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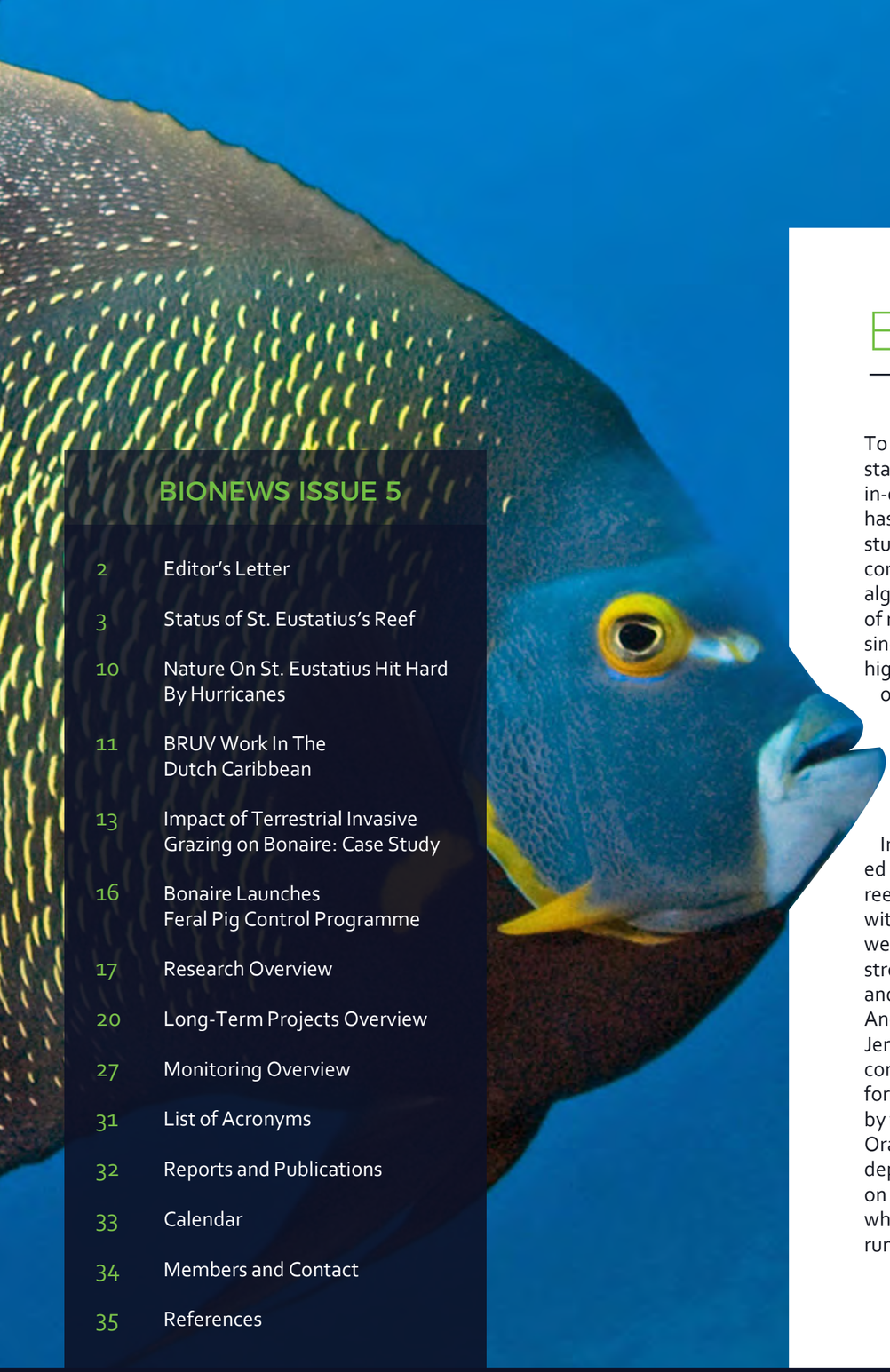

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Editor's Letter

Dutch Caribbean, October 2017

To continue our series of articles focusing on the status of reefs in all five of our islands, we take an in-depth look at how St. Eustatius's reef landscape has changed over the past decades, with recent studies pointing to a rapid decline of the island's coral cover and shift from coral dominated to algae-dominated benthic communities. The cover of macroalgae on the island's reefs has been high since 2007, and there is now also an alarmingly high cyanobacteria cover. The rapid deterioration of St. Eustatius's reefs is a clear indication that they are under mounting pressure from local, regional and global stressors.

Unlike neighboring island St. Maarten, which reefs were severely damaged by Hurricanes Irma this past September, STENAPA has reported that St. Eustatius's reefs faired pretty well. The reefs around the island retained their coral cover, with Giant Barrel Sponges the most affected. A week later, however, Hurricane Maria did have a strong negative impact on some staghorn fields and their recovery is expected to take many years. Another enormous loss has been the loss of the Jenkins Bay and Crooks Castle coral gardens, key components to the island's coral restoration efforts. Sea turtle nesting will most likely be affected by the complete loss of sand on beaches around Oranje Bay and possibly by all the extra sand deposited on Zeelandia beach. Hundreds of trees on the island were also uprooted and damaged, which may lead to erosion and resulting sediment-runoff onto the island's reefs.

We also focus on exciting work that has been undertaken in the waters around our islands. Researchers from Wageningen Marine Research have been collecting data on shark populations since 2012 with the use of stereo Baited Remote Underwater Videos (sBRUV). Prior to this study no data was available on shark populations in the Dutch Caribbean, making the management and conservation of these key predators very difficult. To this date, over 800 sBRUV videos have been deployed across the Dutch Caribbean and data collection is close to completion. Initial results point to reasonably healthy shark populations, notably around Saba.

The loss of vegetation caused by grazing invasive species is a serious issue for islands in the Caribbean region, as it affects terrestrial, coastal and marine ecosystems. Not only does it result in the loss of native terrestrial plant species, the subsequent increase in sediment run-off is typically associated with coral mortality. In this edition of BioNews, we take a look at the impact of invasive grazing species on Bonaire's nature, notably donkeys, pigs and goats, which have already wreaked havoc. Thanks to the generous funding from the Netherlands' Ministry of Economic Affairs through the Nature Fund, projects are now running on our islands to tackle the issue of feral pigs and goats.

Happy reading!
The DCNA Team

Cover photo and Editor's Letter photo by:
© Marion Haarsma, taken in St. Eustatius

Status of St. Eustatius's Reef

Five major studies of St. Eustatius' coral reefs have taken place over the past five years and have shed light on the rapid decline of the island's coral cover and the shift from coral dominated to algae-dominated benthic communities. This shift is being observed throughout the Wider Caribbean Region and is a wake-up call for all involved in the protection of coral reefs. Local threats must be minimized to enable the recovery of the island's reefs and ensure their resilience to mounting global threats such as ocean warming and severe weather events (hurricanes). The recovery of St. Eustatius' reefs is not just of great importance from an ecological standpoint but also an economic one. Approximately 10% of the island's Gross Domestic Product (GDP) is generated through coral-reef-associated tourism and fishery (Bervoets, 2010).

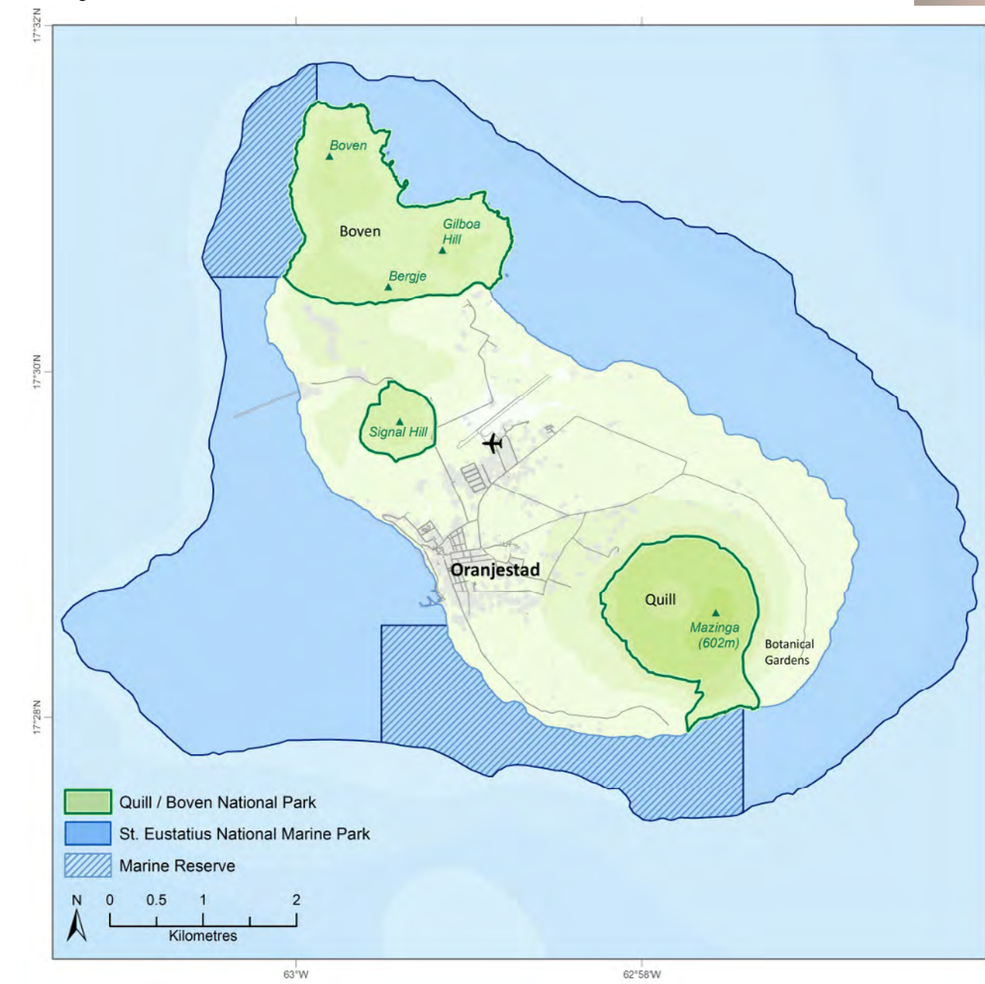
1. Geography and Reef Structure

St. Eustatius is a volcanic island located in the North Eastern Caribbean, north of the St. Kitts Bank. The island is very small, measuring 21 km2, with a maritime area of 1,591 km2 (Jackson et al., 2014). The south of the island is dominated by The Quill, a young dormant stratovolcano, while the north is dominated by the Northern Hills, which are the remains of a much older stratovolcano. In the center of the island is a central plain, the Kultuurvlakte, where the capital city of Oranjestad - and the main population center- is located. St. Eustatius is one of the least populated islands of the Dutch Caribbean, with 3,200 residents recorded in 2016 (CBS).

The total coastline of the island measures 23 km long (Jackson et al., 2014). The coastline consists primarily of rocky cliffs or slopes, with a rapid expansion of seagrass beds consisting mostly of the invasive seagrass species *Halophila stipulacea*, which is found all around the island (E. Houtepen, personal communication, 8th of August 2017). There are two large beaches on the west coast (Gallows Bay) and the east coast (Zeelandia). St. Eustatius is mostly surrounded by fringing corals reefs, for a total reef area of 12 km2 (Jackson et al., 2014). The structure of the coral reefs results from the island's volcanic origins, with most reef communities occurring on large volcanic rocks and boulders that were blown out from The Quill centuries ago (Research group at Scripps Institution of Oceanography UC San Diego, personal communication, June 15, 2017). The spur and groove system's coral fingers in the south of the island are made from hardened ancient lava that flowed from The Quill volcano. Volcanic activity in the north, south and west of the island has also produced patch reefs, and in the northern and southern ends of the island corals have settled on large, shallow ridges and ledges formed by basaltic rocks (Westermann and Kiel, 1961; Roobol and Smith, 2004).

St. Eustatius's reef system is dominated by algae, rubble and low relief gorgonian habitats (Debrot et al., 2014). The dominant hard coral species on shallow reefs include *Porites astreoides, Diploria sp., Montastraea sp.* and *Dendrogyra cylindrus.* Soft corals are most common at depths in excess of 20m, particularly at the drop off. In deeper areas, the coral communities are dominated by *Agaricia* species. The island's reefs are protected by the St. Eustatius National Marine Park (SNMP), which was established in 1996 and is managed by STENAPA.

Map of St. Eustatius.
Image credit: DCNA



2. Status of the reefs of St. Eustatius

In the past five years five major studies have looked at the health of St. Eustatius' coral reefs (Table 1). Between October 2012 and August 2013, Debrot et al. (2014) did a quantitative assessment of habitat diversity and biodiversity of the benthic seascape. Based on 869 video assessments they mapped St. Eustatius' nearshore shelf at depths of 5-30 meters including sea grass beds, coral reefs and algal fields. In June 2015, Naturalis Biodiversity Center in collaboration with 'ANEMOON Foundation' organized a marine biodiversity expedition to St. Eustatius to create a species list against which future studies on the island's marine fauna and flora can be compared (Hoeksema, 2016). The expedition's multi-disciplinary team assessed species composition and richness of various groups of organisms including corals, seaweeds, sponges, mollusks, tunicates and fishes (Hoeksema and Schrieken, 2016). Baseline data was collected from 40 dive stations and 20 shore-side locations down to a depth of 30 m. Biological samples and photographs were taken at each station to document the present state of St. Eustatius's marine biodiversity (Hoeksema, 2016).

In 2015, Piontek and de Graaf surveyed 20 sites within the St. Eustatius National Marine Park at depths between 8 and 18 m to set up a baseline of St. Eustatius's reef health (de Graaf et al., 2015; Piontek, 2016). The Caribbean-Global Coral Reef Monitoring Network (GCRMN) protocol was used to assess the health of St. Eustatius's coral reef ecosystems (Table 2) and the island's fish population was additionally evaluated through the CARIPES survey (EU BEST project) [1]. GCRMN surveys have been repeated every year since 2015 to follow changes and trends. In addition, 104 stereo Baited Remote Underwater Videos (sBRUV) were deployed in 2015 to assess the relative finfish community composition, density and distribution in the shallow coastal waters of the St. Eustatius Marine Park (Van Kuijk et al., 2015).

Table 1: *Summary of major coral reef status surveys conducted on St. Eustatius' coral reefs.*

Data Contributors	Time period	Survey Description	# Sites Surveyed
AGRRA (Klomp & Kooistra, 2003)	1999	Post hurricane (Lenny) rapid assessment of reefs including measures on coral cover and bleaching.	10
Debrot et al., 2014	2012-2013	Video assessments for the benthic map and seascape assessment.	869
White et al., 2006	2004	Fisheries baseline assessment of St. Eustatius's Marine Park.	16
Reef Check	2005, 2007, 2008, 2009, 2010	Monitoring corals, *Diadema antillarum* and macroalgae.	2
McClellan, 2009	2008	Reef fish surveys and measures on substrate composition and habitat complexity.	17
Data monitoring officer	2013-2014	Fish surveys.	15
GCRMN (2015: CARIPES) (De Graaf et al., 2015; Piontek, 2015, 2016)	2015-ongoing	Status and trends of key reef indicators; coral cover, macroalgae cover, coral recruitment, coral disease, biomass herbivore and commercial fish, macroinvertebrates and water quality.	20
Naturalis Biodiversity Center	2015	Marine expedition including assessments on the variation in marine species composition and species richness, the marine benthic diversity (i.e. algae, corals, mollusks, tunicates and fishes) and interspecific associations (host species and parasites, commensals, other symbionts).	40
Scripps Institute of Oceanography and the WAITT Foundation	2016	Coral reef assessments following the GCRMN protocol and a selection of 11 coral reef environments was mapped using 3D imagery.	20
Van Kuijk et al., 2015	2015	The relative finfish community composition, density and distribution in the shallow coastal waters of the St. Eustatius Marine Park based on baited video stations.	104
STENAPA	2017	Post hurricane (Irma & Maria) damage assessment of among others coral reefs.	So far: 7

[1] http://ec.europa.eu/environment/nature/biodiversity/best/pdf/fs_caripes.final.pdf

In November 2016, conservation organizations from Saba, St. Eustatius and St. Maarten joined a research expedition organized by the Scripps Institute of Oceanography and the WAITT Foundation to conduct a rapid scientific assessment of the coral reefs around the windward Caribbean islands (Sandin et al., 2016). The GCRMN protocol was used to establish a regional scale perspective of reef health, with surveys taking place in the fore-reef habitat at depths between 7 and 15 m (Sandin et al., 2016). In St. Eustatius, eleven coral reef environments were mapped with 3D imagery to gather data on benthic and reef fish communities, including their structure and composition (Sandin et al., 2016). The results of these surveys have not yet been released but footage can be seen here: *https://drive.google.com/drive/folders/0By3cTucxJ9GFd3VtUUVueHhpbEU (100IslandChallenge.org,* Scripps Institution of Oceanography at UC San Diego, in partnership with the Waitt Institute). The goal is to repeat the assessment in two years so that changes in reef health can be gauged. At the moment STENAPA is doing a nature damage assessment to determine the damage caused by hurricanes Irma and Maria.

2.1 Benthic cover

Coral cover

De Graaf et al. (2015) used the Reef Health Index (RHI) to describe the island's reef status based on recent survey results. Using the most conservative results, the overall RHI scored St. Eustatius's reefs as "poor" in 2015 (Figure 1) (de Graaf, 2015). The coral cover of St. Eustatius' reefs has declined significantly over the past 15 years. In 2003, the cover of reef-building corals was assessed at 22% (Klomp and Kooistra, 2003) but hit a historic low in 2015/2016 with 5% in 2015 and 5.2% in 2016 (de Graaf, 2015; Piontek, 2016). This seems to be the result of coastal development, coral bleaching events and possible water quality issues (erosion) (MacRae and Esteban, 2007; de Graaf et al., 2015).

Fifty-two species of stony corals (Scleractinia, Milleporidae, Stylasteridae) were observed during the Naturalis Biodiversity Expedition, 50 of which could be identified with certainty (Hoeksema and van Moorsel, 2016). This is higher than previous coral species counts for the island, due in part to the fact that small azooxanthellate species were included (Hoeksema and van Moorsel, 2016). The island's octocoral population was found to be similar to Curaçao with poor species diversity. A total of 35 species of octocoral were identified, with the most common species belonging to the Plexauridae and Gorgoniidae families (Lau, 2016). Gorgonian seafans, such as *Gorgonia mariae*, have decreased in abundance in Curaçao but are still common on St. Eustatius (Lau, 2016). Shallow-water *Acropora palmata* forests used to be found at many places along the shores of St. Eustatius but in the 1980's were almost all killed over the span of a few years by white-band disease, which happened throughout the entire Caribbean region. (Debrot et al., 2014).

Table 2: *Elements of the coral reef ecosystem that the GCRMN method uses to assess its health*

	Elements of the coral reef ecosystem
1	Abundance and biomass of key reef fish taxa (i.e. parrotfish, surgeon fish, groupers, snappers)
2	Relative cover of reef-building organisms (corals, coralline algae) and their dominant competitors (macroalgae)
3	Assessment of health of reef-building corals
4	Recruitment of reef-building corals
5	Abundance of key macro-invertebrate species (i.e. *Diadema antillarum*)
6	Water quality (i.e. water transparency (Secchi-disk)

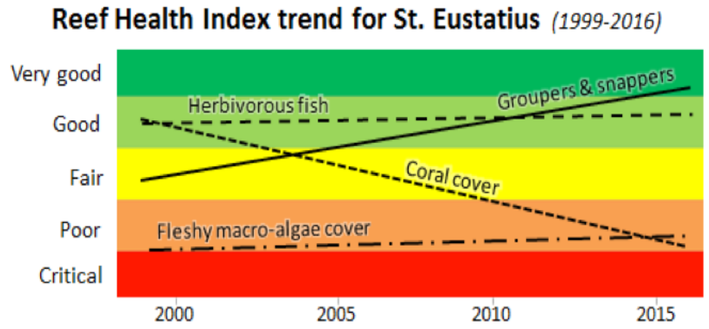


Figure 1: *Reef Health Index trend for St. Eustatius (1999-2016). Source: www.dcbd.nl.*

There are indications that under low stress conditions coral cover will increase in the future as coral recruitment has been assessed as "good". The density of coral recruits was nearly 12 coral recruits per m2 in 2015 and 10 recruits/m2 in 2016 (Piontek, 2016). This is much higher than the average reported for the Wider Caribbean (~4 coral recruits per m2 between 1997 and 2004) (Kramer, 2003). Forty percent of observed recruits belonged to one species, *Siderastrea sidereal* (Piontek, 2016).

Despite the large impacts of Hurricane Irma from last September on land, the short-term impact on St. Eustatius's reefs seems to be relatively small. First observations show that *"in the National Marine Park seven of the most important dive sites have weathered the storm relatively well. There is minor damage to the reef. The hard and soft corals such as sea fans retained their cover. Except for damage to mostly medium-size Giant Barrel Sponges the sites have retained their cover"* (BES reporter, 2017). However, the impact on land where hundreds of trees on the island were uprooted and damaged may lead to erosion and resulting sediment-runoff onto the island's reefs.

"A week later after Hurricane Maria a middle-sized staghorn field located in the southwest of the island (not a dive site) was devastated. Only small fragments remain of what was once a reasonable sized field with healthy bushes of staghorn. This field was on a depth of around 10 to 15m, shallower than the seven dive sites mentioned above. A larger staghorn field to the south of the island in the White Wall was similarly affected by both hurricanes, resulting in large scale damage to all inspected corals. These colonies have been fully destroyed and often no living tissue was found on coral locations and therefore the recovery will take many years. Elkhorn corals have been impacted less by both hurricanes, it appears that the stronger attachment to the seafloor makes these corals stronger and more sturdy" (STENAPA, 2017).

Macroalgae & sponges

Many studies have shown how damaging macroalgae (seaweed) can be to reef health, inhibiting coral settlement and recruitment, slowing coral growth and making them more prone to disease (Jackson et al., 2014). The shift from coral to macroalgae dominance seen in many parts of the Caribbean has also taken place on St. Eustatius's reefs. The cover of macroalgae is very high, averaging 28% in 2015 and 27% in 2016 (Piontek, 2010). Of great concern is also the high cyanobacteria cover, which averaged 15% in 2015 and 16.5% in 2016, as it indicates an increase in local threats, notably eutrophication, and is linked to coral diseases (Piontek, 2016). Cyanobacteria grow over macroalgae so the biomass of this harmful seaweed is likely higher than what was recorded (Piontek, 2016). Factors such as coastal development, coral bleaching events, possible water quality issues (erosion) and the reduction of algae grazing herbivores probably played a role for this shift to algal dominance (de Graaf et al., 2015).

Macroalgae were sampled at 40 different locations during the 2015 Naturalis Biodiversity Expedition (Hoeksema, 2016). Specimens and samples are now being analyzed in the herbarium collection of the Naturalis Biodiversity Center, and more than 175 species are expected to be documented. A new record has also been made for the Atlantic*: Parvocaulis exiguus* (Van der Loos and Prud'homme van Reine, 2016).

Sponges are also an important competitive benthic group (Loh et al., 2015). The coral reef habitats of St. Eustatius appeared to be dominated by macroalgal coverage, next were sponges and finally corals (Debrot et al., 2014). In 2015 sponges were sampled at 36 sites, and 1,457 sponges were recorded, 90% of which belonged to the Demospongiae class. Barrel sponges and several other sponge species were affected by an unknown type of illness/bleaching (García-Hernández et al., 2016).

Photo by: © Hans Leijnse

2.2 Fish

Herbivores have a crucial role within reefs as they can control seaweed from overgrowing coral (Jackson et al., 2014). The density of the herbivorous long-spined sea urchin *Diadema antillarum* is very low (<1 urchin/m2) following its Caribbean-wide mass mortality in 1983/1984 (de Graaf et al., 2015). Statia's population of herbivore fish, parrotfish and surgeonfish was "reasonable at best" in 2015 as is the case for many parts of the Wider Caribbean Region (de Graaf et al., 2015). The species composition around St. Eustatius largely or even fully lacks certain fish species such as the parrotfish species *S. coeruleus* and *S. guacamaia* due to the natural absence of mangroves (Van Kuijk et al., 2015). While the population of parrotfish is higher than the Caribbean average, with a "fair" biomass, the high contribution of surgeonfish to the catch of the trap fishery is reason for concern (de Graaf et al., 2015). The biomass of key herbivorous fish was "very good" in 1999 but only scored "fair" in 2008 and 2014. According to the GCRMN surveys the populations improved as in 2015 and 2016 herbivorous fish scored "very good" again (Piontek, 2016).

The biomass of predatory fish (groupers and snappers) - which are targeted by commercial fisheries - is "reasonable" compared to the Wider Caribbean average (de Graaf et al., 2015). One worrying trend is the near absence of large groupers and snappers (de Graaf et al., 2015; Piontek et al, 2016; Figure 2). Of all the groupers spotted during the extensive fish survey of St. Eustatius's reefs with the use of sBRUV, only about 2% belonged to the large grouper species (Van Kuijk et al, 2015). The lack of slow-growing large apex predators can be a sign of overfishing and is undesirable for population recovery (de Graaf et al., 2015).

St. Eustatius has a relatively healthy population of reef sharks, most likely due to the fact that they are not targeted by coastal fisheries (de Graaf et al., 2015). During the 2015 fish survey, 42 sharks were sighted during 104 sBRUV deployments (de Graaf et al., 2015). Caribbean reef sharks and nurse sharks were most often spotted. *"As top predators, these sharks play an important ecological role in healthy reefs and their higher abundance around St Eustatius compared to most other areas of the Caribbean may contribute to and be a useful indicator of overall coastal ecosystem health"* (de Graaf et al., 2015).

3. Condition of St. Eustatius's reefs compared to other reefs within the Caribbean Region

The average Caribbean-wide coral cover declined sharply between 1970-1983 and 1984-1999 but has remained stable since 1999 (Jackson et al. 2014). *"On St Eustatius, however, the trend in coral cover continued to decline since 1999 reaching a historic low level in 2015. Like in the rest of the Wider Caribbean Region, the macroalgal cover has been high since 2007 and the reef community is at present dominated by macroalgae"* (de Graaf et al., 2015). The +/- 25% macroalgae cover is similar the the average reported for the whole Caribbean.

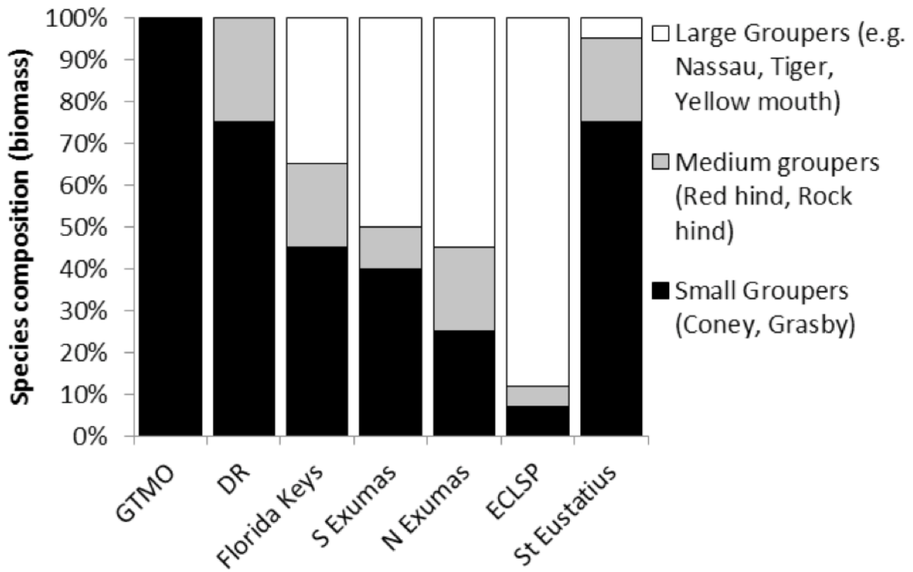


Figure 2: *Composition of grouper assemblages in Guantanamo Bay Naval Base, southeastern Cuba (GTMO), southeastern Dominican Republic (DR), Florida Keys, Southern and Northern Exumas, and the Exuma Cays Land and Sea Park (ECLSP) (redrawn from Chiappone et al., 2000) compared with St Eustatius. From GTMO to ECLSP fishing pressure decreased and management and protection increased. Source: de Graaf et al., 2015.*

Photo by: © Hans Leijnse

4. Local stressors on the reef of St. Eustatius

The dramatic decline in the health of St. Eustatius's reefs and the shift from coral to algal dominance is a clear indication that they are under mounting pressure from local, regional and global stressors. Local threats must be minimized to enable the recovery of the island's reefs and ensure their resilience to mounting global threats such as ocean warming. Bleaching events, for example, have been observed in the Windward Islands since 2005 and have caused significant damage to coral reefs around St. Eustatius. The severe bleaching event of 2005 led to a great loss in coral cover in some of the island's shallower reefs. Coral cover loss of 78.6% was recorded in one dive site (Mushroom Gardens) located in the SNMP's Southern Marine Reserve (MacRae and Esteban, 2007).

Fishermen are the primary users of St. Eustatius' reefs. The island's fisheries are small-scale, with 5 active fishermen and 15 to 20 small boats (> 10m) (de Graaf et al., 2015). The annual catch is 18 tons per km2/y. The island's most important fishery is the Caribbean spiny lobster (*Panulirus argus*) with an annual catch of 11 tons per km2/y, which is the highest recorded through its range (de Graaf et al., 2015). One of the main concerns with this fishery is that 41 % of the landed lobsters - which are caught with lobster traps - are under the minimum legal size (de Graaf et al., 2015).

The status of St. Eustatius's mixed reef fish fishery, with annual catches of 4 tons per km2/y, has been found to be "at most reasonable" but in slightly better shape than the Caribbean average (de Graaf et al., 2015). While the density of reef fish remains reasonable, there is concern about the high contribution of herbivores to the catch of the trap fishery (de Graaf et al., 2015). Currently, approximately 50 % of the annual mixed reef fish catch is made up of small groupers and key herbivore surgeonfish (de Graaf et al., 2015). There is also a near absence of large groupers, which is a potential sign of overfishing (Van Kuijk et al., 2015). To reduce the bycatch of narrow-bodied surgeonfish, escape slots could potentially be introduced. Furthermore, the pelagic fishery is underdeveloped and managers could potentially divert fishing activity from the reef to the pelagic environment.

Divers also make great use of St. Eustatius's coral reefs. Snorkelers and divers from all around the world come to enjoy the island's unique reef formations. The effect of divers on coral reefs is not clear although there are documented negative effects such as broken coral fragments (Lyons et al, 2015).

There are mounting concerns over St. Eustatius's water quality and the resulting impact on the island's coral reef communities. In the early 2000s, erosion and resulting sedimentation was believed to most likely be *"the key and possibly only major factor impacting water quality on St. Eustatius"* (Debrot and Sybesma, 2000). While erosion does occur naturally, overgrazing by free-roaming feral cattle, goats and donkeys has made the problem much worse. Eutrophication is now also a growing issue. The island has no wastewater treatment plant and therefore untreated water from septic tanks and private cesspits is reaching coastal waters and the fringing reefs (de Graaf et al., 2015). Excess nutrients *"may stimulate macroalgal growth resulting in overgrown, abraded and even poisoned stony coral colonies, reduced coral recruitment and/or increased coral disease* (de Graaf et al., 2015). Long term monitoring data to assess trends in sedimentation and nutrient levels are missing. In June 2016 CNSI started taken monthly measurements of nutrients (ammonium, phosphate and nitrate) in the coastal waters around St. Eustatius. Their preliminary results show that nitrate concentrations are particularly high, especially in well water and cistern water (CNSI newsletter, 2016).

Another threat to the island's water quality is the oil terminal NuStar. Oil spills, such as the October 2012 spill, result in the exposure of corals to oil, which interrupts coral larvae settlement (Hartmann et al, 2015). Chemicals and toxins may also leak into the surrounding water of the terminal (de Graaf et al., 2015). The anti-fouling agent Tributyltin (TBT) used on large vessels may cause Imposex, a disorder in marine snails where female marine snails develop male reproductive organs (de Graaf et al., 2015). This disorder has been observed in *Lobatus gigas* on St. Eustatius (de Graaf et al., 2014). Oil tankers can also cause direct damage to reefs. Since the early 1980s, tankers have anchored in the waters of Oranje Bay whilst waiting to bunker at St. Eustatius Terminals. STENAPA has been drawing attention to this problem and sending damage reports to the police, harbor master and the Public Entity.

Photos by: © Hans Leijnse

St. Eustatius's reefs also face natural pressures including storms, which are likely intensified by global warming (Bender et al., 2010). St. Eustatius is located in the Atlantic hurricane zone, and the island's seabed has suffered great damage from hurricanes over the past decades. In the late 1990s, six hurricanes hit St. Eustatius and had profound impacts on the island's reefs (hurricanes Luis and Marilyn in 1995, hurricane Bertha in 1996, hurricane Georges in 1998 and hurricanes Jose and Lenny in 1999) (Jackson et al., 2014). Shallow coral reefs were the most impacted by the series of hurricanes, with many broken colonies of branching *Acropora palmata*. From 2004 to 2014, the island was hit by seven hurricanes. Last September St. Eustatius was hit by category five storm Irma and Maria, one of the strongest Atlantic hurricanes ever observed. It is important to reduce local threats to increase the resilience of the reefs to the global stressors caused by climate change.

Besides, St. Eustatius's is also dealing with invasive species, notably lionfish that were first sighted in 2010 and are reported to negatively impact native coral fish populations (Albins and Hixon, 2008). Sanguinet (2015) reports that the culling program on St. Eustatius has been fairly efficient

Photo by: © Marion Haarsma, taken in St. Eustatius

in minimizing the well-established lionfish population, with marine park staff killing more than 50% of lionfish observed annually since 2012 in the Southern Marine Reserve. However, this method has diving restrictions, which makes it difficult to control lionfish at deeper depths (De Léon et al., 2013).

An adaptive management plan with "*clearly defined quantifiable objectives, targets and reference points of coral reef health indicators*" needs to be put in place, with all stakeholders involved in the decision-making process (de Graaf et al., 2015). The annual monitoring of the island's reefs must also carry on to keep track of changes in reef health and assess the efficiency of management actions (Piontek, 2016). The annual monitoring of 20 sites within the SNMP "*provides a 50% chance of documenting a change of 5% in coral cover as a general guideline*" (Piontek, 2016).

Status of St. Eustatius's Reef

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Nature On St. Eustatius Hit Hard By Hurricanes

Nature on St. Eustatius has been heavily affected by hurricane Irma and Maria that struck the island in the early morning of Wednesday 6 September and 19 September. Most visible are the effects on land. During a preliminary nature damage assessment St. Eustatius National Parks Foundation (STENAPA) counted hundreds of uprooted trees and snapped trunks.

The quick scan of the island revealed that in The Quill National Park 80 to 90% of the trees on the outer north-western slope and the inner south-eastern slope lost their leaves. As a result the Quill looks brown-greyish, instead of vibrant green. At least 20 trees were uprooted and fell blocking the main Quill trail and hundreds of limbs and branches littered the ground. This means that hundreds of trees overall on the Quill are down and many more limbs and branches. The south-eastern part of the crater and the crater trail are also affected, and STENAPA has advised hikers not to enter the crater until the trails have been cleared.

Outside the National Park STENAPA counted 250 trees over a diameter of 1 meter either down or snapped. Of all the districts Oranjestad showed the most damage. Trees provide shade, stabilize the soil, provide food, provide shelter for wildlife, absorb carbon dioxide and release oxygen. Around 95% of the trees along the Caribbean cliff side in Lower Town, many of them old trees, lost their leaves.

In the National Marine Park seven of the most important dive sites have weathered the storm relatively well. There has been minor damage to the reef and corals, hard and soft corals such as sea fans were in tact and coral cover is unaffected although there has been some damage to medium sized Giant Barrel Sponges.

STENAPA has been working on coral restoration projects and unfortunately the coral gardens in Jenkins Bay (6m under water, 10 coral ladders) and Crooks Castle are gone. The coral gardens are part of an EU funded project to grow Elkhorn and Staghorn coral fragments on tree like structures. Mother colonies of Staghorn have been negatively impacted too.

The sand on the beaches on the Caribbean Sea coast (Orange Bay) has been washed away. Due to this sea turtles won't be able to lay their nest on the short term. Conversely 1 to 2 meters sand was deposited on Zeelandia Beach on the Atlantic side. All sea turtle nests laid pre-Maria appear to have been inundated by the sea. Survival rate of these nests are expected to be zero to extremely low. There were roughly 25 nests on Zeelandia beach.

Also in the Botanical Garden trees are down, including numerous branches and limbs. The shade house is destroyed and 2 of the 4 solar panels were blown off the roof of the visitors center. Due to this the drip system doesn't function any more. STENAPA has submitted a report about the results of the preliminary nature damage assessment to the Public Entity of St. Eustatius and other stakeholders.

The Dutch Marines and other volunteers helping to clear the upper slopes of the Quill.
Photo by: © STENAPA

Hurricane Irma destroyed the Shade House at the Botanical Garden.
Photo by: © STENAPA

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BRUV Work In The Dutch Caribbean

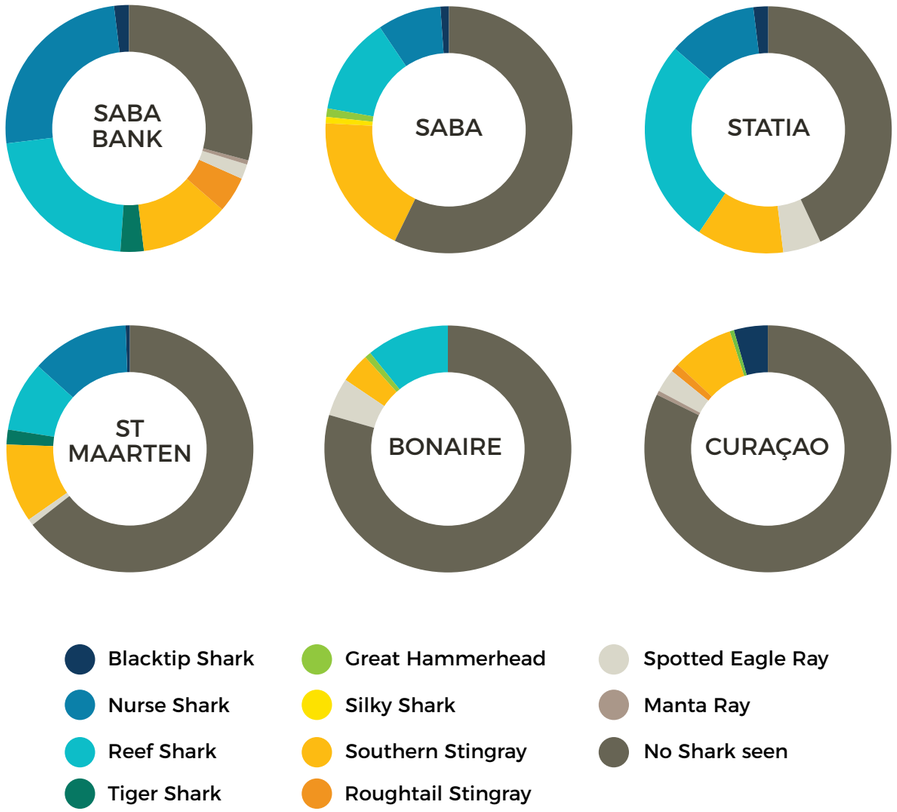

Figure 1: *Percentage of seeing a shark on a BRUV deployment.*

Data collection with stereo Baited Remote Underwater Videos (sBRUV) deployed throughout the islands of the Dutch Caribbean over the past few years is almost completed, with only parts of Bonaire left as final sampling locations. The collected data already gives great insight into the status of shark populations in the waters around Saba, St. Eustatius, St. Maarten, Bonaire, Curaçao and on the Saba Bank (Figure 1). Since 2012 researchers from Wageningen Marine Research with project leader Dr. Martin de Graaf, in partnership with local partners, have used simple, non-invasive stereo Baited Remote Underwater Videos (sBRUV) to gather important information on the size, diversity, species composition and abundance and of shark populations across different management zones in the Dutch Caribbean. To this date, over 800 sBRUV videos have been deployed across the Dutch Caribbean, including 103 around Bonaire (and continuing), 164 around Curacao, 108 around Saba, 164 on the Saba Bank, 104 around St. Eustatius and 214 around St. Maarten.

A first look to the data (Figure 1), shows that the Saba Bank has the highest abundance of sharks.

The two most common species are the nurse shark (Ginglymostoma cirratum) and the Caribbean reef shark (Carcharhinus perezi). Researchers on early expeditions to the Saba Bank recorded seeing sharks on every dive and on average, BRUV deployments recorded 0.23 reef shark sightings per hour, which is higher than sightings at study sites on Belize and the Bahamas and 50% higher than around the adjacent island of Saba (BioNews 1-2017). The other northern Dutch Caribbean islands (Saba, St. Eustatius and St. Maarten) also appear to have relatively healthy shark populations, with the two most common shark species also the Caribbean reef shark and nurse shark (Figure 1). This aligns with early findings that suggested that that northern Dutch Caribbean islands provide ample suitable habitat for sharks (BioNews 30). While data is so far only available for Bonaire and Curaçao - sBRUVs were also deployed around Aruba, however the data has not yet been processed yet but will be soonest – it appears that the Bonaire and Curacao are home to fewer shark species than the Windward islands, with the Caribbean shark by far the most common.

Another interesting finding from this study is that the Dutch Caribbean is home to several threatened shark species, and while these may be incidental it suggests that our islands could play an important role in the conservation of sharks. The silky shark (Carcharhinus falciformis) which is listed as Near Threatened in the IUCN Red List, and the great hammerhead (Sphyrna mokarran), which is listed as Endangered, were both observed around Saba and Bonaire. The Near Threatened tiger shark (Galeocerdo cuvier) was frequently observed around St. Maarten and the Saba Bank.

The information on sharks gathered by the BRUV is incredibly important as prior to this study no data on shark populations in the Dutch Caribbean was available and studies that have taken place worldwide point to a drastic decline in elasmobranch populations over the last few decades (Ruijs & Hogeschool, 2017). While this study is the first of its kind, and therefore no trends can be found, initial results can be compared to others in the Caribbean and the rest of the world. Repeating the study in a few years will enable comparison and will highlight whether the many conservation measures taken in the Dutch Caribbean to protect sharks - such as the declaration of the Yarari marine mammal and shark sanctuary - are being successful.

BRUV deployment on Bonaire.
Credit: Nijs Ruijs,
Hogeschool Zeeland, WUR

Sharks and Rays of the Caribbean
Credit: Jens Odinga
IMARES Wageningen UR

Stereo-BRUV surveys

Sint Maarten:
https://vimeo.com/131461221
https://vimeo.com/125898375
https://www.youtube.com/watch?v=GozFScMDyQE

Bonaire
https://vimeo.com/190565371
https://www.youtube.com/watch?v=UorQUYFvuoU

BRUV Work In The Dutch Caribbean

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Impact of Terrestrial Invasive Grazing on Bonaire: case study

The Nature Funding Projects on Bonaire can be followed on Facebook: ***@NTBDN***

NOS TA BIBA DI NATURALESA

Traha huntu na un desaroyo duradero pa Boneiru

By Michaela Roberts
(PhD student from the University of St Andrews, UK in partnership with Echo)

Long periods of isolation and small island size make island ecosystems highly vulnerable to degradation and invasive species are one of the most significant threats (Cronk, 1997). Due to their role as livestock, introduced species such as sheep, goats, pigs, cows and donkeys are some of the most common invasive species worldwide (Island conservation, 2015). Introduced grazing species consume island vegetation at a rate faster than it is able to regenerate, and islands with invasive grazers are characterised by few, small trees of limited species, and low grass, herb, and shrub cover (Dahlin et al., 2014).

Terrestrial degradation caused by invasive grazing species can impact coastal ecosystems. Degraded vegetation has fewer roots, which would otherwise anchor soils, and has reduced surface complexity, leading to increased sediment run-off. For coral reef ecosystems sediment run-off is associated with coral mortality, reduced coral growth rates, and changes in reef fish populations (Fabricius, 2005). High sediment loads reduce visibility for SCUBA divers. With many islands, including the Dutch Caribbean islands, drawing much of their revenue from marine based tourism, it is therefore in economic interest of the islands as well as the interests of conservation managers to recognise the threat posed by invasive grazing species.

Although the ecological impacts of invasive grazing species are well documented, funding and lack of social acceptability for the most cost effective solutions are key factors limiting effective conservation action (Roberts et al., manuscript in preparation). On Bonaire the local Government backed projects, which are now being funded by the Dutch Ministry of Economic Affairs under their *Nature Fund* initiative, seek to address this funding gap and tackle the issue of feral pigs ***(page 16)*** and to eradicate goats from the Washington Slagbaai National Park (Table 1).

Table 1: *Nature Funding projects on terrestrial invasive grazing species control.*

Nature Funding projects

As part of the 2013-2017 Nature Policy Plan for the Caribbean Netherlands, 22 projects that promote coral reef conservation, sustainable use of nature or the synergy of sustainable use of nature in combination with agriculture and tourism were approved to receive funding through the Nature Fund allocated by the Ministry of Economic Affairs for the BES islands. Ten projects received funding on Bonaire, 7 on Saba and 5 on St. Eustatius.

The following projects focus on terrestrial invasive grazing species control:

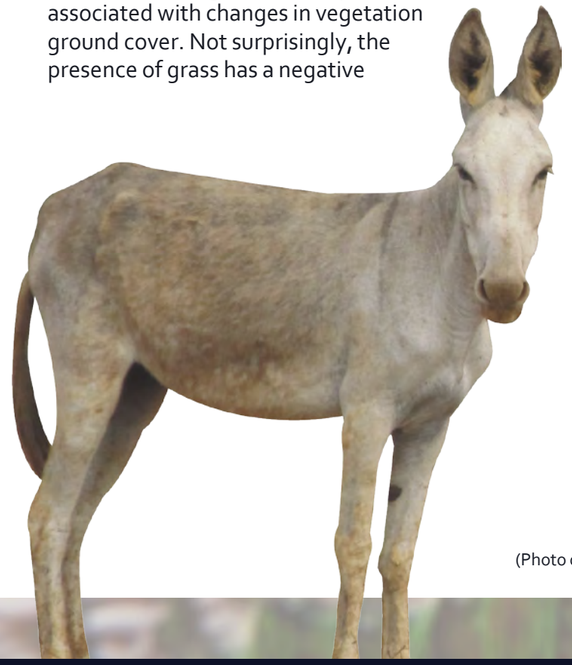
Project	Islands	Lead scientist(s)	Goal	Activities
Goat buy-back program	SAB	**Government of Saba:** Randall Johnson	Protecting nature and agriculture by significantly decreasing the amount of roaming goats.	Shooting/ slaughtering, storing, selling and/or exporting the meat.
Feral Pig Control	BON	**Echo:** Julianka Clarenda **DRO:** Frank van Slobbe	Recovery of habitats so they are better able to provide services for people and nature, improved conditions for agriculture and increased community support for invasive species management.	Feral pig density assessment, pig eradication, raising awareness and support, monitoring program for evaluation of interventions.
Goat eradication and control in Washington Slagbaai National Park	BON	**STINAPA** **DRO:** Frank van Slobbe	Draw the goat population down to a manageable level within 3 years so that the vegetation can recover	Bringing the number of goats down in Slagbaai and Washington, practice and train locals and park staff to effective goat control, monitoring program for evaluation of interventions, developing long-term control programme, outreach and communication.

Bonaire's vegetation is severely under threat due to grazing pressure from introduced species. Vegetation surveys of Bonaire have shown that across the island trees are in low abundance, with limited species richness, and small size (Roberts 2017a).

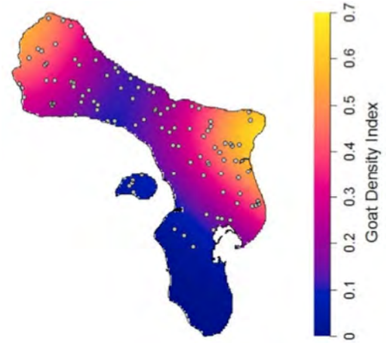
The densities of free roaming goats, pigs and donkeys vary spatially and seasonally across the island. Hotspots of goat density have been identified in the north and east of Bonaire (Figure 1). During the wet season (from November to March) donkey populations are concentrated in the east and around the town of Rincon, with no hotspots identified in the dry season (Figure 1). Pig density is low across the island.

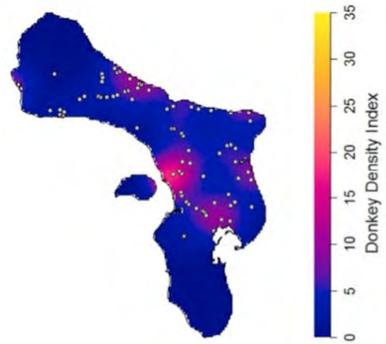
This variation in grazer density is associated with changes in vegetation ground cover. Not surprisingly, the presence of grass has a negative relationship to pig presence and goat density. Combined grass and herb percentage cover is negatively related to donkey density during the dry season (Roberts et al., 2017a). Tree characteristics do not vary with grazing pressure, indicating that grazing pressure already exceeds that of tree recovery island-wide. (Roberts et al., 2017a).

The degradation caused to terrestrial ecosystems by invasive grazing species is associated with changes in coral reef characteristics on Bonaire. Coral cover below depths of 10m has a positive relationship to ground cover and tree biomass of the associated watershed (Roberts et al., 2017a). In light of the negative relationship of ground cover to donkey density, conservation efforts aimed at controlling donkey grazing can be expected to lead to improvements in coral cover.



Donkeys on Bonaire
(Photo credit: Michaela Roberts)





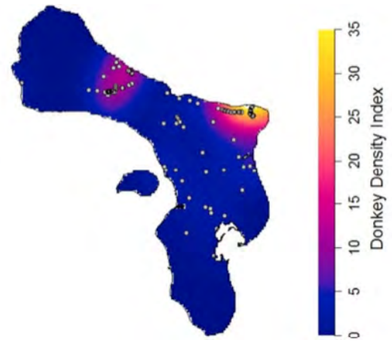


Figure 1: *Map of grazer densities across Bonaire.*
Top left – goat density;
Bottom left – dry season donkey density,
Bottom right– wet season donkey density.

Table 2: *Trade-offs between fencing and eradicating donkey populations for recovery of the dry-forest and coral reef.*

	Fencing	Eradication
Median ground cover (current 4%)	14%	18%
Median coral cover (current 46%)	85%	90%
Economic costs	$2.5 million	$8.8 - $12.9 million
Length of control	10 years	Permanent
Social acceptability (0 to 2)	1.48	0.8

An overgrazed hillside on Bonaire (Photo credit: Michaela Roberts)

On Bonaire the effects of donkey grazing could be reduced either through creation of fenced areas, or by controlling or eradicating donkey populations. Using the relationships described above it is predicted that both measures would have a positive impact on both ground cover and coral cover, with larger impacts seen for eradication (Table 2) (Roberts et al., manuscript in preparation).

Studies on the control of invasive grazing species on Bonaire indicate that eradications are likely to have the greatest positive impact on both the terrestrial and marine ecosystems (Roberts et al., 2017a). However, low social acceptability may preclude this option in the short term. Although the cost of fencing is initially lower than eradication, the lifespan of only 10 years means that total costs exceed that of eradication within 30 years (Roberts et al., manuscript in preparation).

For long-term improvements in environmental conservation on Bonaire it would therefore be in the interests of managers and policy makers to develop a program to increase social acceptability of donkey eradication (Roberts et al., manuscript in preparation).

The connection between grazer caused degradation within the terrestrial ecosystem and degradation on the coral reef through sediment run-off may present the opportunity to secure additional funding for conservation through increasing the existing SCUBA diver fee. Surveys conducted with SCUBA divers estimate a willingness to pay of $83/diver/year for reef improvements expected to arise through fencing, and $93/diver/year for eradication (Roberts et al., 2017b). This would exceed the estimated costs of control programs (Roberts et al., 2017b).

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Bonaire Launches Feral Pig Control Programme

The aim of this project is to control feral pig populations on Bonaire, thereby improving conditions for reforestation, reducing impacts on native dry-forest habitat and minimizing damage to fences and property. Activities will focus on raising awareness about the impact of feral pigs, reducing feral pig populations and monitoring project effectiveness. It is hoped that early intervention will ensure the feral pig population and the associated problems do not escalate beyond their current state and become unmanageable.

A team from Echo Foundation, a local non-profit which focuses on parrot protection and reforestation, has been evaluating the impact of feral pigs on local flora since 2016, monitoring pig activity and removing pigs from the wild. With funding from the Netherlands' Ministry of Economic Affairs through the Nature Fund, staff at Echo Foundation are launching a public campaign and calling for assistance to locate and control feral pig numbers. They have set up a Pig Hotline to report pig sightings and are collecting data on pig numbers, size and colouration. Pigs removed from the wild will be slaughtered and the meat offered for sale and given as prizes in pig meat raffles.

Pigs, along with goats and donkeys, were first brought to Bonaire by the Spanish in the 1500s. Whilst pigs are not exactly new comers to the island, feral pig populations have only become established on Bonaire in the last decade. Escaped domestic pigs become feral in just two generations. Unlike goats and donkeys, where measures to control populations have little public support, feral pigs are not highly valued by the local community and can cause considerable damage to property by burrowing through fences to access food sources such as gardens and fields.

Pigs have a high reproductive rate, producing up to 8 piglets a year and reach sexual maturity early, which coupled with a lack of natural predators, means that feral populations can increase extremely rapidly. Under optimal conditions populations can grow by 500% in just 12 to 15 months. Systematic surveys have yet to be carried out, but sightings indicate that there are currently between 500 and 1000 feral pigs on Bonaire. Adult boars on Bonaire are known to reach 60kg and can have 8cm long tusks.

Feral pigs have a high negative impact on native vegetation, damaging roots and preventing the regeneration of trees (Campbell & Long, 2009). They are generalists and can be found throughout a range of habitats. Signs of feral pig activity include ground that is heavily disturbed and trampled, plants which have been dug up and/or have had their roots exposed (Friebel & Jodice, 2009). Feral pigs are susceptible to high temperatures and highly dependent on water. They are found in high densities around shady areas with water.

Although this is not the case in Rincon, pigs in the wild tend to be cautious and avoid human contact, which can make them difficult to track and catch. Efforts to trap feral pigs, need to be immediately successful as the pigs quickly learn to avoid the traps.

Echo is a non-profit organisation focused on the conservation of the Yellow-shouldered Amazon parrot (Amazona barbadensis) and the dry-forest ecosystems of Bonaire.

One of their objectives is to restore ecosystems on Bonaire through creative conservation and inspire an appreciation of nature through stimulating sustainable use. Echo aims to fulfil this mission through research and monitoring, conservation management and outreach education.

Website: http://www.echobonaire.org

Pigs in Rincon, Bonaire.
Photo credit: Echo

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Research Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Birds	Suitability study and reforestation of exclosures facilitating the Yellow-shouldered Amazon Parrots (Amazona barbadensis) on Bonaire	BON	**Echo:** Lauren Schmaltz, Quirijn Coolen
Birds	Impact of predators and poachers on fledging success of the Yellow-shouldered Amazon parrots	BON	**Echo:** Lauren Schmaltz, Quirijn Coolen **University of Bangor**: Adam Curry (student) and Zak Maynard (student)
Coral Reef ecosystems	Surveys (based on AGRRA and GCRMN) for the assessment of fish and benthos communities including corals, algae, sponges to 20 m depth	BON	**WUR:** Erik Meesters Student: Roger Meijs, Sil Piek, Sarah Veillat, Yun Scholten
Coral Reef ecosystems	Coral-associated fauna of Curaçao	CUR	**Naturalis:** Bert Hoeksema **Leiden University** **CARMABI**
Coral Reef ecosystems	Distribution and impact of the invasive reef coral Tubastraea coccinaea on the coral reefs of Curaçao	CUR	**Naturalis**: Bert Hoeksema **Leiden University**: Auke-Florian Hiemstra (student) **CARMABI**
Coral reef ecosystems	Distribution and impact of the aggressive ascidian Tridemnum solidum on the coral reefs of Curaçao	CUR	**Naturalis**: Bert Hoeksema **Leiden University**: Gabriël Olthof (student) **CARMABI**
Coral reef restoration	3D reconstruction as a monitoring strategy for coral reef restoration of Acropora palmata on Bonaire	BON	**University of Oxford**: Julia Huisman **School of Geography and the Environment** **CRFB**
Economics of ecosystems	The Economics of Ecosystems and Biodiversity (TEEB) on Aruba	AUA	**Wolfs Company:** Esther Wolfs, Boris van Zanten **VU:** Pieter van Beukering **YABI consultancy:** Francielle Laclé
Environmental damage	Environmental Damage after Hurricane Irma and Maria	SAB EUX SXM	**SCF**: Kai Wulf **STENAPA**: Clarisse Buma **NFSXM**: Tadzio Bervoets
Erosion	Erosion around Kralendijk *Part of Nature Funding Project: Erosion control and nature restoration	BON	**DRO** **VU:** Nick Roos (student)

Research Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Erosion	Assuring the adoption of soil conservation measures: The case of a small island	SAB	**WUR:** Jesse Opdam (student), Michel Riksen, Aad Kessler SCF, Agriculture Department of Public Entity Saba
Fish	Baited Remote Underwater Video (BRUV) to study sharks	BON	**WUR:** Erwin Winter, Dolfi Debrot, Martin de Graaf, Twan Stoffers **STINAPA** **HAS**: Mavelly Velandia (student) **WUR**: Sander Delacauw (student)
Fish	Distribution of local and regional surgeonfish disease using a novel technique - Google Images.	BON	**CIEE**: Rita Peachey, Franziska Elmer, Madeline Roth, Lucia Rodriguez, Sasha Giammetti, Megan Hoag
Fish	Identification of the parasite and hosts of the turbellarian infecting reef fish species in Bonaire	BON	**University of North Texas**: Zac Kohl (PhD Candidate) **CIEE:** Franziska Elmer; Rita Peachey; Lisa Kram; Ashley Novak; Andrew Paton
Fishery	Mas Piska pa Boneiru	BON	**KITLV, Leiden University:** Stacey Mac Donald (PhD student) (Funded by WWF - Netherlands & KITLV / Royal Netherlands Institute of Southeast Asian and Caribbean Studies)
Invasive species	Research into mitigation measures for Sargassum Seaweed	SXM	**NFSXM:** Tadzio Bervoets **Government of St. Maarten**
Invasive species	Environmental DNA (eDNA) of lionfish in Lac Bay: A tool for detecting the invasive species in complex habitats (mangroves)	BON	**CIEE:** Rita Peachey **Indiana University:** Stephen Glaholt
Mangrove ecosystems	Pilot-scale testing and evaluation of mangrove ecosystem intervention options (fish fauna, epibionts on mangrove prop roots) *Part of Nature Funding Project: Ecological restoration Lac Bay and South coast, Bonaire	BON	**WUR:** Dolfi Debrot, Douwe Boerstra (student), Laura Timmerman (student) **STINAPA:** Sabine Engel

Research Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Nature Policy Planning	Developing a nature policy plan for Bonaire	BON	**Wolfs Company:** Boris van Zanten, Esther Wolfs, Sacha van Duren **DRO**
Plants	Exclusion of invasive herbivores: A comparison study of vegation at Roi Sango.	BON	**Echo**: Quirijn Coolen **WUR**: Pieter Zuidema, Jessie Foest (student)
Plants	Germination of seeds of indigenous trees of Curaçao	CUR	**CARMABI:** John de Freitas
Plants	Testing effective ways to grow native plants	BON	**Echo:** Quirijn Coolen, Johan van Blerk
Seagrass ecosystems	The effects of the rapidly spreading invasive seagrass Halophila stipulacea on the growth of juvenile Queen Conch (Lobatus gigas)	EUX, SXM	**WUR:** Erik Boman (PhD student) **CNSI:** Johan Stapel **Ecological Professionals Foundation:** Hannah Madden **NFSXM: T**adzio Bervoets *Funded by NuStar

Photo by: © STINAPA Bonaire, taken in Bonaire.

Long Term Projects

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Coral Reef Ecosystems	Deep Reef Observation Project (DROP) (ARMS: Autonomous Reef Monitoring Structures)	CUR	**Smithsonian:** Carole Baldwin
Coral Reef Ecosystems	Postsettlement dynamics of Caribbean corals & Reef restoration	CUR	**UvA:** Valerie Chamberland (PhD candidate) **CARMABI** **SECORE International**
Coral Reef Ecosystems	Bioersion of reefs by coral-excavating sponges	BON,CUR, SAB, EUX	**NIOZ:** Fleur van Duyl **WUR:** Erik Meesters, Didier de Bakker (PhD student)
Coral Reef Ecosystems	Development of restoration methods for threatened Caribbean coral species	BON, CUR, SAB	**CRF Bonaire:** Augusto Montbrun, Francesca Virdis **SECORE Project** **CARMABI:** Mark Vermeij **UvA:** Valerie Chamberland (PhD candidate) **SCF, Sea Saba, Samford University:** Jennifer Rahn
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
Database	Dutch Caribbean Species Catalog: Taxonomic knowledge system Dutch Caribbean (http://www.dutchcaribbeanspecies.org/)	All	**Naturalis:** Sander Pieterse & Berry van der Hoorn
Environmental	Effects of dispersants on the fate of oil in realistic conditions (C-IMAGE consortium, TripleP@Sea Program)	EUX	**WUR:** Tinka Murk, Marieke Zeinstra-Helfrich (PhD student) **CNSI**
Environmental	Ecotoxicological aspects of rational application of chemicals in response to oil spills to reduce environmental damage Development of an area specific net environmental and economic benefit analysis (NEEBA) to support oil spill mitigation decisions; with St. Eustatius as example	EUX	**WUR:** Tinka Murk, Sophie Vonk (PhD student) Lei Wageningen UR: Stijn Reinhard **CNSI**
Interstitial biodiversity	Moleculair biodiversity analysis of marine communities by metabarcoding	EUX	**Naturalis:** Arjen speksnijder **ANEMOON:** Niels Schrieken
Invasive species	Combatting the economic and ecological impacts of overgrazing on inhabited islands	BON	**UsA:** Michaela Roberts (PhD student)

Long Term Projects

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
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**
Molluscs	Population dynamics and role in the food chain of the Queen Conch Lobatus gigas in the Dutch Caribbean Territories	EUX, SAB	**WUR:** Aad Smaal, Leo Nagelkerke, Martin de Graaf Erik Boman (PhD student) **SCF (SBMU):** Jens Odinga **CNSI**
Public Health	DNA waterscan: Monitoring disease vectors in the Caribbean (mosquitoes and midges)	EUX	**Naturalis:** Kevin Beentjes **ECPHF:** Teresa Leslie
Sustainability	Sustainable development Dutch Caribbean (TripleP@Sea Program) - Are human activities a risk for ecosystem services? - Green Statia or how to regain balance between nature and agriculture?	EUX	**WUR:** Diana Slijkerman **WUR (Alterra):** Rene Henkens **CNSI**
Terrestrial biodiversity	Baseline assessments and DNA barcoding of biodiversity of St. Eustatius	EUX	**Naturalis:** Michael Stech, Berry van der Hoorn, Jeremy Miller **STENAPA, CNSI**
NWO Projects in the Dutch Caribbean			
Bioproducts	Stand-alone production of algal products for food, feed, chemicals and fuels	BON	**WUR:** R.H. Wijffels **CIEE:** Rita Peachey
Coral Reef Ecosystems	Caribbean coral reef ecosystems: interactions of anthropogenic ocean acidification and eutrophication with bioerosion by coral excavating sponges - Bioerosion and climate change	BON, SAB, EUX	**NIOZ:** Fleur van Duyl, Steven van Heuzen (PostDoc), Alice Webb (PhD student) **STENAPA** **CNSI**

Long Term Projects

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Coral restoration	Artificial Reefs On Saba and Statia (AROSSTA)	SAB EUX	**VHL**: Alwin Hylkema, Marlous Heemstra **WUR:** Dolfi Debrot **STENAPA**: Jessica Berkel, Erik Houtepen **SCF:** Kai Wulf, Jens Odinga, Aymi Izioka **CNSI**: Johan Stapel **Students**: Callum Reid, Esmee vd Griend, Daniel Heesink
Environmental	Caribbean island biogeography meets the anthropocene	AUA, BON, CUR, EUX, SXM	**VU:** Jacintha Ellers, Matt Helmus, Wendy Jesse (PhD. Student), Jocelyn Behm (Postdoc) **CNSI**
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)
Geosciences	Stability of Caribbean coastal ecosystems under future extreme sea level changes (SCENES) - The effects of climate change on calcifying algae	BON, EUX, SXM	**UU:** Henk Dijkstra, **NIOZ:** Peter Herman, Rebecca James (PhD student) **TU Delft:** Julie Pietrzak **STENAPA** **CNSI**
Geomorphological	4D crust-mantle modelling of the eastern Caribbean region: toward coupling deep driving processes to surface evolution - Reconstructing past climate change	EUX	**UU:** Wim Spakman **NIOZ:** Lennart de Nooijer **Alfred Wegener Institute Germany** **CNSI**
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-Utrecht University	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	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Reptiles	Ecology and conservation of green and hawksbill turtles in the Dutch Caribbean	AUA, BON, CUR, SAB, EUX, SXM	**RuG:** Per Palsbøll, Jurjan van der Zee (PhD student) **RU**: Marjolijn Christianen, **WUR:** Lisa Becking **STCB:** Mabel Nava **CARMABI** **STENAPA** **CNSI**
Tourism and sustainable development	Vulnerability is dynamic: Enhancing adaptive governance to climate change for Caribbean tourism through interactive modelling	CUR	**WUR**: Jillian Student, Machiel Lamers **UOC:** Filomeno A. Marchena
BO-projects in the Dutch Caribbean (Min EZ)			
Coral Reef Ecosystems	BO-11-019.02-038– Analysis photomaterial coral reefs	BON, CUR	**WUR:** Erik Meesters
Coral Reef Ecosystems	BO-11-019.02-022 –Inventory corals Includes monitoring and research of the longest coral reef time-series in the world (since 1973)	BON, CUR	**WUR:** Erik Meesters
Conservation	BO-11-019.02-060 – Status of nature conservation of the Caribbean Netherlands (for new nature policy plan)	BON, SAB, EUX	**WUR:** Dolfi Debrot, Rene Henkens, Peter Verweij **EZ:** Paul Hoetjes, Yoeri de Vries (eds.)
DCBD	BO-11-019.02-002 - Expansion knowledge system Dutch Caribbean	AUA, BON, CUR, SAB, EUX, SXM	**WUR (Alterra):** Peter Verweij
Fisheries	BO-11-019.02-055 – Fisheries Dutch Caribbean	SAB, EUX	**WUR:** Dolfi Debrot Thomas Brunel, Martin de Graaf **SCF (SBMU):** Jens Odinga, Ayumi Izioka **NIOZ:** Kimani Kitson-Walters Students: Fedor den Elzen, Ivo Damen
Marine biodiversity	BO-11-019.02-008 – Saba Bank – Marine biodiversity	SAB	**WUR:** Erik Meesters (benthic communities), Dolfi Debrot, Thomas Brunel, Leo Nagelkerke (fish stocks)

Long Term Projects

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Marine mammals & sharks	BO-11-019.02-054 – Marine mammal sanctuary	SAB, EUX	**WUR:** Dolfi Debrot, Dick de Haan, Meike Scheidat, Ayumi Izioka **SCF (SBMU):** Jens Odinga
Marine mammals	BO-11-019.02-005 – Marine mammals in the Dutch Caribbean	BON, SAB, EUX	**WUR:** Dolfi Debrot
World Heritage nomination	BO-11-019.02-050 – 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
Sustainable Agriculture	The sustainable agriculture and rural development program (POP Bonaire)	BON	**Bonaire Agri & Aqua Business BV:** Sherwin Pourier **Wayaká Advies BV:** Jan Jaap van Almenkerk **DRO:** Frank van Slobbe
Invasive species	Feral Pig Control	BON	**Echo:** Julianka Clarenda **DRO:** Frank van Slobbe
Reforestation	Reforestation Project	BON	**Echo:** Lauren Schmaltz, Quirijn Coolen **DRO:** Frank van Slobbe
Invasive species	Goat eradication and control in Washington Slagbaai National Park	BON	**STINAPA** **DRO:** Frank van Slobbe

Long Term Projects

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Coral ecosystems	Coral Restoration	BON	**CRF Bonaire:** Augusto Montbrun **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	Erosion control and nature restoration	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	Horicultural 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
	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

Long Term Projects

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
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
EU-BEST funded Projects in the Dutch Caribbean			
Marine ecosystems	Marine Park Aruba	AUA	**Directie Natuur en Milieu:** Gisbert Boekhoudt **TNO:** Kris Kats
Coral Reef Ecosystems	Restoration Ecosystem Services and Coral Reef Quality (Project RESCQ)	SAB, EUX, SXM	**WUR:** Erik Meesters **SCF. STENAPA, NFSXM** **Turks & Caicos Reef Fund** **Students:** Niels Wagenaar, Silvan Allard, Pam Engelberts, Roxanne Francisca, Lotte Staat, Carmen Carpendale, Daniela Simal, Emma Louise Pratt, Renate Olie, Amber Mulder
Conservation	Watershed & Biodiversity Conservation of Roi Sangu valley	BON	**Echo:** Lauren Schmaltz, Quirijn Coolen
Terrestrial habitat restoration	Restoration of Key Biodiversity Areas of St. Maarten	SXM	**EPIC (Project lead)**: Kippy Gilders **Subcontractors: Les Fruits des Mer**: Mark Yokoyama (reptile, amphibian, and invertebrate assessment) **The Leon Levy Native Plant Preserve, Bahamas**: Ethan Freid (plant assessment)

Monitoring Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Birds	Flamingo Abundance	BON	**DRO:** Frank van Slobbe **Cargill** **STINAPA:** Paulo Bertuol
Birds	Monitoring vulnerable parrot nests (remote camera sensing work)	BON	**Echo:** Laura Schmaltz, Sam Williams
Birds	Yellow-shouldered Amazon parrot roost counts	BON	**Echo:** Lauren Schmaltz **DRO:** Peter Montanus **STINAPA:** Paulo Bertuol
Birds	Bird Monitoring (Caribbean Waterbird Census)	AUA BON SXM	**FPNA** **DLVV:** Tatiana Becker **STINAPA:** Paulo Bertuol **EPIC**: Adam Brown
Birds	Tern monitoring(artificial nesting islands)	BON	**STINAPA:** Paulo Bertuol **Cargill** **DRO** **WUR:** Dolfi Debrot
Birds	Terrestrial Bird Monitoring Program for Bonaire	BON	**Echo:** Lauren Schmaltz **STINAPA**
Birds	Red-billed Tropicbird monitoring	SAB EUX	**STENAPA** **SCF:** Kai Wulf
Birds	Pelican monitoring	SXM	**NFSXM:** Melanie Meijer zu Schlochtern
Coral reef ecosystems	Coral Bleaching Monitoring	SXM	**NFSXM:** Tadzio Bervoets
Coral reef ecosystems	Global Coral Reef Monitoring Network	BON CUR SAB EUX SXM	**STINAPA:** Caren Eckrich **CARMABI:** Mark Vermeij **SCF (SBMU):** Jens Odinga **STENAPA:** Jessica Berkel **NFSXM:** Tadzio Bervoets **CNSI:** Johan Stapel

Monitoring Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Corals reef ecosystems	Doobies Crack reef damage recovery survey	EUX	**STENAPA:** Erik Houtepen
Corals reef ecosystems	Staghorn coral field monitoring survey	EUX	**STENAPA:** Jessica Berkel
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
Coral reef ecosystems	Coral reef monitoring (Since 2007 using AGRRA methods and filming of permanent transects)	BON	**CIEE**: Rita Pearchey
Environmental	Water quality testing	SXM	**NFSXM:** Tadzio Bervoets **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)	BON CUR SAB SXM EUX	**WUR:** Erwin Winter, Dolfi Debrot, Martin de Graaf **STINAPA:** Caren Eckrich **CARMABI:** Mark Vermeij **SCF(SBMU):** Jens Odinga, Ayumi Izioka **STENAPA:** Jessica Berkel **NFSXM:** Tadzio Bervoets
Fish	Spawning monitoring: Red hind surveys on Moonfish Bank	SAB	**SCF (SBMU):** Jens Odinga, Ayumi Izioka
Insects	Bee tracking	BON	**Echo:** Lauren Schmaltz
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**

Monitoring Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Invasive species	Lionfish abundance and control	BON CUR SXM SAB EUX	**STINAPA:** Paulo Bertuol (50 meter traps) **CARMABI:** Mark Vermeij **NFSXM:** Tadzio Bervoets **SCF (SBMU):** Jens Odinga **STENAPA:** Jessica Berkel
Invasive species	Monkey Monitoring: abundance and distribution	SXM	**NFSXM:** Tadzio Bervoets
Invasive species	Feral pig population assessment (trapping)	BON	**Echo:** Nathan Schmaltz, Sam Williams
Mammals	Bat monitoring	AUA BON	**FPNA** **WildConscience:** Fernando Simal, Linda Garcia
Mammals	Dolphin monitoring (since 1999)	BON	Ron Sewell
Mammals	Caribbean Humpback Acoustic Monitoring Programme (CHAMP)	BON, AUA	**NOAA**: Heather Heenehan, Sofie Van Parijs, Peter Corkeron, Fred Wenzel **STINAPA**: Wijnand de Wolf **AMMF**: Angiolina Henriquez **RCN**: Paul Hoetjes
Mammals	Marine Mammal Monitoring (noise loggers Saba Bank)	SAB	**WUR:** Dick de Haan, Dolfi Debrot **SCF (SBMU)**: Jens Odinga, Ayumi Izioka
Molluscs	Conch (Strombus gigas) on St. Eustatius, Saba Bank, Anguilla	SAB EUX	**WUR:** Martin de Graaf, Erik Boman (PhD student) **SCF (SBMU):** Jens Odinga
Natural resource use	Fishery monitoring (including lionfish, shark bycatch and marine mammal sightings) (* Part of BO-11-019.02-055 – Fisheries Dutch Caribbean)	SAB EUX	**SCF (SBMU):** Jens Odinga, Ayumi Izioka **Gem City Consulting:** Erik Boman **LVV:** Kiman Kitson-Walters **WUR:** Dolfi Debrot, Fedor den Elzen (student), Ivo (student) Damen

Monitoring Overview

September / October 2017

CATEGORY	SUBJECT	ISLANDS	ORGANIZATION(S): LEAD SCIENTIST
Plants	Phenology of bats in cacti landscapes of Aruba	AUA	**WildConscience:** Linda Garcia, FPNA
Plants	Monitoring of tree growth and survivorship in reforestation areas	BON	**Echo**: Quirijn Coolen, Nicholas Verhey
Plants	Terrestrial Habitat Monitoring Program for Bonaire	BON	**Echo**: Lauren Schmaltz
Reptiles	Lesser Antillean Iguana: Monitoring population density & removing invasive Green Iguana and hybrids	EUX	**STENAPA** **RAVON:** Tim van Wagensveld **EcoPro:** Hannah Madden
Reptiles	Boa and Cascabel Monitoring	AUA	**FPNA, Toledo Zoological Society:** Andrew Odum
Reptiles	Behavior of the endemic Aruban Whiptail lizard	AUA	**FPNA, Auburn University:** Jeff Goessling (PhD candidate)
Seagrass and mangrove ecosystems	Seagrass and mangrove monitoring (BON: also conch and benthic fauna)	BON SXM	**STINAPA:** Sabine Engel, Caren Eckrich **WUR:** Klaas Metselaar **NFSXM:** Tadzio Bervoets
Seagrass and mangrove ecosystems	Seagrass restoration BESE elements	BON	**RU:** Marjolijn Christianen **STINAPA** : Sabine Engel
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 **CARMABI (STCC):** Sabine Berendse **STENAPA:** Jessica Berkel **SCF:** Kai Wulf **NFSXM:** Tadzio Bervoets

List of Acronyms

AUA	**Aruba**
BON	**Bonaire**
CUR	**Curaçao**
SAB	**Saba**
EUX	**St. Eustatius**
SXM	**St. Maarten**
AMMF	Aruba Marine Mammal Foundation
ANEMOON	Analyse Educatie en Marien Oecologisch Onderzoek
ASDF	Aruba Sustainable Development Foundation
BEST	Biodiversity and Ecosystem Services in Territories of European overseas
BO project	Policy Supporting Research project
BU	Bangor University, United Kingdom
CARIBSS	Caribbean Speleological Society
CARMABI	Caribbean Research and Management of Biodiversity Foundation
CEAB	The Blanes Centre for Advanced Studies, Spain
CIEE	Council of International Educational Exchange, Bonaire
CRF	Coral Reef Foundation
DCNA	Dutch Caribbean Nature Alliance
DCBD	Dutch Caribbean Biodiversity Database
DRO	Directorate of Spatial Planning and Development, Bonaire
DLVV (Santa Rosa)	Department of Agriculture, Livestock, Fishery and Farmers market (Santa Rosa), Aruba
EcoPro	Ecological Professionals Foundation
ECPHF	Eastern Caribbean Public Health Foundation
EPIC	Environmental Protection in the Caribbean
FPNA	Fundacion Parke Nacional Arikok, Aruba
HAS	HAS University of Applied Sciences, the Netherlands
LVV	Department of Agriculture, Animal Husbandry & Fisheries, St. Eustatius

NFSXM	Nature Foundation St. Maarten
Naturalis	Naturalis Biodiversity Center, The Netherlands
NIOZ	NIOZ Royal Institute for Sea Research, the Netherlands
NWO	NWO Netherlands Organisation for Scientific Research
PL	Project leader
RAVON	Reptielen Amfibieën Vissen Onderzoek Nederland
RuG	University of Groningen, the Netherlands
RU	Radboud University Nijmegen, the Netherlands
SBMU	Saba Bank Management Unit
SCF	Saba Conservation Foundation
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
TUD	Delft University of Technology, the Netherlands
UsA	University of St. Andrews, Scotland
UU	University of Utrecht, the Netherlands
UvA	University of Amsterdam, the Netherland
VHL	University of Applied Sciences VHL, the Netherlands
VU	VU University Amsterdam, the Netherlands
Wildconscience	Wildlife Conservation, Science and Education
WNF	World Wide Fund for Nature
WUR	Wageningen Universitwy and Research Centre, the Netherlands
WUR (Alterra)	Wageningen Environmental Research, the Netherlands

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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.

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*

"Roberts, M., Hanley, S., Williams, S., Cresswell, W. (2017)
Terrestrial degradation impacts on coral reef health: Evidence from the Caribbean.Ocean & Coastal management, 149: 52-68."

"Webb, A.E., van Heuven, S.M.A.C., de Bakker, D., van Duyl, F., Reichert, G.J., de Nooijer, L.J. (2017)
Combined Effects of Experimental Acidification and Eutrophication on Reef Sponge Bioerosion Rates. Frontiers in Marine Science, DOI: 0.3389/fmars.2017.00311."

"Rippe, J.P., Matz, M.V., Green, E.A., Medina, M., Khawaja, N.Z. et al. (2017)
Population structure and connectivity of the mountainous star coral, Orbicella faveolata, throughout the wider Caribbean region. Ecology and Evolution, DOI 10.1002/ece3.3448."

Student Reports

"Arendsen, P. (WUR student) (2017)
Mapping erosion on Saba, How to keep the Unspoiled Queen from tumbling down."

"Fishburn, D.J.C. (2017)
Assessing the viabiliy of the groasis waterboxx for dry forest restoration and reforestation projects. "

"Horn, A. (WUR student) (2017)
Modelling urban floods in semiarid environment: a case study in Paradera, Aruba."

"Houtsma, S. (WUR student). (2017)
The current status of mangrove forests in Spanish Lagoon (Aruba) evaluated from a hydrological point of view. Assessing the water balance and modelling tree growth rates."

"Kuppen, E. (Msc. thesis WUR) (2017)
A hydrological analysis of the Spanish Lagoon Catchment with the AGWA model on Aruba."

"Vogel, T. (WUR student) (2017)
Human induced dust in Aruba. An assessment of the transport and spatial deposition dynamics of dust from off-road driving in Aruba and the effect of driving speed and traffic density."

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Calendar

October

whole month	Event	Sea and learn, Saba.
2-4	Workshop	2nd Technical Workshop of the Transatlantic MPA Network: Marine mammals' protection, a way to enhance transatlantic cooperation between MPAs, Iceland.
5-6	Conference	Our Ocean' Conference, Malta.
12	Reception	Save Our Sharks reception, Amsterdam, the Netherlands.
12-14	Conference	21st Annual European Elasmobranch Association Scientific Conference, Amsterdam, the Netherlands.
17-19	Meeting	WECAFC/CITES/OSPESCA/CRFM/CFMC Working Group on Shark Conservation and Management, Barbados.
18-20	Meeting	14th Scientific Committee Meeting of the IAC, Panama.
20	Meeting	Fishery Commission BES, Barbados.
23-28	Conference	12th COP to the Convention on the Conservation of Migratory Species of Wild Animals (CMS), in Manila, the Philippines.
25	Event	Sustainability Day
30-2 Nov	Conference	19th RedLac Assembly, Dominican Republic.

November

6-10	Meeting	70th Meeting of GCFI, Merida, Mexico.
16-17	Conference	Green Aruba, sustainability in motion, Aruba.
20-24	Meeting	2nd Meeting of the Advisory Committee and 2nd Workshop of the Conservation Working Group of the Sharks MoU, Habitat, Bonaire.
25	Event	Fundraising Auction (STCB) El Encanto Boutique Hotel, Bonaire.
26-01 Dec	Meeting	69th meeting of the CITES Standing Committee, CICG, Geneva, Switzerland.

December

1	Symposium	2nd AcroporaNet Symposium, Amsterdam, the Netherlands.
6-7	Conference	6th Statia Sustainability Conference (SSC6), St. Eustatius.
7-9	Meeting	ICRI General meeting, Nairobi.
13	Symposium	European Coral Reef Symposium, Oxford, UK.

2018 declared International Year of the Reef by the International Coral Reef Initiative (ICRI)

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

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References

The reports and publications on biodiversity related subjects in the Dutch Caribbean 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.

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