed to the preparation of a presentation at an international conference at the University of the Netherland Antilles. The presentation dealt with the conservation and management of wild fauna and flora. During my stay I found three types of examples which I included in my talk at the conference. These can be distinguished by the different geographic range covered by the environmental problem concerned and the geographic range of the necessary human response. The first type of environmental problems concerned only the island of Curaçao or even a smaller part of it. This is for example the necessary management of deer in the North-western part of the island. Management measures seem to take mainly place in a smaller geographic range, namely solely one National Park, than the problem should be naturally addressed. The second type of problem is covering more than one country but stays within the Caribbean region. An example therefore is the conservation and management of Flamingos, a large bird breeding in and migrating to other neighboring areas. Common activities on this regional scale appeared to be necessary, but not taken yet. The third type of problem addresses even a wider geographic scale. One example is the new occurrence of an invasive fish species in the Caribbean Sea. Here, research and management measures might be necessary on an international level which even includes the Panama Channel, parts of the Pacific Ocean and the whole Caribbean Sea. I can use these examples found during my stay with CARMABI as well as the experiences gained there also at my other lectures worldwide. Thank you again for the interesting time and the nice cooperation.

2.5.6. Coral reproductive ecology: where do healthy coral larvae come from on Curaçao?

Aaron Hartmann (Scripps Institution of Oceanography, USA)

Aaron Hartmann, a Ph.D. student at Scripps Institution of Oceanography (CA, USA), continued his dissertation work on coral reproductive ecology in collaboration with Dr. Mark Vermeij and others. The basis of Aaron's project is to see whether coral "health" differs between stony corals living near Eastpoint and Willemstad in terms of the amount of energy they store and use to produce offspring. During trips in the spring and fall, Aaron compared the number and size of larvae produced by two species near Eastpoint and the Water Factory, and found that Eastpoint corals **(Figure 7)** produce both more and larger offspring. Additionally, Aaron found that large larvae were generally better off than were small, evidenced by the fact that they settled at a higher rate and survived to a higher degree after being returned to the reef. Aaron's past work on Curaçao has shown that adult corals at Eastpoint tend to store more energy than those near Willemstad, and his most recent findings suggest that Eastpoint adults may also be a particularly important source of new healthy offspring to reefs along the entire leeward coast. While on the island, Aaron and a collaborator, Valérie Chamberland, produced multiple "Ask a Marine Biologist" videos for YouTube, each designed to answer specific questions about their work from high school students.

The videos can be found at: *http://www.youtube.com/user/VTtoCA?feature=mhee.*

Figure 7. Example of a "healthy" reef near Oostpunt. Coral communities like the ones found here are becoming increasingly rare in the Caribbean.

2.5.7. Population connectivity among Caribbean Marine Protected Areas

Dr. Carlos Prada (Louisiana State University, USA)

Caribbean coral reefs have degraded in the last decades as a result of human intervention. Such decline is so pronounced that some commonly seen species in the seventies are rarely observed today. A measure to counteract such degradation is the establishment of networks of Marine Protected Areas (MPAs). MPAs are fishing free geographical space, that when properly implemented and managed can ameliorate, restore and achieve the long-term conservation of marine populations. Determining the spatial scale of connectivity among marine populations is critical to the effective design of MPA networks. Despite its importance in MPA design, patterns of connectivity among marine populations are scarce and rarely studied among established MPAs. Diana Beltrán (University of Puerto Rico) and Carlos Prada (Louisiana State University) studied patterns of connectivity in the common yellow jawfish (*Opistognathus aurifrons*) within and among Caribbean MPAs, including Curaçao. At large scales, they found that populations are genetically segregated. Populations in Curaçao are genetically distinct from populations in other Antillean islands, such Puerto Rico. Thus, populations in different Islands should be considered independent conservation units. Importantly, populations in Curacao maintain sympatrically deep divergent mitochondrial lineages, exclusive to Curaçao, which could represent the presence of cryptic species. Beltrán and Prada are currently evaluating patterns of genetic diversity at other molecular markers to test this hypothesis. At a smaller spatial scale (<100km) there seems to be some degree of segregation but evidence is inconclusive and would require a larger set of molecular markers. Our current data on the common yellow jawfish across the Caribbean suggests that connectivity between MPAs in different Antillean Islands is restricted.

2.5.8. Microbial to reef scale interactions

Katie Barott (San Diego State University, USA)

Competition between reef-building corals and benthic algae is of key importance for reef dynamics. These interactions occur on many spatial scales, ranging from chemical to regional. Using microprobes, 16S rDNA pyrosequencing and underwater surveys, we examined the interactions between the reef-building coral *Montastraea annularis* and four types of benthic algae. The macroalgae *Dictyota bartayresiana* and *Halimeda opuntia*, as well as a mixed consortium of turf algae, caused hypoxia on the adjacent coral tissue. Turfalgae were also associated with major shifts in the bacterial communities at the interaction zones, including more pathogens and virulence genes. In contrast to turf algae, interactions with crustose coralline algae (CCA) and *M. annularis* did not appear to be antagonistic at any scale. These zones were not hypoxic, the microbes were not pathogen-like and the abundance of coral–CCA interactions was positively correlated with per cent coral cover. We propose a model in which fleshy algae (i.e. some species of turf and fleshy macroalgae) alter benthic competition dynamics by stimulating bacterial respiration and promoting invasion of virulent bacteria on corals. This gives fleshy algae a competitive advantage over corals when human activities, such as overfishing and eutrophication, remove controls on algal abundance. Together, these results demonstrate the intricate connections and mechanisms that structure coral reefs.

2.5.9. Juvenile coral abundance has decreased by more than 50% in only three decades on Curaçao

Mark Vermeij (Carmabi, Curaçao)

A comparison of the community structure of juvenile hermatypic corals of 2 to 37 m depth at the fringing reefs of Curaçao between 1975 and 2005 shows a decline of 54.7% in juvenile coral abundance and a shift in species composition. *Agaricia* species and *Helioseris cucullata*, the most common juveniles in 1975, showed the largest decline in juvenile abundance (a 9 and 120 fold decrease in density respectively) with *Helioseris cucullata* being nearly extirpated locally. In 2005, *Porites astreoides* contributed most colonies to the juvenile coral community, increasing from 8.2% (in 1975) to 19.9% of the total juvenile community. Between 1975 and 2005, juveniles of brooding species decreased in relative abundance while the abundance of juveniles of broadcast spawning species increased or remained the same. These data illustrate the magnitude of the changes that have occurred in only three decades in the composition of juvenile coral communities.

2.5.10. Crustose coralline algae can suppress macroalgal growth and recruitment

Mark Vermeij (Carmabi, Curaçao)

Crustose coralline algae are important components of tropical reef communities because they promote successful settlement by corals and contribute to solidification of the reef framework. We show experimentally that crustose coralline algae are also capable of suppressing the growth and recruitment potential of an abundant reef macroalga, *Ulva fasciata*. When mixed communities of crustose coralline algae were absent, relative growth rates of *U. fasciata* increased by 54.6%. When experimental nutrient additions were used to induce algal spore release, effective recruitment of *U. fasciata* approached zero only when crustose coralline algae were present. Mixed communities of crustose coralline algae are thus capable of limiting the local abundance of already-established macroalgae by reducing both their growth rate and recruitment success. This experimental observation was confirmed by field surveys. Because crustose coralline species also induce settlement and metamorphosis in a large number of scleractinian coral species, their abundance and species composition are expected to affect the (future) abundance of macroalgae and corals, which are often used to characterize degraded and 'healthy' reefs, respectively.

2.5.11. The die-off of a key reef building coral *Acropora palmata* and its impact on associated fish communities on Curaçao

Valérie Chamberland (Universite de Quebec a Montreal, Canada)

Prior to the 1980's, large *Acropora palmata* (Elkhorn coral) colonies dominated coral communities in shallow reefs (> 4 m depth) across the Caribbean. Due to its abundance and branching morphology, *A. palmata* fulfills an essential role in the maintenance of healthy and productive reefs by providing shelter to an enormous amount of reef organisms. Dense populations of this branching species also yield important physical benefit as they are known for their great wave energy dissipation capacity and thus protection of coastal areas. Due to a disease outbreak, the abundance of *A. palmata* has severely decreased throughout the Caribbean during the last 30 years and declines in abundance are estimated to more than 97%. As in the wider Caribbean, the shallow reefs of Curaçao have impoverished considerably in the past four decades. Data from 1969 indicates that the south coast of the island used to harbour large (tens of meters length) and continuous areas of *A. palmata.* Back then, it covered up to 75% of the shallow reef bottom and formed aggregations of large stands measuring more than 4 m^2. Nowadays, *A. palmata* is mostly found in scarce patches along the south coast of Curaçao and does no longer dominate shallow reefs. A new study quantified long-term shifts in fish community

structure following the demise of these framework-building species. Preliminary results indicate that the decline of *A. palmata* has negatively affected local fish abundances **(Figure 8)**. It was estimated that the shallow fish biomass was reduced by 67% and that one third of the species diversity was lost. The demise of this dominant structural framework builder has likely caused a corresponding reduction of their ecosystem functions, e.g., as a provider of habitat structure and complexity to other reef organisms.

Figure 8. Example of how healthy populations of the elkhorn coral (*Acropora palmata*) attract large amounts of fish. When such coral communities disappear, the fish will disappear as well..

2.5.12. The role of coral-eating invertebrates during coral reef degradation

Alexander Wolf (ZMT, Germany)

Macroalgae are a potential threat to Curaçao's coral reefs. They can overgrow adult corals and take up space on the reefs preventing the settlement of young corals. Under the supervision of Associate Prof. Maggy Nugues (Univ. Perpignan) and Prof. Christian Wild (Univ. Bremen), Alexander Wolf, PhD student at the Center for tropical marine ecology (ZMT) in Bremen, studies the interaction between macroalgae, corals and corallivorous invertebrates. Last year he found that the polychaete fireworm *Hermodice carunculata* takes refuge inside macroalgae and that its presence is associated with more coral mortality **(Figure 9)**. Algae and corallivores can thus act in synergy to cause reef degradation. This year, Alex continued his work and investigated the distribution pattern and feeding habits of this fireworm. He and his volunteer helpers Nanne van Hoytema and Michael Doane surveyed the abundance of the worm all along the coast of Curaçao and examined whether the worm prefers to feed on coral settlers or adult colonies. Coral settlers are essential to replenish coral populations and ensure their persistence. First results show that fireworms have a strong preference for coral settlers, but that this preference declines as the worms get larger. Alex's work illustrates the complex interactions among reef organisms and shows that even small animals such as fireworms can affect the health of the reefs. The project has been financed by ZMT. Additional PhD Students from the ZMT are continuing their fieldwork in March 2012.

Figure 9 – Fireworm (*H. Carunculata)* feeding on a coral (*T. coccinea*)

2.5.13. Sensory ecology of coral reef fish

Richard W. Hill and Aaron M. Florn (Michigan State University, USA), Pedro R. Frade (University of Vienna, Austria)

During work done at CARMABI in 2007, we discovered a new set of small molecules in the tissues of reef corals of every species we examined. These molecules, similar to amino acids, are called betaines (pronounced bee-tanes) because, many years ago, one of them was initially described in sugar beets. They are abundant in crop plants like corn, alfalfa, and tobacco – where they play important roles in protecting photosynthesis from environmental stress. We looked for them in corals because all the reef-building corals – owing to their symbiosis with algae – are photosynthetic. Reports in the scientific literature indicate that animals often use betaines as sensory cues. Moreover, betaines are often added to aquaculture diets to make the diets more attractive to the fish or crustaceans being cultured. Now that we know that reef corals contain betaines, we wanted to find out if coral reef fish use them as sensory cues. For example, if a parrotfish damages some coral tissue while eating and betaines leak out of the tissue into the water, are other fish attracted or repelled? To start to find answers to this question, we came back to CARMABI in the summer of 2011 to take advantage of the excellence of the opportunities and research support that CARMABI provides. We invented a device that would allow us to release four gallons of betaine-containing seawater gradually and soundlessly over a period of about an hour. In carefully designed tests, we used this device to release water into the ambient seawater of two coral reef plots. Sometimes the released water contained betaines that we had added, but at other times it did not. When we were doing the releases, we did not know whether betaines were present or not. During each release, using scuba, we observed and recorded the numbers of fish of all species, as a way of detecting if fish were attracted or repelled. The data are not yet analyzed, but we think they will greatly advance our understanding of betaines as possible sensory molecules.

2.5.14. Mechanisms underlying coral and algae competition

Allison Gregg, Katie Barott, Dr. Forest Rowher (San Diego State University, USA)

San Diego State University's Dr. Forest Rowher and graduate students Katie Barott and Allison Gregg visited Curaçao in September 2011 to investigate the mechanisms underlying coral and algae competition. During previous research conducted at CARMABI, Katie found that corals in contact with short filamentous turf algae exhibited very low oxygen levels. These low oxygen levels are not seen at borders between coral and crustose coralline algae (CCA), which are important in building the reef structure. Turf algae also produce sugars that the bacteria naturally occurring on the coral surface readily consume, and this is thought to lead to the low levels of oxygen at the coral-turf algae interface. To see how the bacteria living on the coral are changing the oxygen levels, the group used biological oxygen demand (BOD) optodes. BOD optodes are oxygen sensors that change color in the presence of different concentrations of oxygen. They fed the bacteria sugars released from turf algae and CCA and compared how much oxygen they consumed, finding that the bacteria consumed much more oxygen in the presence of turf algal sugars than those of CCA. This tells us that the turf algae are feeding the bacteria, and the bacteria are breathing oxygen, making the oxygen levels lower. Another major finding during the research conducted at CARMABI this year was that the naturally occurring green fluorescent protein (GFP) in corals is decreased when in contact with turf algae, compared to CCA **(Figure 10, see page 25)**. The function of GFP in corals is not fully known, but its intensity can decrease when corals are sick.

These findings have provided much insight to the complex relationship between corals and benthic algae, and together our results show us that turf algae are bad for the coral animal and stimulate bacterial growth, which may also be harming the corals that are fighting against turfs.

Figure 10 – Using special equipment the green fluorescence of corals can be measured and used as an indicator of their "health".

2.5.15. Research in Curaçao by FORCE team (Future of Reefs in a Changing Environment)
Despite their great value, the ecological state of Caribbean reefs has deteriorated rapidly in the last few decades; corals provide complex structures that influence biodiversity, fisheries production and coastline protection, to name but a few functions. In January 2011, we conducted a rapid ecological assessment of reefs at eight sites along the south coast of Curaçao. Reefs at a depth of 10-15m were assessed for benthic cover (coral, soft coral, sponge, algae, rock, sand etc), coral recruits, algal biomass, incidence of disease and bleaching, reef structure, and fish community composition.
Benthic substrate at all eight sites was dominated by algae (40%) and coral (27%). The highest mean coral cover was found at Oospunt (44%) and Playa Lagun (41%), although at the time of surveying incidence of bleaching was high. Fish communities at the surveyed sites were diverse (101 species), and were characterized by graysbys, parrotfish, soldierfish and abundant planktivores. Marie Pampoen was the most impacted site surveyed, with only 7% coral cover and the lowest diversity and abundance of fish. The reefs at the eastern and western ends of Curaçao were the most structurally complex. Preliminary analysis revealed fish diversity was positively related to reef complexity, meaning more complex reefs typically had more diverse fish communities in Curaçao, and the flatter reef areas had fewer species.
The FORCE team has surveyed reefs in 11 countries around the Caribbean. In comparison to other surveys conducted, coral reefs in Curaçao are relatively healthy with high coral cover, fish abundance and fish diversity, although coral diversity at the surveyed sites was low relative to the average of other countries surveyed by the FORCE team. The data from these surveys will be used to investigate the role of reef health and structure in determining fish communities, aiding our understanding of different scenarios of climate change and governance and how they may affect reefs and related livelihoods in the region.

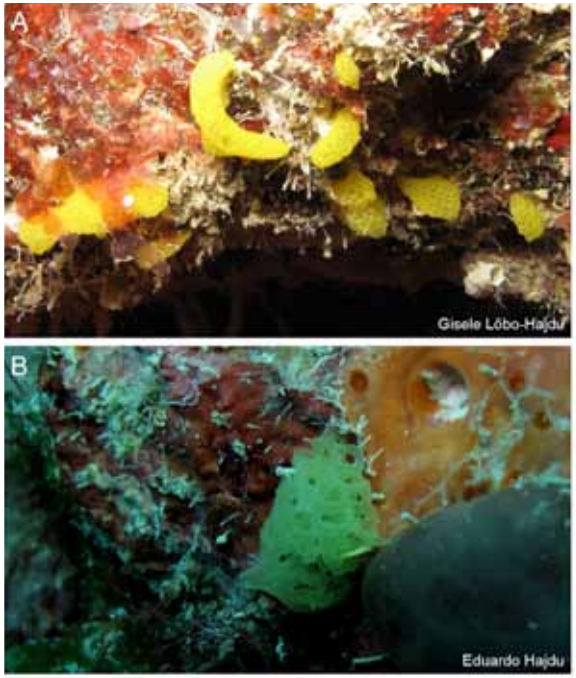


Figure 11: two new species of yellow Clathrina discovered on Curaçao in 2011 by researchers of the Universidade Federal do Rio de Janeiro (UFRJ, Brazil)

2.5.16. Looking for the marine sponge *Clathrina aurea* in Curaçao
Báslavi Cóndor, Prof. Dr. Michelle Klautau and Prof. Dr. Eduardo Hajdu (Universidade Federal do Rio de Janeiro, Brazil)
A team from the Universidade Federal do Rio de Janeiro (UFRJ, Brazil) is studying the unexpected occurrence of the calcarean sponge Clathrina aurea (Porifera) in Southwestern Atlantic (Brazil) and Southeastern Pacific (Peru). For this study the researchers are analyzing the connectivity among those populations and tried to find this species also in Curaçao to investigate if populations kept a continuous distribution through the Panama Channel. Samples collections were performed by SCUBA in the localities of Daai Booi, Hook´s Hut, Sunset Waters, Porto Marie, Playa Kalki, Playa Jeremi and Caracasbaai down to 20 m depth, in August 2011. The UFRJ team had the collaboration of Prof. Gisele Lôbo-Hajdu from the Universidade do Estado do Rio de Janeiro (UERJ, Brazil). Several calcarean sponge species were collected, including individuals morphologically similar to C. aurea. Back in Brazil, these C. aurea-like samples were analyzed using traditional morphological techniques (spicule skeleton composition) and molecular approaches (DNA sequencing). The results indicate that they are not C. aurea and correspond to two new species of yellow Clathrina **(Figure 11)**.

2.5.17. DOC release by benthic primary producers
Benjamin Mueller and Fleur C. van Duyl (Royal Netherlands Institute for Sea Research, The Netherlands)
Dissolved organic carbon (DOC) is the largest pool of reduced carbon in the oceans. Due to its important role in the nutrition of bacteria and macrobenthic reef organisms such as sponges, and its possible role as indicator for reef health, DOC is attracting increasing notice in coral reef research.

Algae and corals have been identified to release DOC in the water column. However, reported DOC release rates vary widely between studies. PhD student Benjamin Mueller and his supervisor Dr. Fleur C. van Duyl from the Royal Netherlands Institute for Sea Research (NIOZ) visited CARMABI to investigate the DOC release of 4 benthic algae, 1 crustose coralline algae (CCA) and two stony corals to answer the question whether algae release more DOC than corals. In order to determine DOC release rates they collected the benthic algal species *Cladophora sp., Dictyota pinnatifida, Halimeda opuntia* and turfalgae, the CCA *Lithophyllum congestum* and the stony corals *Madracis mirabilis* and *Montastraea annularis* on reefs along the leeward coast of Curaçao. The organisms were transported to the Carmabi research station and kept in aquaria **(see Figure 12)** for at least 24 h to let them recover from the handling stress. After recovery they were placed in stirred incubation chambers for 5 hours under natural light conditions and water samples were taken in distinct time intervals to monitor the DOC concentration over time. The dry weight of algae and the surface area of corals and CCA were immediately determined after the incubations. Furthermore, they assessed how much dry weight of algae/ surface area of corals can be found in 1 m2 of reef covered with the respective organism. DOC rates were then calculated and could be expressed in release per m2 of reef covered with the specific algae/coral per hour. Preliminary findings suggest that algae release DOC at constant rates during the daylight period, whereas corals exhibit periods of DOC release and DOC uptake. Overall, algae appear to net release DOC whereas corals tend to net take up DOC. These findings suggest that an increase in the abundance of algae (i.e. phase shift) might lead to a higher production of DOC on coral reefs. This may have major implications for biogeochemical cycles on coral reefs.

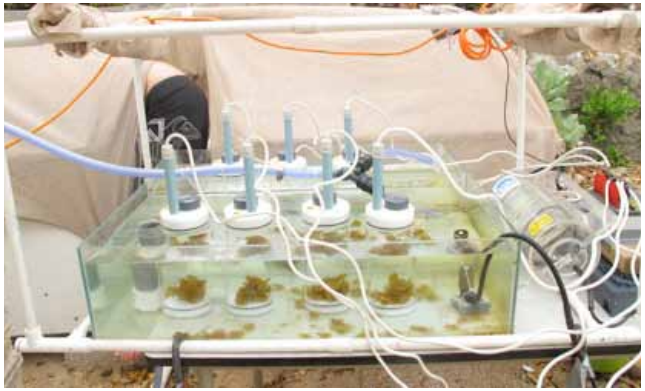


Figure 12: Set up with incubation chambers to determine DOC release rates of corals and algae.

2.6. Academic programs

2.6.1. Coastal Biology (Pensylvania State University)

Dr. Iiana Baums (Penn State, USA)

The Coastal Biology course (Biol482) of the Pennsylvania State University, offers a field trip to Curaçao, where the class experience the coastal environments they have studied during the semester. During the course, the students develop original research proposals that are evaluated by their peers and performed during the stay in Curaçao. Last year projects included titles such as: “Effect of Water Flow on root fouling in Rhizophora mangle Forests” and “Effects of Shell Sizes on Oxygen Consumption in Tropical Hermit”. At the beginning of the week the students have the opportunity to explore the coral reefs, mangroves, seagrass beds, salinas and fossilized reefs of the Island. The rest of the week is devoted to the selected research projects. During their stay at the Carmabi research station the students interact with locals, visiting scientists, and tourists, gaining some insight of Curaçao’s society. In 2011, we were fortunate enough to be there during Carnival. One of the highlights of the trip has been the safari tour to Christoffel Park. This trip was a life changing experience for the students. Says one participant “Doing lab work will never come close to the knowledge that is gained in the field. This is a wonderful course and Penn State should continue to offer it for years to come”.

A video of this class’ adventures on Curaçao can be found at: *http://youtu.be/4Dnb5WMmj4k.* The relevant portions begin at 1:22 and 14:52.

2.6.2. 'International Excursion Tropical Marine Biology' of the University of Amsterdam 2011

Nine students of the University of Amsterdam attended the MSc field course at CARMABI in April 2010 **(Figure 13)**. This course, focusing on the diverse marine life on coral reefs, is the main field excursion of the Master program Limnology and Oceanography of the UvA, but is also open for students from other master programs. The course was taught by Mark Vermeij and Petra Visser with assistance of Joost den Haan. Every day started with a lecture on reef organisms and their ecology. Emphasis was on corals and algae, but the biology and ecology of other reef organisms were also discussed. During the rest of the day, the students were underwater, in the laboratory or studying on the identification of the many coral and macro algal species they observed at the reefs. During the field and lab work, students practiced to make surveys of the benthic community composition, to measure temperature and light profiles, and to determine photosynthetic rates of corals and macro algae using PAM fluorometry. In small groups, students designed their own research plan on a specific topic and performed field and lab work on this topic during one week. This year's topics were: (1) Algal dispersal by herbivores, (2) Feeding ecology of the red lionfish, and (3) nutrient limitation assays for *Lobophora variegata* and phytoplankton. After three weeks, the students presented and discussed their results. During the last week of the course, they focused on data analysis and writing of their report.

Figure 13: Students of the University of Amsterdam's coral reef field course prepare for a dive.

2.7. Research: Long term developments

Carmabi is currently actively 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 currently available at Carmabi and provide accommodations for up to 25 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 Curacaoan Government, the Dutch Ministry of Education, Culture and Science (OCW) and Carmabi itself **(Figure 14)**.

Lastly, one staff member of Carmabi, Dr. M. Vermeij is still (part-time) employed by the University of Amsterdam to oversee research projects of their students and teach the course "Tropical Marine Ecology" in Amsterdam and a fieldcourse at Carmabi. In addition he started teaching a similar course at the University of Utrecht (Netherlands) in 2011.

Figure 14: Carmabi Science Center

Ch3 Parks & Savonet Museum

3.1. Park department

The parks department has fine tuned her objective during 2011 shifting the focus towards a more sustainable financial operation while maintaining high standards of conservation. In order to achieve this goal the department has chosen to direct all efforts to enhance the relationship between man and nature, thus underlining our responsibility towards care and nurture of nature.

Our primary target will at all times remain the local visitor as the love and appreciation for our own nature, culture and history needs to be maintained and improved. The accommodation of a higher number of visiting tourists contributes towards economic growth.

Keeping all the above in consideration the department has undertaken the initial steps during 2011 on a number of endeavors to improve park management. Improvements are realized in the areas of infrastructure, product development, promotion, human resources, partnership and education. Before delving a little deeper into these, however, it would be good to review a few key statistics of 2011.

3.1.1 Statistics Christoffel Park

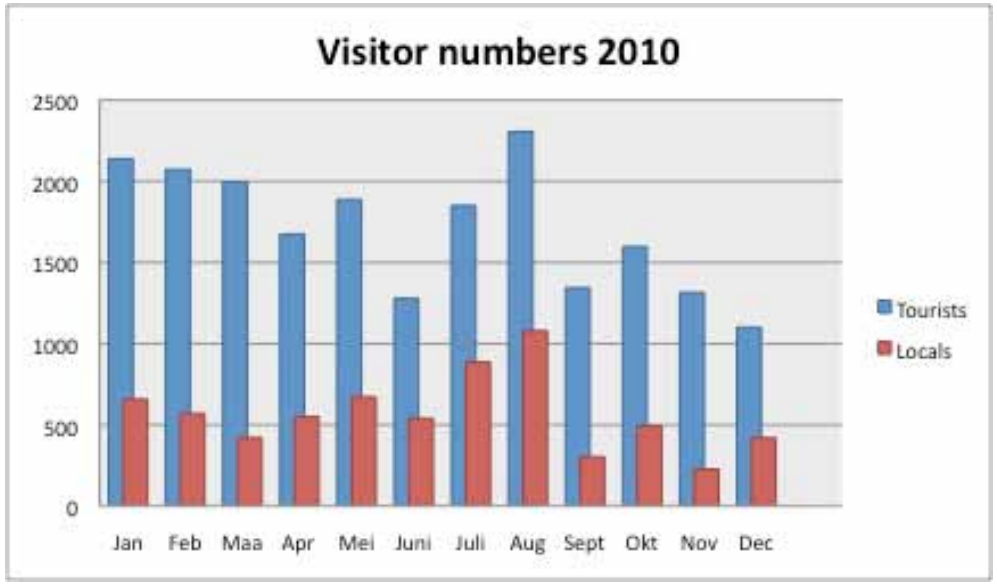


Figure 15

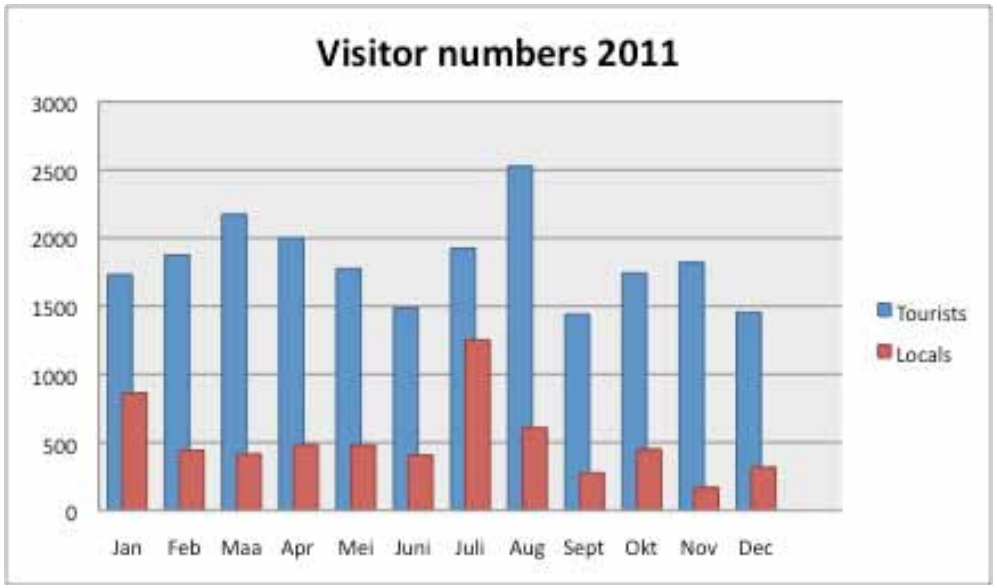


Figure 16

Figure 17

3.1.2. Infrastructure

Christoffelpark: The park infrastructure has for many years been the victim of limitations made to fund allocation. Much needed maintenance work has not been able to proceed. As a result the fence around the park and the path to the top **(Figure 18)** are in a deplorable state. Because of many successive years of heavy rainfall a number of roads and paths in the park had been overgrown. At the end of 2011 much effort has therefore been made through our own personnel and through hiring of outside temporary workers in restoring the two main car routes and to re-open 4 walking trails on the north side of the Christoffelpark. This effort will continue in 2012 as well as making the most southern portion of Christoffelpark, the Zevenbergen area, accessible once more to visitors.

Zorgvliet Plantation House: Preventive and urgent maintenance work needed to be done and has been completed around the ruins of Zorgvliet in order to prevent forever losing this great historic resource.

3.1.3 Product development

Christoffelpark: The initial steps have been undertaken in 2011 and are slated to be completed in the second quarter of 2012 for the development of historical tours within Christoffelpark. These will concentrate around the three Plantation Houses of Savonet, Zorgvlied and Zevenbergen with surrounding structures.

Savonet Museum: Part of the Savonet Storehouse (Magasina) has been converted into a conference center to accommodate groups of up to 50 persons.

Christoffelshop: The Christoffelshop has been re-allocated within the compound of the Savonet Plantation house to better serve the visitor and boost revenue. In 2012 the revenue is slated to be boosted through a diversification of the available sales items.

3.1.4 Promotion

Marketing activities of the department have been downsized during 2011 and limited only towards direct sales promotions through local and foreign parties. A new brochure has been developed for the Christoffelpark and Savonet Museum. The Park department and the department PR & Marketing also made a start in improving the presence of the museum on third party websites.

3.1.5 Human Resources

Because of a vacancy for park ranger the selection process for hiring of a park ranger resulted in a new park ranger starting to work in 2012. Preparations have been made for the first aid training of personnel to be followed by team building and customer services.

3.1.6 Partnerships

Partnerships have been sought and fostered with business partners in the immediate proximity of Christoffelpark. This effort will be further developed and expanded in 2012.

Figure 18: Path to mountain St. Christoffel

3.1.7 Education

The volunteers from the Nature and Environment Education (NME) department have been assisted by the park management to undertake various education activities for schoolchildren such as guided trips within the park and lessons on the life of birds.

3.2. Savonet Museum

The Savonet museum **(Figure 21)** has been opened in 2010. The year 2011 was our first year in which the museum was operational and has been successful. The financial sustainability of the Savonet operations has to improve though. Half of the Savonet historical storage building (magasina) has therefore been converted into a conference center which will be rented to interested parties. The museum grounds will also be rented to parties who are looking for a historical venue to organize events. Examples of such events can be cultural events, sporting events, family celebrations of many kinds and weddings. Catering services are available. Making optimal use of the museum grounds for these purposes will also contribute positively towards the countries cultural and historical heritage.

We also aim at increasing the number of visitors, both local and tourists. During 2011 a study regarding the marketing of the Savonet Museum has been realized. The study was conducted by intern Miran Pool and contains an analysis of the target groups and a strategy in reaching optimal results. It will serve as a point of departure for the implementation of a marketing strategy for the museum. The product itself will also be improved. A plan for a nature museum is being written. The museum will portray both geologic and natural displays which are unique and significant to the area. Furthermore a playground for visiting children and a petting-zoo will be realized.

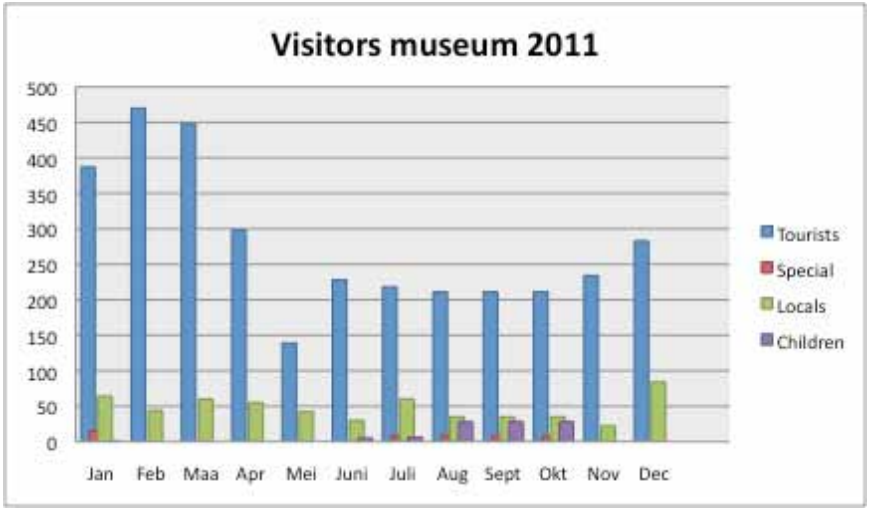


Figure 19

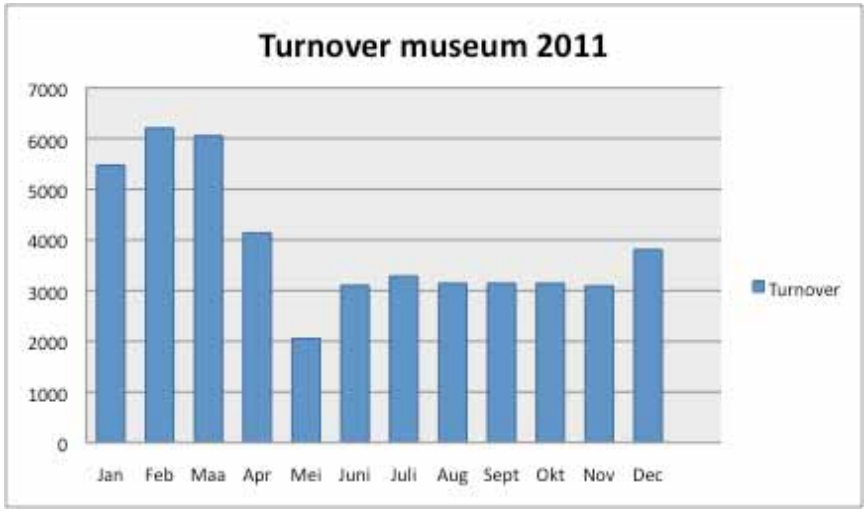


Figure 20

3.3. Shete Boka

The necessary steps to integrate management of Shete Boka Park and the Christoffelpark have been initiated in 2011 and will be completed early in 2012. The marketing of the Christoffelpark product and the Shete Boka Park product will remain separate, thus providing our customers with a wide array of possible venues and activities.

Further developments of the Shete Boka area include re-opening of car-routes, walking trails and picnic areas damaged by recent rains. Furthermore additional walking and biking trails will be developed, some which will include both the Shete Boka Park as well as the Christoffel Park. The creation of additional picnic areas is also planned. The area of Shete Boka is suitable for many outdoor sport activities, the promotion of which will be subject of attention during 2012. The general promotion and marketing of these products will be of high priority.

Figure 21: Savonet museum

Ch4 Small Conservation Area Management

4.1. Daaibooi

The management and care contract for the natural area located behind the beach has not been completed. The efforts to solidify this opportunity will be continued in 2012.

4.2. Hermanus

The management contract of Hermanus with the Island government expired in 2009. A renewal of this contract was requested a the end of 2009. Up till the end of 2011 the renewal of the contract was not finalized.

4.2. Kueba di Yèchi & Kueba di Ratón

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

4.2. Kabouterbos

Problems with regards to water management in the inner city of Willemstad, where kabouterbos is located, have continued to limit the optimal use of the area. Discussions regarding a unified approach pertaining the area together with the neighboring zoo have been held whereby maintenance or enhancement \of kabouterbos as a city park is the primary point of departure for CARMABI.

Ch5 Environmental Education

The school program consists of park visits and school visits. The parks were visited by in total 114 schools. The visited parks included the Christoffelpark, Daaibooi, Kabouterbos and Shete Boka. In total 64 schools were visited for classroom teaching and within these schools 128 classes were taught. During the school year 2010-2011 in total 15,628 kids participated in the Carmabi educational program of which you find the specification below.

The Christoffelpark was visited by 7,182 students from groups 6 and 7. Shete Boka and Daaibooi were visited by 2,375 students from group 8. A total of 2,487 pupils of groups 1,2,3,4 and 5 went to the Christoffelpark for lessons on birds (group 4 and 5) and lessons on nature (group 1,2 and 3). The groups 1,2 and 3 in former years went to the Kabouterbos 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 3,584 students were reached. Schools could choose this year from three topics: Bats, reptiles, domestic animals. Reptiles was the most popular topic followed by bats. Preparations were made for the introduction of the new topic micro world which offers students the possibility to use small microscopes. This topic will be taught the first time in the school year 2011 – 2012.

Since the nature program existed it focused on the nature on land. Nature on land is very important and can be observed easily. The nature in sea is another story. It cannot be observed that easily and is more threatened at this moment than nature on land. Especially the coral reef is threatened by global factors such as global warming and the acidification of the oceans and by local factors such as coastal development, fishery, run-off from land and maritime activities. The coral reef, however, is very important for Curaçao. The coral reef protects our coasts against storms, facilitates coastal fishery, forms the foundation for the dive tourism industry and furthermore a healthy coral reef prevents the build-up of pathogenic bacteria.

For all these reasons we decided to devote more attention to the importance of the coral reef. Our aim is that all children once during their school career have come to Carmabi for a lesson on the importance of the coral reef. We therefore have started end of 2011 the preparations for the creation of a Marine Education Center (MEC) within the existing Carmabi building at Piscadera. We were very happy to receive a donation from the RBC Royal Bank (former RBTT) to make this possible. We hope that this center will be completed next year.

Ch6 Advisory & consultancy services

6.1. Present product offerings

At present Carmabi offers the following products to government departments and private persons:
- Biological inventories and determination of conservation priorities (including monitoring activities)
- Ecological research (terrestrial and marine)
- Vegetation mapping (at island level and of managed park areas)
- Development of park and nature management plans
- Informational and educational products of fauna, flora and ecosystems (terrestrial and marine)
- Surveys of visitors of protected areas
- Reforestation with indigenous plant species.

6.2. Important projects done by the department

A number of important projects were carried out this year and some of these will be briefly described below.

6.2.1 Naturalized and invasive alien plant species in the Dutch Caribbean

Invasive species are considered one of the two biggest threats to nature besides habitat fragmentation. Some authors even consider it the most important threat to biodiversity conservation.
In April the BES islands were visited and a short visit was paid to St. Maarten in order to determine which invasive plant species are a problem or which naturalized species can be found and which one could become a problem based on literature data. Known problematic invasive species are *Cryptostegia grandiflora* (pal'i lechi, rubber vine: **Figure 22**) and *Antigonon leptopus* (beyisima, corallita: **Figure 23**). *Azadirachta indica* ("neem": **Figure 24, blz 42**) has shown on Curaçao to be a potentially very invasive species and a close look will be given to this species on the other islands as well.

Figure 22: Cryptostegia grandiflora overgrowing and killing other plants (Bonaire)

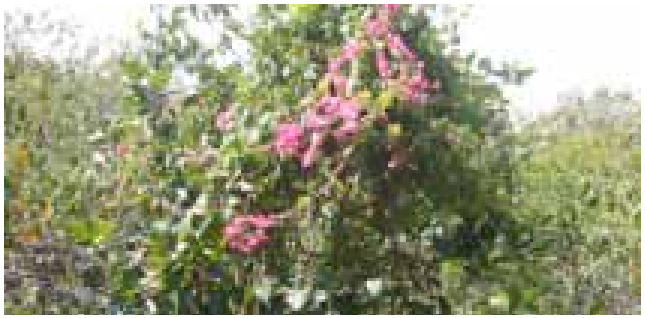


Figure 23: Antigonon leptopus overgrowing other plants (shrubs)

6.2.2. Inventory of Bonaire's coral reefs (with particular attention to previously undescribed phenomena illustrating the ongoing decline of Bonaire's reefs)

Several indicators exist that the reefs along the southwestern shore of Bonaire are currently in decline, despite the fact that Bonaire (arguably) still has "the best reefs in the Caribbean. This short document aims to illustrate that coral reefs on Bonaire are already degrading, in most part in response to land-based human activities. While the new zoning plan will surely help to safeguard the island's natural resources on land, the lack of "integrated coastal management" will not prevent a worsening of the reefs along Bonaire's southwestern shore. The inherent complexity of coral reef ecosystems makes it extremely difficult to make pinpointed management recommendations at present and as such a conservative approach (i.e., "the precautionary principle") should prevail in decisions regarding the future of Bonaire's coral reefs. Future development plans should be designed to minimize the amount of land-based pollutants, i.e., nutrients and organic and/ or chemical compounds, to the coastal environment. Examples include (but are not limited to) reforestation of the lands directly bordering the high water line to serve as a natural filter for terrestrial run-off, prevention of direct flow of rainwater (including that through rainwater systems along roads etc.) to the ocean

through the construction of dams and/ or wetlands and a general reduction in erosion through near shore developments, goats and donkeys.

6.2.3. Biodiversity database

Data on more than 775 indigenous plant species of the six islands of the Dutch Caribbean (Curaçao, Bonaire, Aruba, Saba, St. Eustatius and St. Maarten) were revised or added. In December also input of relevant data on indigenous amphibians and reptiles also started and comprised input on 23 species of reptiles and amphibians. Next year data input on the other half of these groups will take place.

Figure 24: 'Neem' trees in natural areas in the suburbs of Kralendijk (Bonaire)

Figure 24: 'Neem' tree invading the natural area of Jan Thiel (Curaçao)

6.2.4. Vegetation maps of St. Eustatius and Saba

Carmabi has produced vegetation maps for the islands of Curacao and Bonaire. These publications proved very useful as input in spatial planning on these islands and therefore these projects were also undertaken for the Windward Islands. Below you will see the draft maps for St. Eustatius and Saba **(Figure 25)**. These maps will form part of a publication in which a description of the natural vegetation types and landscape types found on the islands will be given. Landscape types are a combination of geomorphological features and vegetation types that occur in those areas.

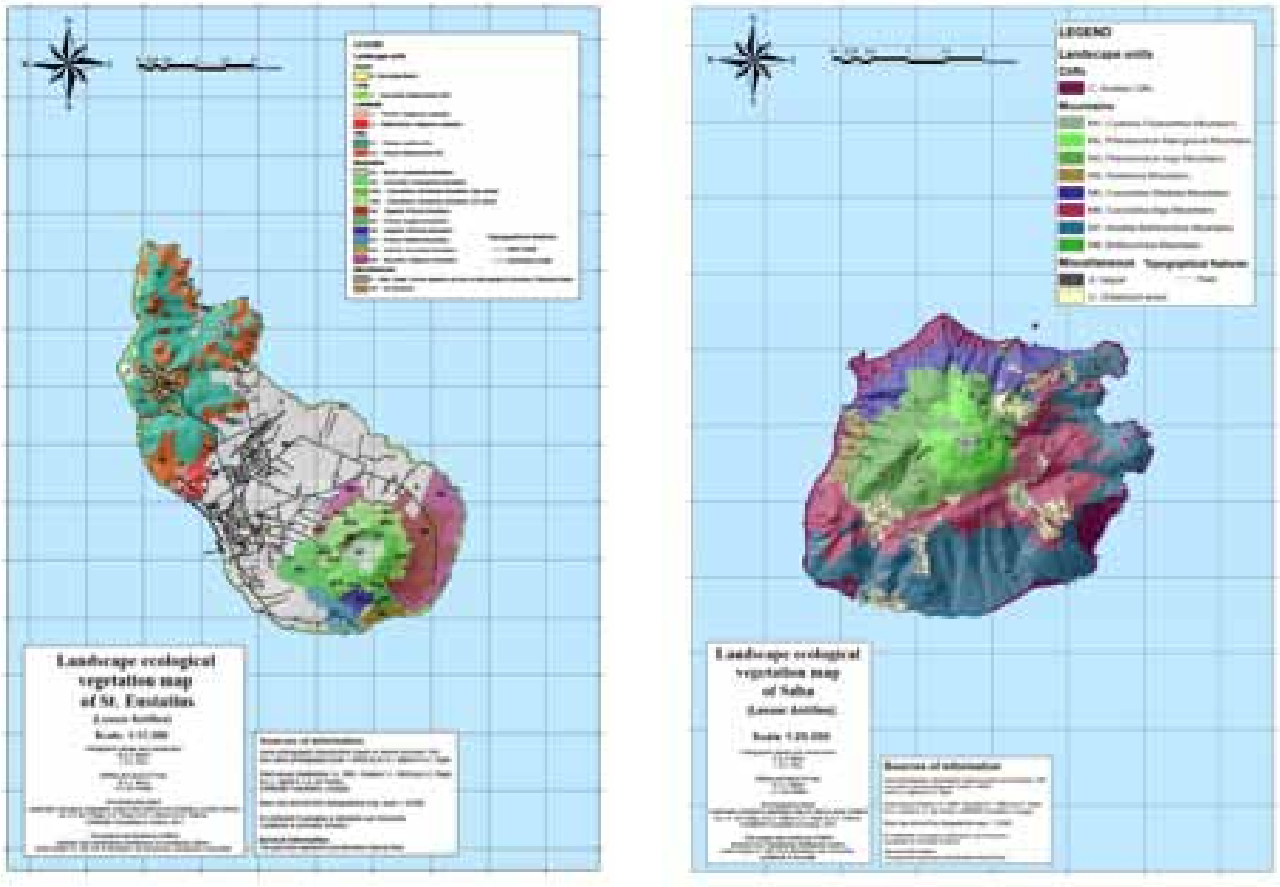


Figure 25: Landscape ecological vegetation maps of Windward Islands of Saba and St. Eustatius

6.2.5. Birds and bats survey in area of new wind farm Tera Kòrá

For this project Carmabi was subcontracted by EcoVision NV. The aim of the project is to determine whether the park of (bigger) wind turbines could have a negative impact on the bird species and bat species that fly around in the area. It is known that important bat populations are found in several caves in the area (e.g. Kueba di Raton, Kueba di Jèchi). In other countries studies have shown that especially migratory species become victims of wind turbines in wind farms. No publications could be found on the possible negative impact of wind turbines on birds and bats in our region. According to scientific publications the following group of birds might be at risk in wind parks: aquatic birds like ducks and herons, raptors (e.g. owls) and marine birds and terns.

In connection with this project we would like to express a word of thanks to the Department of Electrical Systems (ing. C. de Windt and ir. R. Schoop) of the Faculty of Engineering of the University of Curaçao that helped us out with several technical issues we encountered in the later phase of the project **(Figure 26)**.

6.3. Actions taken to improve services

6.3.1. Junior biologist to be added to the department next year

In order to improve the services of the Department for the future we a position for a junior environmental consultant was advertised at the end of this year. The idea is to have this biologist join the department as soon as possible in the beginning of 2012.

6.3.2. Photographic equipment and GPS apparatus

The Department has obtained funding from the Prins Bernhard Cultuurfonds Caribisch Gebied for the purchase of photographic equipment. This will make it possible to make nice photos for our reports when relevant. Funds to buy a GPS apparatus were also donated to Carmabi and this will make it possible to accurately register occurrences of organisms in the field and to make digital maps in which these occurrences can be indicated. We thank the Prins Bernhard Cultuurfonds Caribisch Gebied for their donations!

Figure 26: Equipment installed on a wind test tower in the Tera Kòrá wind farm and used for registration of sounds emitted by bats ('active monitoring')

6.4. Contributions of the Department of Consultancy & Advisory to several important and relevant projects

6.4.1. National plan for 'Hazard mapping and vulnerability assessment'

In August John de Freitas contributed with data and insights on the terrestrial environment to develop a priority matrix for the island's vulnerability assessment. This project is coordinated by the director of the Fire Department as the national disaster coordinator. This project is part of the Regional Risk Reduction Initiative Project a Caribbean program executed by the United Nations Development Programme (UNDP) and funded by European Union. The objective of this regional program is to characterize the natural, and where identified as significant, human-induced hazards to which the Dutch and English overseas territories are exposed and identify geographic and socioeconomic areas of vulnerability. Furthermore the project seeks to strengthen local capacities to develop and implement mitigation strategies by providing tools and best practices to support comprehensive disaster risk management. A consultant from one of the English speaking countries in the Caribbean is working on the final report of all input from the stakeholders.

6.4.2. Alterra (Wageningen University, Netherlands)

As part of a research trip to the BES Islands Caspar Verwer M.Sc. of the Center for Ecosystem Studies of Alterra (institute of Wageningen University) visited Carmabi on October 6. The purpose of the interview of Carmabi's staff member John de Freitas was to hear about the experience and opinion of Carmabi on topics like erosion, erosion control, reforestation, spatial planning and invasive plant species.

6.4.3.Surinam delegation working in the field of ecotourism

On November 22 a quite extensive Surinam delegation consisting of a number of both government officials and business owners working in the field of (eco)tourism visited Carmabi. Their mission was to look into possibilities for future co-operative projects and they were briefed on important aspects of the nature of the island and also its management aspects.

6.4.4. Participation in radio program 'Hoyer i Futuro di nos Medio Ambiente' at Radio Hoyer on World Environmental Day (June 5)
John de Freitas was interviewed in this weekly radio program to talk about the situation of the nature of the island and in which the island mangrove areas received quite some attention together with other aspects of the terrestrial ecosystems and species of Curaçao (with emphasis on the Christoffelpark).

6.4.5. John de Freitas lecturer in course 'Sustainable development' of Master Program of the Law Faculty of the University of Curaçao
As part of the co-operation program between the University of Curaçao and Carmabi, John de Freitas was invited to give two lectures during the Master course 'Integratievak2'.

6.5. Reports by the department of consultancy and advisory services

• EcoVision & Carmabi. 2011. Bird and bat monitoring survey Wind farm Tera Kòrá. 80 pp.

• Freitas, J.A. de. 2011. Inventarisatie van beschermde planten in het wegtracé en aangrenzende kavels in Sabadeco Crown West fase 2 en 3. Carmabi report. 26 pp.

• Freitas, J.A. de. 2011. Mogelijke schade aan de flora van het conserveringsgebied Tera Kòrá als gevolg van de werkzaamehden die verband houden met het transport en de installatie van de nieuwe windturbines. Rapport in opdracht van NuCuraçao Windparken BV. 22 pp.

• Freitas, J.A. de. 2011. Flora- en landschapstypen Playa Kanoa. Rapport in opdracht van NuCuraçao Windparken BV. 17 pp.

• Haberkorn, D. 2011. Mapping potential distributions and identification of factors that determine the occurrence of rare plant species in the Christoffelpark on the island of Curaçao (Dutch Caribbean). Carmabi & University of Wageningen. 55 pp.

• Lace, M.J., J.E. Mylroie, P.N. Kambesis & E. Larson. 2011. Slope failure risk at the Hato International Airport, Curaçao. Carmabi Report. 9 pp.

• Lace, M.J., J.E. Mylroie, P.N. Kambesis & E. Larson. 2011. Assessment of the stability of the Hato caves. Carmabi Report. 12 pp.

• Velde, J. van der, J.C. Barrois & J. de Freitas. 2011. Bonaire Bolivia analyse omgevingsaspecten en vlekkenplan. RBOI & Carmabi. 17 pp.

• Vermeij, M.J.A. 2011. Inventory of Bonaire's coral reefs (with particular attention to previously undescribed phenomena illustrating the ongoing decline of Bonaire's reefs). Carmabi Report. 17 pp.

• Vermeij, M.J.A. 2011. Environmental associated with the planned expansion of Karel's Beach Bar, Bonaire. Carmabi Report. 22 pp.

• Vermeij, M.J.A. 2011. Impact on the environment of two proposed piers near the future Delfins/Chogogo Resort, Bonaire. Carmabi Report. 12 pp.

Ch7 PR & Marketing

7.1. PR & Marketing department

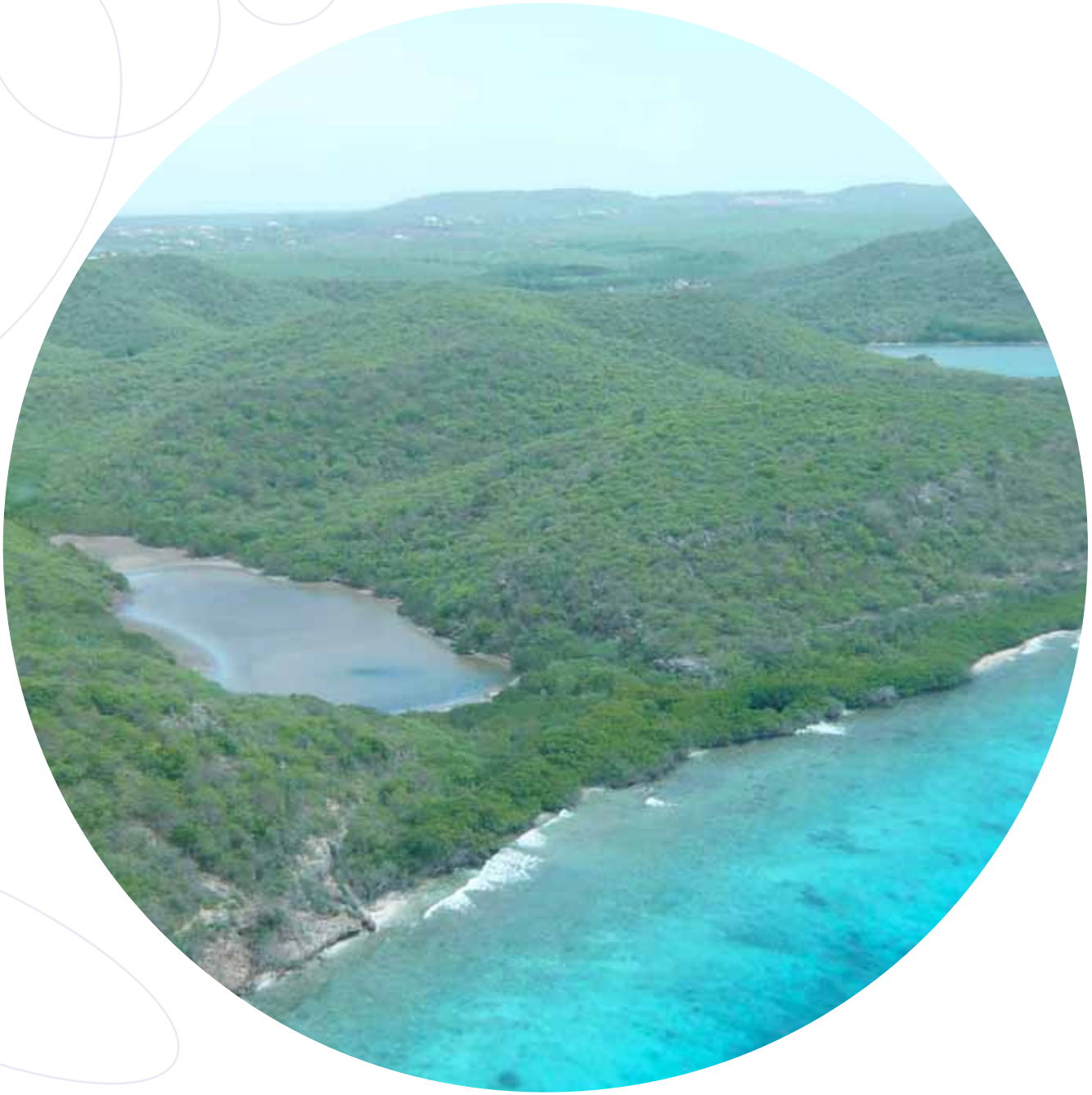
The PR & marketing department is a relatively young department. It became an official department in September 2011. Before it became an official department PR & Marketing were executed by the former park manager.
The department is in charge of the corporate communication of Carmabi Foundation and the marketing of its products, such as the Christoffelpark, Savonet Museum and the Science center.
The main focus of the PR & Marketing department in 2011 was creating a clear structure within the department, maintaining the corporate style, writing communication plans and press releases.

7.2. Future: Projectlist 2012

- Restructure corporate website and sub-websites
- Corporate communication plan Carmabi
- Marketing communication plan Savonet
- Marketing communication plan Christoffelpark
- Marketing communication plan Science center
- Donation program
- Social media program
- Media Center

7.3. Other efforts

For more marketing/sales efforts executed in 2011, please also read Chapter 3.



Ch8 Miscellaneous

8.1. Carmabi Science Center

The construction of the Carmabi Science Center, next to the main Carmabi building at Piscadera, is progressing rapidly. On the 22nd of July Minister Constancia laid the first stone. Although two construction workers stood by to assist her, she lifted and placed the heavy “blokki 8” all by herself. On the 2nd of December the highest point was reached and the traditional “Spantenbier” could be celebrated. This was done in the presence of Ministers Lionel Jansen (Education, Science, Culture and Sport) and Jacinta Constancia (Health, Nature and Environment) and the deputy Representative of Holland, Mrs. Patricia Grollé who, in unity, sprayed the white flag with beer. The building is expected to be completed end of November this year. The design of the Science Center was done by the design bureau Broos van Werkhoven. The construction is done by the contractors firm Nederlands Antilliaans Bouwbedrijf (NAB).

Initially the Science Center was expected to cost approximately ANG 3.1 million. Of this amount, ANG 2.7 million was funded by the Social Economic Initiative (SEI), a program funded by the Dutch government and Carmabi contributed ANG 417,000. After the design was completed the cost of building had risen to almost ANG 4.8 million. We lacked almost ANG 1.7 million.

We were therefore very happy with the decision of Secretary General Roborgh of the Ministry of Education, Culture and Science in Holland to donate € 500,000 to cover a large part of difference. We were also happy with the decision of the Council of Ministers in Curaçao to provide ANG 440,000 to supplement the donation of the Ministry and cover the remainder of the difference.

The new building will provide space for a cafeteria annex presentation room on the ground floor. The first floor will harbor new laboratory facilities as well as a bigger library. Student dormitories will occupy the second floor whereas on the third floor, the space below the roof, the somewhat more luxurious “professor” rooms will be constructed.

The new building makes expansion of the science program possible. The advantages are twofold. Firstly more research is done and more knowledge is generated. This knowledge can be used to improve management of the coral reef. A well managed reef contributes a lot to the Curaçao economy because of money generated through diving tourism and fishery and money saved through less need for artificial coastal protection and less public health costs because of clean sea water. A coral reef thus generates in between ANG 1,6 million and ANG 16 million per running kilometer per year. Secondly the spending of the foreign students within the Curaçao economy amounts to about ANG 1 million at present. Because the Science Center makes it possible to expand the science program this amount will be more or less doubled in ten years.

Figure 27: First stone Carmabi Science Center

Figure 28: Spantenbier

Figure 29: Carmabi Science Center

Figure 30: Carmabi Science Center

Figure 31: Carmabi Science Center

Figure 32: Carmabi Science Center

8.2. Hato Caves

During the last months of 2010 it rained a lot. The Hato Caves are inside a limestone rock wall. Since limestone is quite porous and allows water to pass through it literally rained inside the Hato Caves. As a result part of the caves was also inundated. This posed two problems. First of all the cave guides became quite nervous fearing that the caves might collapse. Secondly the electrical installation, that provides light in the caves, failed because of many short circuits. The cables were buried about twenty years ago along the paths in the caves in a not very professional way and were now affected by the water.

To solve the first problem we invited a team of limestone cave experts from the Department of Geosciences, Mississippi State University. This team headed by professor John E. Mylroie investigated the caves and concluded the caves were save. Later on an official report was presented.

The second problem was more difficult to solve. After studying the problem it was concluded that the entire electrical installation needed to be replaced completely and the caves were temporarily closed for security reasons. We invested about ANG 100,000 replacing the entire electrical installation. The caves are now save to enter again and fully operational.

Figure 33: Hato Caves team

8.3. Queens visit

Queen Beatrix accompanied by her son Prince Willem-Alexander and his wife Princess Maxima visited Curaçao end of 2011. Initially a visit to Savonet was included in the program of the Royal Party. Later the program was changed and the director, Mr. Stokkermans, was invited to a diner with the royal guests in the governors palace in Punda on the 2nd of November. During the diner their was a lot of room for discussion because the tables were organized in such a way that each table had a theme and the royal guests rotated amongst the tables. The deterioration of the Curaçao coral reef was brought to the attention of the Queen, Prince and Princess by the Carmabi Director.

8.4. Introductory Tour New Representative of Holland

On the 5th of August 2011 an introductory tour was organized for the new Representative of Holland on Curaçao, Mr. Gerard van der Wulp, who would like to know more about the nature on Curaçao. Mr. van der Wulp was accompanied by Mr. Bart Snels, also from the Representation of Holland. The tour was organized and guided by the director of Uniek Curaçao, Mr. Theo van der Giezen, and the director of Carmabi, Mr. Paul Stokkermans. The first stop was at Carmabi at Piscadera were the new Science Center under construction was visited. This Science Center is financed mainly by the Dutch Government. Paul Stokkermans informed the party about the progress made. The second stop was at Ascencion Park were Theo van der Giezen guided the party and explained about the work of Uniek Curaçao being done at the Ascencion. The last stop was made at Savonet were Mr. van der Wulp was given a tour of the museum by Helena de Bekker.

Figure 34

Ch9 Donations

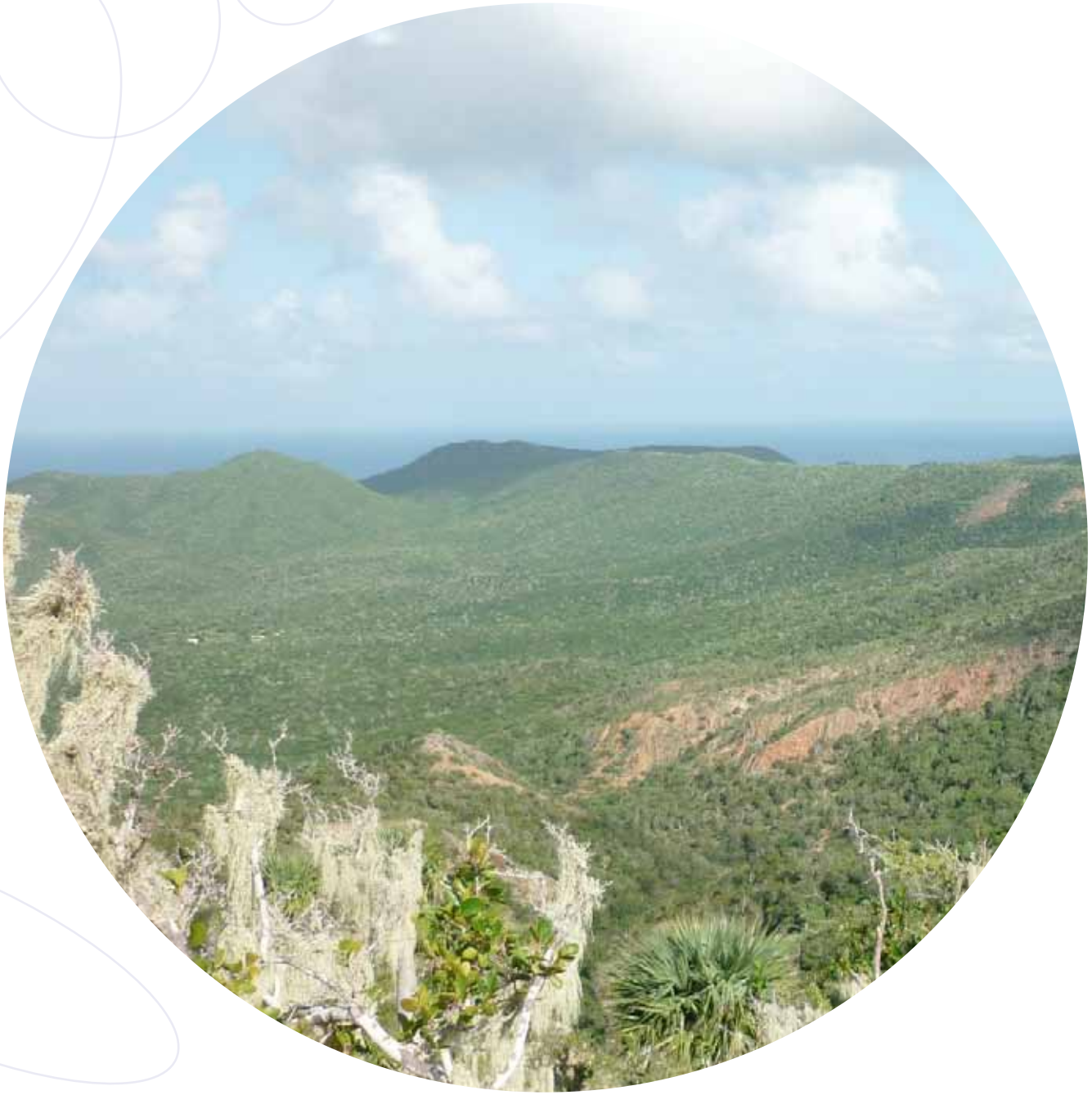
Donors

• Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (BZK) Nederland
• Ministerie van Onderwijs, Wetenschap en Cultuur (OCW) Nederland
• Ministerie Gezondheid, Milieu en Natuur (GMN) Curacao
• EU
• Nationale Postcode Loterij
• Prins Bernhard Cultuurfonds
• Percy Henriquez Fonds
• Bellevue Curaçao NV
• RBTT Bank
• ING Bank
• Samenwerkingsverband Nationale Parken Nederland
• International Union for Conservation of Nature (IUCN)
• Reefcare
• Vrienden van Carmabi

Volunteers

• Ryan de Jongh
• Eric Newton
• Gerard van Buurt
• Mark Fraites
• Ans Bronneberg
• Frensel Mercelina
• Reginald Rosario
• Yvonne Losano
• Thelia Lieuw Sjong

on behalf of Carmabi Foundation



Ch10 Committees & workrelations

10.1. Forum IUCN Dominican Republic

Carmabi director Paul Stokkermans attended from the 5th till the 7th of October 2011 the 7th IUCN Regional Mesoamerican Forum and the 1st IUCN Caribbean Forum in the Dominican Republic. The IUCN helps the world find pragmatic solutions to the most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice. Carmabi is a member of the IUCN.

Figure 35: Forum IUCN Dominican Republic

The meeting was organized by the IUCN Regional Office for Mesoamerica and the Caribbean Initiative (IUCN-ORMA/Caribe). It was the first time the Caribbean held a Forum of its own. During the Forum an analysis of the regional situation, the IUCN 2013-2016 World Program and the preparations for the World Conservation Congress to be held in Jeju Island, Republic of Korea, 6-15 September 2012, were discussed.

During the Forum also a meeting of the Caribbean Regional Committee was held. Carmabi was elected as the treasurer of the committee.

Figure 36: Forum IUCN Dominican Republic

10.2. Meeting DCNA Aruba

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

The DCNA holds two meetings every calendar year. In 2011 the meetings were held 24-26 May in St. Eustatius and 15-17 November in Aruba. Carmabi director Paul Stokkermans participated in the Aruba meeting. During the meeting many conservation and organizational issues were discussed. Part of the meeting was a tour of the Arikok National Park which is managed by the Arikok National Park Foundation. The tour was guided by the director of the foundation Mr. Roy Maduro.

Ch11 Financial report

BALANCE SHEET AS AT DECEMBER 31, 2011

	2011 ANG	2010 ANG
Assets		
Non-current assets		
Property and plant	282,847	290,387
Other fixed assets	123,669	140,886
	406,516	431,273
Current Assets		
Receivables	231,646	265,254
Inventory	11,104	19,860
Cash and cash equivalents	1,162,502	1,308,749
	1,405,252	1,593,863
Total assets	1,811,768	2,025,136

	2011 ANG	2010 ANG
Equity and liabilities		
Equity		
Capital	106	106
Earmarked reserve	420,782	517,000
Retained earnings	337,903	557,439
	758,791	1,074,545
Non-current liabilities		
Non interest bearing loans and borrowings	154,000	154,000
Deferred income	65,128	65,128
	219,128	219,128
Current Liabilities		
Pension contribution payable	106,561	102,109
Taxes and social security payable	51,390	40,486
Other liabilities	675,898	588,868
	833,849	731,463
Total equity and liabilities	1,811,768	2,025,136

STATEMENT OF OPERATIONS FOR THE YEAR 2011

	2011 ANG	2010 ANG
Income		
Grants	557,984	550,122
Admission fees	493,907	429,734
Rental income	140,886	208,528
Other income	443,032	1,041,025
	1,635,809	2,229,409
Expenses		
Personnel expenses	1,193,792	1,098,002
Depreciation expenses	40,881	44,920
Other operating expenses	737,299	542,848
	1,971,972	1,685,770
Operating result	(336,163)	543,639
Interest income	20,409	17,595
Result for the year	(315,754)	561,234
Earmarked in 2011		
Investment in Knowledge Center	-	417,000
Maintenance Hato Caves	(96,218)	100,000
Retained earnings	(219,536)	44,234
	(315,754)	561,234

Appendix I Publications & reports

Peer reviewed scientific publications

1. Barott KL, Rodriguez-Brito B, Janouškovec J, Marhaver KL, Smith JE, Keeling P, Rohwer FL (2011) Microbial diversity associated with four functional groups of benthic reef algae and the reef-building coral *Montastraea annularis*. Environmental Microbiology 13: 1192–1204.

2. Barott KL, Rodriguez-Brito B, Youle M, Marhaver KL, Vermeij MJA, Smith JE, Rohwer FL (in press) Microbial to reef scale interactions between the reef-building coral *Montastraea annularis* and benthic algae. Proceedings of the Royal Society B.

3. Debrot AO, van Buurt G, Vermeij MJA (2011) Preliminary overview of exotic and invasive marine species in the Dutch Caribbean. IMARES Report number C188/11. 29pp.

4. Dornburg A, Warren DL, Iglesias T, Brandley MC (2011) Natural History Observations of the Ichthyological and Herpetological Fauna on the Island of Curaçao (Netherlands Antilles). Bulletin of the Peabody Museum of Natural History 52(1):181-186. 2011

5. Foster NL Paris CB, Kool JT, Baums IB, Stevens JR, Sanchez SA, Bastidas C, Agudelo C, Bush P, Day O, Ferrari R, Gonzalez P, Gore S, Guppy R, McCartney M, McCoy C, Mendes J, Srinivasan A, Steiner S, Vermeij MJA, Weil E, Mumby PJ (in press) Connectivity of Caribbean coral populations: complementary insights from empirical and modelled gene flow. Molecular Ecology.

6. Fricke A, Titlyanova TV, Nugues MM, Bischof K (2011) Depth-related variation in epiphytic communities growing on the brown alga *Lobophora variegata* in a Caribbean coral reef. Coral Reefs. DOI 10.1007/s00338-011-0772-0

7. Fricke A, Teichberg M, Beilfuss S, Bischof K (2011) Succession patterns in algal turf vegetation on a Caribbean coral reef. Botanica Marina 54: 111-126.

8. Huijbers CM, Nagelkerken I, Govers LL, van de Kerk M (2011) Habitat type and schooling interactively determine refuge-seeking behavior in a coral reef fish throughout ontogeny. Mar. Ecol. Prog. Ser. 437: 241–251. Open access.

9. Hultgren KM, MacDonald K, Emmett D (2011) Sponge-dwelling snapping shrimps (Alpheidae: Synalpheus) of Barbados, West Indies, with a description of a new eusocial species. Zootaxa 2834:1-16.

10. Grimsditch G, Arnold S, de Bey H, Brown J, Engel S, de Leon R, Vermeij MJA (2011) Coral Reef Resilience Assessment of the Bonaire National Marine Park, Netherlands Antilles. IUCN. Open access.

11. Grol MGG, Nagelkerken I, Rypel AL, Layman CA (2011) Simple ecological trade-offs give rise to emergent cross-ecosystem distributions of a coral reef fish. Oecologia 165:79–88.

12. Grol MGG, Nagelkerken I, Bosch N, Meesters EH (2011) Preference of early juveniles of a coral reef fish for distinct lagoonal microhabitats is not related to common measures of structural complexity. Mar. Ecol. Prog. Ser.: 432: 221–233.

13. Kelly LW, Barott KL, Dinsdale L, Friedlander AM, Nosrat B, Obura D, Sala E, Sandin SA, Smith JE, Vermeij MJA, Williams GJ, Willner D, Rohwer F (2011) Iron induced phase-shifts on coral reefs. ISME Journal. doi:10.1038/ismej.2011.114.

14. Kimireia IA, Nagelkerken I, Griffioen B, Wagner C, Mgaya YD (2011) Ontogenetic habitat use by mangrove/seagrass-associated coral reef fishes shows flexibility in time and space. Estuarine, Coastal and Shelf Science 92: 47-58.

15. Marhaver KLM (2011) Bleaching corals of two species appear to feed from neighboring algal turfs. Coral Reefs DOI: 10.1007/s00338-011-0782-y

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Scientific reports

1. EcoVision & Carmabi. 2011. Bird and bat monitoring survey Wind farm Tera Kòrá. 80 pp.

2. Freitas, J.A. de. 2011. Inventarisatie van beschermde planten in het wegtracé en aangrenzende kavels in Sabadeco Crown West fase 2 en 3. Carmabi report. 26 pp.

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Appendix II Board & Personnel

Personnel 2011

Board

• Dito Abbad M.Sc., chairman
• Peter Bongers M.Sc., treasurer
• Jeff Sybesma PhD, secretary
• Erwin Koense, board member
• Verna Garmes LLM, board member

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

Carmabi ambassador in the Netherlands
• André Cohen Henriquez

Scientific Department
• Mark Vermeij PhD, head of the section

Consultancy department
• John de Freitas M.Sc., manager

Nature management section
Christoffelpark
• Antoine Solagnier Park manager
• Cyrill Kooistra, Ranger
• Wolter Samboe, Ranger
• Pedro Andrea, Ranger
• Briand Victorina, Ranger
• Oswald Ricardo, Ranger
• Mark Paul Wisman, Technician
• Alice Cijntje, Front desk officer
• Araceli Ersilia, Front desk officer
• Sharletta Victorina, Front desk officer
• Rachel Tokaai, Assistant events & sales
• Abigail Flocker, Assistant restaurant
• Shudeska Eisden, Assistant restaurant
• Xiomara Concetion, Janitor

Marine Park
• Ryan de Jongh, volunteer, Honorary Staff member
Kabouterbos
• Cyrill Kooistra, Ranger
Hato Caves
• Contracted to Indian Caves N.V. (Mrs. M. Vrolijk)

Environmental education section
• Paul Stokkermans M.Sc.

(Semi) Volunteers education section
• Clarette Schoop, Guide NME
• Sonaly Rijnschot, Guide NME
• Ruthlyn Bernadina, Guide NME
• Erquiles Albertus, Guide NME
• Ludgardys Cijntje, Guide NME

Marketing & PR department
• Kim-Lee Mattheus, Head Marketing & PR

Administration department
• Ethline Isenia, Head administration & financial controller
• Shahaira Martina: Assistant financial controller
• Larissa Hooi-Francisca: Administrative assistant &Office manager

New personnel 2011
• Antoine Solagnier, Park manager
• Kim-Lee Mattheus, Head Marketing & PR
• Larissa Hooi-Francisca
• Shudeska Eisden
• Ludgardys Cijntje
• Erquiles Albertus

Left/retired 2011
• Leon Pors M.Sc.
• Michelle da Costa Gomez B.Sc.
• Janine Albert
• Xiomara Flemming
• Maria de Los Angeles Francisca
• Nelson Hooi
• Joanne Rich
• Miran Pool (intern)

Board

				
Dito Abbad	Peter Bongers	Jeff Sybesma	Erwin Koense	Verna Garmes

Personnel

						
Paul Stokkermans	Mark Vermeij	John de Freitas	Antoine Solagnier		Ethline Isenia	Shahaira Martina
						
Larissa Hooi-Francisca	Carlos Winterdaal	Sislyn Rosalia	Cyrill Kooistra	Wolter Samboe	Pedro Andrea	Briand Victorina
						
Oswald Ricardo	Mark Paul Wisman	Alice Cijntje	Araceli Ercilia	Rachel Tokaai	Shudeska Eisden	Abigail Flocker
						
Xiomara Concetion	Sonaly Rijnschot	Ruthlyn Bernadina	Clarette Schoop	Erquiles Albertus	Ludgardys Cijntje