

CLIMATE CHANGE EFFECTS & *Recommendations*



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Dutch Caribbean Nature Alliance
Safeguarding nature in the Dutch Caribbean



Climate change effects and Recommendations

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Editor's Letter

Dutch Caribbean, 2020

Conditions all around the world are changing due to climate change. These changes can be felt throughout all environments, from changing water conditions affecting coral reefs to intensifying storms and droughts threatening terrestrial forests. Immediate and meaningful action is required if these environments are to be protected. Together, through local and international corporation, we can work to buffer these areas, giving the environment time and space to adapt to these changing conditions.

This special edition BioNews will address issues related to climate change in the Dutch Caribbean and identify what governing documents are currently in place to support future conservation measures. The Intergovernmental Panel on Climate Change has focused their attention on addressing areas within the following four areas: (1) freshwater resources, (2) terrestrial environments, (3) coastal erosion and marine ecosystems and (4) food production and livelihood. This document will walk through each of these four environments, as they relate to the Dutch Caribbean, and highlight the biggest threats these islands will be facing in the upcoming years.

Introduction

In October of 2018, The Intergovernmental Panel on Climate Change (IPCC) released a special report urging government officials from around the world to accelerate actions to curb carbon emissions. High levels of carbon emission are the main driver of global warming, and experts predict that if gone unchecked, global warming will have catastrophic effects [19]. For small island nations, especially those within the Caribbean, this is of dire importance. With even small increases in temperatures, drastic changes can be felt within this region. Scarcity of freshwater and intensifying of droughts and storms are some of the most pressing concerns within the Caribbean [7, 29]. In addition, research shows that sea level rise within the Caribbean will be similar to that of the global average of 1.8 mm per year [33].

The IPCC's fifth assessment report (AR5) stated that beyond a reasonable doubt, Earth's climate is warming, and has been at an unprecedented rate since the 1950s [17]. They found, with a scientific certainty of nearly 95%, that the increase in concentration of greenhouse gases, attributed to human activity, has been the dominant reason for this increase [17]. This report stressed that sea levels have been rising faster than the previous two millennia [17], and changes in rainfall have altered freshwater systems changing the quality and quantity of water available [18].

AR5 climate change predictions, using an intermediate-low emissions scenario, provides a guide to what changes the Caribbean may

experience. Under this scenario, there is an expected surface temperature increase of between 1.2 and 2.4 °C by 2100. This report also predicts a sea level rise of between 50 to 60 cm. There is a predicted decrease of average annual rainfall of between 5-6%, however, large variations within the Caribbean can make these changes difficult to predict. The previous version of this report, AR4, specified that there could be an increase in rainfall during the wet season (November – January) for the north Caribbean (including Saba, St. Eustatius and St. Maarten) and a decrease in rainfall in the southern Caribbean (including Aruba, Bonaire and Curaçao). This report also predicts a lengthening of the dry season, causing an increase in the frequency and violence of droughts, tropical storms and hurricanes.

The recently published Nature and Environment Policy Plan for the Caribbean Netherlands (2020-2030) specifically called out the need to build resilience against the effects of climate change. This plan outlined four strategies to build a healthier and stronger local environment, capable of dealing with these climate change related stressors. This policy plan also emphasized the need to improve our knowledge base by studying these effects and formulating long term mitigation and adaptation strategies.

Since 1993, the Convention on Biological Diversity (CBD) has been enforced as an international treaty created by the United Nations Environment Program. The CBD aims

to provide an international legal framework to support the conservation and sustainable use of natural resources to ensure the preservation of biological diversity. Within this framework, they established 20 targets, one of which specifically addresses a nation's abilities to protect their ecosystems from the effects of climate change. The Dutch government recently released its sixth status report, where all six islands were rated as "progressing towards target but at an insufficient rate", highlighting the need to improve these efforts.

Within AR5, there is a chapter dedicated to issues specifically affecting Small Island Developing States (SIDS). Here they drew attention to issues already concerning these SIDS due to climate change, and highlighted the necessity for action. This chapter broke these issues into 4 main categories: (1) freshwater resources, (2) terrestrial environments, (3) coastal erosion and marine ecosystems and (4) food production and livelihood.

This special edition BioNews will dive deeper into these four categories and reflect on how they will impact the islands within the Dutch Caribbean. This special edition will also provide some recommendations for both the island governments and residents on what can be done to minimize the effects of climate change and help build resilience on the islands.

PLAN FOR LAND & WATER

NATURE AND ENVIRONMENT POLICY PLAN
CARIBBEAN NETHERLANDS 2020 -2030

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Ministries of Agriculture, Nature and Food Quality, Infrastructure and Water Management and Interior and Kingdom relations of The Netherlands



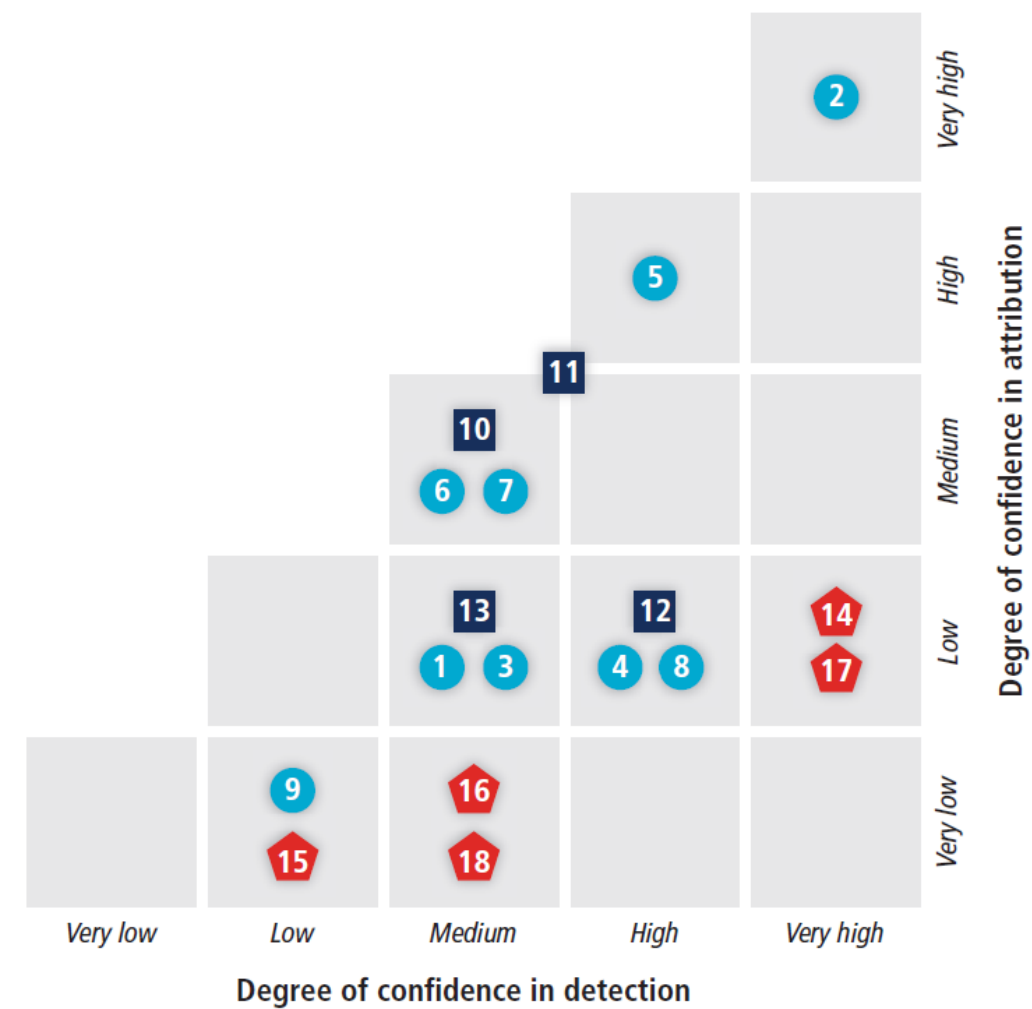
Tropical Storm Omar, 2008. Photo by: © A.O. Debrot

Uniqueness of Small Islands

Although climate change is a global issue, these changes will leave small islands particularly vulnerable. McCarthy et al identified many of these issues in "Climate Change 2001: Impacts, Adaptions and Vulnerabilities" which was submitted as part of the Third Assessment Report of the Intergovernmental Panel on Climate Change [27]. These issues are summarized below.

- Small islands are highly exposed to **natural hazards**, such as storm surges, hurricanes and droughts.
- The **limited physical size** means that these islands may not be able to physically adapt to these changing conditions. For example, coastal squeeze may not allow island populations to move inwards to avoid sea level rise.
- **Limited natural resources and isolated nature** could further increase dependence on imports.
- **Decreasing freshwater availability** is already an issue, which will continue to worsen as sea level rise leads to a mixing of water types in natural aquifers.
- **High population densities**, particularly along the coastline could threaten the very livelihood of these islands if these areas become uninhabitable.
- **Growing urbanization and industrial activities** place additional stress on these threatened ecosystems and require additional resources to sustain.
- Existing **infrastructure** may not be enough to meet these increasing requirements, especially as conditions continue to get warmer and drier, therefore investment in updating and increasing these capabilities will be necessary.
- Lastly, limitations concerning **funding** and **human resources** could hinder islands' ability to adapt fast enough to keep pace with climate change. Careful planning and resource management needs to be a high priority to ensure each island is able to evolve and adapt as necessary.

Furthermore, the AR5 assessment included an entire working group dedicated to small islands. They concluded that although small islands contribution to global greenhouse gases emissions is often negligible, these areas will likely be the first and most severely affected by the effects of climate change [33]. This working group identified 18 of the most significant threats to these small island nations and ranked them by degree of confidence in our ability to both detect changes within the issue and how directly it relates to climate change. As can be seen in the figure below, sea level rise and coral bleaching were identified as the two greatest threats which can be most easily detected and attributed to climate change.



Coastal systems

- 1. Greater rates of sea level rise relative to global means
- 2. Sea level rise consistent with global means
- 3. Marine inundation of low-lying areas
- 4. Shoreline erosion
- 5. Coral bleaching in small island marine environments
- 6. Increased resilience of coral reefs and shorelines in the absence of direct human disturbance
- 7. Acidification of surface waters
- 8. Degraded coastal fisheries
- 9. Degradation of mangroves and seagrass

Terrestrial systems

- 10. Saline incursion degrading ecosystems
- 11. Altitudinal species shift
- 12. Incremental degradation of groundwater quality
- 13. Island marine overtopping and rapid salinization of groundwater

Human systems

- 14. General environmental degradation and loss of habitat in urban locations
- 15. Reduced tourism
- 16. Human susceptibility to climate-induced diseases
- 17. Casualties and damage during extreme events
- 18. Re-location of communities/migration

Figure 1: Key climate change issues ranked by the ability for researchers to detect and attribute these changes to climate change as they relate to small island [33]

Effects of Climate Change

In 2010, the Ministry of Agriculture, Nature and Food Quality (LNV) commissioned a report to define the most significant threats and to suggest possible mitigation strategies for the Caribbean Netherlands. In this report they identified the most significant consequence of climate change to be loss of coral reefs, erosion of coasts and beaches, salinification of groundwater sources, loss of hilltop vegetation and flora, soil humus loss and erosion, increases in various disease vectors, changes in ocean currents and fish recruitment and an increase in invasive species [10].

Unfortunately, a 2017 State of Nature report assessed the effects and future perspective of climate change within the Dutch Caribbean as “very unfavorable” [11]. This low rating is due to the lack of an effective mitigation strategy for facing climate change related threats.

The latest IPCC report, AR5, divided the effects of climate change into the following four categories: (1) Freshwater Resources, (2) Terrestrial Environments, (3) Coastal Erosion and Marine Ecosystems and (4) Food Production and Livelihood. This section will take a closer look at these four areas and highlight the primary concerns for the Dutch Caribbean.

Freshwater Resources

Even in the best of conditions, freshwater is a limited resource for all of the Dutch Caribbean. However, given the rapid increase in demand and changes in land use, freshwater is becoming increasingly limited. These limitations are further exacerbated by decreased rainfall, increased temperature, along with the intrusion of seawater through sea level rise and the increased reach of tides, waves and storm surges [18].

Ponds

Although most of the Dutch Caribbean islands have limited access to freshwater, Sint Maarten is home to two important freshwater ponds. Little Bay Pond and Fresh Pond are permanent freshwater sources which provide critical habitat, rare in this region [32]. These areas are important roosting, foraging and breeding grounds for a variety of bird species along with a number of fish, mollusks and small invertebrates [32]. These areas are already threatened by human expansion and deteriorating conditions due to pollution; additional hardships such as changes in rain patterns, worsening storms and overall temperature increases could threaten the existence of these ponds entirely.

Salt Pans and Caves

Changes in rainfall could also affect the salt pans and salinas of these islands, which although are predominately saltwater, do serve as freshwater collection points during rainy seasons. These saltwater bodies form near the coast and experience salinity shifts from near freshwater to hypersaline conditions throughout the year [21]. Salinas are important areas for many different species of seagrass, fish, crustaceans and coastal birds, specifically flamingos, terns and sandpipers [9, 23, 24, 39]. There are also a number of freshwater caves within these islands which are important habitats for bats along with shrimp and many different freshwater crustaceans. These cave areas will be put under increased pressure caused by salt water intrusion as sea level rises.

Infrastructure Requirements

Depleted freshwater resources will place further strain on the island’s infrastructure. Management of these freshwater resources along with the investment in new facilities to generate and manage freshwater will become increasingly important. Desalination plants will continue to play a critical role, as they are the most important, if not only, source of freshwater for these islands.



Caribbean Flamingo at Saliña Slagbaai, Washington Slagbaai National Park.
Photo by: © Henkjan Kievit

Terrestrial Environments

Sea level rise will continue to pose a significant threat to the terrestrial environments within the Caribbean. Reliable sea level record keeping dates back to the 1880s, and the Caribbean has seen an average sea level rise of around 20 cm since then [1]. The IPCC AR5 concluded that sea level rise for the Caribbean has been on par with the global average, of an annual increase of around 1.8 mm [17]. New projections, however, predict that sea level rise could be as high as another 0.3 to 1.2 m by 2100 [1]. Unfortunately, a combination of insufficient mapping coupled with frequent tectonic activity within the Caribbean can make predicting sea level rise very difficult [1].

Beach Erosion

Sea level rise, paired with increased wave action through storm surges, larger tidal differences and increased waves further exacerbate beach erosion, a serious issue for the Dutch Caribbean. With sand being a limited resource, beach erosion often leaves behind hard fossilized substrate unsuitable for beach habitat which many species depend on, especially nesting sea turtles. By their very nature, sandy beaches are very dynamic areas, responding to small changes between the hydrodynamic forces created by each unique coastline [36]. Predicting climate change's impact on these coastlines will need to take a variety of factors into consideration, however, it can be certain that sea level rise, wave conditions, storm surges and changes in river flows will play an important role in how these coastlines evolve [36].

Loss of Vegetation

Most of the Dutch Caribbean hosts dry tropical forests, areas that are mostly dominated by cacti which play a critical role by providing fruit during dry periods to many species of bats and birds [34]. Dry tropical forests are also important for retaining sediment, preventing coastal erosion, increasing the retention of freshwater and capturing carbon dioxide within the soil and plants. Other delicate areas, such as the cloud and rainforests of the northern islands of St. Maarten, Saba and St. Eustatius are also susceptible to drastic weather changes. Increased temperatures will work to drive the elfin forests of Saba and St. Eustatius further uphill, which increases their exposure to extreme weather such as droughts and hurricanes [10]. Furthermore, the drier lower regions will then become more susceptible to fires, further threatening these areas [10].

Increase in Invasive Species

Climate change is also expected to see an increase in exotic and invasive species, the effects of which are often magnified on small islands due to land area limitations and high level of endemic species [18]. One study documented a total of 61 invasive species within the Dutch Caribbean including 12 mammals, 16 birds, 13 reptiles, 5 amphibians, 2 freshwater fish, 3 insects, 2 mollusks and 8 earthworms [6]. The State of Nature report for the Caribbean Netherlands, assessed the current state of invasive species as "very unfavorable" [11]. Overall, stressors due to climate change weaken local species making them less resistance to invasive species.

Coastal Erosion and Marine Ecosystems

Coastal and marine ecosystems, aside from being a significant driver for tourism, often serve as the life force for these small islands. These areas provide crucial habitat for a variety of marine animals along with protecting the islands from physical damage such as erosions, storm surges and sea level rise.

Ocean Acidification

Ocean acidification threatens the livelihood of highly calcified organisms such as mollusks, echinoderms and reef-building corals along with other reef organisms and fish [18]. Coupled with additional water quality changes, such as increasing temperature, decreasing oxygen, increase in pollution and eutrophication, these organisms are under immense pressures [18]. Ocean acidification can lead to a weakened coral skeletal structure, lessening its ability to withstand high energy waves. Hard, complex coral structures play an important role in coastal dynamics, helping to diminish wave energy before it reaches the beach, preventing high sand erosion [2].

Loss of Seagrass

Seagrass beds are also experiencing hardships due to climate change. Experts estimate that seagrass beds have been declining at an annual rate of nearly 7% worldwide, with 29% already lost completely [4]. Water temperature increases and the reduction of light able to reach seagrass beds due to worsening water conditions have had significant consequences for overall seagrass health

[18]. Further climate change related factors such as increased wave energy, ocean acidification, increase in invasive seagrass species and increased carbon dioxide levels have further threatened the remaining seagrass fields [4].

Deteriorating Coral Reefs

Coral reefs are some of the most biodiverse habitats on Earth, and are facing some of the largest threats due to climate change [20]. It is estimated that nearly 500 million people depend on coral reefs for their livelihood [20], so even small changes within this environment could have huge consequences. A 2019 publication highlighted the struggles already facing these reefs, by documenting the human impact on coral reefs within the Dutch Caribbean [30]. This study found that deteriorating water quality has already led to significant loss of coral cover and strength thus threatening coral's overall health and resilience [30].

The largest threats to reefs are ocean acidification (leading to a weakening of their overall structure), changes in water quality and increase in water temperature (leading to a decrease in coral health and increase in episodic bleaching events) [20]. The AR5 predicts that over half the world's coral reefs could suffer from heat stress by 2080 [18]. There has already been an increase in coral bleaching events, which are predicted to become increasingly severe within the Caribbean by 2074 [18]. Even under intermediate-low emissions scenarios, these incidents could occur as early as 2030 [18].

Effects of Climate Change

Loss of Mangroves

Mangroves play an important role in providing a buffer between the terrestrial environments and the near shore coastal waters. Their complex root system provides a barrier between these two environments, which limits erosion and protect against storm events [18]. Mangroves provide vital ecosystem services in the form of coastal protection, important nursery and foraging areas for many species of fish, crustaceans and birds, along with supporting other important habitats such as seagrass beds and coral reefs. Traditionally these forests are well adapted to rising sea levels [28], however additional pressures due to climate change, urbanization, tourism and over exploitation are now putting this habitat at risk [37, 35].

Increase in Algal Blooms

There is an expected increase in algal blooms, which will create a hostile coastal environment, possibly outcompeting coral and creating marine conditions unsuitable for current marine life. Through climate changes contribute to changes in salinity, increase in temperature, increase in carbon dioxide and coastal upwelling conditions, conditions could allow for large algal blooms [12]. These algal blooms can be harmful to the environment through the release of toxins, which are immediately a threat to smaller animals and can bioaccumulate up the food chain threatening larger animals, like sea turtles, dolphins, whales and sharks [12]. Algal blooms can also create dead zones, or hypoxia regions, devoid of oxygen needed to sustain life [12].

One example of an algal bloom which has recently devastated the Caribbean has been sargassum. This free-floating macroalgae has recently experienced episodic blooms due to climate change related conditions within the ocean. This has resulted in large amounts of sargassum entering bays, lagoons and beaches within the Dutch Caribbean. These influxes of sargassum have required human intervention to have it removed, as large quantities of sargassum can negatively affect sea turtle nesting beaches, seagrass bed and mangroves [8].

Changes in Ocean Currents

Globally, ocean currents are being altered due to the combination of increasing sea surface temperatures and the influx of freshwater as icecaps continue to melt. A 2011 study worked to identify long-term trends within Caribbean currents. In general, Caribbean currents tend to move in a clockwise-motion throughout the Caribbean, entering in the south, near Venezuela, traveling north along Central America, turning eastward around the Mexican Yucatan until hitting the windward islands where they then turn south. This study identified an acceleration in the rise of sea surface temperatures within the Caribbean [22]. This same study found that the greatest increase in water temperatures were occurring off the coast of Venezuela, most likely due to the decrease in upwelling (where deep cold water is brought up to the surface due to trade winds) [22].

In addition, many coral reef species rely on coastal currents during their sensitive larval stage. Therefore, even small changes in these currents could have huge impacts on the ecological connectivity of these reefs [10]. Furthermore, the sardine fishery is the largest fishery within the Caribbean [38] and is dependent on the upwelling region off the coast of Venezuela. Changes in the sardine populations could have significant impacts on the fish and marine mammal migration patterns within this region [10].



Algal Bloom On Bleached Coral.
Photo by: © John Burns/Hawai'i Institute of Marine Biology - HIMB/NOAA

Effects of Climate Change

Food Production and Livelihood

Sea level rise poses significant threat to the livelihood of small island states since most of the inhabitants live along the shoreline. As these coastal areas continue to develop, over-development could worsen terrestrial and marine environments through introduced pollution and changing coastal dynamics leading to overall erosion [18]. There is an additional concern that limited freshwater resources could lead to sanitation and hygiene issues, increasing health risks and communicable diseases within the islands [18].

Collapse of Local Fisheries

According to AR5, changes to water quality and temperature have been predicted, with high confidence to impact species distribution and migration patterns which could have a negative impact on fisheries especially in low latitudes [18]. 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 [3]. This is not only an issue for food availability, but will also have economic impact as there are a number of fishermen on these islands which depend on fisheries to make a living.

Coastal Instability

As a large portion of these small island populations are located along the coastline, intensifying ocean activity such storm surges and sea level rise, coupled with deteriorating coastal stability through erosion could pose a significant threat to the livelihood of these populations [18]. These situations have been made worse through additional human activity such as over-urbanization and over-population, creating a situation which is unsustainable into the future.

Worsening Storms

Climate changes contribution to overall increases in ocean surface temperatures results in the increase frequency and intensity of tropical storms, particularly cyclones and hurricanes. Real life implications of this have already been seen, with the increasing number of “100-year storms”, which has devastated many Caribbean islands [1]. The degradation of wave-breaking coral reefs coupled with worsening storms will likely contribute to more storm related damages [14].

Increase in Diseases

Mosquitos pose a significant threat to human health worldwide by spreading a variety of vector-borne diseases such as zika, yellow fever, chikungunya, dengue and malaria [40]. Vector-borne diseases are responsible for over 17% of all infection diseases worldwide [40]. A warmer and more humid climate, due to climate change, could also lead to a population boom for mosquitos, increasing the risk of these diseases [12, 16].

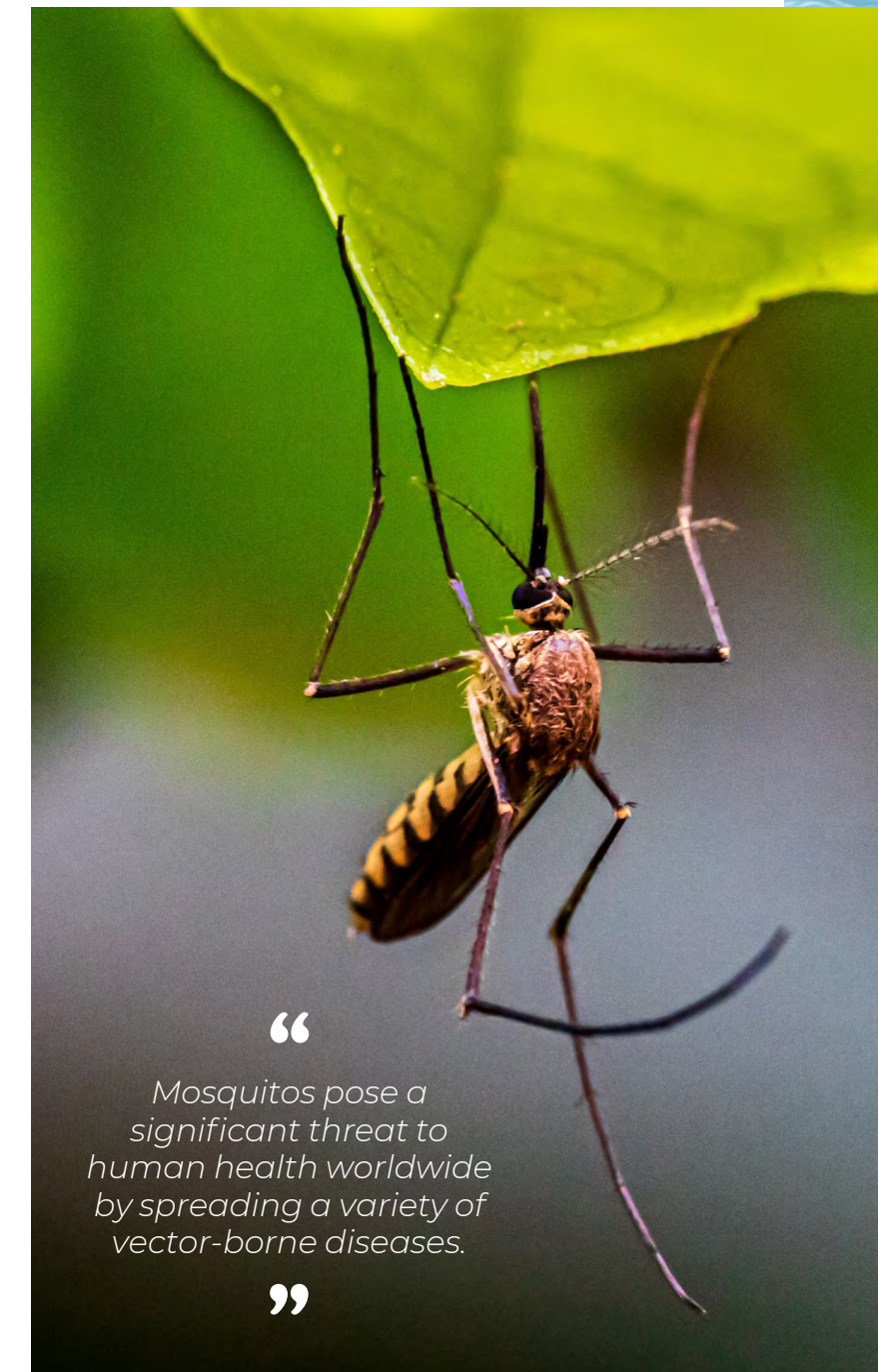
In addition, increases in air temperature can lead to an increase in cardiovascular and respiratory diseases, especially within the elderly [41]. These increased temperatures can raise the level of ozone and other pollutants, as well as pollen and other aeroallergens, further threatening individuals with weakened cardiovascular or respiratory systems [41]. Experts predict that there will be an increase in water- and foodborne infectious diseases caused by global warming. This is primarily the result of limited water and food supply and improper treatment of wastewater, therefore most of this risk can be mitigate through investment in food and water security and proper wastewater treatment [25].

Loss of Tourism

Tourism is a significant economic driver for the Caribbean, where it averages 14.8% of GDP and 12.9% of employment [1]. Climate change has already been identified as one of six mega trends affecting tourism [5]. According to the UN, a sea level rise of one meter would cause more than 29% of major resort properties in the Caribbean to be partially or fully inundated by water, while 49% would be damaged or destroyed by a combination of sea level rise and storm surge [13]. Deteriorating conditions and damage done by worsening weather patterns could devastate the tourism industry, as was experienced on St. Maarten after Hurricanes Maria and Irma in 2017.

Unfortunately, the tourism sector produces a large amount of carbon dioxide emissions [15]. This is particularly true within the Caribbean, where hotels require round-the-clock energy as visitors adapt to a much warmer climate [13]. While the Caribbean as a whole contributes less than 2% to global greenhouse gas emissions, regional emissions on a per capita level are significantly higher than the global average (USAID), with tourism mostly to blame [13].

Many tourists visit the Dutch Caribbean to experience the unique natural environments present. As these environments deteriorate further, this will surely have a negative impact on tourism. Storm surges, sea level rise, increase in wave action, and temperature extremes can damage key ecosystems such as wetlands, lagoons, beaches, and reefs; which are often principal tourism assets for the Dutch Caribbean [26].



“
Mosquitos pose a significant threat to human health worldwide by spreading a variety of vector-borne diseases.
”

Effects of Climate Change

Recommendations

Climate Proofing

An unfortunate combination of human led ecological degradation paired with the effects of climate change are now putting unprecedented pressures on the environment. The effects of climate change can cause a wide range of damaging affects which will require unique and innovative solutions to combat.

Climate proofing is the idea that through financial investment and action, changes can be made to make our environment more resilient to climate change. Through efforts of sustainability and resilience, each island can be confident that they will be able to meet the challenges of climate change for years to come. When done properly, these changes will not only make these islands more resilient, but will provide a quality of life increase for residents and visitors alike, further increasing economic and social benefits to the islands.

The 2010, the Ministry of Agriculture, Nature and Food Quality (LNV) commissioned report concluded that the most effective way for the government to mitigate losses due to climate change would be to increased efforts in land-use planning and zoning (for example: limitations on coastal development and increased reforestation) as well as terrestrial and marine conservation (for example: limiting overgrazing by free roaming animals and investment and improvement of infrastructure to minimize eutrophication of coastal waters) [10].

Climate proofing will look different for each island, as the requirements will vary depending on each island’s specific needs. However, using the four categories listed within the AR5 report, governments should be able to design their response to meet their specific needs. Climate proofing will require action across all levels, including small changes within our daily lives to larger, social changes within each island.

Adapt

The only effective way to deal with the impending changes will require some element of adapting. These changes will need to take place at every level, from individual households to entire governments. Some suggested changes could include coastal restoration, protecting coastlines against sea level rise. At a societal level, the IPCC recommends investments into safer housing and improved education [18]. They state that safer housing will make create more resilient communities and increased education can lead to creative, long-term solutions to adapt to these changes.

The IPCC report emphasizes that traditional skill sets may become increasingly important as climate change continues. Traditional methods of food production could help increase food security. Perhaps each island can see what crops were cultivated in the past to support its residents, and look at new and creative ways to continue this legacy. Traditional building methods, such as elevated floors or aerodynamic roofs to combat high winds could be integrated into newer designs to make more storm resilient houses on the islands.

The 2010 “*Climate change effects on the biodiversity of the BES islands*” report outlined a few of the key environmental policy areas which must be taken into consideration [10]. The goal is through adapting current environmental policies, the evolving needs of each of the islands can be met. These key areas of consideration have been outlined in the table below.

Key Environmental Policy Considerations

| | |
|---------------------------------------|--|
| Land-use planning and zoning | Implement Coastal Setback Policy |
| | Preserve the full diversity of habitats |
| | Preserve sufficient area of each habitat type |
| | Ensure habitat connectivity |
| Forestry and Terrestrial Conservation | Control feral grazing |
| | Reforestation and freshwater conservation |
| Marine Conservation | Eutrophication- improving wastewater treatment |
| | Overfishing |



These sentiments were also repeated in the 2017 State of Nature report which highlights a variety of areas in which policies could be put into place to protect and improve the current state of the environment. These included the need for coastal protection through spatial planning, minimizing erosion through reforestation and limiting livestock densities on land. Reefs could be improved by limiting overfishing, minimizing eutrophication and improving wastewater treatment. Overall, working to strengthen and improve interconnectivity between all ecosystems will be crucial in building a more resilient environment for the future.

Lastly, there are ways we can all adapt to help improve the areas around us. The table below highlights some of the daily changes we can make to help build a healthier more resilient environment around us. Each island offers unique opportunities to get involved, so make sure to check in with your local parks department to see what opportunities are available near you.

How you can help create a healthier and more resilient nature

Minimize Your Carbon Footprint

- Drive less
- Dry your clothes outside instead of in a dryer
- Turn off lights before leaving the house

Minimize Physical Interactions with Nature

- Don't trample seagrass
- Don't touch coral
- Don't spray pesticides on local insects

Get Involved

- Participate in beach cleanups
- Participate in reforestation projects
- Research local volunteer opportunities

Minimize Waste

- Use reusable shopping bags
- Recycle
- Say no to plastic straws and utensils

Garden

- Grow your own herbs
- Experiment with different fruits and vegetables
- Grow native plants to support local insect populations



Recommendations

Innovate

Governments will also need to explore new, innovative ideas to combat these changes. Creative solutions, such as Bonaire's AlgaePARC, could provide alternative food and fertilizer sources for the island through cultivating algae. Investment into alternative fuel sources, such as wind, wave or solar energy could help lower these island's carbon footprint while taking advantage of the unique environment the Caribbean has to offer. Researchers are also exploring alternative farming techniques through hydroponics which could allow these islands to improve food security where farming has otherwise been limited.



Educate

Perhaps the easiest and most important step is to become educated on the affects of climate change. Before any of these larger changes can be made, we must understand our role in the environments within these islands and how our everyday activity is impacting the island's ability to adapt to these changes. Climate change is inevitable, and the more we understand its impacts on these islands, the faster we will be able to implement innovative, adaptive changes into our society.

Conclusion

Although adapting to climate change may appear a daunting task, through creative and innovative actions, we all have the opportunity to make the world a better place. This is the perfect opportunity to reevaluate how we interact within our environments and find new ways to minimize our footprints and promote healthier environments. Governments now have the opportunity to reinvest in greener technologies to allow for sustainable resource allocation and promote human capital investment which will in turn improve the overall wellbeing of its residents.

Now is the time to encourage education and mindfulness within our islands. We as individuals should evaluate how we are affecting our environment, and take small steps to leave the island a little better than how we found it. We should encourage our government to consider the environment a critical economic asset, and work together to help build resilience and strength within our natural resources so that we can combat these changing conditions for years to come.



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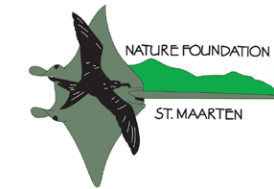
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DCNA produces "BioNews", a free monthly digital newsletter featuring recent nature related news-items about the Dutch Caribbean as well as overviews of recent publications, current research and monitoring programmes and upcoming events.

Want to know more? Check the [BioNews archive](#)

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