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## Capstone Papers

### **Title**

More Than a Paper Park: Designing a Management Plan for Curaçao's Fish Reproduction Zones

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### **Author**

Shabo, Carly

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# *Designing a Marine Management Plan for Fish Reproduction Zones of Curaçao, Lesser Antilles*



Carly Shabo  
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Submission for Master of Advanced Studies-Marine Biodiversity and Conservation  
Scripps Institution of Oceanography, UC San Diego

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*Reef-fish in Oostpunt, Curaçao*

## 1. Summary:

This document provides a brief report of activities conducted as part of the final capstone project for submission to Scripps Institution of Oceanography's Master of Advanced Studies graduate degree program in Marine Biodiversity and Conservation. The project: *Designing a Marine Management Plan for Fish Reproduction Zones of Curaçao, Lesser Antilles*, was completed with the support of the Waitt Institute, CARMABI Institute, and Curaçao's Ministry of Health, Environment and Nature. It was drafted using successful previous management plans as a reference and was edited and finalized after site visits and stakeholder engagement. The Fish Reproduction Zone Management Plan will be submitted to the Ministry for consideration as well as submitted with this report for review and evaluation by the Capstone Advisory Committee.

## 2. Background:

Curaçao, a lesser Antilles Island located in the southern Caribbean Sea, is well known for its clear blue waters and white sand beaches. In recent years, Curaçao's reef fish stocks have declined due to commercial fishing, habitat destruction, invasive species, and pollution.

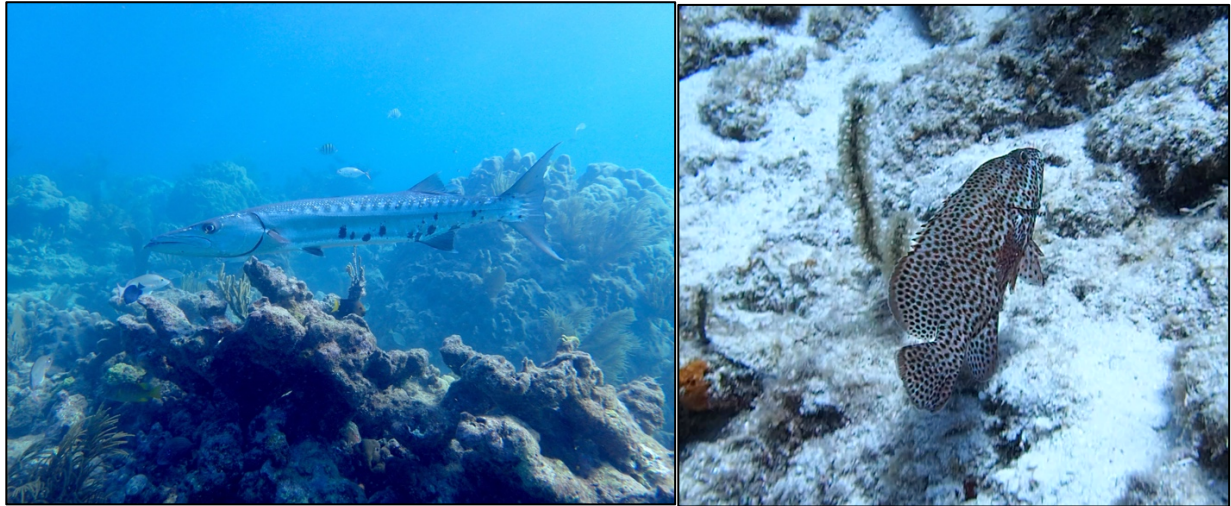


*Coral rubble and marine algae growth in the proposed Westpunt FRZ (left) and recreational fishing vessels off of Playa Piscado, Westpunt (right)*

In order to effectively manage the marine resources, a plan was needed for the six soon-to-be designated Fish Reproduction Zones (FRZs) to ensure sustainability through effective management, compliance, and enforcement. These Zones, first proposed by the Government of Curaçao in 2011 and passed by the Council of Ministers in December 2018, are designed to protect fish stocks from exploitation and to promote the overall ecosystem recovery through undisturbed reef fish reproduction (Flower et al., 2018).

The high ecological value of these resources, and the importance of the fish nurseries, adult habitats, and spawning grounds found within the proposed marine protected areas (MPAs), illustrate the need for this type of protection (LVV, 2003). It has been proposed that closure of areas where spawning occurs could enhance fishery yields and improve exploitable biomass through increased fish body size (Gell, 2003). Although the main economic drivers in Curaçao surround the oil refineries and tourism industry, there is a small commercial fishery as well as significant subsistence fishing along the leeward coast (CIA, 2019). Even though the size of the fishing fleet is limited, and has declined in recent years, fishing pressure has remained extremely

high (Vermeij, 2012). The two major fisheries found within Curaçao's waters include a troll fishery that targets pelagic fish and a reef fishery that targets demersal reef species (Kraan, 2017). The top species landed through the troll fishery (wahoo) and reef fishery (barracuda, grouper, and snapper) all could benefit from a designated reserve to replenish stocks (Kraan, 2017). The troll fishery accounts for the majority of landings reported and would not be heavily impacted by the implementation of the nearshore FRZs (LVV, 2003).



*A barracuda (left) and grouper (right) found within the proposed Oostpunt Fish Reproduction Zone*

This management plan will work to reverse the rapid decline of key reef fish species and allow for their returned contribution to a healthy overall coral reef ecosystem. Fish Reproduction Zones (FRZs), a type of MPA, are a widely used management tool in fisheries due to their potential to increase fish abundance both in and outside the zone (Gell, 2003). Increased abundance due to the implementation of a MPA can, in turn, improve the biological and economic value of the area (Gell, 2003). This type of MPA is considered an economically efficient solution to maintaining sustainability of marine resources when managed and enforced effectively (Spiegel et al., 2004). For the purpose of this project, I created a feasible plan that can be implemented to manage the soon-to-be designated FRZs found along the Curaçao's coastlines and improve the marine ecosystem as a whole.

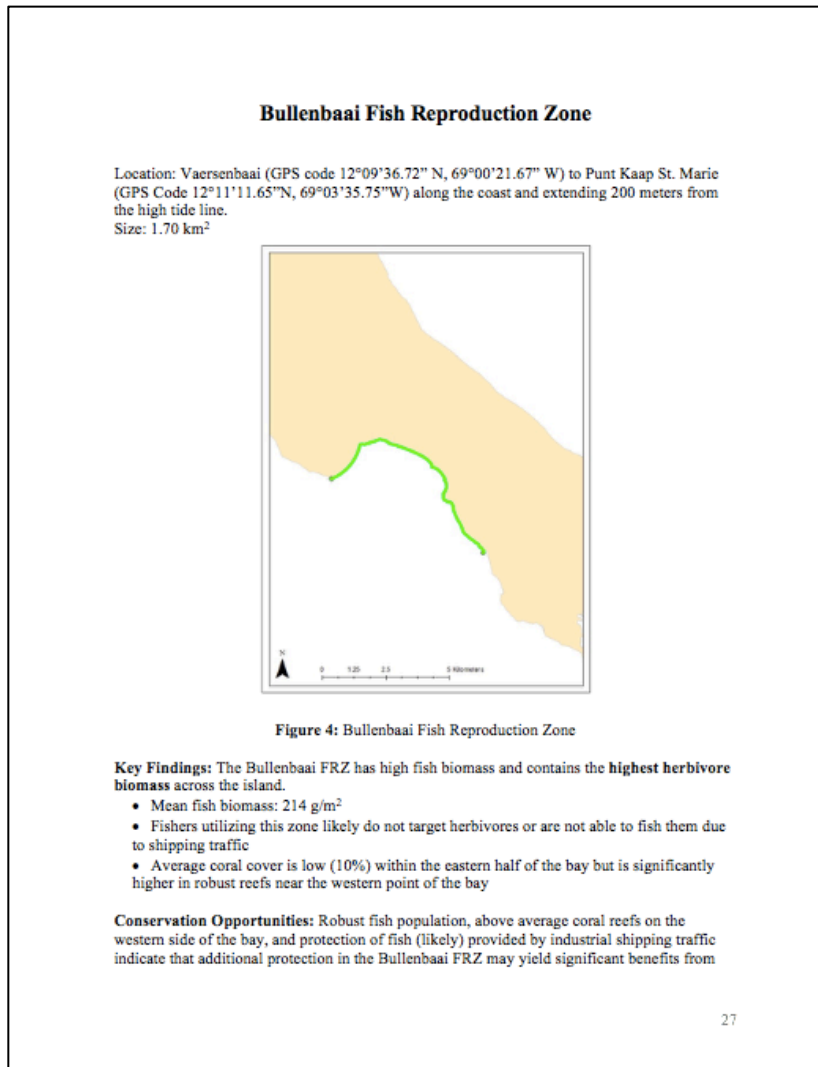


*Fish schooling within the proposed Westpunt Fish Reproduction Zone*

### 3. Methods:

#### 3.1 Pre-field Work:

In order to create this management plan, an initial draft was created using previous Caribbean MPA Management plans as a reference. These plans were collected in a literature review and effective components were noted and included in the plan I created. This draft, which was edited and approved by my Capstone Chair, was then used as a base to engage stakeholders once I arrived in Curaçao. Included in this document is a table that encompasses justification of the management actions I proposed. This table, which incorporates examples from around the world of MPA successes, strategies utilized, and the timeframe in which results were noted, was an aspect that the Ministry on Health, Environment, and Nature (GMN) found helpful to ensure continued support from local people for the implementation of FRZs. Additionally, Zone profiles and maps were created using ArcGIS software to highlight the specific problems each zone faced, and how the establishment of FRZs could mitigate those threats.



*Excerpt from the Fish Reproduction Zone Management Plan, Section 4: Fish Reproduction Zone Locations and Characteristics, Bullenbaai Fish Reproduction Zone Profile*

Finally, the rules/regulations and objectives and strategies for management are highlighted in clear, concise lists and tables so that they can be quickly summarized and distributed to resource users in Curaçao.

<p><b>(a)</b></p> <p><b>Objective 3</b> Maintain effective surveillance and enforcement that reduces illegal activities.</p> <p><b>Table 6</b></p> <table border="1"> <thead> <tr> <th>Action</th> <th>Leading Authority</th> <th>Priority</th> </tr> </thead> <tbody> <tr> <td>3.1 Train appropriate members with regard to nature conservation to build capacity for enforcement</td> <td>GMN MVJ- Coastguard</td> <td>High</td> </tr> <tr> <td>3.2 Patrol each site regularly, but not on a predictable schedule, to ensure compliance. More accessible Zones (Westpunt, Bullenbaai, Willemstad, Spaarnc Water) should be patrolled at least two times per week</td> <td>MVJ- Coastguard</td> <td>High</td> </tr> <tr> <td>3.3 Advise enforcement efforts through media</td> <td>GMN</td> <td>Medium</td> </tr> <tr> <td>3.4 Provide the framework for citizens to report violations</td> <td>GMN</td> <td>Medium</td> </tr> </tbody> </table> <p><b>Objective 4</b> Increase awareness and understanding of rules, importance, and management.</p> <p><b>Table 7</b></p> <table border="1"> <thead> <tr> <th>Action</th> <th>Leading Authority</th> <th>Priority</th> </tr> </thead> <tbody> <tr> <td>4.1 Inform the public of rules and regulations through printed and web-based guides (available in multiple languages through tour companies, dive shops, information booths, permit offices, etc.) and/or signage at FRZ entry points (docks, boat launches, beaches, etc.)</td> <td>GMN</td> <td>High</td> </tr> <tr> <td>4.2 Information regarding the FRZs must be available at landing sites to inform fishermen of rules and regulations and updated results of the FRZs overtime with information provided through the monitoring program</td> <td>GMN</td> <td>High</td> </tr> <tr> <td>4.3 Raise awareness and develop a regular education schedule (in schools and to stakeholders) regarding: <ul style="list-style-type: none"> <li>The objectives of the FRZs as stated in management plan</li> <li>The boundaries of the FRZ</li> <li>The proposed benefits of the FRZ</li> <li>The consequences/penalties for not acting within the regulations</li> </ul> </td> <td>GMN CARMABI-MNE program</td> <td>Medium</td> </tr> </tbody> </table>	Action	Leading Authority	Priority	3.1 Train appropriate members with regard to nature conservation to build capacity for enforcement	GMN MVJ- Coastguard	High	3.2 Patrol each site regularly, but not on a predictable schedule, to ensure compliance. 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This activity is highly regulated and is only permitted within certain areas within the FRZs with guidance and permission from leading authority agencies.</li> <li>Stock replenishment of other species (such as <i>Strombus gigas</i>) through aquaculture or other means is permitted with appropriate permits. This activity is highly regulated and is only permitted within certain areas within the FRZs with guidance and permission from leading authority agencies.</li> </ul> <p><b>Other:</b></p> <ul style="list-style-type: none"> <li>Maintain a respectful distance to wildlife. <ul style="list-style-type: none"> <li>Interacting with marine life should not be attempted. Activities that involve closely approaching and interacting with marine mammals and sea turtles in the wild are prohibited. This includes attempting to swim with or feed these animals.</li> <li>Wildlife must not be fed as it can disturb their natural feeding patterns.</li> </ul> </li> <li>The introduction of foreign species, plants or animals, is forbidden.</li> <li>Litter and waste of any kind can be hazardous for wildlife and must not be disposed in the FRZs at any time.</li> </ul>
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*Excerpts from the Fish Reproduction Zone Management Plan, Section 5: Management Plan Objective 3 and 4 and Recommended Action, Leading Authority, and Priority Level (left) and Rules and Regulations for the FRZs (right).*

### 3.2 Field Work:

#### Stakeholder Engagement:

In order to effectively edit and complete my management plan, I met with various groups on Curaçao. Under the direct guidance of the Waitt Institute's site manager, Endirah Palm, and Faisal Dilrosun of the Ministry on Health, Environment, and Nature (GMN), I attended meetings and discussed the initial draft with representatives from the Ministry of Traffic, Transport, and Urban Planning (VVRP) and the Ministry of Economic Affairs. Mr. Dilrosun worked with me to clarify the language within the document and helped me to better understand the regulations his ministry intended to see within the document. His extensive knowledge of Curaçaoan regulations helped to edit the final document to better reflect a feasible and reasonable plan for implementation.

I also consulted on enforcement and permitting issues with members Maritime Authority, the Harbormaster, the Harbor Safety Offices, and the Dutch Caribbean Coast Guard. Additionally, I met with non-profit groups including Uniek Curaçao and the Sea Turtle Conservation Curaçao, as well as Curaçao's Tourism Board and a recreational fisherman, to better understand the desires of the local people. I discussed the level of enforcement of marine laws

currently, and what was needed to heighten enforcement as new regulations are implemented. We discussed feasibility, both in regard to availability of personnel and budgetary constraints, current education efforts regarding marine conservation, and legal and illegal fishing hotspots and methods.



*Stakeholder Engagement Meetings in Curaçao with Faisal Dilrosun of the Ministry of Health, the Environment and Nature and Miriam Yonker of Traffic, Transport, and Urban Planning (left-photo by Endirah Palm) And the Dutch Caribbean Coast Guard (right-photo by Mark Danielson)*

While I expected the meeting with the fisherman to be the most contentious, as I intended to discuss severely limiting take in the Fish Reproduction Zones, it was actually extremely pleasant. Edwin Koense comes from a long line of recreational fishermen and he has fished his entire life. He showed me hundreds of photos of fish he had caught over the years as he revealed his concerns over the number of fish and the size of fish he had been catching recently. He noted that he now has to go much further (usually to Bonaire) to catch the fish he used to be able to obtain just offshore, and the fish he was able to catch nearby were much smaller than they used to be. Overall the message from all of my meetings was the same: the fish were disappearing, and everyone is concerned.

#### **Site visits:**

Additionally, I attempted to visit each proposed Zone to assess its condition. I received a scientific assessment from Waitt of various locations around Curaçao but wanted to see each site for myself to view the included ecosystems as well as its current usage. This assessment helped to inform the justification behind protection of each Zone and their various habitats and levels of degradation. In the end, I was able to visit all but one Zone, the Noord FRZ, as it is on the windward side of the island and most boats do not venture there due to “sporty” boating conditions. I was able to view the Noord FRZ from land to confirm it was a lesser-used area and I did successfully snorkel or dive the remaining 5 proposed Fish Reproduction Zones.





*Site visits to proposed (a) Oostpunt Fish Reproduction Zone (b) Westpunt Fish Reproduction Zone*

When I returned from Curaçao, I used the information gained from the site visits and stakeholder meetings to finalize the management plan to the satisfaction of my Committee and Mr. Dilrosun of GMN.

#### **4. Challenges:**

Producing a Management Plan that satisfied the ecological needs of the Curaçaoan waters and the social needs of the people was the most challenging component of the project. While a no-take reserve was the original intention, a compromise had to be reached to allow for the continuation of a long standing tradition of beach seine netting for “bigeye scad.” Without this exception, local buy in to the new regulations would be extremely low and it jeopardized the project moving forward. For that reason, the plan forbids all fishing except for this low impact form (with all necessary governmental permits). In reality, I expected significantly more challenges getting all stakeholders to agree that fishing needed to cease in these waters. Every group that I met with agreed that the number of fish present in Curaçao’s waters was dangerously low, and something drastic needed to be done to solve the issue as soon as possible.

#### **5. Deliverable:**

The defined end product for this project was a management plan for the Fish Reproduction Zones that is submitted to the Ministry of the Health and the Environment for consideration. The document produced includes background on the justification of establishing limited-take zones, the value of conservation of these Zones, threats and issues faced in these areas, locations and characteristics of each zone, and the management plan itself.

The Management Plan intends to provide guidance for the implementation of Fish Reproduction Zones. It contains management objectives and specific strategies and actions to achieve each objective as well as the overall goal of the sustainable use of Curaçao’s marine resources within the Fish Reproduction Zones. The general objective, the maintenance of marine resources and habitats in the Fish Reproduction Zones is promoted to ensure a viable ecosystem for current and future generations, can be achieved through the following objectives:

1. Provide the institutional framework for management by legally naming and signing Fish Reproduction Zones into law.

2. Halt the degradation of habitats and promote maintaining current or increasing levels of fish abundance
3. Maintain effective surveillance and enforcement that reduces illegal activities.
4. Increase awareness and understanding of rules, importance, and management.
5. Ensure management strategies can be adapted over time.
6. Ensure adequate and sustainable financing for implementing the Fish Reproduction Zone Management Plan long-term.

Specific rules and regulations, as well as a monitoring strategy is included within the management plan to ensure the plan can adapt in changing conditions. Additionally, background information on the physical and biological characteristics was included as an appendix to support the rest of the document. The management plan, totaling 51 pages has been reviewed by my Capstone Advisory Committee, as well as a Senior Advisor of the Ministry on Health, Environment, and Nature.

#### **6. Target audience:**

The goal of this project was to create a management plan to be approved by the Waitt Institute and Faisal Dilrosun, a Senior Advisor on Health, Environment and Nature, and submitted to the Ministry of GMN. Currently, the Fish Reproduction Zones are approved by Curaçao's Council of Ministers, but the legal adoption of this MPA is still dependent on receiving one final ministerial signature. This management plan can help clarify the goals of the MPA and may allow the legislation to pass.

#### **7. Acknowledgements:**

The Fish Reproduction Zone Management Plan could not have been produced without the support of the Scripps Institution of Oceanography MAS-MBC staff and my Capstone Advisory Committee. Additionally, I would like to thank Faisal Dilrosun of GMN who's invaluable insight informed much of the final document. I am grateful to Endirah Palm, the Waitt Site Manager from Blue Halo Curaçao, for setting up the stakeholder meetings and the Curaçaoan individuals that took the time to meet with me to workshop the draft document. All photos in this document are taken by me unless otherwise noted.



*A seagrass bed within Curaçao's Fish Reproduction Zones*

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