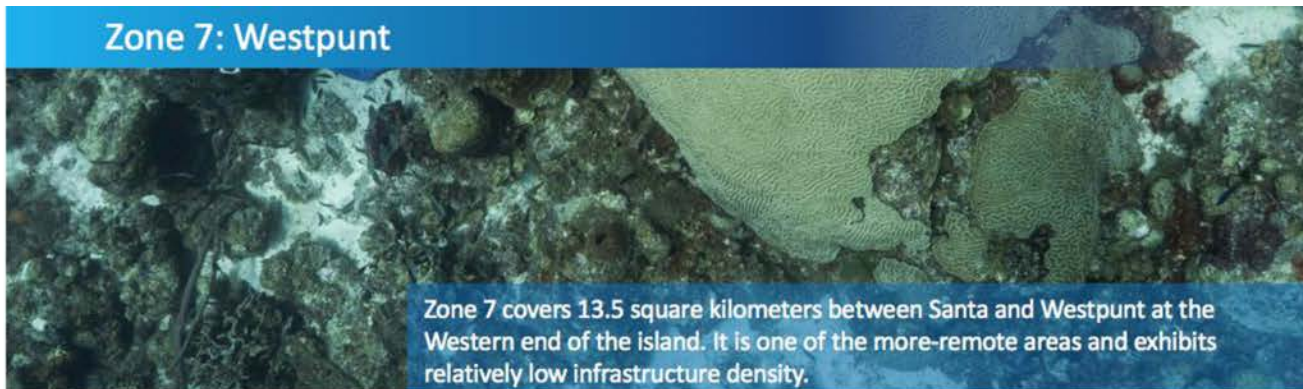


Zone 7: Westpunt



Zone 7 covers 13.5 square kilometers between Santa and Westpunt at the Western end of the island. It is one of the more-remote areas and exhibits relatively low infrastructure density.

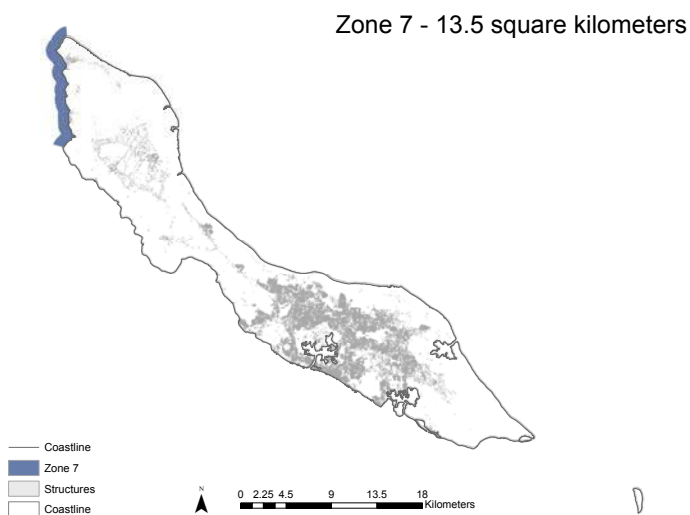
KEY FINDINGS

- Zone 7 has the highest fishing pressure and the lowest fish biomass in Curaçao.
- Similar to Zone 6, coral cover has been impacted significantly by hurricanes, coral bleaching and coral diseases.
- Trash on the seafloor is highest in Zone 7 when compared to other zones.
- Ocean use by divers is high despite its remote location.

CONSERVATION OPPORTUNITIES

- Zone 7 would benefit from management actions to reduce fishing pressure, including through enforcement of existing regulations, limited access permitting, or gear-based restrictions.
- Installation of moorings could help reduce anchor damage to reefs.
- In addition to specific fisheries management tools, modest protection could reduce physical destruction in some areas of Zone 7 and provide areas for fish stocks to increase.

CORAL	COVER	Below Average
	JUVENILE CORALS	Below Average
	CORAL HEALTH	25%
	DECLINE	29%
BIOMASS	TOTAL FISH	Very Low
	HERBIVORES	Very Low
	CARNIVORES	Low
POLLUTION	INFRASTRUCTURE	Low
	SEWAGE	Below Average
	TRASH	Highest
USE	FISHING	Highest
	DIVING	Very High



Zone 8: North Shore



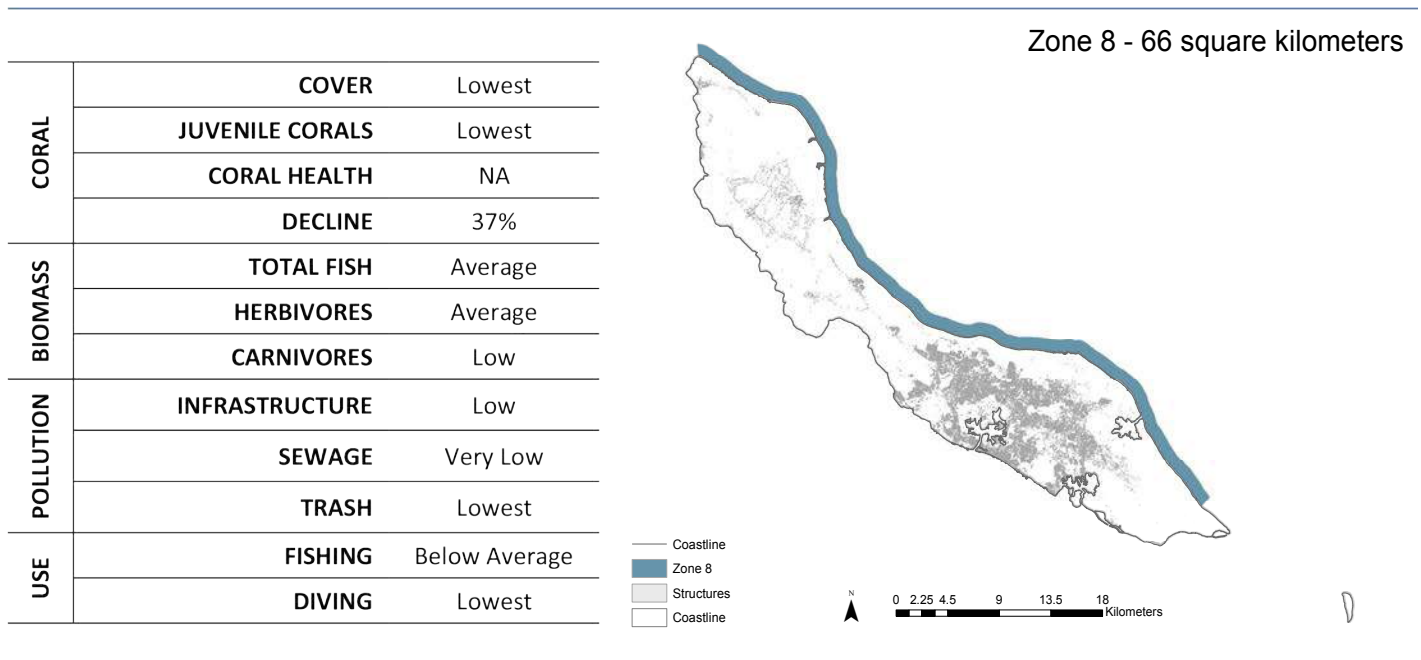
Zone 8 spans the entire North shore over 66 square kilometers. It is the largest and least used zone.

KEY FINDINGS

- Zone 8's has the most consistent and continuous shallow habitat, which is almost entirely comprised of dense sargassum covering the seafloor.
- Coral cover and recruitment are lowest in all of Curaçao in Zone 8, which is likely due to rough oceanic conditions that inhibit coral reef growth. That said, there are patches of extremely high coral cover (up to 100%) in >20m.
- Although there is little trash in Zone 8, there are dense quantities of automobile tires extending for more than 12 kilometers along the coast. The authors do not know the source of the tires or when they were deposited.
- Reports indicate ongoing illegally discharge untreated sewage in Zone 8.

CONSERVATION OPPORTUNITIES

- Zone 8 is a good candidate for protection due to its unique habitats and limited human activity from diving or fishing. It should also be a target for enforcement of sewage dumping restrictions.
- This Zone also presents an excellent opportunity for continued research to better understand if these habitats play a critical role in conserving the coral and fish communities of Curaçao due to their inaccessibility from human impact.



A path forward

The purpose of this Marine Scientific Assessment is to inform the development of a sustainable ocean policy that will improve the health of Curaçao's marine ecosystems, support coastal economies and support livelihoods. Building on this report and other assessments, the Waitt Institute developed a suite of recommendations for a Curaçao Sustainable Ocean Policy, which were submitted to the Government of Curaçao and the Curaçao Parliament in July 2016.

In designing a Sustainable Ocean Policy, Curaçao should build on the knowledge gained through this research, past scientific endeavors, and the other assessments that support Blue Halo Curaçao. When considering actions, five key approaches stand out: (1) protect and restore existing coral reef ecosystems; (2) maintain and improve Curaçao's marine-based economy, including fishing, diving and tourism; (3) minimize water pollution to support ecosystem and human health; (4) achieve coordinated and efficient governance; and (5) ensure a system of sustainable finance.

Protecting and Restoring Marine Ecosystems

Curaçao is one of the few remaining islands in the Caribbean that maintains healthy coral reef and fish populations. These include Zone 1 (Klein Curaçao) and Zone 2 (Oostpunt). Curaçao can depend on these zones as nursery areas that support reef and fish communities elsewhere on the island. These areas not only provide valuable ecosystem services to Curaçao, but are also important draws for tourism and will provide continued revenue into the future with effective management.

One key way to protect and enhance these areas and other potential sites is to establish marine protected areas (MPAs) that are “no-take marine reserves”—i.e. areas that prohibit the harvest of any species. A primary function of MPAs is to decrease the harvest of fish. Less fish harvest leads to increased abundance and size of fish. Larger fish have been proven to have exponentially more reproductive potential, meaning that with larger fish

come more fish larvae.

MPAs have been implemented around the world since the designation of the first MPA in 1935 (Gubbay, 1995). Studies of MPAs over time have revealed key factors that determine the success or failure of protected areas at achieving conservation goals. These include: (1) ensuring maintenance of ecosystems; (2) ensuring ecological connectivity between sites; (3) conserving multiple sites to ensure resilience; (4) ensuring adequate size and location to ensure viable management and enforcement; (5) protecting representative sites to support all ecosystems; and (6) maintain support for sustainable use of the marine ecosystem (GRID-Arendal 2014). Special focus in Curaçao should be given to preserving 1) nursery functions 2) existing healthy fish stocks, and 3) designating areas for recovery.

The best sites to consider for establishing no-take reserves and other types of MPAs to maintain or enhance coral reef ecosystem health are Zones 1, 2 and 3 (Klein Curaçao, Oostpunt and Caracasbaai) (Figure 15). Among these, Zone 2 (Oostpunt) is the best candidate for protection in whole or in part, because it has the highest coral cover and high coral recruitment along with low fisher and diver use. In order to maintain connectivity, specific areas in Zones 4-8 should be partially protected with a focus on those areas that maximize ecosystem health and minimize displacement of fishers and divers. Such protected areas enable connectivity and spill-over effects into nearby fishing areas. Particular areas to consider include the above average coral reefs on the western side of Bullenbaai in Zone 5 and the deeper coral areas (>20 meters depth) with extremely high coral cover (nearly 100%) along the North Shore (Zone 8), as well as other deeper coral environments in other zones. Not only will no-take zones promote the recovery of ecologically and economically important fish species, corals are also 6 times more likely to regrow after a disturbance when protected by a no-take reserve (Mumby et al. 2014). Additional sites to consider for protection are the sites home to critically endangered coral species (e.g., *Acropora* and *Montastraea* spp.) and mangrove and seagrass habitats that are important nursery habitats for a large number of reef fish on Curaçao

Potential No Take Zones

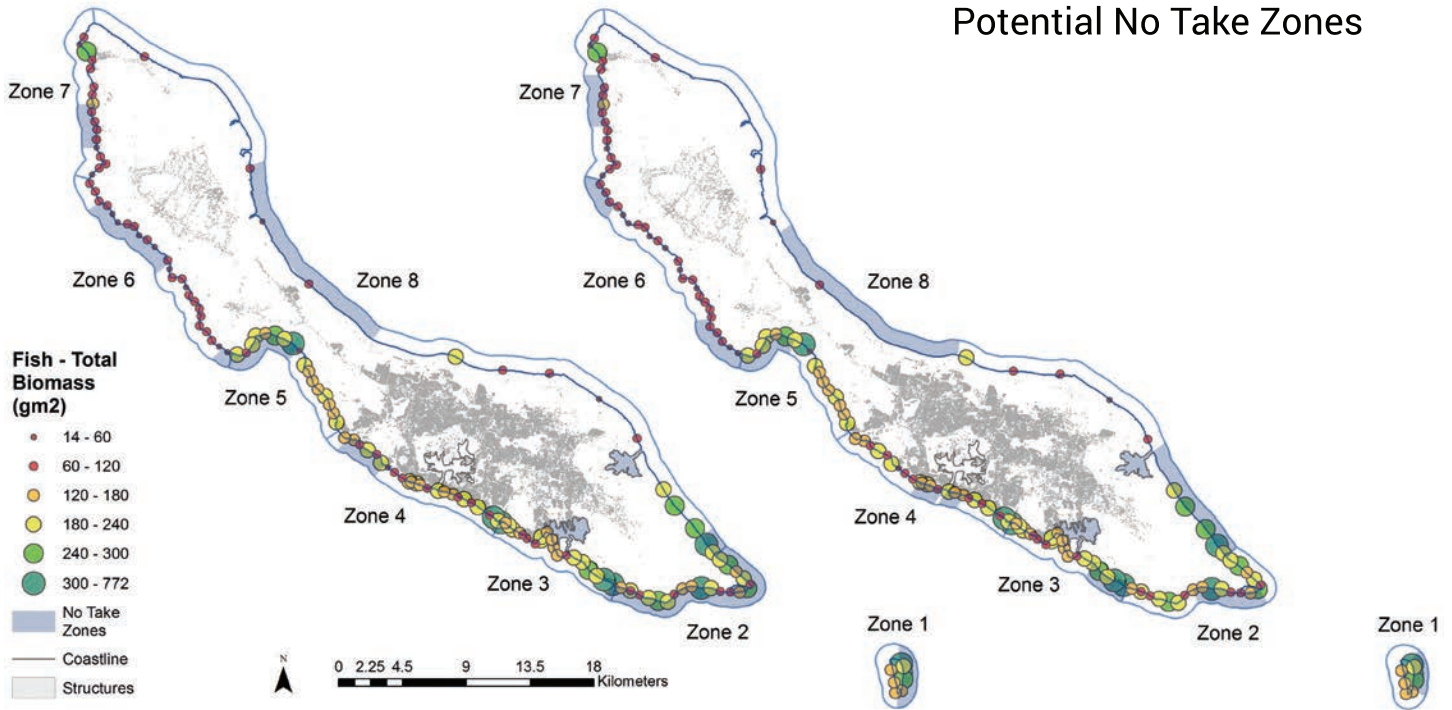


Figure 15. Potential no take zone networks around Curaçao. These plans are designed to protect nursery areas (inland bays), existing robust fish stocks, and to support impact areas as they recover. The plan on the left is optimized for protection and restoration of fish biomass and the plan on the right is optimized for the protection and restoration of fish biomass and the preservation of high value fishing and diving areas.

(Nagelkerken et al. 2000; Verweij et al. 2008).

Protecting reefs and fisheries serve as natural mechanisms to restore habitats. In addition to protection, active mitigation and restoration actions can prevent harm and help restore Curaçao's damaged habitats. Given that Zone 3 has the most diving among the eight zones, Curaçao should consider strategies to mitigate diving impact along with protection of this zone through diver education and establishment and maintenance of mooring buoys. Other types of restoration and mitigation strategies include active restoration by planting mangroves, seagrasses and corals; and removal of trash in the water and on beaches.

Improving Domestic Fisheries

Several approaches to support improvement of domestic fisheries include: protecting key stocks while ensuring ongoing access to marine resources; improving fisheries management measures related to gear usage, permitting, and other com-

mon tools; improving ecosystem, fisheries, and socioeconomic monitoring to inform adaptive decision-making; and ensuring compliance through collaboration, education and enforcement. Of particular concern for fisheries management is Zone 7, which is a high use and high value fishing zone. This zone ranks among the second lowest for fish biomass of all the zones on the island indicating severe overfishing.

Domestic fisheries in Curaçao are small in scale and fishers generally fish in specific locations. This means that while fishing is distributed across the island, place-based decisions will affect different fishers in different ways. For instance, because Zone 1 is a highly valued and utilized fishing area for some fishers and is an important site for protection, Curaçao should consider balancing fishing and protection with the use of territorial use rights for fisheries (TURFs) or other area-based licensing or fishing rights. While existing domestic fisheries permits are area-based in nature, most fishers are not required to have a permit. A more robust TURF system could help both small and

larger scale domestic fishers ensure access to resources and achieve sustainable fisheries.

Curaçao has a rich history in marine research focused on the marine ecology of Curaçao's coral reef environments. Less studied are the deep sea and pelagic habitats, as well as mesophotic reefs that exist between depths of 30 to 100 meters. In addition, fisheries data are lacking and difficult to collect with small vessels using a large number of ports over a large geographic area (Dilrosun 2002). This lack of data makes it difficult to formally evaluate fishing practices. In addition, and like most places worldwide, socioeconomic research regarding ocean use and users is lacking. To overcome these challenges, a more robust system of research and monitoring is needed to support science-based management decisions.

Unlike many small island nations, Curaçao has a substantial at-sea presence and the capacity to take strong enforcement actions. Discussed in the Legal Framework Report (ELI 2016), Curaçao could improve its ability to enforce its fisheries laws by updating certain legal provisions to enable easier enforcement. However, achieving compliance is not just about enforcement. Crucial to it is creating a legitimate system of management, educating the fishing community, and engaging fishers in management and decision-making.

Minimizing Water Pollution

Protection of Curaçao's marine environment requires maintaining existing good water quality and improving areas of poor water quality. While Curaçao should address water quality island-wide, the water quality of Zone 4 is particularly problematic as it has the highest levels of sewage among all zones. Additional data from Carmabi also indicate that other forms of waterborne pollutants are common in this area, such as fecal bacteria, antibiotic-resistant bacteria and toxic algae that can cause fish kills. Curaçao should ensure the safe disposal of human waste to reduce coastal sewage pollution, which can damage reefs and cause human disease to people swimming, diving or otherwise spend time in the ocean. Sewage should be treated instead of dumped in the ocean through one of approximately 60 dump locations between

the Seaquarium and Piscadera. Klein Hofje, the largest sewage treatment plant on the island, is currently not operational and re-opening this facility deserves the highest priority.

Like fisheries research and monitoring, water quality research and monitoring is lacking. Of utmost importance is to monitor coastal water quality for human pathogens that could cause illness to beachgoers, swimmers, divers and others in contact with the coastal environment. Such regular monitoring can help inform government where to target limited resources and inform ocean users as to where and when polluted waters should be avoided.

Improving Ocean Governance

Many nations face the challenge of having disparate government bodies managing ocean resources. Without coordination or a cohesive management system, cumulative impacts from multiple human uses and conflict among ocean users can prevent sustainable management. Two approaches can help overcome this challenge: (1) marine spatial planning; and (2) coordinated ocean governance.

Marine spatial planning is the ocean equivalent of land-use planning—using best available science and public participation, this planning approach understands existing use and the ecosystem, and develops a spatial plan to ensure long-term sustainable use into the future. This zone-based Scientific Assessment provides Curaçao with a strong starting point for the development of a marine spatial plan. It provides a baseline of the existing status of marine resources and the use of the coastal ecosystem for fishing and diving. To start, Curaçao should revisit the data, including the zone summaries, and further evaluate the site-based characteristics to determine the best path forward. This marine spatial plan should be forward-looking to minimize conflict among diving, fishing conservation, and other ocean and coastal uses; maximize ecosystem services and economic well-being of ocean users; minimize cumulative impacts to the ecosystem, including impacts from land-based sources; and ensure community well-being.

In addition to a marine spatial plan, Curaçao would benefit from coordinated inter-ministerial collaboration. Already it has formed the Blue Ribbon Committee to support Blue Halo Curaçao, which includes civil servant representatives from most of Curaçao's ministries. Formalization of this Committee to guide Blue Halo Curaçao would be a strong step in the direction of enabling more informed and efficient decision-making.

Financing a Sustainable Ocean Policy

In conclusion, these approaches mean little without the necessary funding to implement them. Long-term financing of sustainable ocean management requires a multi-prong approach including two major elements: (1) the use of taxes, fees, and fines to support ocean management; and (2) the creation of a dedicated fund to ensure that those taxes, fees and fines support ecosystem management and are not diverted for other government purposes.

Given that tourism is a crucial part of Curaçao's economy and relies heavily on the health and aesthetics of Curaçao's ocean ecosystems, Curaçao should identify opportunities to impose reasonable taxes and fees on island visitors. Such taxes and fees should target cruise-ship passengers, divers, snorkelers, and non-resident recreational sport-fishers, as well as fees accompanying hotel stays.

Other fees should come from those adversely impacting marine resources as part of a mitigation framework. For instance, developers who injure coral reefs, mangroves or seagrass beds should pay the cost to restore those injuries to the condition that would have existed had the resource not been injured. Such an approach will help prevent further loss of valuable resources and put the cost in the hands of those who gain from the impact.

Finally, fines from illegal activities should also support management and enforcement. Fines relate to (1) illegal activities such as illegal dumping or illegal fishing and (2) accidents such as accidental oil spills or other harmful discharges into the marine environment.

Closing Note

Curaçao is at an exciting and important milestone as it embarks on a path to improve the well-being of its human and marine communities through improved ocean governance. The purpose of this assessment is to inform the development of a Sustainable Ocean Policy and is part of a larger body of research including community consultations, an analysis of Curaçao's legal framework, and an economic valuation of Curaçao's marine resources. As such, this Report and the Waitt Institute's recommendations for a Sustainable Ocean Policy mark an important milestone for the Blue Halo Curaçao partnership.

The opportunity presents itself to preserve existing functional marine ecosystems and to improve damaged resources to maximize the benefits that Curaçaoan's derive from their ocean now and in the future. In doing so, Curaçao has the opportunity to become a leader in ocean conservation by protecting and improving some of the best remaining coral reef communities left in the Caribbean for the benefit of its people of and the greater Caribbean community. Sustainable resource management will require tradeoffs that balance short-term and long-term gains that benefit not only the ecosystems, but also the local communities and economies. Cooperative and efficient compromises between ocean stakeholders and the government will be necessary from both sides and will lead to greater efficiencies in recovery.

Significant challenges exist and must be overcome to reverse the damages that have been done to coral and fish communities. Fortunately, Curaçao is actively taking the steps to cultivate a culture that safeguards its ocean resources for the benefit its people now and into the future. It is a testament to the priorities of Curaçaoans that they actively seek to know and protect their ocean to preserve their way of life. The Waitt Institute looks forward to continuing to support the Blue Halo Curaçao partnership as it works towards the development and implementation of a sustainable ocean policy.

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