

State of Nature in the Dutch Caribbean: Saba and the Saba Bank

Wageningen Research recently published an alarming report on the state of nature for the three Dutch Caribbean islands (Bonaire, Saba and St. Eustatius), commissioned by the Ministry of Agriculture, Nature and Food Quality. All 33 experts that worked on this report concluded that the “*Conservation status¹ of the biodiversity in the Caribbean Netherlands is assessed as moderately unfavorable to very unfavorable*”.

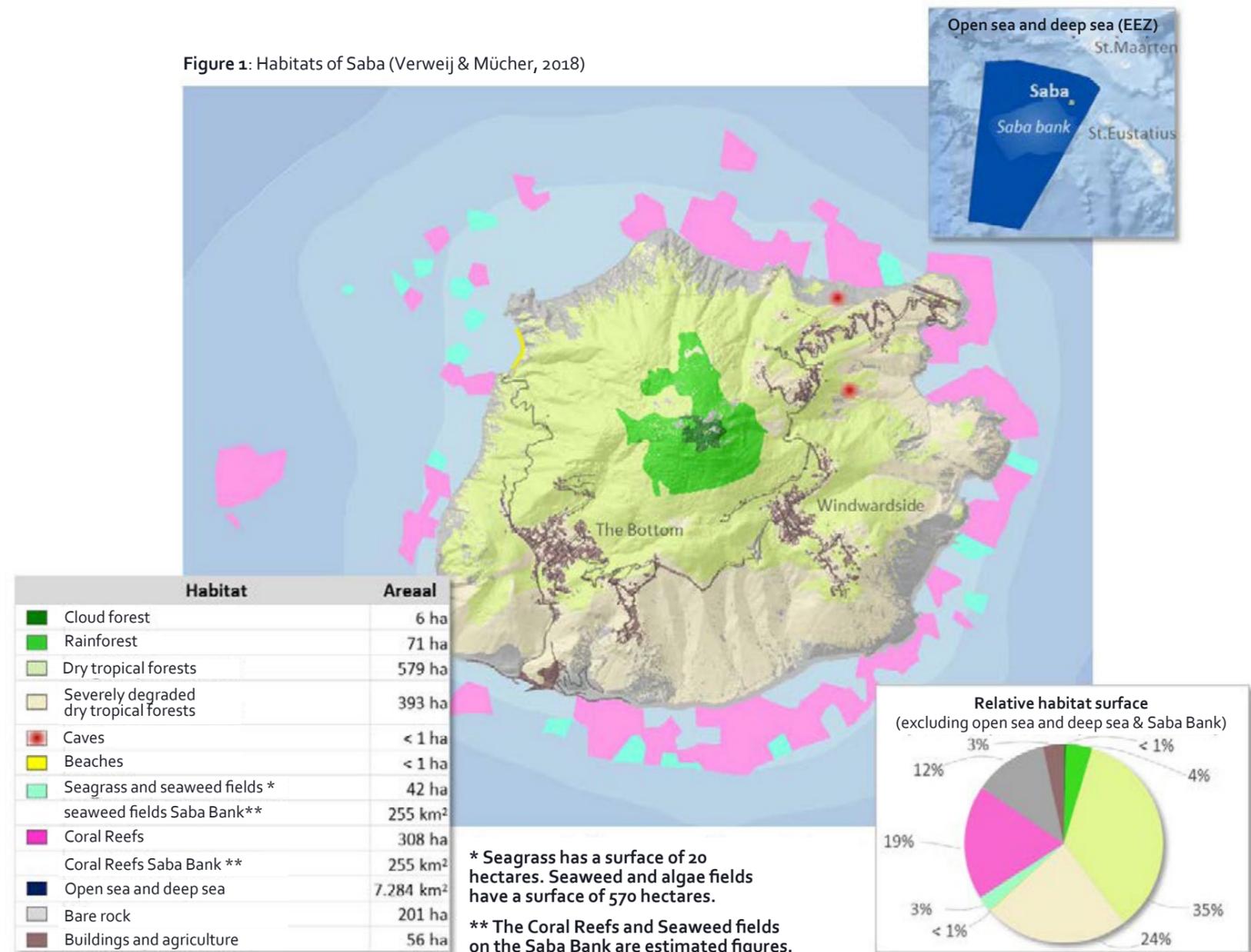
Saba and St. Eustatius are two special municipalities which make up the Caribbean Netherlands leeward islands. Saba consists of the main island, Saba, and a large submerged carbonate platform, the Saba Bank. The Saba Bank is the largest national park in the Kingdom of the Netherlands (Saba Bank: 268.000 hectares; Wadden Sea 240.000 hectares), and has some of the richest biodiversity within the Caribbean Sea ([Sabapark.org](http://www.sabapark.org)). From the cloud and rain forests on top of Mount Scenery volcano to the rich coral reefs and seaweed

fields underwater, Saba is rich with a variety of different habitats. Unfortunately, the recent Wageningen Research report shows that many of these areas, both above and below water, are showing signs of degradation.

Governments are beginning to understand that managing nature goes beyond just protecting natural assets, but can also help promote positive economic growth (Ministry of Economic Affairs, 2013). Protecting the environment means protecting the services they provide such as natural coastal protection and recreational use for locals and tourists (de Knegt, 2014). TEEB (The Economics of Ecosystems and Biodiversity) recently valued the annual total economic value of nature on Saba at 28.4 million USD (Cado van der Lely et al., 2014). It was also found that nature-oriented tourism made up 27% of this value (van de Kerkhof et al., 2014). This clearly shows the importance of properly protecting and managing natural environmental resources.

1. The Conservation Status is used in the European Union for reporting on the status of species and habitats protected under the European Habitat Directive (see http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm).

Figure 1: Habitats of Saba (Verweij & Mûcher, 2018)



Tropical cloud, tropical rainforest and dry tropical forest

Saba is 1 of the 2 Dutch Caribbean islands which has tropical cloud, rain and dry forests. Starting at sea level, its typical to find tropical dry, rain and then cloud forests as height increases. Since Saba has been mostly isolated, this has allowed the vegetation and fauna of these forests to be quite unique (De Freitas et al., 2012, 2016). Using a classification system set up by the World Wildlife Fund (WWF) Neotropical Ecoregion, the status of the tropical cloud and rain forest of Saba has been labeled "critical/threatened" while the tropical dry forest has been classified as "vulnerable" (WWF, 2017).

Saba hosts 71 hectares of rainforest and 6 hectares of cloud forest. Unfortunately, historical values of these areas are unknown, which makes determining shifts in habitat coverage, area and distribution very difficult. However, by comparing current maps with vegetation maps from 60 years ago, researchers have highlighted some of these differences. Hurricanes and tropical storms can have devastating affects on the local cloud and rain forests, however, if given enough time to recover, most of these forests' "return" to their earlier state (Freitas et al. 2016). In 2017, hurricanes hit Saba, levying damage both on land and underwater. Unfortunately, damage done by hurricanes coupled with grazing by free roaming feral livestock limited the recovery of these areas. For these reasons, the conservation status of the cloud and rain forest have been evaluated as "very unfavorable".

Dry tropical forests account for 972 hectares of land on Saba, all of which show signs of degradation and a 40% of this area even shows signs of heavy degradation. Although long-term monitoring data are lacking, when comparing current

states against historical data, it can be seen that these areas have been negatively affected due to changes in the island's land use. Agriculture and livestock grazing have degraded the dry forest to mostly grasses and shrubbery. Invasive species of insects have wiped out almost all local white cedar and *Opuntia* cacti population along the coast. For these reasons, the conservation status of the dry forests has been evaluated as "very unfavorable".

It is recommended that measures be taken to minimize overgrazing by stray livestock. In addition, protection of native species can only be done through the careful managing of invasive species. Finally, it is recommended that research should be done to establish breeding methods of local plant species to aid in reforestation efforts.

Caves

Caves provide important habitat for many different types of bats and other animals. Since Saba has a volcanic origin, there are not as many caves here as on other Dutch Caribbean islands. The sulphur mine serves as a type of cave system, along with natural caves which form along the steep cliff edges of Hell's Gate. Caves on the island can be threatened by urbanization and disruption by visitors, along with water quality issues if sewage is untreated and drained near the caves. This can have negative impacts on the various species of animals living in and around these caves. For these reasons, the conservation status of caves has been evaluated as "moderately unfavorable".

Beaches

Beaches around the Caribbean are under severe pressure due to urbanization, tourism, climate change (rising sea levels), invasive species, pollution and illegal mining of sand. Saba has very limited permanent beach areas and therefore,

very little beach vegetation to stabilize sediment as it is washed ashore (De Freitas et al., 2016). Due to the steep bathymetry and high wave action around Saba, very little sand is available in shallow waters. It is for these reasons that beaches are not very common on Saba. The conservation status of beaches has been evaluated as "very unfavorable".

Seagrass and Seaweed Fields

Seagrass and seaweed fields play an important role in the environment as they provide food, shelter and nurseries for many different reef species (Chaves et al., 2013). In addition to this, seagrass can capture CO₂, improve water quality and mitigate erosion by stabilizing sediment. Saba has some small seagrass and seaweed fields, measuring 20 and 22 hectares respectively. The Saba Bank does not have any known seagrass fields but it does have a very large seaweed field, recent estimates put it at >25,500 hectares. The seaweed fields of the Saba Bank are considered to be the most diverse area for seaweeds in the Caribbean. The surface area of the seaweed fields of the Saba Bank do not appear to be shrinking over time, however, they are threatened by degraded water quality due to climate change and pollution.

Since 2011, large patches of floating seaweed, Sargassum (*S. fluitans* and *S. natans*), has been a Caribbean wide problem. This seaweed floats into shallow waters or onto shore where it decomposes, creating a thick mat along the sandy bottom. This mat can cause damage to the local seaweed and seagrass fields. This is an issue that is continuing to get worse and will need to be carefully monitored in the future. The assessment for the state of seaweed has been evaluated as "moderately unfavorable".

Coral Reefs

Over the last 25-40 years coral reefs around the world have seen downward trends, with one study indicating that groundcover of coral has fallen by over 50% in the Caribbean over the past 40 years (Bak et al. 2005a, de Bakker et al. 2016, de Bakker et al. 2017). The Saba Bank hosts over 255 km² of coral reef, whereas Saba has around 8 km² (van der Land 1977, Bak 1977). There are differences between these two areas, the Saba Bank hosts a traditional coral reef, where coral skeletons provide the support structure as the coral colonizes and grows, whereas around Saba corals grow on solidified lava rock.

Saba has also experienced a downward trend for its coral coverage, which has been documented over the last 25 years. Due to limited data collected within the Saba Bank prior to 2010, trends for historical data are limited with consistent data only available for the last decade. Since 2010, regular trips have been taken to study the status at 10 unique locations. Overall, there has been a decline in coral coverage, especially after Hurricane Lenny in 1999 and two bleaching events in 1998 and 2005. These results are particularly interesting due to the remoteness of the Saba Bank, as it can be assumed this area is minimally affected by landpollution, yet still shows similar downward trends as the other Caribbean islands.

Changes in sea water temperature, water quality, increase in algae and overfishing of herbivore grazers has led to an overall decrease in coral coverage throughout the entire Caribbean. It is recommended that measures are taken to maintain a coral coverage of at least 30%, a value derived off historical averages. The conservation status of coral has been evaluated as "very unfavorable".

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Open Sea and Deep Sea

For this report, any water depth deeper than 100m is treated as “deep sea” and or “open sea”. Due to the steep bathymetry of Saba and the Saba Bank, deep sea and/or open sea conditions exist just a few hundred meters from the coast. Saba and the Saba Bank open sea and deep sea areas have been a part of the Yarari marine mammal and shark sanctuary since 2015. These deep waters support a unique set of life and are important in promoting biodiversity within the Caribbean Sea.

Although removed from most direct land pollution, these areas are still affected by overall water quality shifts, sea temperature rise, overfishing and anthropogenic noise and garbage pollution (Eakin et al. 2010, Debrot et al. 2014). The conservation status of the open and deep sea has been evaluated as “moderately unfavorable”.

Marine Mammals

Of the 33 species of marine mammals known to reside in the Caribbean, 5 species have been reported around Saba and the Saba Bank (Debrot et al., 2011a; Witte et al., in prep.). Information concerning these species comes mostly from visual observations that have been reported. It is thought that the waters around Saba and the Saba Bank provide important areas for migration, wintering and food foraging for many species of

marine mammals. These waters are especially important for wintering humpback whales, migrating dolphins and a local population of sperm whales (Debrot et al. 2013, 2014a).

Marine mammals are particularly vulnerable to human activities, through both direct collision with boats and disruptions due to recreation, eco-tourism, fishing and hunting. There is currently not enough information to make conclusive statements concerning short- and long-term trends. Therefore, it is recommended that basic management of the Yarari marine mammal and shark reserve be implemented. In addition, it is also recommended to continue and expand passive acoustic monitoring of marine mammals to gain more information on resident and migratory species. The assessment for the conservation status of marine mammals has been evaluated as “moderately unfavorable”.

Sea Turtles

The seagrass fields around Saba are an important foraging site for sea turtles. The Saba Bank has also been known to provide foraging areas for sea turtles, including hawksbill turtles, which like to feed on the algae and sponges available there (Lundvall, 2008). Since Saba has very limited permanent beach areas, it is not normally a site for turtle nesting. In 2015, there was one green turtle nest which successfully hatched.

A decrease in available beaches along with water quality issues which affect the sea turtles and their food supply has led to increase in stress for these sea turtles. It is recommended that water quality and seagrass beds be monitored and managed to ensure foraging grounds are available for these sea turtles. The conservation status of sea turtles has been evaluated as “very unfavorable”.

Conch

The Queen Conch is an iconic species in the Caribbean, known for its unique taste and beautiful shell (source: US National Oceanic and Atmospheric Administration). Conch has been overfished throughout the Caribbean region, however, due to a moratorium put in place in 1996, local populations around Saba and the Saba Bank are healthy by comparison (Meesters et al., 2010).

Although local numbers seem to have bounced back, it is still important to carefully monitor and manage these populations. These populations could play an important role in safeguarding this species in the future. Overall, the conservation status of the Queen Conch in the Caribbean Netherlands has been evaluated as “moderately unfavorable”. Unlike many other locations in the Caribbean region, the Saba Bank was found to have healthy populations of Queen Conch (Boman, 2017).



Green Sea Turtle, photo by: © Jannie Koning

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Spiny Lobster, photo by: © MMBockstael-Rubio

Fishery

Fishing has always played an important role within the Caribbean; however, fish stocks are now at risk due to a barrage of issues, limiting the amount and size of catch available. There has been a notable decrease in the size and number of large predators, signaling that fish stocks could be in jeopardy (Sandin et al., 2008; Pattengill-Semmens, 2002; van Kuik et al., 2015). Recent studies, however, show that large predator fish densities around Saba appear to be among the highest in the Caribbean (Vlugt, 2016). This is most likely due to the limited fishing which occurs around these waters. Research indicates that the Saba Bank has a large shark population which is important to keep the coral reefs healthy (Toller et al., 2010).

The most important species for commercial fishing in this region are the spiny lobster (60% of the commercial fishing) and redfish (various types of snappers) (40%) (Lundvall, 2008; Boonstra, 2014). Saba instituted a moratorium on new fishing licenses for redfish in 2006 to combat decreasing fish stock, while new licenses for lobster trapping are still being issued.

Maintaining fish stocks is a complex endeavor, which is still not fully understood. New regulations and changes in fishing equipment can help to mitigate by-catch and allow local fisherman to continue to fish in a more sustainable way. It is recommended that measures be taken to monitor and control fishing aiming to minimize the risk of overfishing in these areas.

Overall, the assessment for the state of fish stock for Saba has been evaluated as “favorable” and for the Saba Bank as “moderately unfavorable”.

Local and regional stressors

Throughout the Dutch Caribbean, overgrazing by free roaming livestock (goats, donkeys, cows and pigs) is considered to be the largest

threat to terrestrial ecosystems (Ministry of Economic Affairs, 2013; Smith et al., 2014). Aside from the pressures direct grazing places on native or rare plants, overgrazing can also contribute to a variety of other ecological and economic issues, such as sedimentation of near shore waters or loss of agricultural and recreational areas (Westermann and Zonneveld, 1956; Fabricius, 2005; Debrot et al., 2015).

Although no official population counts of free ranging goats have been made, expert estimates put the average density above the 1 goat per ha on Saba (Debrot, pers. obs.). Damage is less obvious on Saba due to the island having more abundant plant life than the other Dutch Caribbean islands. However, their impact can be seen on the lowest slopes where erosion is most noticeable (Debrot & Sybesma, 2000). It is recommended that monitoring programs be put in place and population management strategies are implemented to minimize damage caused by overgrazing. The assessment for the state of overgrazing has been evaluated as “very unfavorable”.

The Ministry of LNV (Agriculture, Nature and Food Quality, previously Ministry of Economic Affairs) requested studies be done to document the number of invasive species within the Dutch Caribbean. These studies found 211 potentially invasive species at various stages of invasion. Invasive species can wreak havoc on the local environment, as seen by the invasive livestock on local plants, or the wild cats on the nesting Red-Billed Tropic Birds on Saba. Around 2010, guinea pig and rabbits were also introduced to Saba. Since both of these are recently new to the island, it may still be possible to eradicate both populations through a culling program. Underwater, lionfish are decimating local reef fish populations. Early detection is key when managing these invasive species. It is very important to carefully monitor and manage these populations to ensure they are kept under control. Public awareness can play a key role in identifying and monitoring shifts in population dynamics. The assessment for the state of invasive species has been evaluated as “very unfavorable”.

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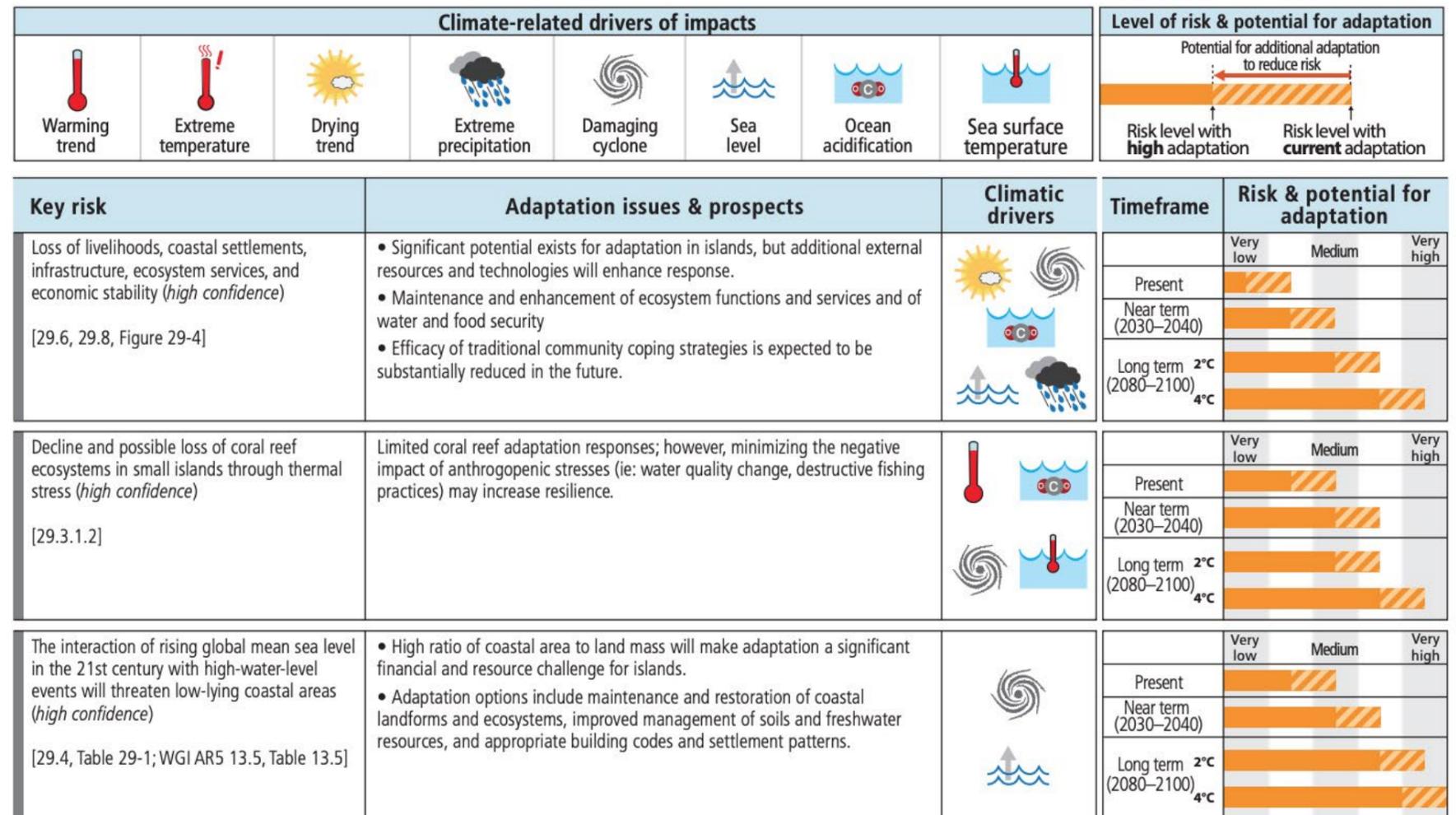
Climate Change

The Caribbean will continue to be affected by global stressors due to climate change. This includes, but is not limited to, more extreme weather patterns, worsening of overall water quality, and sea level rise. These changes will place even more pressure on the islands, and careful management will be required to minimize these effects. Although overall greenhouse emissions from these small islands is minimal when compared to the global scale, these islands will be the first and some of the most drastically impacted by global climate changes (IPCC, 2013).

The degradation of wave-breaking coral reefs coupled with worsening storms will likely contribute to more storm related damages (Frieler et al., 2013). Deterioration of coral reefs, shifts in migration patterns and the worsening of water quality conditions can also negatively affect fisheries, and could lead to a total collapse of specific commercial fish species (Bari and Cochrane, 2011). A warmer and more humid climate could also lead to a population boom for mosquito populations, increasing the risk of mosquito-related diseases (EPA, 2014; de Hamer, 2015). Worsening of specialized habitats could also endanger local species which depend on these specific conditions to live (Myers et al., 2000; Roberts et al., 2005).

As the Nature Policy Plan of the Dutch Caribbean (Ministry of Economic Affairs, 2013) states, "It is not possible to influence climate change from the islands, however it is possible to improve the resilience of ecosystems so that they can adapt to changes better and the consequences are kept to a minimum". Therefore, it will continue to be of the utmost importance for each island to do its part in monitoring and implementing policies to minimize the damages caused by climate change. Efforts such as monitoring waste water treatment and reforestation can help minimize anthropogenic effects on each island. The assessment for the state of climate change has been ranked as "very unfavorable".

Figure 2: Climate-related drivers of impacts on small islands (Nurse et al., 2014)



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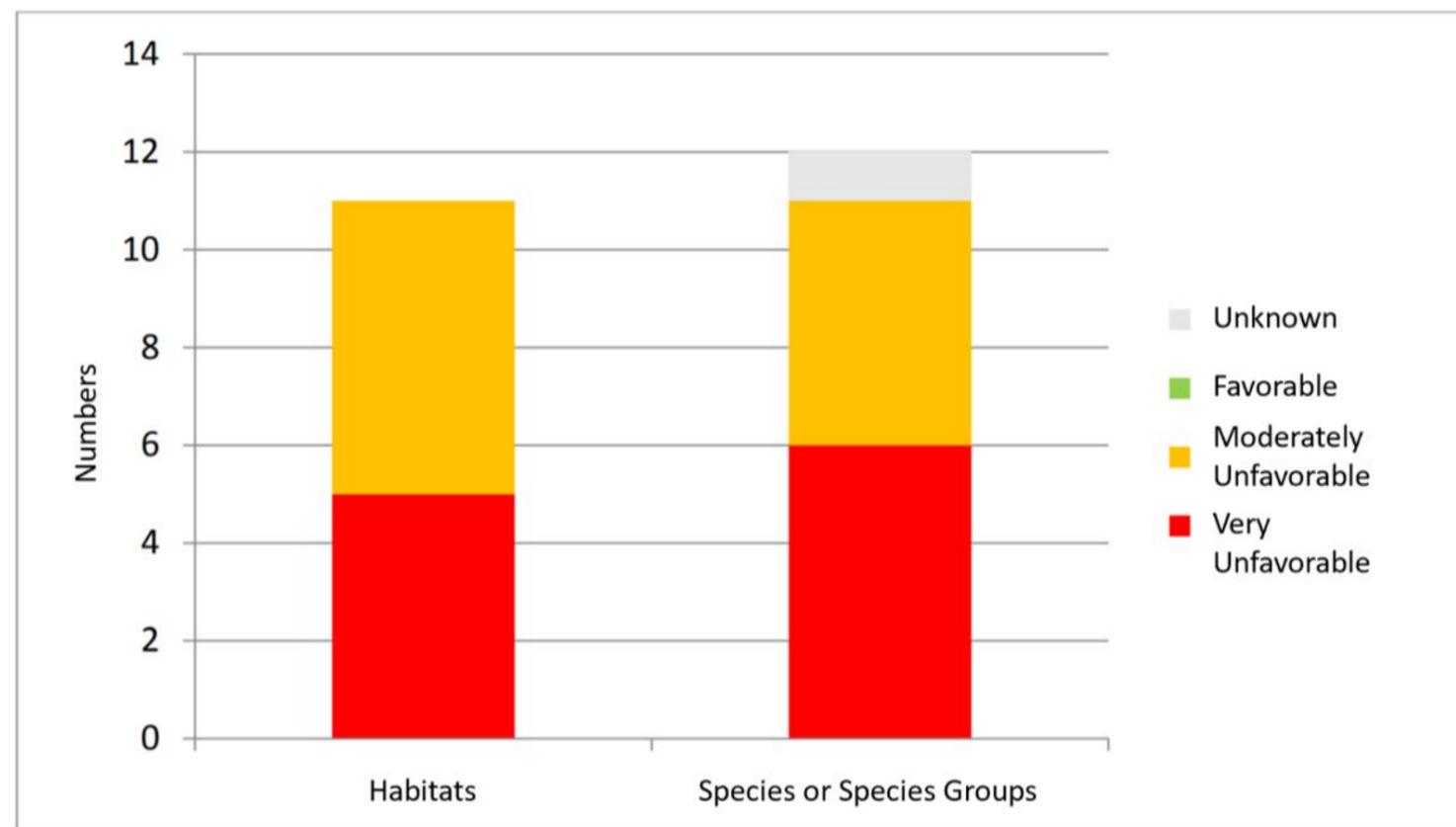
Conclusions and Recommendations

The assessment of the overall biodiversity within the Dutch Caribbean has been assessed as moderately unfavorable to very unfavorable. Figure 3 below illustrates the seriousness of these issues, as all categories have been evaluated as moderately to very unfavorable, given available data. The most significant threats to the future of these islands are largely related to overfishing, overgrazing by free roaming livestock, invasive species and climate change. Free roaming livestock, invasive species and climate change are being responsible for the quality rating of more than 80% of the habitats as moderate to very unfavorable.

Overall monitoring and management efforts need to be increased to meet the requirements to protect the rich biodiversity of the Dutch Caribbean. There is a disturbing lack of information concerning many important species groups such as bats, sharks, orchids and pollinators. Understanding the current status of each of the islands will be crucial for planning the way forward.

Collaborate efforts between government, NGOs, business and knowledge institutions (known as the Golden Triangle) will be increasingly important for a sustainable future. In 2013, the economic value of ecosystem services for Saba was estimated at 63% of GDP, yet less than one thousandth (0.1%) of the annual budget goes toward conservation efforts (van Beek et al., 2015). A fundamental shift in how governments view investing in their own environments will be required to accomplish the tasks required for a sustainable future.

Figure 3: Assessment of the current state of nature (2017) of 11 habitats and 12 species (group) and in the Dutch Caribbean



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