BIONEWS

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Dutch Caribbean Nature Alliance
Safeguarding nature in the Dutch Caribbean

DCNA

BIONEWS ISSUE 39

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Editor's Letter

Dutch Caribbean, October 2020

The St. Maarten Nature Foundation recently retrieved acoustic receivers (loggers) to learn about the movement patterns and home ranges of Caribbean reef and Nurse sharks around St. Maarten. The majority of the sharks fitted with acoustic devices showed remarkably high site fidelity. The small home ranges of the sharks show that reserves and marine parks offer good opportunities to protect these shark species.

Orbicella annularis is an important reef-building coral and an endangered species. Previous studies suggest it is also one of the most intensely grazed corals by parrotfishes in the Caribbean. Yet, the healing capacity of Caribbean corals from parrotfish predation scars remains poorly understood. In a recent study published in Coral Reefs, researchers from California Polytechnic State University monitored the healing of over 400 recent parrotfish predation scars on *O. annularis* colonies on the islands of St. Croix and Bonaire for up to two months in 2018 and 2019, respectively.

Researchers from the Netherlands and Mexico studied three bays on Saint Martin to illustrate the ability of seagrass and algae fields to withstand hurricane level storms while continuing to dissipate energy and anchor sediments. Through field surveys, biomechanical measurements and computer simulations this project demonstrated the importance of coastal ecosystems such as seagrass beds and macroalgae in the protection of coastlines.

Between 2008 and 2010, STINAPA Bonaire and volunteers took to counting Brown Booby seabirds along the northwestern coast of Bonaire. These numbers represent the first study of its kind in over 50 years and showed a slow increase in numbers since the establishment of the Washington Slagbaai National Park in 1969.

Enjoy!
The DCNA Team

Tracking Sharks around Sint Maarten

The St. Maarten Nature Foundation recently retrieved acoustic receivers (loggers) to learn about the movement patterns and home ranges of Caribbean reef and Nurse sharks around St. Maarten. The majority of the sharks fitted with acoustic devices showed remarkably high site fidelity. The small home ranges of the sharks show that reserves and marine parks offer good opportunities to protect these shark species.

Acoustic telemetry study

Nurse shark and Caribbean reef shark behavioral studies are carried out using VEMCO acoustic telemetry. Acoustic telemetry is a technique which enables researchers to track animals underwater such as sharks, using transmitters attached to the animals internally in combination with acoustic receiver stations setup throughout the study area. Acoustic transmitters were implanted in the abdominal cavities of the sharks to allow for each shark to be tracked over a long period of time. The acoustic receivers register the unique code of a shark, along with the time and date when the tagged shark swims within the detection range of the receiver (max 800m from the receiver in optimal conditions).

In total, a network of 32 acoustic receivers have been set up, eight of them on the Saba Bank and the remainder on Saba, St. Eustatius and St. Maarten (8 each). These studies were set-up by Wageningen Marine Research in close cooperation with the local Protected Area Management Organizations, and funded by the Dutch Ministry of Agriculture, Nature and Food Quality (LNV) and DCNA (Postcode Lottery project Save Our Sharks). In addition, tagging sharks on St Maarten is kindly funded by private funders through their "Adopt a Shark Program". Pilot studies on Saba started in 2014 and expanded to the Saba Bank and the other islands in 2015.

Results

With this study, individual movements and scale of home ranges can be assessed. The first intriguing finding is that the majority of the sharks fitted with acoustic devices showed remarkably high site fidelity. This is not too surprising for nurse sharks, which spend much of their time lying on the bottom in and around coral reefs, but is much more surprising for Caribbean reef sharks which are considerably more mobile. The small home ranges of the Reef and Nurse sharks show that reserves and marine parks offer good opportunities to protect these shark species.

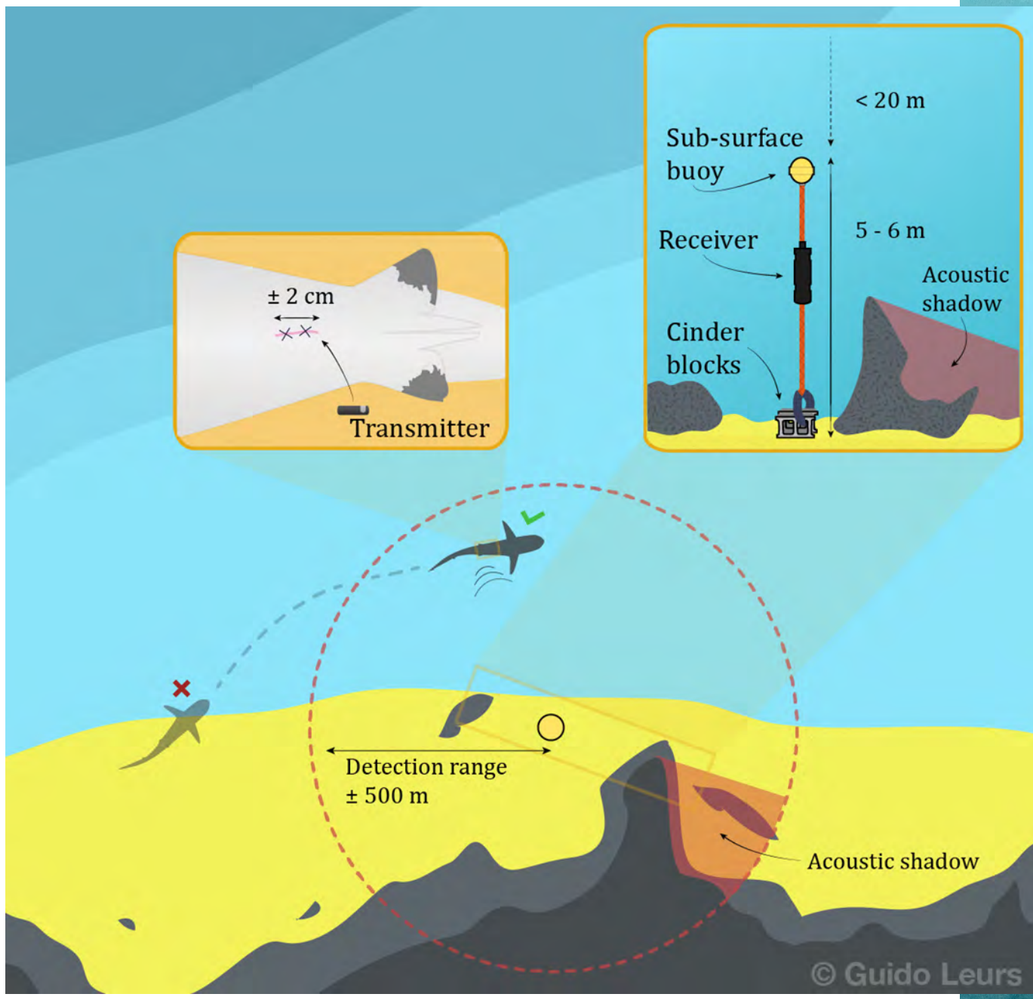
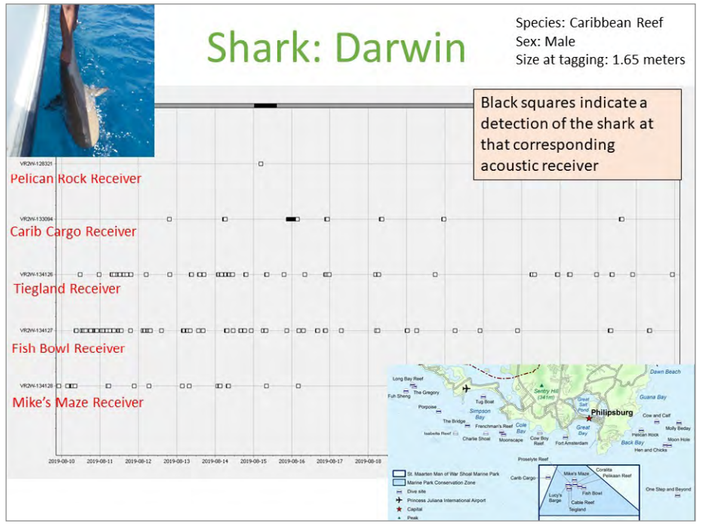


Fig. 1. Concept of acoustic telemetry. Underwater setup includes a receiver array (top right) and an acoustic transmitter implanted in the abdominal cavity of a shark (top left). Credit: Guido Leurs

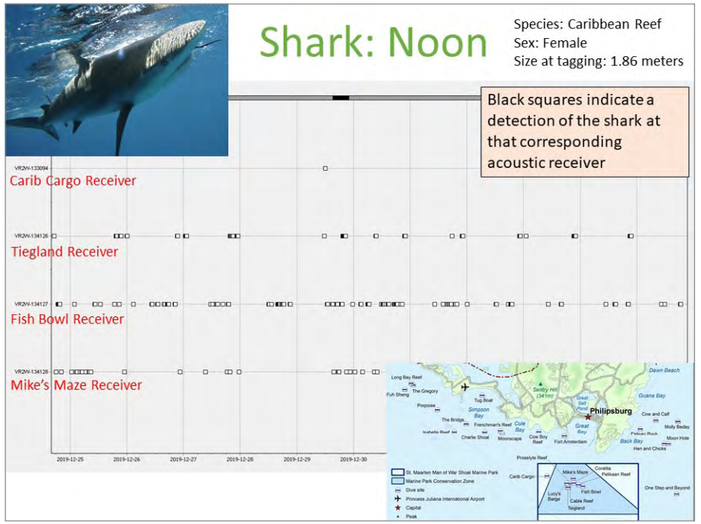
Update on three of the adopted sharks on St. Maarten:



Darwin, is a very adventurous male Caribbean Reef Shark. His home base is the Man of War Shoal Marine park where his tag is picked up by the receivers at Mike's Maze, Tiegland, and Fishbowl very often. But Darwin did spend some time traveling all around the island, going as far east as Pelican Rock and as far west as The Gregory (near the French boarder).

These solo trips are dangerous for sharks this size (1.65 meters at the time of tagging) as predators can be found in the deeper waters they must pass through.

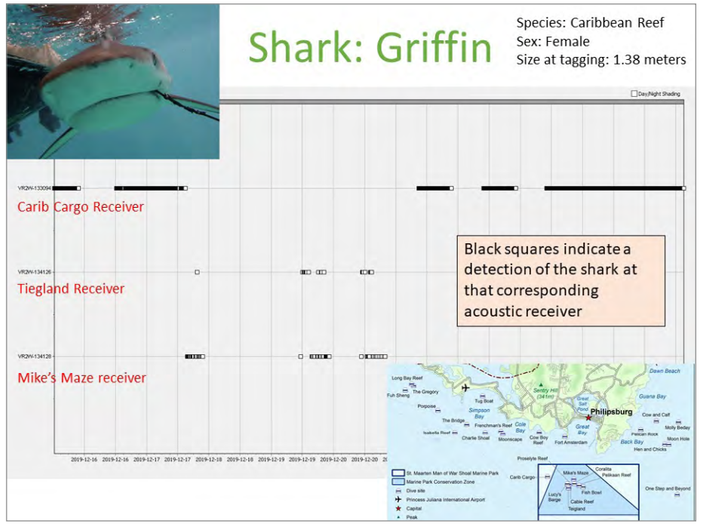
Image credit: Melanie Meijer zu Schlochtern (NFSXM)



Shark, Noon, is a female Caribbean Reef Shark and is very active. When she was tagged Noon was 1.86 meters long (just over 6 feet). She spends the majority of her time within the Marine Park bouncing between the Tiegland, Fish Bowl, and Mike's Maze Receivers. Noon did also take a couple of trips around the island visiting Carib Cargo, traveling all the way to Pelican Rock, and even going as far west as The Bridge Dive Site.

Taking these trips, in particular the one to Pelican Rock, is a dangerous feat for a shark this size as large predators can be found in the deep waters she needs to cross to reach these sites.

Image credit: Melanie Meijer zu Schlochtern (NFSXM)



This shark, Griffin, who was adopted by Learning Unlimited, is a female Caribbean Reef Shark. Griffin was originally tagged near the dive site Carib Cargo, which seems to be her 'home base' as she spends the majority of her time there.

While she spends most of her time near this beautiful wreck she has traveled through the Man of War Shoal Marine Park, with her tag being picked up at Mike's Maze, Tiegland, Fish Bowl, and even Pelican Rock.

Image credit: Melanie Meijer zu Schlochtern (NFSXM)

More information

Follow Nature Foundation St. Maarten and DCNA on Facebook to keep learning about sharks

Tracking Sharks around Sint Maarten

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Recovery of *Orbicella annularis* corals from parrotfish predation

***Orbicella annularis* is an important reef-building coral and an endangered species. Previous studies suggest it is also one of the most intensely grazed corals by parrotfishes in the Caribbean. Yet, the healing capacity of Caribbean corals from parrotfish predation scars remains poorly understood. In a recent study published in Coral Reefs, researchers from California Polytechnic State University monitored the healing of over 400 recent parrotfish predation scars on *O. annularis* colonies on the islands of St. Croix and Bonaire for up to two months in 2018 and 2019, respectively.**

Parrotfishes: herbivores & corallivores

Parrotfishes are abundant herbivores that primarily graze upon algae, thereby mitigating coral-algae competition and indirectly benefiting the recruitment and growth of coral colonies. At a local scale, management efforts to increase populations of parrotfishes are believed to be critically important to maintaining resilient, coral-dominated reefs. Yet, some parrotfish species also occasionally graze coral – a behavior known as corallivory. Corallivory can cause the localized mortality of coral tissue and may have long-term impacts such as reduced coral growth and fecundity and increased susceptibility to disease. While evidence suggests that parrotfishes likely have an overall net positive impact on coral communities, some researchers have expressed concern that they may have detrimental impacts on heavily predated coral species, such as *O. annularis.*

To better understand the consequences of corallivory for *O. annularis*, they evaluated (1) coral healing rates, (2) total coral healing, and (3) developed a model to predict tissue loss from a standing stock of parrotfish predation scars. This is the first study to monitor coral tissue healing rates and recovery thresholds from naturally occuring parrotfish bite scars in the Caribbean.

Coral healing rates

The team evaluated how coral healing rates were influenced by factors such as the initial scar size, number of scars per coral colony, colony size, colony water depth, and island. They found temporal thresholds in *O. annularis* healing rates, where the majority of scar healing occurs within the first few weeks and scars have minimal healing after approximately 45 days. Additionally, they found that smaller scars have higher initial healing rates than larger scars. However, the number of scars per coral colony, colony size, colony water depth, and island had no observable effect on coral healing rates.

Total coral healing

They compared how these same factors influenced the total amount of coral healing over two months, which their research suggests encompasses the full timespan during which healing occurs. They found that the initial scar size alone was an important predictor of total coral healing and that there were distinct size-based thresholds in coral tissue regeneration. They observed that small scars (≤1.25 cm2) often fully heal, while larger scars (≥8.2 cm2) – presumably resulting from repetitive, localized predation by parrotfishes – had minimal tissue regeneration. They used these findings to develop a predictive model of total *O. annularis* tissue loss based on the initial size of parrotfish predation scars.

A large, recent parrotfish predation scar on Orbicella annularis inflicted by a Stoplight parrotfish (Sparisoma viride). Photo by: © Hannah Rempel

Predicted coral tissue loss

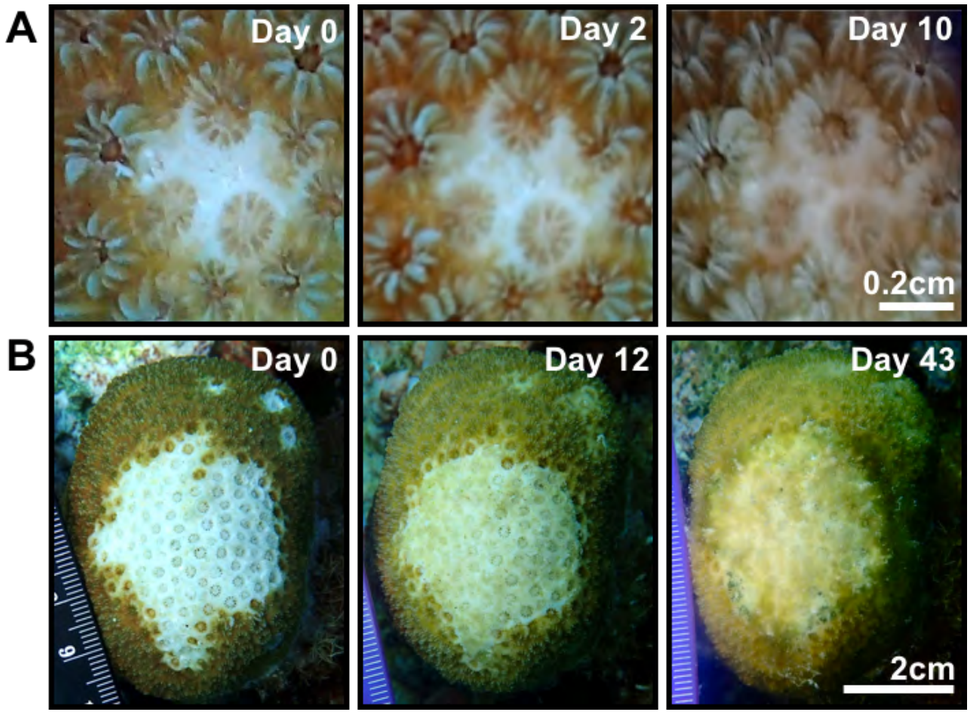
They surveyed the size and abundance of recent parrotfish predation scars present on O. annularis colonies at a point in time and used their model to predict coral tissue loss from these scars. They observed that 87% of scars were small (≤1.25 cm2) and their model predicted that these small scars would fully heal or result in minimal tissue loss. In contrast, while only 6% of observed scars were large (≥8.2 cm2), their model predicted that these large scars had minimal healing and would result in 96% of the total tissue loss for predated colonies.

Conclusions & future directions

This study suggests that the immediate negative consequences of parrotfish corallivory for *O. annularis* appear to be driven primarily by a few exceptionally large bite scars. Interestingly, there was no observable difference in healing rates or total coral healing between islands despite stark contrasts in parrotfish and coral community composition on St. Croix and Bonaire. This suggests that these findings and this predictive model may be broadly applicable to other regions of the Caribbean. This study presents an important advance in understanding the recovery of a heavily predated, ecologically important, and endangered Caribbean coral from parrotfish corallivory. The group's ongoing work seeks to address how the intensity of parrotfish corallivory is influenced by the community composition of corals and parrotfishes across multiple spatial scales and regions of the Greater Caribbean. Areas for future research include quantifying the indirect consequences of corallivory for coral growth and fecundity and the factors driving selective parrotfish corallivory.

For more information:

Rempel, H.S., Bodwin, K.N., Ruttenberg, B.I. 2020. Impacts of parrotfish predation on a major reef-building coral: quantifying healing rates and thresholds of coral recovery. Coral Reefs 39:1441–1452. https://doi.org/10.1007/s00338-020-01977-9



Small scars healed rapidly, as seen in this image series – (Day 0) a recent parrotfish predation scar, (Day 2) soft tissue had begun regenerating inwards from the scar perimeter, (Day 10) the soft tissue layer fully regenerated over the entire scar area. Photo by: © Hannah Rempel

Recovery of *Orbicella annularis* corals from parrotfish predation

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Importance of Seagrass and Macroalgae in the Protection of Coastlines

Researchers from the Netherlands and Mexico studied three bays on Saint Martin to illustrate the ability of seagrass and algae fields to withstand hurricane level storms while continuing to dissipate energy and anchor sediments. Through field surveys, biomechanical measurements and computer simulations this project demonstrated the importance of coastal ecosystems in the protection of coastlines.

Coastlines around the world are experiencing a wide range of issues, as the effects of global warming are leading to an increase in coastal erosion and intensifying of storms. Fortunately, nature has provided a line of protection which is likely the most sustainable and effective solution. The Caribbean coastal ecosystem often includes fringing coral reefs, which act as a surf break to shelter the sandy lagoons and bays behind them. These protected areas provide the perfect environment for seagrass and macroalgae meadows, linking these two distinct environments together. Seagrass and calcifying algae work to stabilize sediment with their roots and lessen wave energy through their leaves and the complex bottom topography they create.

Hurricane Protection

Native seagrass, Thalassia testudinum, has been seen to be very resilient in the face of storms. The long, flexible leaves of seagrass work to capture and stabilize sediment, which overtime creates a complex bottom bathymetry. This in turn leads to waves been refracted within the shallow waters, causing a lessening of wave energy as they propagate into shallower areas. It is in this way that these seagrass and algae meadows work to fortify the sandy bottoms and minimize wave energy reaching the beach face, allowing these areas to withstand the brutal forces of hurricanes.

2017 marked the most active and destructive storm season for the Caribbean since 1970. Saint Martin was hit by 3 hurricanes, two of which were category 5; Hurricane Irma, Jose and Maria. Researchers worked to compare the seagrass beds before and after this hurricane season to understand the influences of these areas on protecting coastline during hurricanes. This study used a combination of field surveys, biomechanical measurements and wave modeling simulations to understand how Caribbean seagrass meadows respond to storm events.

The Study

Between October 2015 and March 2016, researchers conducted monitoring along three sites along the east coast of Saint Martin. These areas were selected because of the different types of hydrodynamic characteristics they represented, wave-sheltered (Baie de L'Embouchure), wave-exposed (Orient Bay) and unidirectional flow (Islets de L'Embouchure). All three sites have large seagrass and calcifying macroalgae meadows and are next to a coral reef, which protects them from the largest waves. Six months after the destructive hurricane season of 2017, researchers returned to these three sites to reexamine these meadows to determine the long-term effects of the storms.

In addition, researchers were able to use computer modelling simulation to run a variety of scenarios to see how the different bottom topography of the Baie de L'Embouchure altered the level of coastal protection. Researchers focused on three main scenarios: (1) waves entering the bay with flat, smooth bottom and no vegetation, (2) waves entering with a biogeomorphic bottom (uneven sand) but no vegetation and (3) a healthy seagrass meadow with biogeomorphic bottom and lush seagrass.

The Results

Researchers found that even after the extreme conditions of the 2017 hurricane season, there was very little change in the bathymetry and make up of the Thalassia testudinum dominated seagrass fields. This example shows how critical these seagrass meadows really are, both in being a resilient habitat and environment in the face of high energy waves, while also continuing to provide coastal protection during storms.

Only the exposed area of Orient Bay experienced a small loss of seagrass whereas the other two sites actually experienced an expansion of seagrass cover into previously bare areas. These results are similar to other studies within the Caribbean, which highlights Thalassia testudinum's strength and resilience to wave forces, experiencing very little, if any long-term damage even after strong hurricanes.

It is likely these seagrass and algae have evolved to meet the demanding needs of their environment. This area of the Caribbean often has strong, reoccurring storms, so any species which has flourished here will have needed to evolve to withstand these conditions. These species of seagrass and

algae are known to have long, strong, flexible leaves and thalli which allows them to bend, both withstanding the strong hydrodynamics forces of these storms while also protecting the sandy sediment their roots depend on.

Through computer modeling, researchers were also able to highlight the importance of having both a biogeomorphic bottom and lush seagrass cover. Simulations with neither resulted in waves traveling up the smooth bathymetry allowing the brunt of wave forces to reach the beach. However, once a more natural environment was simulated, including an uneven bottom and lush vegetation, researchers demonstrated an exponential rate of decay over the first 150m of seagrass meadow. Smaller, more patchy meadows also worked to dissipate energy, but were less effective.

Investing in Our Future

This study highlighted the benefits of healthy seagrass and algae meadows by demonstrating how even after an extreme storm event, the bathymetry of these bays remained unchanged. In fact, in some cases, they even measured a bed-level rise, showing sediment was being trapped by the seagrass within the bay. These seagrass and algae fields provide important coastal protection services proportional to their size, so the larger and wider these meadows, the more drastically they will reduce wave energy. Therefore, it is important that if islands wish to continue to protect their coastlines, these seagrass meadows must be protected and enhanced. In addition, this study showed how the fringing coral reefs worked to help dissipate large wave energy before they reach the seagrass meadows. Without these reefs, the seagrass and algal meadows would need to withstand the entire force of these waves, so maintaining large, healthy reefs is also critical to protecting these coastlines.

From the other side, coastal erosion from rain runoff can smoother and kill seagrass beds. Healthy mangrove forests and vegetation along the coastline can minimize this terrestrial erosion and provide a line of defense between the land and sea. Together we can work to continue to push for conservation and restoration efforts for these environments, using what nature has provide to continue to protect these coastlines into the future.

For more information, see the full report

James, R.K., Lynch, A., Herman, P.M.J., van Katwijk, M.M., van Tussenbroek, B.I., Dijkstra, H.A., van Westen, M., van der Boog, C.G., Klees, R, Pietrzak, J.D., Slobbe, C., Bouma, T.J. 2020. Tropical Biogeomorphic Seagrass Landscapes for Coastal Protection: Persistence and Wave Attenuation During Major Storms Events. Ecosystems ttps://doi.org/10.1007/s10021-020-00519-2

Photo by: © Rebecca James

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Bonaire's First Brown Booby Population Count in Over 50 Years

Between 2008 and 2010, STINAPA Bonaire and volunteers took to counting Brown Booby seabirds along the northwestern coast of Bonaire. These numbers represent the first study of its kind in over 50 years and showed a slow increase in numbers since the establishment of the Washington Slagbaai National Park in 1969.

Brown Boobies *(Sula leucogaster)* are large seabirds, known to roost along cliff edges in the Caribbean. These birds typically nest in large colonies and plunge-dive to catch small fish and squid. Each season, these birds usually lay two eggs, but its common for only one to survive the first few months after hatching.

Brown Boobies on Bonaire

Although these birds can be seen on each of the ABC islands, they are not known to breed here. The northwest coast of Bonaire is a known roosting area, with reports dating as far back as the 1950s. Originally, around 200 Brown Boobies were known to use these cliffs as roosting areas, however, accounts of raids by fishermen could wipe out half of this population within a single hunt. These birds were often caught for food and for their liver, which was an important ingredient to be used in 'bruha' (black magic).

Luckily, since 1969, the areas around these roosting areas were designated a nature reserve, which would eventually become the Washington Slagbaai National Park managed by Stichting Nationale Parken Bonaire (STINAPA Bonaire). This designation meant that hunting these birds here was now illegal. Although hunting has officially been banned for nearly 50 years, no updated populations counts had been conducted since.

Population Counts

Between 2008 and 2010, a population count study was conducted in this area by STINAPA Bonaire and a group of 17 citizen scientists (trained volunteers) to provide an estimated number of Brown Boobies roosting along the northwestern coast of Bonaire as well as to note any other roosting seabirds or banded birds in the area. In addition, this study worked to increase awareness of these seabirds among reserve staff, local residents and visitors involved in the monitoring program.

The numbers provided were the first update in over 50 years. During the study, 7 cliffside sites were selected between Malmok and Playa Funchi, areas known to be regularly visited by roosting seabirds. Seabirds in these areas could only enter and exit the roosts by flying in from the sea, so monitoring consisted of taking an initial count, then adding or subtracting birds as they flew in or out over the course of an hour.

The Results

During the study, the largest number of Brown Boobies counted was in July 2009, with 240. Throughout the study they saw no evidence of breeding nor any banded birds, however a few other roosting birds such as Masked Boobies (*Sula dactylatra*) and Brown Noddies (*Anous stolidus*) were documented.

Another interesting trend was that the highest number of Brown Boobies were counted in July of each year, and a minimum number occurring in January. Although the numbers for the Brown Boobies were lower in 2009 than in 2010, this data suggests that the overall numbers may be on the rise. This is most likely attributed to establishing and managing the protected area around these roosting sites.

Photo by: © Kai Wulf

Overall, there is still a lack of information concerning these important seabirds. Further information on the breeding grounds for these species could help researchers understand changes in population dynamics. Additionally, a color banded tagging technique would be useful for tracking particular birds without requiring the birds to be physically captured to read the tag. This study provided the first official update in nearly half a century concerning these iconic seabirds. Understanding changes in local seabird populations can allow conservationists and policy makers to create effectively manage plans for these species into the future.

Report your sightings

Please report any sightings or photos you have of Brown Boobies, or any other seabird species on https://dutchcaribbean.observation.org. This is a free website and app (iPhone (iObs) & Android (ObsMapp) which allows local citizens to report sightings of important plants and animals. These tools are available in over 40 languages and can be used by biologists and citizens and tourists alike. Species reports by local communities are invaluable for nature conservation efforts to help increase public awareness and overall species protection. Besides, Observation.org is working together with Naturalis Biodiversity Center on automated species identification software. Your uploaded photos are of great value to make this possible. For questions, please contact *research@DCNAnature.org*

For the full research note please read:

Simal, F., A. Vallarino, E. Beukenboom, R. Paula, H. Beaumont, G. Zaragoza, E. Wolfs, P. Holian, and E. Albers. (2020). Brown Boobies (Sula leucogaster) roosting at Washington-Slagbaai National Park, Bonaire, Caribbean Netherlands. Journal of Caribbean Ornithology 33:78–81.

A map showing the seven selected sites between Malmok and Playa Funchi along the northwestern coast of Bonaire. Map credit: Alison Ollivierre

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Bonaire's First Brown Booby Population Count in Over 50 Years

Research Overview

October 2020

CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
Bats	Bat maternity roost: Effect of barrier on the two species of small insectivorous bats	BON	**Wildconscience**: Fernando Simal, Daniela Simal (student)
Birds	Suitability study and reforestation of exclosures facilitating the Yellow-shouldered Amazon Parrots (Amazona barbadensis)	BON	**Echo:** Julianka Clarenda
Coral reefs	Status coral reefs (GCRMN transects at 115 sites-every 3 years since 2014)	BON	**WUR:** Erik Meesters **Students:** Chantal Visser, Max van Aalst, Arjen Okma, Freek Hoen **STINAPA:** Caren Eckrich
Climate change	Teatime4science (seagrass and mangroves http://www.teatime4science.org)	BON	**STINAPA:** Sabine Engel
Fisheries	Lobster larvae recruitment on the Saba Bank	SAB	**SCF:** Ayumi Kuramae Izioka
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	Shark bycatch monitoring programme	SAB	**NEV:** Paddy Walker, Irene Kingma **SCF:** Ayumi Kuramae Izioka **MOTE marine lab**: Robert Nowicki
Fisheries	Nurse shark bycatch reduction	SAB	**SCF:** Ayumi Kuramae Izioka
Fish	Assessing the Spawning Potential Ratios of Reef Fish Species on St. Eustatius	EUX	**CNSI:**Kimani Kitson-Walters **IMBRSea**: Lisanne Van Harten (student)
Invasive species	Invasive Vervet monkey and possible management options.	SXM	**Anglia Ruskin University:** Alice Manley (student) **NFSXM**

Research Overview

October 2020

CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
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	Flora Caribisch Nederland	BES	**CARMABI:** Erik Houtepen **WUR:** J.A.M. Janssen, S.M. Hennekens **van Proosdij Botanisch Advies:** AS.J. van Proosdij
Plants	Vegetation of the Shete Boka National Park	CUR	**CARMABI:** Erik Houtepen **WUR:** H. Bartolomeus
Reptiles	Red-bellied racer snake research	EUX	**RAVON:** Tim van Wagensveld **CNSI:** Hannah Madden,
	Tracking digital footprints in Bonaire's landscapes wit Artificial Intellegence	BON	**WUR:** Jan Tjalling, Peter Verweij Zakiul Jailani (student)

Long Term Projects

CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
Anthropogenic Impact	Anthropogenic Impact Analyses, Aruba National Park	AUA	**FPNA:** Giancarlo Nunes
Terrestrial and marine environment	Open Science for Aruba (a baseline study of the island's environment focusing on air quality, green coverage on land, water quality and coral reef coverage using satellite imagery and setting up monitoring stations for air- and water quality)	AUA	**Metabolic Foundation**: Tony Sevold, Christie Mettes
Coral Reef Ecosystems	Population Structure and Connectivity of hermatypic corals in the Southern Dutch Caribbean (part of SISSTEM)	AUA BON, CUR	**KU Leuven:** Filip Volckaert **University of Aruba:** Diana Melville (PhD student)
Coral Reef Ecosystems	Deep Reef Observation Project (DROP) (ARMS: Autonomous Reef Monitoring Structures)	CUR	**Smithsonian:** Carole Baldwin
Coral Reef Ecosystems	Youth-powered coral reef video surveys in Aruba	AUA	**ScubbleBubbles Foundation:** Miranka van Breugel, Nichole Danser
Coral Reef Ecosystems	RAAK PRO Diadema: Diadema Antillarum Population Assessment & Restoration	EUX SAB	**CNSI:** Kimani Kitson-Walters **VHL**: Alwin Hylkema, **STENAPA:** Jessica Berkel, **SCF, Students:** Meike de Breuyn
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 Virdis
Coral Reef Restoration	St. Maarten's Coral Restoration Project	SXM	**NFSXM**: Melanie Meijer zu Schlochtern, **CRF**
Coral Reef Restoration	Coral Restoration (coral nurseries)	SAB, EUX	**SCF:** Ayumi Kuramae, **STENAPA:** Jessica Berkel
Coral Reef Restoration	Plant a million coral initiative (IntelliReefs)	SXM	**NFSXM**: 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 Virdis **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

Long Term Projects

CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
Coral Reef Restoration	Artificial structures that encourage larvae settlement and discourage the growth of competitor species	CUR	**University of Illonois**: 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, Hannco Bakker, Bert Hoeksema
Interstitial biodiversity	Moleculair biodiversity analysis of marine communities by metabarcoding	EUX	**Naturalis:** Arjen speksnijder **ANEMOON:** Niels Schrieken
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
Invasive species	* Impact of Halophila stipulacea on the availability of benthic diatoms as a food source for a commercially important deposit feeders in a native and invasive habitat * Halophila stipulacea regrowth study to understand the general biology and spread of the seagrass.	EUX	**CNSI:** Johan Stapel,Anna Maitz, Kimani Kitson-Walters
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 (Obtain ecosystem baselines and overview for Parke Marino Aruba sites)	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
Paleoecology	ISLANDER: Island **S**ustainability: the **L**egacy of **A**nthropogenic and **N**atural **D**isturbance on **E**cological **R**esources	CUR	**UvA:** S. Yoshi Maezumi (PhD student) **CARMABI:** Erik Houtepen, Mark Vermeij **NAAM**: Claudia Kraan **Simon Fraser University:** Christina M. Giovas **University of Queensland:** Kelsey M. Lowe **QLC Inc. and InTerris Registries™**: Michiel Kappers
Plants	Botanical Garden Aruba	AUA	**FPNA:** Natasha Silva
Plants	Wildlife Garden Reserve	AUA	**FPNA:** Giancarlo Nunes
Plants	Local vascular plants inventory (Funded by Prince Bernhard Cultural Fund)	SXM	University of Puerto Rico: Franklin Axelrod , **EPIC**

Long Term Projects

CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
Public Health	DNA waterscan: Monitoring disease vectors in the Caribbean (mosquitoes and midges)	CUR, EUX	**Naturalis:** Klaas-Douwe B. Dijkstra **ECPHF:** Teresa Leslie **CBHRI:** Delia-Maria Goilo (NWO DUCAMID project)
Reforestation	Reforestation Project on St. Eustatius	EUX	**Mac & Field**: Tim van Wagensveld & Stacey Mac Donald **STENAPA**: Clarisse Buma, **LVV:** Gershon Lopes
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"*
Sustainability	Sustainable Island Solutions through Science, Technology, Engineering and Mathematics (SISSTEM): - Vertical Farming on Aruba: opportunities for Small Island States (Kryss Facun) - Development of an optimal waste management system for Aruba (Colleen Weekes) - Population Structure and Connectivity of hermatypic corals in the Southern Dutch Caribbean (Diana Melville) - Detection and spatial analysis of urbanization and land use change in small island states, by means of GIS and remote sensing techniques (Start pending) - Connectivity of Marine Fish Populations (Start pending) - Sustainability in the agri-food chain group: life cycle analysis for a more sustainable agrifood chain on Aruba (Start pending) - Comparative research on social innovation and just resilience in the governance of small insular socio-ecological systems (Start pending) - Engineering sustainability… or sustainable engineering. Research project on the edge of sustainability, engineering, entrepreneurship, and education in Aruba (Start pending)	AUA	**University of Aruba**: Eric Mijts **KU Leuven**: Jo Van Caneghem, Wim Dewulf, Karel Van Acker, Bram Van de Poel, Filip Volckaert PhD students: Kryss Facun, Colleen Weekes, Diana Melville
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, Rocca Chin-on, Robin Barten (PhD students) **Institute for Sustainable Technology:** Rita Peachey

Long Term Projects

CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
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	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) **STINAPA**: Sabine Engel, Jessica Johnson
BO-projects in the Dutch Caribbean (Min LNV)			
Birds	BO-43-021.04-018 - Flamingo mortality	BON,	**WUR:** Dolfi Debrot, **Cargill Salt Bonaire** **Mangrove Center:** Elly Albers & STINAPA**, OLB**
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
Fisheries	BO-43-021.04-006 + BO-11-019.02-055 - Fish stocks and fisheries Caribbean Netherlands	EUX, SAB, BON	**WUR:** Dolfi Debrot, **CNSI:** Kimani Kitson-Walters **PiskaBon, STINAPA**, **SCF:** Kai Wulf, Ayumi Kuramae
Goats	BO-43-021.04-019 - Support professionalization goat farming Bonaire	BON	**WUR:** Francesca Nijenhuis
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:**Bart Noort **SCF (SBMU):** Ayumi Kuramae Izioka
Marine mammals	BO-43-021.04-007 –Marine mammals in the Dutch Caribbean	BON, SAB, EUX	**WUR:** Dolfi Debrot, Dick de Haan, Meike Scheidat
UNESCO	BO-43-021.04-004 + BO-11-019.02-050 Bonaire National Marine Park as Unesco World Heritage	BON	**WUR:** Dolfi Debrot
KB-projects in the Dutch Caribbean (Min LNV)			
Spational Planning	KB-36-005-002, KB-33-010-003- Nature inclusive spatial planning for Small Island Development States	BON	**WUR:** Peter Verweij

Monitoring Overview

October 2020

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:** 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, **FPNA:** Giancarlo Nunes **STINAPA:** Paulo Bertuol, Caren Eckrich **STENAPA , CNSI** **Curassavica:** Michelle da Costa Gomes **CARMABI:** Erik Houtepen, **NFSXM**: Binkie van Es
Birds	Red-billed Tropicbird reproductive success	EUX	**STENAPA:** Erik Boman, **CNSI:** Hannah Madden
Birds	Red-billed Tropicbird monitoring	SAB	**SCF:** Kai Wulf, **WUR:** Mardik Leopold Michiel Boeken
Birds	Red-billed Tropicbird migration routes	EUX	**CNSI:** Hannah Madden **Clemson** University: Patrick Jodice
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, , Roxanne Francisca **CARMABI:** Mark Vermeij **SCF (SBMU):** Ayumi Kuramae Izioka **STENAPA:** Jessica Berkel **NFSXM:** Melanie Meijer zu Schlochtern **CNSI:** Johan Stapel, Kimani Kitson-Walters

Monitoring Overview

October 2020

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 **NIOZ:** Fleur van Duyl, Rolf Bak
Coral reef ecosystems	Coral Spawning Monitoring	BON CUR EUX	**CNSI:** Kimani Kitson-Walters **STENAPA, CARMABI:** Mark Vermeij **RRFB:** Francesca Virdis
Environmental	Water quality testing (BON: impact of increasing freshwater production on the reefs in front of the desalination plant in Hato)	BON SXM	**STINAPA:**Caren Eckrich, , Roxanne Francisca **WEB Bonaire** **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
Environmental	Coastal waters (light, temperature, three depths)	BON	**STINAPA:**Caren Eckrich, , Roxanne Francisca
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, Roxanne Francisca **CARMABI:** Mark Vermeij **SCF(SBMU):** Ayumi Kuramae Izioka **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:** Kaj Schut
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

Monitoring Overview

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CATEGORY	SUBJECT	DC ISLANDS	ORGANIZATION(S): LEAD SCIENTIST(S)
Invasive species	Feral pig population assessment (trapping)	BON	**Echo**
Invasive species	Mitigation and monitoring of Boa, Rubber Vines, and Feral Cats in nature conservation sites	AUA	**FPNA:** Giancarlo Nunes
Mammals	Bat monitoring	AUA BON	**FPNA: Giancarlo Nunes** **WildConscience:** Fernando Simal, Linda Garcia
Mammals	Dolphin monitoring (since 1999)	BON	Ron Sewell
Mammals	Marine Mammal Monitoring (sighting forms and noise loggers)	AUA BON SAB EUX SXM	**WUR:** Bart Noort, Dolfi Debrot **BON**: Caren Eckrich **SCF (SBMU)**: Ayumi Kuramae Izioka **AMMF:** Angiolina Henriquez, **STENAPA:** Jessica Berkel **NFSXM**: Melanie Meijer zu Schlochtern **SCCN, CARI'MAM Project**
Mammals	Curaçao deer monitoring	CUR	**CARMABI:** Erik Houtepen
Plants	Dry forest monitoring	BON	**Echo:** Julianka Clarenda, **STINAPA:** Paulo Bertuol
Plants	Monitoring of tree growth and survivorship in reforestation areas	BON	**Echo**: Julianka Clarenda
Plants	Vegetation Christoffel Park	CUR	**CARMABI**: Erik Houtepen
Reptiles	Lesser Antillean Iguana: Monitoring population density & removing invasive Green Iguana and hybrids (Mohamed bin Zayed Species Conservation Fund)	EUX	**STENAPA:** Erik Boman **RAVON:** Tim van Wagensveld, **UvA:** Thijs van den Burg
Reptiles	Boa Life History	AUA	**FPNA:** Giancarlo Nunes, **Eckerd College**: Jeff Goessling
Reptiles	Population dynamics 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
Reptiles	Sea turtle monitoring: -Satellite tracking -Nest monitoring -In water surveys (BON, CUR, SXM) -Fibropapillomatosis presence (BON) - Sand temperature nesting beach (EUX)	AUA, BON, CUR, SAB, EUX, SXM	**TurtugAruba Foundation** **STCB:** Kaj Schut **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.*

Photo by: © Miro Zumrik

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.*

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.

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.*

Photo by: © Mark Vermeij

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 delicatesse? (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).*

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)

Photo by: © Brenda Kirkby

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.

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], Curacao [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)*

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
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
EPIC	Environmental Protection in the Caribbean
FIU (EEL)	Florida International University Environmental Epigenetics Lab
FSU	Florida State University
FPNA	Fundacion Parke Nacional Aruba
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
NFSXM	Nature Foundation St. Maarten
NAAM	Archaeology at the Archaeology at the National Archaeological-Anthropological Memory Management, Curacao
Naturalis	Naturalis Biodiversity Center, Leiden, The Netherlands
NEV	Dutch Elasmobranch Association
NIOZ Sea Research	Royal Netherlands Institute for Sea Research
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
Scripps	Scripps Institution of Oceanography, U.S.A.
SBMU	Saba Bank Management Unit
SCF	Saba Conservation Foundation
SECORE	SECORE 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
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
WWF	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.

"Boer, P. (2020).
Identification key of the ant species of Aruba, Bonaire and Curaçao"

"Brunel, T., Debrot, D., Kitson-Walters, K. (2020).
Update on the 2012-2018 trends in the St Eustatius fisheries. Wageningen University & Research report C031/20"

"Hovestadt, A., Neckheim, T.C.M. (2020)
A critical checklist of the non-marine molluscs of St. Martin, with notes on the terrestrial malacofauna of Anguilla and Saint-Barthélemy, and the description of a new subspecies. Folia conchyliologica 57"

"Maitz, A., Kitson-Walters, K., Boman, E. (2020).
Phytomyxid infection in the non-native seagrass Halophila stipulacea in St Eustatius, Caribbean Netherlands. Aquatic Botany 168"

"van der Zee, J. P. (2020).
Evolutionary ecology of sea turtles. [Groningen]: University of Groningen. https://doi.org/10.33612/diss.135516256"

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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