

BIONEWS



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Editor's Letter

Dutch Caribbean, October 2019

A recently published report issued by the Kingdom of the Netherlands has sounded the alarm that only four of twenty 'Aichi Targets' of the 'Convention on Biological Diversity (CBD)' have been achieved in the Dutch Caribbean, highlighting increased need for conservation management actions in the Caribbean part of the Kingdom. The CBD is an international agreement under the United Nations Environment Program that aims to provide an international legal framework to support the conservation and sustainable use of natural resources, ensuring the preservation of biological diversity of contracting parties. In order to achieve this, the contracting parties to the CBD have established a set of goals and targets to promote conservation and sustainable use of natural resources worldwide known as the Aichi Targets. The Kingdom of the Netherlands highlights that of the twenty targets which were set for 2020 only four are on track of being achieved on time. These results stress the immediate need for action by conservation groups and government agencies alike.

A collaborative effort between private, government and university partners, has been working to develop a microalgae production test facility on Bonaire to create a renewable food source for food and animal feed. Further research could also lead to the use of the microalgae to produce a biofuel which could be used in place of fossil petroleum. The project will soon enter its second phase, with the construction of a small-scale facility to prove the feasibility of the project on the island.

The Bridled Quail-dove is a regionally endemic species that, on Statia, is only found in upper elevations of the Quill (above ~150m) and inside the crater. Since 2017, annual surveys have highlighted an alarming decline in populations. At an estimated population decrease of ~77% since 2017, this species has caught the attention of conservationists and requires immediate protection.

The new RAAK PRO Diadema project aims to restore long spined sea urchin populations (scientific name *Diadema antillarum*) on the coral reefs around Saba and St. Eustatius. Long spined sea urchins were the

most important herbivores on Caribbean coral reefs. In 1983, more than 95% of the sea urchins died, due to an unknown disease. Without the grazing of the sea urchins, the algae increased in abundance, smothering adult corals and inhibiting the settlement of juvenile corals. As a result, the reef became covered with algae instead of corals. Nowadays, more than 35 years after the die-off, long spined sea urchins are still very rare. They are sometimes abundant in shallow waters, such as harbors, but are seldom seen on the deeper coral reef.

During the 2019 edition of the DCNA convention on Bonaire, biologists from local organizations such as Aruba National Park Foundation, STINAPA Bonaire, Reef Renewal Foundation Bonaire, CARMABI Curaçao, Saba Conservation Foundation, Sint Maarten Nature Foundation and STENAPA and CNSI of Sint Eustatius will be united on October 28 for a full day of workshops. The central focus of the workshops is coral recovery, with insights from science and with best practices. The Dutch Organization for Scientific Research (NWO) and the World Wildlife Fund will also be present. In addition to their participation in the other workshops, Arjan de Groene (WWF-NL) will give a presentation about the coral action plan for the Caribbean Netherlands and Joseph Stuefer (NWO) will further elaborate on the upcoming call for scientific research proposals in the Dutch Caribbean.

An international research team is on Bonaire from 21 October to 9 November to investigate its marine biodiversity. Although Bonaire's reefs are well monitored, their marine biodiversity has not been well explored. Since Bonaire is rich in marine habitats, it has a high potential for the discovery of rare species or even species new to science. Eventually, the team hopes to say more about how species diversity is distributed around the island and how it compares with that of other Caribbean islands.

Enjoy!
The DCNA Team

Kingdom Report Sounds Alarm on Biodiversity Conservation in the Dutch Caribbean

Only Four of Twenty Biodiversity Targets On Track to Achieve Goals in the Dutch Caribbean

A recently published report issued by the Kingdom of the Netherlands has sounded the alarm that only four of twenty 'Aichi Targets' of the 'Convention on Biological Diversity (CBD)' have been achieved in the Dutch Caribbean, highlighting increased need for conservation management actions in the Caribbean part of the Kingdom. The CBD is an international agreement under the United Nations Environment Program that aims to provide an international legal framework to support the conservation and sustainable use of natural resources, ensuring the preservation of biological diversity of contracting parties. In order to achieve this, the contracting parties to the CBD have established a set of goals and targets to promote conservation and sustainable use of natural resources worldwide known as the Aichi Targets. The Kingdom of the Netherlands highlights that of the twenty targets which were set for 2020 only four are on track of being achieved on time. These results stress the immediate need for action by conservation groups and government agencies alike. The Dutch Caribbean Nature Alliance (DCNA) stresses that although current support from the Netherlands is mainly aimed at the islands of Saba, St. Eustatius and Bonaire which are now constitutionally part of the Netherlands, nature knows no borders and it is therefore of the utmost importance that the Kingdom of the Netherlands supports the

nature conservation plans and projects of all six Dutch Caribbean Islands.

The current Strategic Plan for Diversity was signed by all contracting parties of the CBD convention in 2010 and runs through 2020. The plan highlights twenty biodiversity benchmarks known as the "Aichi Biodiversity Targets". Every five years, each participating country including the Kingdom of the Netherlands is expected to submit a National Report on the current status for these benchmarks, the latest report gives an update through 2018.

Since 2010, the Kingdom of the Netherlands consists of the Netherlands, with the public entities Bonaire, Saba and Sint Eustatius; and three autonomous countries, Aruba, Curaçao and Sint Maarten. Collectively Aruba, Bonaire, Curaçao Saba, Sint Eustatius and Sint Maarten are called the Caribbean part of the Kingdom of the Netherlands or the Dutch Caribbean.

Alarming Trends

This most recent report from the Kingdom of the Netherlands, released in April this year, states that although there has been some significant progress toward meeting the national targets, the 2020 deadline will not be fully met. For the Dutch Caribbean, the largest threats to reaching the Aichi Targets are amongst others overgrazing by free roaming feral livestock, invasive species,

overfishing, and pollution. These threats make island habitats less resilient to the major threat of climate change. The report also states that not enough is being done to deal with these local threats.

In total sixteen of the twenty Aichi targets are not on track for one or more of the Dutch Caribbean islands in achieving the 2020 targets. Additionally, a total of 13 targets are on progress but at an insufficient rate for some of the islands. Furthermore, it was found that, for the Dutch Caribbean islands, an alarming five of the Aichi Targets had a worsening trend, while no significant change was seen for 50% of the targets for some of the Dutch Caribbean islands. The five targets with a worsening trend on some or all of the Dutch Caribbean islands includes (5) loss of natural habitats, (7) sustainable agriculture, (12) reducing risk of extinction, (14) ecosystem services, (15) ecosystem restoration and resilience.

Successes

The report did highlight some successes for the Dutch Caribbean and four targets are currently on track to reach the 2020 targets for some of the islands. These Aichi targets are (1) awareness of biodiversity, (2) biodiversity values integrated into national and local development and poverty reduction strategies and planning, (8) pollution reduction and (17) establishing biodiversity strategies and action plans. The report reflects



A degraded Dutch Caribbean coral reef.
Photo by: © Erik Meesters (WUR)

positively on the public awareness campaigns across all of the Dutch Caribbean that stresses the importance of protecting nature, reducing pollution and encouraging sustainable use of resources. The other three targets are only on track to achieve the targets on the so-called BES-islands of Bonaire, St. Eustatius and Saba.

In many cases, long-term monitoring data is lacking for many of the twenty Aichi Targets on each of the six Dutch Caribbean islands, therefore, the analysis completed was based on experts' judgments and the actual success varied significantly across the six Dutch Caribbean islands. Since 2010, the BES islands saw an overall increase in funding support and conservation actions, and therefore probably saw greater improvements when compared against Aruba, Curaçao and Sint Maarten, though clearly not enough.

Urgent call for support to all islands

The CBD report highlights both the successes and failures of current environmental policies and management practices in the Dutch Caribbean. The six Dutch Caribbean islands are a part of the larger Caribbean Islands Biodiversity Hotspot including many natural habitats including coral reefs, mangrove forests, seagrass beds, tropical cloud and

rain forests, and caves all with a high level of biodiversity (number of plant and animal species). These islands are highly dependent on the health of these ecosystems both economically and socially. For all Dutch Caribbean islands to meet the Aichi Targets will not be possible without continued support from local conservation groups, public volunteers and governmental aid.

The Dutch Caribbean Nature Alliance (DCNA) is a non-profit foundation that works with dedicated nature management organizations on the six Dutch Caribbean islands to protect biodiversity and stimulate sustainable nature conservation efforts. Every island in the Dutch Caribbean has its own unique natural habitats but faces similar challenges to keep them protected. Climate change, deforestation, overfishing, sargassum influx events, rampant construction and the effects of unsustainable tourism are only a few examples. Collaboration and knowledge sharing is critical in maximizing the efficiency of these efforts.

The full report for the Kingdom of the Netherlands can be found here:

<https://www.dcbd.nl/document/sixth-national-report-kingdom-netherlands>




Snowy Egret (*Egretta thula*) between pencil-like roots of black mangrove
Photo by: © Marjolijn Lopes Cardozo

Kingdom Report Sounds Alarm on Biodiversity Conservation in the Dutch Caribbean

The 20 Aichi Targets for the Dutch Caribbean

THE AICHI TARGETS:



| Target Category | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | |
|---|-----|-------------------|--------------------------|-------------------|-----|---------------------------------|-----|-------------------|-----|-----|-----|----|----|----|----|-------------------|-------------------|----|----|--------------------------|-------------------|
| On track to exceed target | | | | | | | | | | | | | | | | | | | | | |
| On track to achieve target | All | BON SAB EUX | | | | | | BON SAB EUX | | | | | | | | | BON SAB EUX | | | | |
| Progress towards target but at an insufficient rate | | AUA SXM | AUA BON SAB EUX | BON SAB EUX | | BON CUR SAB EUX SXM | | AUA CUR SXM | All | All | All | | | | | BON SAB EUX | SXM | | | BON CUR SAB EUX | BON SAB EUX |
| No significant change | | CUR | CUR SXM | AUA CUR SXM | | AUA | | | | | | | | | | AUA CUR SXM | AUA CUR | | | AUA SXM | AUA CUR SXM |
| Moving away from target | | | | | All | | All | | | | | | | | | | | | | | |
| Unknown | | | | | | | | | | | | | | | | | | | | | |

- Key:**
1. Public Awareness
 2. Integrated biodiversity values
 3. Removal of perverse incentives
 4. Sustainable production/consumption
 5. Loss of natural habitats
 6. Sustainable Fisheries
 7. Sustainable Agriculture
 8. Pollution
 9. Invasive Alien Species
 10. Climate Change/Ocean Acidification
 11. Protected Areas
 12. Reducing risk of extinction
 13. Genetic Diversity
 14. Ecosystem Services
 15. Ecosystem restoration and resilience
 16. Nagoya ABS Protocol
 17. NBSAP Revision
 18. Traditional Environmental
 19. Knowledge Transfer
 20. Resource Mobilisation
- AUA - Aruba
 BON - Bonaire
 CUR - Curaçao
 SAB - Saba
 EUX - Sint Eustatius
 SXM - Sint Maarten
 All - All Six Dutch Caribbean Islands
 N/A - Not Applicable

Kingdom Report Sounds Alarm on Biodiversity Conservation in the Dutch Caribbean

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AlgaePARC: Bringing Innovation to Bonaire

A collaborative effort between private, government and university partners, has been working to develop a microalgae production test facility on Bonaire to create a renewable food source for food and animal feed. Further research could also lead to the use of the microalgae to produce a biofuel which could be used in place of fossil petroleum. The project will soon enter its second phase, with the construction of a small-scale facility to prove the feasibility of the project on the island.

Future Fuel Sources

It is estimated that humans are now consuming energy 105 times faster than what can be supplied using natural petroleum (Netravali and Chabba, 2003). Researchers are looking for alternative energy sources to help bridge this gap. One such alternative fuel source which is gaining a lot of attention recently is biofuel (Chisti, 2007). Biofuels are fuels which are derived from living organisms, for example algae, which can provide a biodegradable and renewable energy source (Song et al., 2008). There are many advantages to using algae as a biofuel including the facts that it can be grown at sea, thus eliminating competition for land use, it naturally filters water, so it can be grown in a variety of water qualities, its production is carbon neutral and it has a very high combustion efficiency (Kumar, 2012). In addition, research is continuing to find new ways to extract oils and proteins out of algae, which could potentially lead to algae being used to create innovative food sources, particularly animal feed (WUR, 2017).

AlgaePARC

A project, known as AlgaePARC, is running on on Bonaire. The idea of the project is to build a microalgae test facility on the island, which will be used to develop the technology for renewable food and fuel production (WUR, 2017). The project was initiated by Wageningen University and Research and the government of Bonaire. Further support came in December of 2017, when Netherlands Organization for Scientific Research (NWO) issued a grant for €800,000 to be used to expand this research by funding two PhD students, Rocca Chin-on and Robin Barten (WUR, 2017). In addition, the Ministry of Economic Affairs (now Ministry of Agriculture, Nature and Food Quality (LNV)) and OCTA (the innovative program for overseas areas of the EU) have also funded a feasibility study for this project (Sikkema, 2017). Lastly, the possibility of creating biofuel which could be used for air travel has piqued the interest of TUI, who has also signed on to the project in support (WUR, 2017). This research would be an excellent opportunity to expand Bonaire's local economy past tourism and encourage intellectual investment on the island.

Why Bonaire?

A significant factor in the growth of algae is exposure to sunlight, an issue many labs in the Netherlands have had difficulty overcoming. Researchers believe that if the growth lab could be built somewhere with a larger amount of sunlight, it would be possible to maximize production efficiency (WUR, 2017). Bonaire could provide such a solution, as the island is known

for its consistent sunlight and weather year-round. One potential issue could be the island's high temperatures; however, researchers have already recommended two possible solutions. The first involves building a series of platforms near shore to allow seawater to naturally cool the algae tubes/reactors (WUR, 2017). The second option would be to carefully select algae which can withstand such high temperatures to allow production via pools on land, such as in the salinías (Sikkema, 2017).

To compete against other sources of fuel is still a challenge, as the cost of reducing algae to biofuel is still much higher than natural petroleum. A professor of Bioprocess Technology from Wageningen University, René Wijffels has been instrumental in supporting this project. He points out that although creating a biofuel may not be economically feasible now, using algae to create fish and animal feed could greatly benefit Bonaire in the long run (Sikkema, 2017). In the meantime, researchers and manufacturers are still learning how to maximize the efficiencies of reducing algae to make biofuel, and the cost of this reduction process continues to improve. Hopefully, researchers will continue to find new ways to reduce the cost of the process, making algae biofuel a competitive fuel alternative in the near future.



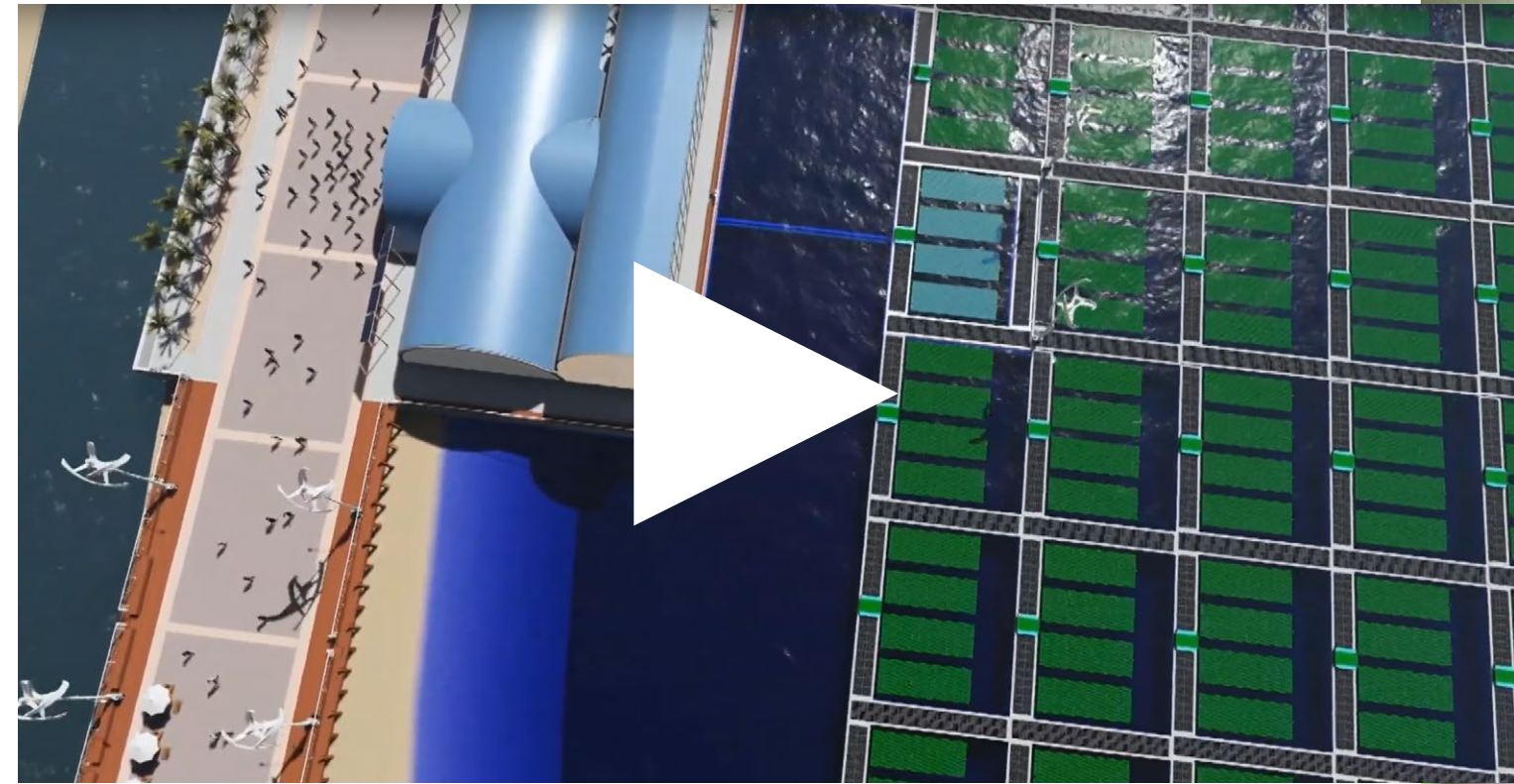
Bonaire: Paradise for Innovation

The production facility will be located at a Water and Energy Company Bonaire (WEB) station in Barcadera (Zwart, 2018). Bonaire offers consistent sunlight and temperatures year-round, an ideal climate for the such a production facility. The proximity to the ocean at the site in Barcadera also offers the potential for floating platforms to be used for cooling, a more environmentally friendly alternative than running a cooling system (Zwart, 2018).

Setting up this facility will be a multi-step process. The first step was to isolate microalgae already present in the salt pans and salinas of Bonaire. This research was conducted by Wageningen University. The second step, which will begin soon, is to establish the research station at the WEB facility to prove the feasibility of the project. Once this has been successful, Bonaire can work to scale up the production to allow the algae to be grown commercially (Zwart, 2018).

Investing In The Future

Projects such as AlgaePARC, help bring Bonaire to the forefront in innovative environmental research. This project could not only provide an affordable animal feed and fuel source to the island, but will bring about new business and incentivize young, bright talent to stay on the island. As the island continues to face the challenges brought about by climate change, finding innovative ways to cut the island's carbon footprint will be very important. Furthermore, investing in the intellectual future of the island will be instrumental in helping to build a sustainable future for Bonaire.



A conceptual video of what the full scale facility would look like (WUR, 2019)

AlgaePARC: Bringing Innovation to Bonaire

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Alarming Decline of Bridled Quail-Dove populations on Statia

Hannah Madden (Caribbean Netherlands Science Institute), Frank F. Rivera-Milán (US Fish and Wildlife Service) and Kevin Verdel (University of Utrecht)

The Bridled Quail-dove is a regionally endemic species that, on Statia, is only found in upper elevations of the Quill (above ~150m) and inside the crater. Since 2017, annual surveys have highlighted an alarming decline in populations. At an estimated population decrease of ~77% since 2017, this species has caught the attention of conservationists and requires immediate protection.

The Plight of the Dove

Last year we reported the results of a post-hurricane assessment of the Bridled Quail-dove (*Geotrygon mystacea*) population on Statia. Once thought to have been a common resident of the West Indies, declining populations are now isolated within coastal dry forest patches of the eastern Caribbean. Introduced, non-native predators such as feral cats, mongooses and rats are thought to negatively impact Bridled Quail-dove populations by preying on adults, eggs and/or chicks. Other external factors that contribute to population declines include hunting, volcanic activity, hurricanes, and habitat loss and alteration. Furthermore, this species is sensitive to openings in the forest canopy, which also

affects nesting. Despite its current classification as a species of Least Concern by the IUCN (in 1992 it was classified as Near Threatened), the Bridled Quail-dove is likely of conservation concern due to data deficiency and population declines across its entire habitat. The only surveys we are aware of took place in Montserrat (2007) following a volcanic eruption, St. Croix (1992) following hurricane Hugo, and Guana Island, British Virgin Islands (2018). Populations on other islands such as Puerto Rico are thought to be so limited that the species was excluded from a Columbids study (1995). Calling and breeding activity are dependent on rainfall, therefore the dove is sensitive to hurricanes and extended periods of drought. Similar to other Columbids, the Bridled Quail-dove lays clutches of two eggs in a flimsy nest made of twigs up to six meters above the forest floor. Furthermore, Bridled Quail-doves do not fare well in areas of human activity.

Current Study Highlights Rapid Decline in Population

Our pre-hurricane assessment in May 2017 was initially encouraging, with an estimated 1,039 (minimum 561 - maximum 1,621) quail-doves

across its local habitat of 440 hectares, possibly the highest known density in the region. Post-hurricanes season, in November 2017, we repeated the surveys and recorded a decrease of 22% to 803 (minimum 451 - maximum 1,229). Furthermore, in May 2018, we recorded a decline to 253 individuals (minimum 83 - maximum 486).

We repeated surveys across the entire Quill (440 hectares) during May 2019, coinciding with the quail-dove's peak breeding season. Estimations for detection probability, density and population size were calculated by measuring the perpendicular distance of the quail-dove from the transect centerline during repeated surveys. The results are very concerning since the population has continued to decline to 238 individuals (minimum 118 - maximum 390). The surveys of May 2018 and 2019 showed that little if any successful post-hurricane reproduction has occurred. Additionally, the majority of detections were recorded inside the crater and near the crater rim, with very few detections at lower elevations. This means that the population is highly clumped at low numbers, which increases the chance of local extinction.



Bridled Quail-Dove. Photo by: © Hannah Madden

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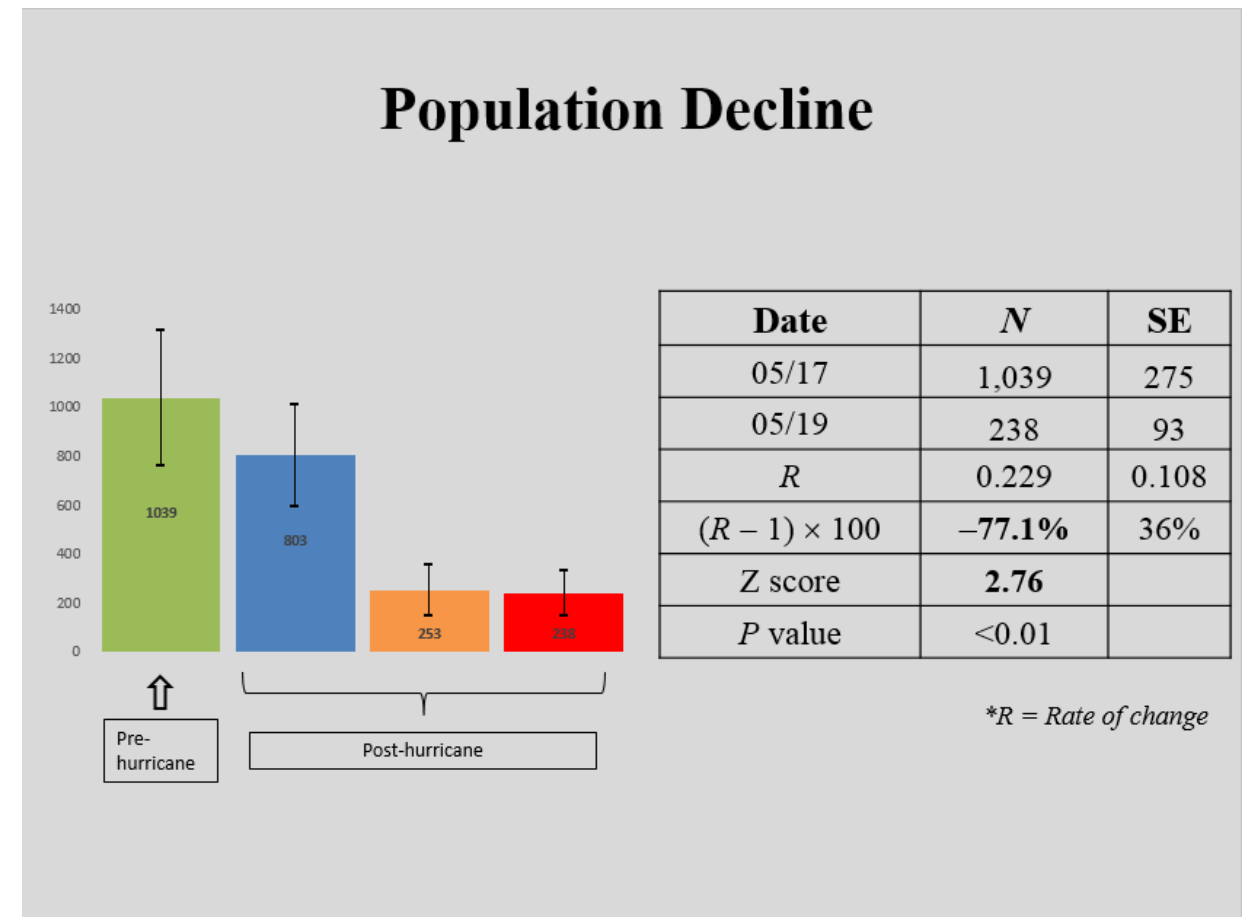
Possible Causes for Population Decline

Indirect effects of hurricanes, human-induced habitat degradation and increased predation continued to affect quail-dove survival and reproduction in 2019. Rat and other invasive predator species may increase in density following hurricane-induced changes in foraging resources, affecting quail-dove survival and reproduction even further. A feral cat was detected during surveys inside the crater, probably as a result of forest openness after the hurricane. Due to the fact that members of the Columbidae family have early maturity and short lifespans, conservation efforts should focus on successful reproduction through invasive species management. The integrity of the Quill should be improved to help forest-dependent birds and other wildlife recover in order to enhance their prospects for long-term survival on Statia.

Uncertain Future for Quail-Doves on Statia

Unfortunately, the frequency and intensity of hurricanes are predicted to increase as a result of climatic change. Furthermore, Caribbean islands are expected to see more frequent and severe droughts. Between 2013 and 2016, the region experienced a widespread drought due in part to El Niño. Large scale trends are difficult to estimate since precipitation has been very inconsistent over the past century. However, there does appear to be a regional trend towards an increase in variability of precipitation. This increase in variability will continue to threaten the local quail-dove populations.

We are grateful to BirdsCaribbean for funding Frank's travel expenses in 2017, to St. Eustatius National Parks for allowing us to conduct surveys in the Quill National Park, and to Caribbean Netherlands Science Institute (CNSI) for facilitating this ongoing project. This July, Hannah Madden presented the results of this research at BirdsCaribbean's regional meeting in Guadeloupe.



Alarming Decline of Bridled Quail-Dove populations on Statia

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New Diadema project aims to restore sea urchins in Saban and Statian waters

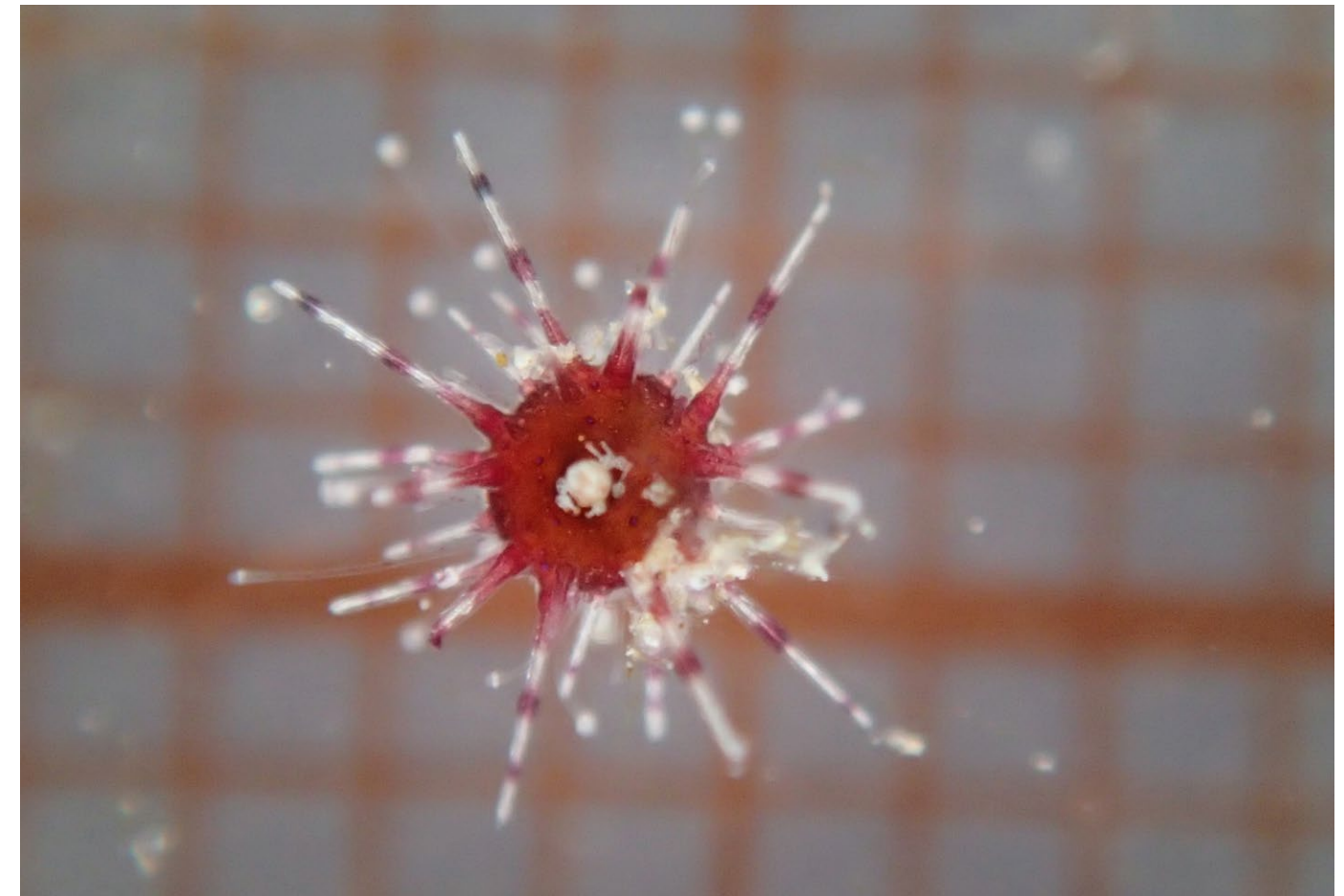
By Alwin Hylkema

The new RAAK PRO Diadema project aims to restore long spined sea urchin populations (scientific name *Diadema antillarum*) on the coral reefs around Saba and St. Eustatius. Long spined sea urchins were the most important herbivores on Caribbean coral reefs. In 1983, more than 95% of the sea urchins died, due to an unknown disease. Without the grazing of the sea urchins, the algae increased in abundance, smothering adult corals and inhibiting the settlement of juvenile corals. As a result, the reef became covered with algae instead of corals. Nowadays, more than 35 years after the die-off, long spined sea urchins are still very rare. They are sometimes abundant in shallow waters, such as harbors, but are seldom seen on the deeper coral reef.

Worldwide coral reefs face many threats that are difficult to tackle locally, like global warming and ocean acidification. This makes it even more urgent to remove as much local threats as possible. Restoring the sea-urchin populations will remove the overgrowing algae and will make the reefs more resilient to the other threats they face. To do this, University of Applied Sciences Van

Hall Larenstein, STENAPA, Saba Conservation Foundation, Wageningen Marine Research, Wageningen University, Caribbean Netherlands Science Institute, University of Applied Sciences HZ, ISER Caribe, Wortel Product Design and Golden Rock Dive Center work together in the new RAAK PRO Diadema project. The project is partly funded by the Dutch Organization for Scientific Research (NWO) and will run for four years, starting this September.

The first priority of the team will be to investigate why sea urchin populations on most reefs have not recovered. Pilot experiments show a high abundance of very small juvenile sea urchins, while no adults were observed on these reefs. This is an indication that there is potential for population recovery and research will therefore focus on the first steps in the sea urchins life cycle. The ultimate goal is to develop a new method to maximize settlement and survival of larvae and juveniles and, by doing this, restore the populations of this important herbivore. The sea urchins will, once more, graze away the algae and aid in the recovery of Sabas and Statias coral reefs.



Juvenile long-spined sea urchin are red with striped spines. The squares on the background are 1x1mm.

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The path to Coral Recovery: Scientific Foundations and Practical Lessons

During the 2019 edition of the DCNA Convention on Bonaire, biologists from local protected area management organizations including Aruba National Park Foundation, STINAPA Bonaire, Reef Renewal Foundation Bonaire, CARMABI Curaçao, Saba Conservation Foundation, Sint Maarten Nature Foundation, STENAPA and CNSI of Sint Eustatius will be united on October 28th for a full day of workshops. The central focus of the workshops will be coral recovery, with insights from science and practices. The Dutch Organization for Scientific Research (NWO) and the World Wildlife Fund (WWF-NL) will also be present. In addition to their participation in the other workshops, Arjan de Groene of WWF-NL will give a presentation on the Coral Action Plan for the Caribbean Netherlands and Joseph Stuefer from NWO will further elaborate on the upcoming call for scientific research proposals in the Dutch Caribbean.

Coral as a building block of the Caribbean

Coral restoration is high on the agenda worldwide, and it certainly is in the Dutch Caribbean. The unique nature of the Caribbean part of the Dutch Kingdom is built out of and surrounded by coral. Saba and Sint Eustatius are

volcanic in origin while Aruba, Bonaire, Curaçao and Sint Maarten are made up of fossil coral structures from times when the sea level was higher. The Dutch Caribbean is therefore built on a coral reef millions of years old.

Current Importance of coral

Tourists have traditionally come to the Dutch Caribbean islands to admire the uniqueness of the region's nature, including world-renowned coral reefs. In surveys from 2013, the economic value of the ecosystem services provided by nature on Bonaire, Saba and St. Eustatius represented 31%, 63% and respectively 24% of the annual Gross Domestic Product (GDP) of the islands. On Sint Maarten recent studies by the Nature Foundation has shown that coral reefs contribute USD 50 million to the economy of the island. This clearly shows that nature is the engine that drives the economy of all six islands in the Dutch Caribbean. If there is no adequate action against the current threats to coral reefs, the value will decrease considerably with major consequences for the well-being of the population.

First Hand Experience

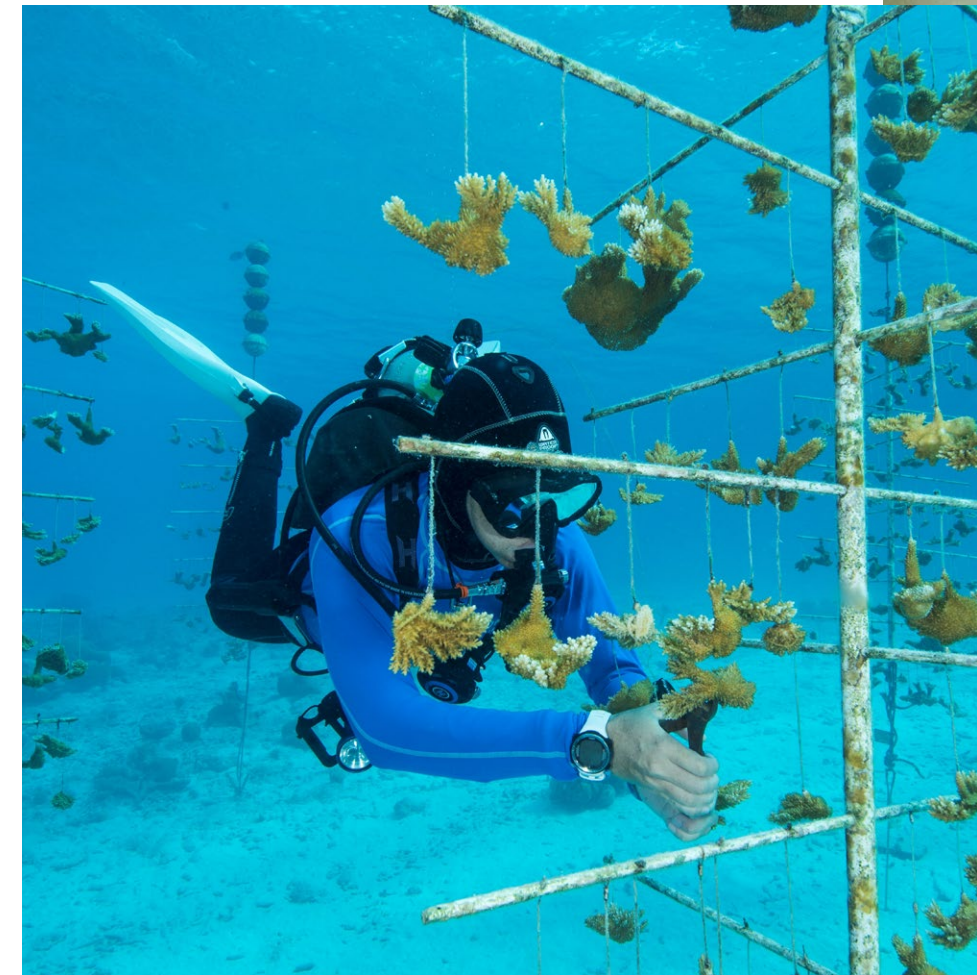
As part of the solution to promote coral recovery, the Coral Restoration Foundation Curacao and Reef Renewal Foundation Bonaire, among others,

are focused on the future actions to restore these valuable coral reef ecosystems. Through presentations and organized field excursions organized by Reef Renewal Foundation Bonaire, attending biologists will get to see a fully tested and optimized method for reef restoration with their own eyes. This workshop will give the biologists a platform to exchange knowledge and experience about the different coral restoration programs and techniques on the Dutch Caribbean islands.

Public lecture: Status of Coral reefs

The health of coral reefs being crucial to the sustainable prosperity of the islands in the long term is a key theme for the meetings. For any member of the public interested in and committed to the status of coral reefs and who would like to meet the regional experts in person, there will be a public lecture by Dr. Erik Meesters of Wageningen University and Research on **Monday October 28 from 7:30 PM to 9:00 PM at Captain Don's Hotel, Kralendijk, Bonaire.**

For more information, please contact DCNA: (+599) 717-5010 or research@dcanature.org



Coral Restoration. Photo by: © Reef Renewal Foundation Bonaire

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Marine biodiversity research expedition on Bonaire

An international research team is on Bonaire from 21 October to 9 November to investigate its marine biodiversity. Although Bonaire's reefs are well monitored, their marine biodiversity has not been well explored. Since Bonaire is rich in marine habitats, it has a high potential for the discovery of rare species or even species new to science. Eventually, the team hopes to say more about how species diversity is distributed around the island and how it compares with that of other Caribbean islands.

Bonaire's reefs are a famous tourist attraction but are threatened by a number of local and regional pressures such as climate change effects, free roaming livestock, invasive exotic species, coastal development, erosion and eutrophication by waste water. It is important to improve the resilience of the coral reefs so that they are better able to withstand the effects of climate change, such as warmer seawater (coral bleaching) and extreme weather conditions (longer periods of drought and more powerful hurricanes). Important management considerations include implementing coastal protection through spatial planning, reduction of erosion through reforestation of indigenous trees and shrubs, reduction of free roaming livestock and protection of particular species.

Instead of monitoring the coral cover, the research team will focus on topics that are related to the presence or absence of particular species. It is essential to know which species need protection, while other species can be harmful to others and these should also be known. Indeed, some associated animals can damage their hosts, especially when they occur in high densities, like Christmas tree worms. Some species of crabs, shrimps, and snails are completely depending on the presence of a few species of host organisms, such as coral and sponges, which they use as a habitat to live in. If a host species disappears, then its associated species become extinct as well.

Since the team also has research experience in other Caribbean localities, it may perhaps be able to find species that have never been observed in Bonaire before, or it may observe that some species that are generally rare in the Caribbean, can be found abundantly in Bonaire. In other localities, which were visited in previous years, the team found species that were new to science or represented new records for the Caribbean. The latter can be important in order to detect the presence of introduced species, which potentially can become invasive.

Each team member brings his/her own expertise regarding marine animals and plants.

Some members are specialized in well-known groups of organisms, such as corals, sponges, and algae, while others know about species that are not easily found because they concern animals that are usually well hidden, small, or camouflaged. Most team members are from the Netherlands, but others are from Italy, Japan, Puerto Rico, Russia and the USA. Part of the Dutch team is based at Naturalis Biodiversity Center (Leiden) and the others are representatives of ANEMOON Foundation, which is specialized in monitoring marine species. The team collaborates with STINAPA and DCNA at Bonaire. The research is partly funded by the WWF Netherlands Biodiversity Fund.



Although Christmas tree worms are attractive animals, too many of them can be harmful when they overgrow their host corals (Curaçao, 2014).

Photo by: © Bert W. Hoeksema

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Research Projects

September & October 2019

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|-----------------------|---|------------|--|
| Bats | Impact of barriers in maternity caves | BON | HAS: Jilly Sarpong (student) Wildconscience: Fernando Simal VISR: Jafet Nassar |
| Birds | Suitability study and reforestation of exclosures facilitating the Yellow-shouldered Amazon Parrots (<i>Amazona barbadensis</i>) on Bonaire | BON | Echo: Julianka Clarenda |
| Birds | Perception of local people on the conservation of Yellow-Shouldered Amazon Parrot | BON | WUR: Younes Zian (student), Luuk Fleskens Echo: Julianka Clarenda |
| Climate change | Teatime4science (seagrass and mangroves http://www.teatime4science.org) | BON | STINAPA: Sabine Engel |
| Coral Reef Ecosystems | Ecology and biology of the 2019 coral spawning | CUR | CARMABI/ Secore/ Marhaver Lab |
| Coral Reef Ecosystems | Factors effecting juvenile <i>Diadema</i> (longspine sea urchin) survival | SAB | WUR: Oliver Klokman(student) SCF |
| Coral Reef Ecosystems | Environments and circumstances for sea urchins to settlement | SAB | VHL: Tessa Volbeda (student) SCF |
| Coral Reef Ecosystems | AROSSTA project - artificial reefs (reef balls) and how different shapes are performing for fish, sessile organisms and stony corals. | SAB | RUG: Raven Cammenga (student) SCF HVL: Alwin Hylkema |
| Coral Reef Ecosystems | Fluid dynamics on reefs | CUR | University of Illinois Urbana-Champaign: Mark Levenstein CARMABI |
| Coral Reef Ecosystems | Larval biology of corals and reef microbiology | CUR | MC: Kristen Marhaver CARMABI |
| Coral Reef Ecosystems | Parrotfishbehavior and population trends | BON | Calpoly: Hannah Rempel Dive friends Bonaire (citizen scientist) |
| Coral Reef Ecosystems | Marine biodiversity of Bonaire: a baseline survey | BON | Naturalis: Bert W. Hoeksema ANEMOON Foundation, Bennekom, The Netherlands: Godfried van Moorsel STINAPA, Bonaire: Caren Eckrich |

Research Projects

September & October 2019

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|-------------------------------------|---|-----------------|--|
| Coral Reef Ecosystems | Iron limitation on Caribbean reefs | CUR | WUR: Mischa Streekstra, CARMABI |
| Coral Reef Ecosystems | NIOZ-MARUM Expedition. Caribbean coral reefs, between resilience and warmer climates (hydrodynamics, drones, bathymetric surveys and different types of sensors) | CUR | NIOZ: Fleur van Duyl, Paulo Stocchi, Andi Haas MARUM: Alessio Rovere, Ciro Cerrone (PhD student) ZMT: Elisa Casella |
| Environmental friendly alternatives | Industrial Compostable Alternatives for Styrofoam (Literature study Funded by WWF-NL) | BON, SAB EUX | WWF-NL: Arjan de Groene, Claudia Alessio |
| Fisheries | Market & Supply Chain Analysis study (Funded by WWF-NL) | BON, SAB EUX | WWF-NL: Pieter van Baren The Good Fish Foundation: Irene Kranendonk |
| Fisheries | Historical fisheries (Funded by WWF-NL) | BON, SAB EUX | WWF-NL: Pieter van Baren Terramar Museum Bonaire: Ruud Stelten |
| Fisheries | Co-management in small scale fisheries (Literature study Funded by WWF-NL) | BON, SAB EUX | WWF-NL: Pieter van Baren, Simaima Petzold, Philipp Pattberg |
| Fisheries | Testing and comparing various lionfish traps to study their potential use in a directed lionfish fishery (funded by WWF-NL) | SAB | SCF (SBMU): Ayumi Kuramae Izioka VHL: Tom Brokke and Marc Veldman (students) |
| Fish | Killifish Genome Size Variability | AUA | FPNA: Giancarlo Nunes , BU: Nicholas Sakich |
| Fish | Shark telemetry project | BON | STINAPA: Caren Eckrich and Roxanne-Liana Francisca HAS: Brent Hoogervorst (student) |
| Marine gastropods | Karko (Strombus gigas) in the zone of -40 up to -60m | BON | WMR: Hans Verdaat |
| Plants | Testing effective ways to grow native plants | BON | Echo: Johan van Blerk |
| Plants | Germination of seeds of indigenous trees of Curaçao | CUR | CARMABI: John de Freitas |
| Plants | Vegetation Christoffel Park | CUR | CARMABI: Erik Houtepen |
| Reptiles | Lesser Antillean iguana nest research (funded by WWF-NL) | EUX | RAVON: Tim van Wagenveld, Ronald Zollinger |
| Sargassum- seagrass | Effect of sargassum on seagrass beds | BON | RU: Mauk Westerman Holstijn (student), Luuk Leemans |
| Sargassum | Effect of sargassum brown tides on mangroves, seagrass beds and water quality in Lac Bay | BON | WUR: Mauk Westerman Holstijn (student) RU: Luuk Leemans |
| Sponges | Sponge ecology and energetics | CUR | UvA: Meggie Hudspith CARMABI |

Long Term Projects

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|------------------------|--|------------|---|
| Anthropogenic impact | Anthropogenic Impact Analyses, Aruba National Park | AUA | FPNA: Giancarlo Nunes |
| Coral Reef Ecosystems | Deep Reef Observation Project (DROP) (ARMS: Autonomous Reef Monitoring Structures) | CUR | Smithsonian: Carole Baldwin |
| Coral Reef Ecosystems | Developing a plan to manage the waters around Curaçao sustainably, profitably, and enjoyably for this and future generations - including mesophotic reef dropcam project | CUR | Waitt Institute (Blue Halo Curaçao): Kathryn Mengerink |
| Coral Reef Ecosystems | Diadema Antillarum Population Assessment | EUX | CNSI: Kimani Kitson-Walters VHL: Alwin Hylkema, STENAPA: Jessica Berkel |
| Coral Reef Ecosystems | Bloom dynamics of benthic cyanobacterial mats on coral reefs | BON | FSU: Ethan Cissell (Ph.D. student), Sophie McCoy |
| Coral Reef Ecosystems | The role of parrotfish behavior in structuring benthic coral reef communities | BON | FSU: Joshua Manning (Ph.D. student), Sophie McCoy |
| Coral Reef Restoration | Epigenetic responses to environmental stressors in Acropora corals, and applications to coral reef conservation | BON | FIU (EEL): Serena Hackerott (PhD student), Jose Eirin-Lopez, RRFB: Francesca Viridis |
| Coral Reef Restoration | St. Maarten's Coral Restoration Project | SXM | NFSXM: Tadzio Bervoets, Melanie Meijer zu Schlochtern, CRF |
| Coral Reef Restoration | Plant a million coral initiative (IntelliReefs) | SXM | NFSXM: Tadzio Bervoets, Melanie Meijer zu Schlochtern SeaLagacy, Reeflife Restoration and Sea to Sky ventures |
| Coral Reef Restoration | Development of restoration methods for threatened Caribbean coral species | BON, CUR | RRFB: Augusto Montbrun, Francesca Viridis SECORE Project, CARMABI: Mark Vermeij Secore: Valerie Chamberland |
| Coral Reef Restoration | Postsettlement dynamics of Caribbean corals & Reef restoration | CUR | CARMABI: Mark Vermeij Secore: Valerie Chamberland |
| Coral Reef Restoration | Artificial structures that encourage larvae settlement and discourage the growth of competitor species | CUR | University of Illinois: Amy Wagoner Johnson, Bruce Fouke, Gabriel Juarez San Diego State University: Forest Rohwer CARMABI: Kirsten Marhaver, Mark Vermeij |
| Database | Dutch Caribbean Species Register: Taxonomic knowledge system Dutch Caribbean (http://www.dutchcaribbeanspecies.org/) | All | Naturalis: Sander Pieterse, Hanco Bakker, Bert Hoeksema |

Long Term Projects

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|---------------------------|---|------------|---|
| Interstitial biodiversity | Moleculair biodiversity analysis of marine communities by metabarcoding | EUX | Naturalis: Arjen speksnijder ANEMOON: Niels Schrieken |
| Invasive species | Impact of <i>Halophila stipulacea</i> on the availability of benthic diatoms as a food source for a commercially important deposit feeders in a native and invasive habitat | EUX | CNSI: Johan Stapel, Kimani Kitson-Walters, Anna Maitz |
| Mangrove ecosystems | Mangrove habitat compensation and reforestation | AUA | FPNA: Giancarlo Nunes |
| Marine ecosystems | Taxonomy and biodiversity in Lac Bay | BON | STINAPA Sabine Engel, Caren Eckrich Ecosub: Godfried van Moorsel CEAB: Daniel Martin |
| Marine ecosystems | Marine species discoveries in the Dutch Caribbean | All | Naturalis: Bert Hoeksema CNSI, CARMABI |
| Marine Park | Marine Park Aruba | AUA | FPNA: Sietske van der Wal, DNM: Gisbert Boekhoudt |
| Marine Litter | Clean Coast Bonaire (Citizen science project, OSPAR methodology) | BON | Boneiru Duradero: Sharon Bol, Carolyn Caporusso |
| Plants | Botanical Garden Aruba | AUA | FPNA: Natasha Silva |
| Plants | Wildlife Garden Reserve | AUA | FPNA: Giancarlo Nunes |
| Public Health | DNA waterscan: Monitoring disease vectors in the Caribbean (mosquitoes and midges) | CUR | Naturalis: Klaas-Douwe B. Dijkstra ECPHF: Teresa Leslie |
| Reforestation | Reforestation Project on St. Eustatius | EUX | Mac & Field: Tim van Wagenveld & Stacey Mac Donald STENAPA: Clarisse Buma, LVV: Gershon Lopes |
| Reptiles | Behavior of the endemic Aruban Whiptail lizard | AUA | FPNA: Giancarlo Nunes Eckerd College: Jeff Goessling |
| Reptiles | Boa Life History | AUA | FPNA: Giancarlo Nunes Eckerd College: Jeff Goessling |

Long Term Projects

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|-------------------------------------|---|------------------|---|
| Sponges | The role of sponges as key ecosystem engineers of coral reef ecosystems Pumping iron: can iron availability fuel the sponge loop and affect coral reef community structure? (Misha Streekstra) | CUR | Uva: Jasper de Goeij, Benjamin Mueller CARMABI: Mark Vermeij PhD students: WUR: Misha Streekstra UvA: Sarah Campana*, Meggie Hudspich*, Niklas Korner* * Part of the ERC project "SPONGE ENGINE — Fast and efficient sponge engines drive and modulate the food web of reef ecosystems" |
| Threats and risks | Are human activities (related to an oil terminal and dive tourism) a risk for ecosystem services ? | EUX | WUR: Diana Slijkerman |
| NWO Projects in the Dutch Caribbean | | | |
| Bioproducts | Stand-alone production of algal products for food, feed, chemicals and fuels - Bioprospecting and directed evolution of microalgae from Bonaire | BON | WUR: R.H. Wijffels, Rin Barten, Rocca Chin-on, Robin Barten (PhD students) Institute for Sustainable Technology: Rita Peachey |
| Coral restoration | Artificial Reefs On Saba and Statia (AROSSTA) | SAB EUX | VHL: Alwin Hylkema, Marlous Heemstra WUR: Dolfi Debrot, STENAPA: Jessica Berkel SCF: Kai Wulf, Aymi Kuramae Izioka CNSI: Johan Stapel Students: Marnik van Cauter (VHL) & Martijn Peters (VHL) |
| Environmental psychology | Confronting Caribbean Challenges: Hybrid Identities and Governance in Small-scale Island Jurisdictions - Behavioral differences between/within the BES islands when it comes to nature conservation and cultural heritage. | BON, SAB, EUX | KITLV, Leiden University: Gert Oostindie (Project director) KITLV, Leiden University: Stacey Mac Donald (PhD student) |
| Invasive species | Exotic plant species in the Caribbean: foreign foes or alien allies? (1) Socio-economic impacts of invasive plant species (2) Ecological impacts of invasive plant species | BON, SAB, EUX | (1) UU: Jetske Vaas (PhD student), Peter Driessen, Frank van Laerhoven and Mendel Giezen (2) UU: Elizabeth Haber (PhD student), Martin Wassen, Max Rietkerk, Maarten Eppinga. CNSI |

Long Term Projects

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|--|---|------------------------------|---|
| Invasive species | Global defaunation and plant invasion: cascading effects on seagrass ecosystem services | BON | WUR: Marjolijn Christianen, Fee Smulders (PhD student) Smithsonian: Justin Campbell (coordinator Caribbean wide research project), Olivier Kramer STINAPA: Sabine Engel, Jessica Johnson |
| BO-projects in the Dutch Caribbean (Min EZ) | | | |
| Coral Reef Ecosystems | BO-43-021.04-003 –Inventory corals Includes monitoring and research of the longest coral reef time-series in the world (since 1973) | BON, CUR | WUR: Erik Meesters |
| DCBD | BO-43-021.04-001 - Expansion knowledge system Dutch Caribbean | AUA, BON, CUR, SAB, EUX, SXM | WUR (Alterra): Peter Verweij |
| Invasive species | Socio-ecological connectivity of tropical coastal ecosystems: how to enhance restoration and conservation of ecosystem services (Study on (1) carbon and nutrient fluxes between the mangroves, seagrass bed and coral reef at Lac Bay 2) the impact of Sargassum events on seagrass beds and mangroves in Lac Bay and 3) Lac Bay as a socio ecological system.) | BON | RU: Luuk Leemans (PhD student), Marieke van Katwijk WUR: Marjolijn Christianen |
| Fisheries | BO-43-021.04-006 - Fish stocks and fisheries Caribbean Netherlands | EUX, SAB, BON | WUR: Dolfi Debrot CNSI: Kimani Kitson-Walters PiskaBon, STINAPA SCF: Kai Wulf, Ayumi Kuramae |
| Marine biodiversity | BO-43-021.04-002 – Saba Bank – Marine biodiversity | SAB | WUR: Erik Meesters (benthic communities), Dolfi Debrot, Thomas Brunel, Leo Nagelkerke (fish stocks) |
| Marine mammals & sharks | BO-43-021.04-005 – Management plan marine mammal and shark sanctuary Yarari | SAB, EUX | WUR: Dolfi Debrot, Dick de Haan, Meike Scheidat, Ayumi Kuramae Izioka SCF (SBMU): Ayumi Kuramae Izioka |
| Marine mammals | BO-43-021.04-007 –Marine mammals in the Dutch Caribbean | BON, SAB, | WUR: Dolfi Debrot, Dick de Haan, Meike Scheidat |

Long Term Projects

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|--|---|------------|---|
| World Heritage nomination | BO-43-021.04-004 – World Heritage nomination Bonaire National Marine Park | BON | WUR: Dolfi Debrot, Wolfs Co.: Esther Wolfs UNESCO: Josephine Langley, DRO: Frank v Slobbe CARMABI: Mark Vermeij, John de Freitas Curacao Footprint Foundation: Leon Pors |
| “Nature Funding” Projects in the Dutch Caribbean (Min EZ) | | | |
| Coastal ecosystems (Lac Bay: Mangroves and seagrass beds) | Ecological restoration Lac Bay and South coast, Bonaire | BON | STINAPA: Sabine Engel, WUR: Klaas Metselaar STCB: Mabel Nava, DRO: Frank van Slobbe |
| Invasive species | Feral Pig Control | BON | Echo: Julianka Clarenda, DRO: Frank van Slobbe |
| Reforestation | Reforestation Project | BON | Echo: Julianka Clarenda, DRO: Frank van Slobbe |
| Invasive species | Goat eradication and control in Washington Slagbaai National Park | BON | STINAPA, DRO: Frank van Slobbe |
| World Heritage nomination | World Heritage Nomination Bonaire Marine Park and/or other interconnected sites | BON | Wolfs Company: Esther Wolfs, Boris van Zanten, Amilcar Guzman, Viviana Lujan DRO: Frank van Slobbe |
| Terrestrial ecosystems | Combating Erosion and Nature Restoration on Bonaire | BON | Bonaire Agri & Aqua Business BV: Sherwin Pourier Wayaká Advies BV: Jan Jaap van Almenkerk DRO: Frank van Slobbe |
| Terrestrial ecosystems | Cave and karst nature reserve | BON | DRO: Frank van Slobbe, CARIBSS: Fernando Simal |
| Nature communication | Campaign environment and nature on Bonaire | BON | DRO: Frank van Slobbe, Peter Montanus |
| Agriculture | Horticultural Project | SAB | Government of Saba: Randall Johnson |
| Recreation | Hiking trails | SAB | Government of Saba: Robert Zagers |
| Pollution | Tent Reef Protection | SAB | Government of Saba: Robert Zagers |
| Invasive species | Goat buy-back program | SAB | Government of Saba: Randall Johnson |

Long Term Projects

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|--------------------|------------------------------------|------------|--|
| | Yacht mooring project | SAB | Government of Saba SCF: Kai Wulf |
| | Saba national park | SAB | Government of Saba SCF: Kai Wulf SABARC: Ryan Espersen |
| | Crispeen trail project | SAB | Government of Saba: Robert Zagers SCF: Kai Wulf |
| Community outreach | Nature Awareness project | EUX | Government of St Eustatius STENAPA: Clarisse Buma CNSI: Johan Stapel, Hannah Madden |
| Nature management | Strengthening management of nature | EUX | Government of St Eustatius STENAPA: Clarisse Buma |
| Invasive species | Rodent assessment and control | EUX | Government of St Eustatius CNSI: Johan Stapel, Hannah Madden ECPHF: Teresa Leslie |
| Coral ecosystems | Coral restoration | EUX | Government of St Eustatius STENAPA: Jessica Berkel CNSI: Johan Stapel |
| Erosion | Erosion control | EUX | Government of St Eustatius CNSI: Johan Stapel |

Monitoring Overview

September & October 2019

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|-----------------------|---|---------------------------------|---|
| Birds | Flamingo Abundance | BON | DRO: Frank van Slobbe Cargill, STINAPA: Paulo Bertuol |
| Birds | Monitoring vulnerable parrot nests (remote camera sensing work) | BON | Echo: Julianka Clarenda, Sam Williams |
| Birds | Aruban Brown-Throated Parakeet Conservation | AUA | FPNA: Giancarlo Nunes , ABC: Greg Peterson |
| Birds | Aruban Burrowing Owl Conservation | AUA | FPNA: Giancarlo Nunes , ABC: Greg Peterson GLOW: David Johnson |
| Birds | Yellow-shouldered Amazon parrot roost counts | BON | Echo: Julianka Clarenda DRO: Peter Montanus, Diego Marquez STINAPA: Albert Christiaan |
| Birds | Bird Monitoring (Caribbean Waterbird Census) | BON SXM | STINAPA: Paulo Bertuol EPIC: Adam Brown |
| Birds | Tern monitoring(artificial nesting islands) | BON | STINAPA: Paulo Bertuol Cargill, DRO, WUR: Dolfi Debrot |
| Birds | Terrestrial Bird and Habitat Monitoring | BON, CUR SAB, SXM EUX | Echo: Julianka Clarenda STINAPA: Paulo Bertuol, Caren Eckrich STENAPA , CNSI Curassavica: Michelle da Costa Gomes CARMABI: Erik Houtepen Nature Foundation: Binkie van Es |
| Birds | Red-billed Tropicbird monitoring | SAB EUX | STENAPA SCF: Kai Wulf |
| Birds | Pelican monitoring | SXM | NFSXM: Melanie Meijer zu Schlochtern, Saskia Werner |
| Coral reef ecosystems | Global Coral Reef Monitoring Network | BON CUR SAB EUX SXM | STINAPA: Caren Eckrich, CARMABI: Mark Vermeij SCF (SBMU): Ayumi Kuramae Izioka STENAPA: Jessica Berkel NFSXM: Melanie Meijer zu Schlochtern CNSI: Johan Stapel, Kimani Kitson-Walters Students: Julia Stuijzand (WUR) en Wiebke Homes |

Monitoring Overview

June & July 2019

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|-----------------------|---|--|--|
| Coral reef ecosystems | Monitoring and research of the longest coral reef time-series in the world (since 1973) (Part of BO-11-019.02-022 –Inventory corals) | BON CUR | WUR: Erik Meesters, Didier de Bakker (PhD student) NIOZ: Fleur van Duyl, Rolf Bak |
| Environmental | Water quality testing | SXM | NFSXM: Melanie Meijer zu Schlochtern EPIC: Natalia Collier |
| Environmental | Nutrient (phosphate, ammonium, nitrate and nitrite) monitoring of St Eustatius' coastal waters | EUX | CNSI: Johan Stapel |
| Fish | Shark monitoring: - Shark sightings - Shark Abundance, distribution and movements (tagging, acoustic telemetry) | AUA BON CUR SAB SXM EUX | WUR: Erwin Winter, Dolfi Debrot, Martin de Graaf FPNA: Giancarlo Nunes, STINAPA: Caren Eckrich CARMABI: Mark Vermeij SCF(SBMU): Ayumi Kuramae Izioka, Guido Leurs STENAPA: Jessica Berkel NFSXM: Melanie Meijer zu Schlochtern |
| Fish | Spawning monitoring: Red hind surveys on Moonfish Bank | SAB | SCF (SBMU): Ayumi Kuramae Izioka |
| Fish | Fish and fishery monitoring (Barracuda's, sharks and eagle rays, tarpons, marine mammals, (fishing) boats, fisherman) | BON | STCB: Mabel Nava |
| Hydrology | Hydrology Lac Bay | BON | STINAPA: Sabine Engel, WUR: Klaas Metselaar |
| Insects | Bee tracking | BON | Echo: Julianka Clarenda STINAPA: Sabine Engel, Johan Blerk |
| Invasive species | Goat and/or donkey removal: - Washington Slagbaai National Park - Lac Bay area (exclusion plots) - Quill National Park (exclusion plots) | BON EUX | STINAPA: Paulo Bertuol WUR: Dolfi Debrot, DRO: Frank van Slobbe STENAPA |
| Invasive species | Lionfish abundance and control | BON CUR SXM SAB EUX | STINAPA: Paulo Bertuol (50 meter traps) CARMABI: Mark Vermeij NFSXM: Melanie Meijer zu Schlochtern SCF (SBMU): Ayumi Kuramae Izioka STENAPA: Jessica Berkel |
| Invasive species | Feral pig population assessment (trapping) | BON | Echo |

Monitoring Overview

| CATEGORY | SUBJECT | DC ISLANDS | ORGANIZATION(S): LEAD SCIENTIST(S) |
|----------------------------------|---|------------------------------------|---|
| Mammals | Bat monitoring | AUA BON | FPNA WildConscience: Fernando Simal, Linda Garcia |
| Mammals | Dolphin monitoring (since 1999) | BON | Ron Sewell |
| Mammals | Marine Mammal Monitoring (noise loggers Saba Bank) | AUA SAB EUX SXM | WUR: Bart Noort, Dolfi Debrot SCF (SBMU): Ayumi Kuramae Izioka AMMF: Angiolina Henriquez STENAPA: Jessica Berkel (sighting forms) NFSXM: Melanie Meijer zu Schlochtern (sighting forms) SCCN |
| Molluscs | Conch (<i>Strombus gigas</i>) on St. Eustatius, Saba Bank, Anguilla | SAB EUX | WUR: Martin de Graaf, Erik Boman (PhD student) SCF (SBMU): Ayumi Kuramae Izioka |
| Plants | Monitoring of tree growth and survivorship in reforestation areas | BON | Echo: Julianka Clarenda |
| Reptiles | Lesser Antillean Iguana: Monitoring population density & removing invasive Green Iguana and hybrids (Mohamed bin Zayed Species Conservation Fund) | EUX | STENAPA: Clarisse Buma RAVON: Tim van Wagenveld, UvA: Thijs van den Burg |
| Reptiles | Red-bellied racer snake monitoring | EUX | CNSI: Kimani Kitson-Walters |
| Reptiles | Boa Life History | AUA | FPNA: Giancarlo Nunes, Eckerd College: Jeff Goessling |
| Reptiles | Behavior of the endemic Aruban Whiptail lizard | AUA | FPNA, Eckerd College: Jeff Goessling |
| Seagrass and mangrove ecosystems | Seagrass and mangrove monitoring (BON: also conch and benthic fauna) | BON EUX SXM | STINAPA: Sabine Engel, Caren Eckrich WUR: Klaas Metselaar NFSXM: Melanie Meijer zu Schlochtern CNSI: Kimani Kitson-Walters |
| Seagrass ecosystems | Seagrass restoration BESE elements | BON | STINAPA: Sabine Engel, WUR: Marjolijn Christianen |
| Reptiles | Sea turtle monitoring: -Satellite tracking -Nest monitoring -In water surveys (BON, CUR, SXM) -Fibropapillomatosis presence (BON) | AUA, BON, CUR, SAB, EUX, SXM | TurtugAruba Foundation STCB: Mabel Nava, STCC: Sabine Berendse STENAPA: Jessica Berkel, SCF: Kai Wulf NFSXM: Melanie Meijer zu Schlochterns, Saskia Werner |

Monitoring and Research Wishlist

The Dutch Caribbean nature conservation organisations are in need for research projects on specific topics to safeguard biodiversity and promote the sustainable management of the natural resources of the islands.

1. Coastal water quality/nutrients and interaction with groundwater:

Note: Recently during the NICO expedition researchers looked at this around Bonaire and Curaçao.

- Possible link to fish diseases/incidence of Fibropapillomatosis in green turtles in Lac, Lagoon and Curaçao can be used to determine the linkages with water quality, pollutants in sediments, etc serving as indicators, or sentinels for the health of these important ecosystems.
- Pollutants (oil, heavy metals, pesticides, endocrine disruptors, plastics, microbial etc) entering coastal waters (subterraneously) from land and their effects on marine organisms (Curaçao).
- Quantifying terrestrial hydrological controls on nutrient and sediment fluxes into shallow seas (Bonaire).
- Stoichiometric aspects of nutrient enrichment on Caribbean reefs (Curaçao).
- What do coral communities do "well" in places where they are not expected? What makes corals cope with more nutrients, warmer waters etc? (Curaçao)
- Design of cheap but effective waste water systems (using waste to generate biomass, energy etc.) (Curaçao)
- Water quality & pollutants in sediment of Spanish Lagoon (Aruba).
- Economical and feasible waste and waste water management options (St. Maarten).
- Water quality testing and impacts of poor water quality on marine life (St. Maarten).
- Monitoring the sedimentation on the reefs around Saba.

2. Climate Change

- Evaluation of the most probable effects of climate change and sea level rise (all islands), including risk analysis in coastal zones including coral reefs and recommendations for coastal zone management and climate proofing.
- Effects on sea turtles and their nesting beaches.
- Effects of changing temperatures and hurricane damage on cloud forest of Saba.
- Develop an effective terrestrial monitoring program to enable hurricane damage and recovery assessment.
- Island specific mitigation measures for climate change effect (St Maarten).

3. Hydrology

- Mapping of groundwater levels and flows [Bonaire].
- Nearshore-offshore mixing (Curaçao).
- A thorough study of Simpson Bay 's hydrology and water quality, particularly related to land-based sources of pollution. Identify key sources of pollution and track them back to their source (St. Maarten).

4. Morphodynamics

(near shore coastal hydrodynamics, current models):

- Currents and sand transportation (and production from Halimeda) in Lac (Bonaire) – very important to management of this Ramsar site. **Note:** HVL student has started to investigate this
- Investigate all sand producing organisms to better understand where sand (and beaches) come from (Curaçao).
- Effects on beach accretion and depletion Statia and potential of reef restoration/beach restoration.
- Sedimentation rates (St. Maarten).

5. Yarari Sanctuary

- Marine mammals: aerial survey (SSS islands (Saba Bank and waters surrounding Saba, St. Maarten and St. Eustatius), seasonal presence, isolation and abundance as well as seasonal migratory destination(s) and population history of humpback and Bryde's whales in the Dutch Caribbean.
- Sharks: Ecological role of Saba Bank for sharks (nursery for nurse sharks, tigersharks, silky sharks?).
- Analyze 10 year dolphin sighting database (Bonaire)
- Ecological role of the Saba Bank passage (between Saba and Saba Bank) for deepwater sharks (e.g. dog fish).

Monitoring and Research Wishlist

The Dutch Caribbean nature conservation organisations are in need for research projects on specific topics to safeguard biodiversity and promote the sustainable management of the natural resources of the islands.

6. Invasive species:

- Follow up studies of impact of rats (and cats) on nesting tropic birds.
- The effects of the invasive seagrass *Halophila stipulacea* on the native seagrasses in the area of Lac Bay, St. Eustatius and St. Maarten, and the ecological impacts (e.g. on green turtles feeding in Lac [and Lagun], Bonaire and St. Eustatius; on conch feeding and recruitment [aggregations of juvenile conch under *Halophila* in Statia], sea urchins, etc.)
Note: NWO funded Projects by Marjolijn Christianen (WUR) looked at this in relation to sea turtles. Also Erik Boman (WUR) & CNSI looked at this in relation to conch.
- *Scaevola taccada* (White inkberry/Beach naupaka) spread and potential impact on sea turtle nesting on Klein Bonaire.
- Donkey, cat, pig population size distribution and grazing impact on Bonaire. **Note:** Echo is working on a pig control programme.
- Management of *Corallita*
Note: A running NWO project looked at this.
- Trapping lionfish in deep waters. **Note:** A project is running by WUR and WNF on the Saba Bank.
- Impact and potential management plans for invasive species. This includes: monkeys, iguanas, mongoose, african land snail, racoons, red eared slider (St. Maarten).
- Invasive species (size, distribution, threat management): boa, rubber vine, tilapia, goats, rats, cats, dogs, cane toad (Aruba).

7. Birds

- Migratory birds – patterns, habitat use with an emphasis on nesting species (Bonaire).
- **Yellow shouldered parrot:**
 - ◇ Genetics of yellow shouldered parrot (establish uniqueness of Bonairean Parrot as compared to Venezuelan islands).
 - ◇ What is the effective (i.e., breeding) population size of lora as compared to the total population.
- **Flamingos**
 - ◇ Ecology of the flamingos, in particular the Pekelmeer and flamingo sanctuary. Food availability and fluctuations and effects on breeding success.

8. Carrying capacity/management effectiveness

- BNMP reef carrying capacity and implications for management (only old and dubious data available, urgent need for an update under current circumstances and how carrying capacity is influenced by management, e.g. can carrying capacity be increased with proper management. Consider also new types of recreation such as kite surfing and assess actual effects).
- Effectiveness of nature management, both marine and terrestrial (is management having an effect and what management actions should be improved or instated?)
- Saba/Statia trails (effects of use, potential mitigation measures?)
- Assess effectiveness of restoration efforts (e.g. reforestation, are the right species being planted, is the focus on rare species correct or counterproductive? **Note:** Echo is working on this on Bonaire). Aruba would like to see reforestation of native, endangered, and key fauna supporting flora.
- Study the difference between cruise tourism and stay-over tourism regarding their pressure on the terrestrial and marine environment, taking into consideration the infrastructure needed to accommodate these types of tourism [Bonaire]. **Note:** Wolfs Company did a study on this.



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Monitoring and Research Wishlist

9. Fisheries research

- **Conch:** vertical (depth) migration of conch.
- **Commercial fish species:** identify reproductive season or peak spawning period and area and assess connectivity between islands.
- **Saba Bank:**
 - ◇ carrying capacity of main target species (red snappers and lobster (also part of BO program) Feasibility of habitat restoration/artificial habitat for lobster fisheries on the Saba Bank.
 - ◇ Unused stocks: identify potential and sustainability of currently unused fish stocks such as diamond-back squid, swimming crabs.



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10. Sociological study of nature perception in the community

- How does the local community perceive nature and nature conservation and to what degree do they enjoy nature, how might this be improved? How effective is current communication, if any, to improve enjoyment of nature in the community and perception of the need to protect nature?
- Sustainable tourism – perception/expectations of tourists and residents as tourism grows (Bonaire).
- Invasive species control on islands where free-roaming livestock is a cultural norm – changing traditions in a changing world (Bonaire).
- Sociological/anthropological study of the cultural value of the endangered Lesser Antillean iguana *Iguana delicatissima*. How often is it caught? Perceived as a delicatessen? (St. Eustatius)
- Assess the extent of current pollution from land by plastic bags, styrofoam and other plastic debris. How willing are people to change their behavior vis a vis plastic bags, and what would be needed to effectively curb the continued generation of this type of marine debris.
- Sustainable development opportunities for tourism dependant islands (St. Maarten).

The Dutch Caribbean nature conservation organisations are in need for research projects on specific topics to safeguard biodiversity and promote the sustainable management of the natural resources of the islands.

11. DNA barcoding to monitor biodiversity (is already running on St Eustatius by Naturalis)

- Biodiversity inventory: terrestrial. (St. Maarten and Aruba (also marine))
- Endemic, Endangered, and Keystone species (size, distribution, conservation management): Shoco (continue program), Bats (continue program), Prikichi, Santanero, Cascabel (renew program), Pollinators, Key fauna supporting flora (Aruba).
- Natural history Flora and Fauna distribution.

12. Improve baseline data on sharks (continue Shark research, especially shark tagging, movement and abundance).



Photo by: © Stan Shea

Monitoring and Research Wishlist

The Dutch Caribbean nature conservation organisations are in need for research projects on specific topics to safeguard biodiversity and promote the sustainable management of the natural resources of the islands.

13. Coral reefs

- Which herbivores can be used to reverse coral to algal phase shifts? Which algae are consumed and which ones aren't? (Curaçao)
- Effects of habitat fragmentation and its effect on gene flow on coral reefs (Curaçao).
- The contribution of waterflow to reef health (Curaçao).
- Shipping impacts to nearshore coral reef environments (Bonaire).
- GCRMN reef monitoring (St. Maarten needs funding for long-term project).
- To battle and research the impact of stony coral tissue loss disease (St. Maarten)
- Coral restoration, as we lost about 60% of our corals or more in the last 2 years (St. Maarten).

14. Economic valuation of key habitats (St. Maarten)

15. Environmental impact assessment landfill (St. Maarten)

16. Anthropogenic stressors:

- Effects, potential mitigation measures: Off-road vehicles (Aruba).
- Carrying capacity of (1) Off-road vehicles, (2) Conchi – (3) Natural Pool, Caves (Aruba).

17. Sargassum and Seagrass:

- Sargassum predictions, impacts, management (All).
- Sea grass research such as abundance, distribution and status (St. Maarten).

18. Turtles:

- Fibropapillomatosis in green turtles: cause, spread and severity of the disease (Bonaire, Curaçao).
- Sea Turtle Research (St. Maarten).

19. Mangrove Restoration (St. Maarten)



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Monitoring and Research Wishlist

Additional notes:

The following are research questions from previous years and still very much valid for Aruba, Curaçao and St. Maarten. They are mostly completed or underway on the Caribbean Netherlands' islands but some are still valid.

Collection and evaluation of baseline data

including species inventories and production/updating of habitat maps for key habitats and species including:

- **Marine environments**
(coral reefs, seagrass beds, mangrove forests):
 - ◇ **Habitat maps** for all marine ecosystems: Aruba, Bonaire (windward side), Saba [done], Saba Bank, St Eustatius [done], St Maarten
 - ◇ **Revised habitat maps for the leeward shore:** Bonaire [done], Curaçao [note that there are habitat maps for Bonaire and Curaçao produced by Fleur van Duyl but these are now decades out of date. Recently a report from WUR came out (Mücher et al. Hyperspectral Coral Reef Classification of Bonaire). During the NICO expedition bathymetric data has been collected by Dr. Henk de Haas (NIOZ) for the Dutch Caribbean islands but this data still needs to be analyzed.
- **Terrestrial environments:**
 - ◇ **Habitat maps** for Aruba [habitat maps produced and ground truthed by CARMABI exist for all islands except Aruba]
 - ◇ **Species inventories** (all islands) [Statia starting soon]
 - ◇ **Cost effective methods for assessing terrestrial habitat change** [remote sensing is now being proposed for monitoring]
 - ◇ **Detailed inventories and mapping for key ecosystems** including
 - › Cactus habitats (Bonaire)
 - › Elfin forest (Saba)
 - › Boven forest types (Statia)
 - ◇ **Baseline data and population dynamics** (including reproductive biology and conservation ecology) for **key species** including:
 - › Caribbean coot
 - › Northern Caracara
 - › Red bellied racer (Saba, Statia)

The Dutch Caribbean nature conservation organisations are in need for research projects on specific topics to safeguard biodiversity and promote the sustainable management of the natural resources of the islands.



Photo by: © Diego Marquez

List of Acronyms

| | |
|------------|---|
| AUA | Aruba |
| BON | Bonaire |
| CUR | Curaçao |
| SAB | Saba |
| EUX | St. Eustatius |
| SXM | St. Maarten |
| ABC | Aruba Birdlife Conservation |
| AMMF | Aruba Marine Mammal Foundation |
| BEST | Biodiversity and Ecosystem Services in Territories of European overseas |
| BO project | Policy Supporting Research project |
| BU | Brock University, Canada |
| Calpoly | Canadian Institute for Advanced Research, Canada |
| CARIBSS | Caribbean Speleological Society |
| CARMABI | Caribbean Research and Management of Biodiversity Foundation |
| CEAB | The Blanes Centre for Advanced Studies, Spain |
| CRF | Coral Restoration Foundation |
| DCNA | Dutch Caribbean Nature Alliance |
| DCBD | Dutch Caribbean Biodiversity Database |
| DNM | Directie Natuur en Milieu, Aruba |
| DRO | Directorate of Spatial Planning and Development, Bonaire |
| EcoPro | Ecological Professionals Foundation |
| ECPHF | Eastern Caribbean Public Health Foundation |
| EPIC | Environmental Protection in the Caribbean |
| ETH | ETH Zürich, Switzerland |
| FIU (EEL) | Florida International University Environmental Epigenetics Lab |

| | |
|-------------------|--|
| FSU | Florida State University |
| FPNA | Fundacion Parke Nacional Aruba |
| GLOW | Global Owl Project |
| HAS | HAS University of Applied Sciences, the Netherlands |
| LVV | Department of Agriculture, Animal Husbandry & Fisheries, St. Eustatius |
| MinLNV | Ministry of Agriculture, Nature and Food Quality |
| MC | Marhaverlab, Curacao |
| MARUM | MARUM – Center for Marine Environmental Sciences, Bremen |
| NFSXM | Nature Foundation St. Maarten |
| Naturalis | Naturalis Biodiversity Center, Leiden, The Netherlands |
| NEV | Dutch Elasmobranch Association |
| NIOZ Sea Research | Royal Netherlands Institute for Sea Research |
| NTU | Nottingham Trent University, UK. |
| NWO | Netherlands Organisation for Scientific Research |
| RAVON | Reptielen Amfibieën Vissen Onderzoek Nederland |
| RRFB | Reef Renewal Foundation Bonaire |
| RuG | University of Groningen, the Netherlands |
| RU | Radboud University Nijmegen, the Netherlands |
| SCCN | Southern Caribbean Cetacean Network |
| SABARC | Saba Archaeological Center |
| Scripps | Scripps Institution of Oceanography, U.S.A. |
| SDSU | San Diego State University, U.S.A. |
| SBMU | Saba Bank Management Unit |

| | |
|----------------|--|
| SCF | Saba Conservation Foundation |
| SCORE | SCORE International, U.S.A. |
| Smithsonian | Smithsonian's National Museum of Natural History |
| STCB | Sea Turtle Conservation Bonaire |
| STCC | Sea Turtle Conservation Curacao |
| STENAPA | St. Eustatius National Parks Foundation |
| STINAPA | National Parks Foundation Bonaire |
| SU | Swansea University, UK |
| TU | Temple University, USA |
| UIU | University of Illinois Urbana-Champaign, U.S.A. |
| UC | University of California, Berkeley, U.S.A |
| UU | University of Utrecht, the Netherlands |
| UvA | University of Amsterdam, the Netherlands |
| VHL | University of Applied Sciences VHL, the Netherlands |
| VISR | Venezuelan Institute of Scientific Research |
| VU | VU University Amsterdam, the Netherlands |
| Wildconscience | Wildlife Conservation, Science and Education |
| WNF | World Wide Fund for Nature |
| WMR | Wageningen Marine Research, the Netherlands |
| WUR | Wageningen University and Research Centre, the Netherlands |
| WUR (Alterra) | Wageningen Environmental Research, the Netherlands |
| ZMT | Das Leibniz-Zentrum für Marine Tropenforschung, Bremen |

Reports and Publications Overview

Below you will find an overview of the reports and publications on biodiversity related subjects in the Dutch Caribbean that have recently been published.

"Bakker, D.M. de, Duyl, F.C., Perry, C.T., Meesters, E.H. (2019).
[Extreme spatial heterogeneity in carbonate accretion potential on a Caribbean fringing reef linked to local human disturbance gradients. Global Change Biology."](#)

"Griffith, M.P., Coolen, Q., Barros, M., Noblick, L.R. (2019).
[Sabal lougheediana \(Arecaceae\), a critically endangered, endemic palm species from Bonaire. Phytotaxa 420 \(2\): 095–101."](#)

"Johnson, R.A. et al. (2019).
[Seagrass ecosystem metabolic carbon capture in response to green turtle grazing across Caribbean meadows. Journal of Ecology"](#)

"Korzhevina, O.A., Hoeksema, B.W., Ivanenko, V.N. (2019).
[A review of Caribbean Copepoda associated with reef-dwelling cnidarians, echinoderms and sponges. Contributions to Zoology. DOI: 10.1163/18759866-20191411"](#)

"Lugo, A.E., Medina, E., Cuevas, E., Ramos González, O. (2019).
[Ecological and Physiological Aspects of Caribbean Shrublands. Caribbean Naturlist No. 58"](#)

"MacRae, D., Meyer, K. de (2019).
[A new approach to monitoring marine protected areas management success in the Dutch Caribbean. Chapter 20 in Marine Protected Areas: Science, Policy and Management"](#)

"Pratt, A., Baldwin, C.C., Vecchinione, M. (2019).
[Octopods of deep reefs off Curaçao, southern Caribbean, including description of one newly discovered species. Ingenta connect"](#)

"van der Zee, J.P. et al (2019).
[Population recovery changes population composition at a major southern Caribbean juvenile developmental habitat for the green turtle, Chelonia mydas. Scientific Reports 9."](#)

"Webb, A.E. (2019).
[Reef dissolution : Rates and mechanisms of coral dissolution by bioeroding sponges and reef communities. PhD thesis"](#)

Student Reports

"Molenaar, A. (student), Beukering, P. (2019)
[The socio-cultural value of the Simpson Bay Lagoon. An economic valuation amongst the heterogeneous population of Saint Martin. "](#)

These reports and publications can be found in the Dutch Caribbean Biodiversity Database (DCBD) (<http://www.dcbd.nl>). The DCBD is a central online storage facility for all biodiversity and conservation related information in the Dutch Caribbean.

If you have research and monitoring data, the DCNA secretariat can help you to get it housed in the DCBD. Please e-mail us: research@DCNANature.org



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Calendar

October

| | | |
|-------------|------------|--|
| whole month | Event | Sea and Learn, Saba |
| 12 | Event | International Migratory Bird Day |
| 15,17 | Workshop | Women making waves in nature, Bonaire |
| 24-26 | Conference | Sarg'expo (international sargassum conference), Guadeloupe |
| 26-29 | Convention | DCNA convention "Marine Parks", Bonaire |
| 26-27 | Event | Dutch Caribbean Junior Ranger exchange, Bonaire |
| 28 | Workshop | Dutch Caribbean Biologist workshop, Bonaire |
| 28-29 | meeting | DCNA Board meeting, Bonaire |
| 31-3 nov | Workshop | Workshop Carimam project, Dominican Republic |

November

| | | |
|-------|------------|---|
| 4-8 | Conference | 72nd Annual conference of the Gulf and Caribbean Fisheries Institute, Dominican Republic. |
| 11-20 | Workshop | Financial Sustainability Workshop, St. Eustatius, Saba, St. Maarten (DCNA, WNF, WolfsCompany) |
| 15 | Symposium | 4th annual AcroporaNet Symposium, Texel, the Netherlands |
| 21 | Event | World Fisheries Day |

December

| | | |
|----|------------|--|
| 12 | Conference | 2nd World Marine Mammal Science Conference, Barcelona, Spain |
| 10 | Meeting | Fisheries Commission BES meeting, Saba |
| 11 | Meeting | EEZ committee meeting, Saba |

More events to add to this calendar?
Please e-mail us: research@DCNAnature.org



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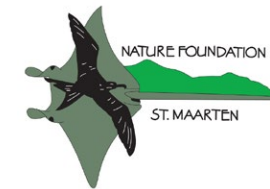
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Kingdom Report Sounds Alarm on Biodiversity Conservation in the Dutch Caribbean

Ministry of Agriculture, Nature and Food Quality. 2019. Convention of Biological Diversity Sixth National Report of the Kingdom of the Netherlands.

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Wageningen University & Research (WUR). "AlgaePARC Bonaire." YouTube, 15 Apr. 2019, www.youtube.com/watch?v=INB5ywOUoRE.

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