Enforcement Recommendations for the Barbuda Blue Halo Initiative

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Introduction

This document provides recommendations to support the draft Sustainable Coastal Policy developed by the Barbuda Council, local stakeholders, and other relevant parties with the support of the Waitt Institute. The Blue Halo concept is a comprehensive ocean zoning and sustainable fisheries management approach that makes use of scientific data, substantial feedback from the community, and optimization to maximize environmental benefit while minimizing negative impact to fisheries and the economy. The proposed zones are the outcome of several months of consultations with stakeholders, modifying boundaries based on feedback and obtaining buy-in along the way. This community engagement is the first step in effective monitoring, control, and surveillance of marine sanctuaries and other enforceable zones. This report outlines technology tools and process recommendations to maximize the success of implementing the proposed plan. The aim of the report is to provide a discussion framework for monitoring and enforcement planning to meet the goal of the Initiative: sustainable, profitable, and enjoyable use of ocean resources, for this and future generations.

The report focuses on enforcement needs associated with the draft plan agreed upon by the Barbuda Council on December 4th, 2013. This plan focuses on zoning for the coastal waters, within 1 league (3.45-miles) of the shore of Barbuda, where the Council has management authority. The plan includes 6 sanctuary zones (areas closed to all fishing, with the lagoon sanctuary opening after an amount of time defined by the Barbuda Council), 4 mooring/anchoring zones, and 4 no-net zones (3 coastal areas, and all reef with a 20 meter buffer around it). The boundaries of these zones have been straightened (for ease of compliance and enforcement) since the October version and that is reflected in this paper. This report describes these zones in detail, with a focus on applicable key enforcement technologies, and how enforcement challenges can be addressed. The resulting recommendations are provided along with the accompanying costs and personnel demands.

These draft zones are at an advantage for enforcement as they are coastal and do not extend far off shore. This simplifies enforcement challenges substantially and creates an opportunity for solutions that are lower in cost and complexity as a result of the short range from shore required. There are a number of technologies that were omitted as a result of cost, complexity, or institutional needs, but which can be reconsidered in the future as enforcement resource and capacities evolve.

Ocean Protection Through Technology

Typically, technologies that can be used for Monitoring, Control, and Surveillance (MCS) purposes and other illegal fishing mitigation can be divided into the following categories: information technologies (databases and the

internet), platforms (like aircraft or vessels), and sensing equipment (radar, acoustic, space-based, etc.). The purpose of these technologies is primarily to help in the detection, data transmission, and management of information pertaining to ocean uses. Detection technologies are the sensors and other equipment that allow for monitoring, either cooperatively or non-cooperatively, of fishing activity. Cooperative detection technology is equipment that can be electively placed upon fishing vessels to report status and location for better fisheries management (things like low-cost VMS). The non-cooperative version is undetectable or unpermitted observation technologies that can help to identify those who do not want to be found or are not participating in cooperative methods. Data transmission technologies are the communication channels that allow for the information that is detected to make its way to the appropriate sources. Finally, the information must be collected, compiled, and managed in a way that promotes improvements in management, allows stakeholders to take targeted action, and provides legally admissible evidence.

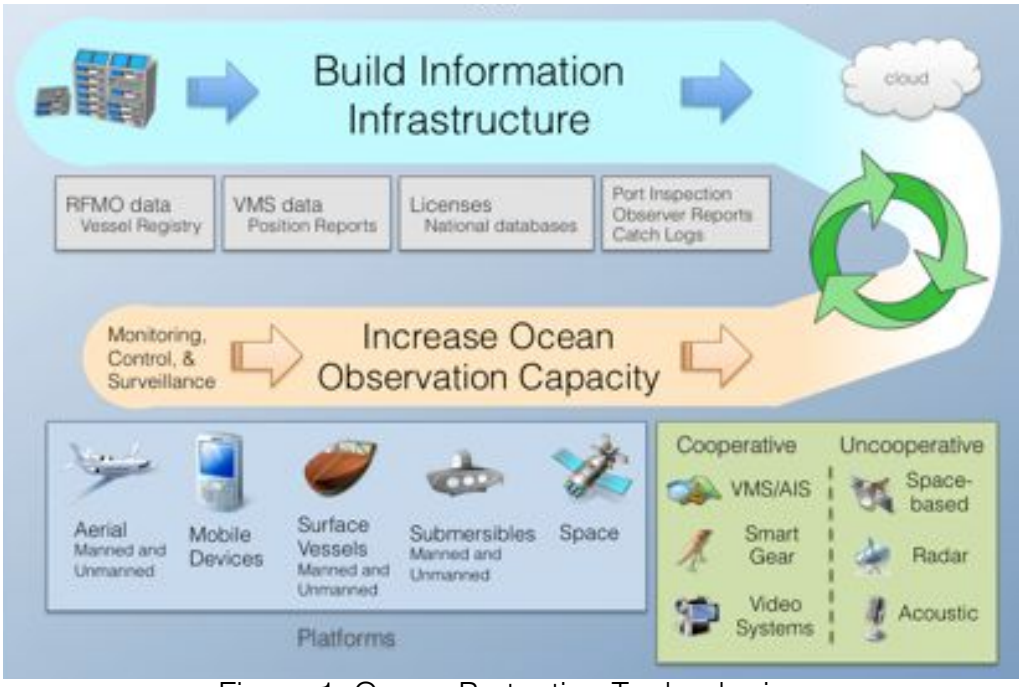

Figure 1: Ocean Protection Technologies

There are a number of technologies that can enable MCS and enforcement make better use of resources. Strictly speaking, there is no single, perfect technological solution to stopping illegal fishing. A combined approach is required. This report evaluates potential enforcement options and makes recommendations for Barbuda in support of current fisheries policies and the Blue Halo Initiative.

Current Barbuda Capacity

In terms of enforcement capacity, the island of Barbuda is currently limited in the efforts they can take for the surveillance and protection of their coastal waters. As is currently outlined in the laws, the Fisheries Division and the Antigua and Barbuda Defence Force (ABDF) Coast Guard are responsible for enforcement of fisheries regulations, as well as patrolling EEZ waters to prevent illegal fishing by foreign vessels. There also exists the potential for supplemental

monitoring and enforcement support from the staff members at the Codrington Lagoon National Park, who are tasked with management and protection of the lagoon areas (particularly in the protection of the lagoon sanctuaries – this will be outlined in greater detail in the sanctuary section below). Any police action that would be required would need to be coordinated with the Royal Police Force on Barbuda, as they are the only armed presence and they maintain the sole holding cell on the island. Any arrest that occurs generally places the assailant in that cell until they are transferred to Antigua by plane or boat for prosecution.

The twin-island nation of Antigua and Barbuda currently relies primarily on the Antigua and Barbuda Defence Force (ABDF) to provide Coast Guard capabilities for both islands. The ABDF Coast Guard is currently headquartered on the island of Antigua, located at the St. John's Deep Water Harbor, with additional bases at English Harbor and Camp Blizard. There exists no permanent Coast Guard presence on Barbuda, although Antigua and Barbuda is in ongoing discussions with the U.S. government regarding potential U.S. support for establishing a base on Barbuda. Currently, coast guard patrols slated for Barbuda leave out of Antigua (a 45 minute trip with the current flotilla performance), and occur only once or twice a month.

The ABDF Coast Guard has approximately 65 individuals on its roster (officers, engineers, etc.) with the current patrol plan allowing for a single crew to be on the water each day. The rest of the staff is spread amongst the operations center and other sustainment tasks, which leaves that single patrol as their current on-the-water support. The operations center, as it is currently configured, requires significant personnel to support its 24 hours a day operation. The center's primary focus is on operations planning and support for patrol and search and rescue. The resources, as they are currently configured, would not allow for patrol of Barbudan waters at any greater frequency than bi-monthly.

The ABDF Coast Guard maintains a fleet of five vessels, all of which were donated by the United States to help primarily in counter-narcotics operations. The largest vessel, the Liberta, is a 65-foot all-aluminum vessel with two diesel engines that came from Swift ships of Morgan City, Louisiana. It was during our meetings with Commander Nicholas that we found out that this vessel was currently dry-docked, in need of $1.5 million ECD worth of repairs. The next largest vessel is the Palmetto, a 40-foot aluminum hull boat in good working order. This vessel is a favorite of the people of Barbuda, as it is named after a landmark on the island and has been used in Barbuda under special circumstances in the past (as in March 1996, when Princess Diana and her two sons visited the K-Club resort). There are also two 22-foot Boston Whaler "Guardian" boats which arrived in the late 1980s under the U.S. Military Assistance Program, equipped with 155 HP outboard motors and radios, towing, and navigation equipment. The remaining vessel is a Rigid Hull Inflatable Boat (RHIB). There were reports of two additional 33-foot fast interceptor vessels given as a part of the Caribbean Basin Security initiative (CBSI) – Secure Seas Programme but it is unsure if they are in use by the Coast Guard at the moment. Maintenance seems to be a persistent challenge, with resources constraining the number of vessels that are in patrol-ready status.

Per ABDF documentation, Coast Guard responsibilities include assisting in the inspection of domestic fishing vessels for licensing, training of fishers

(basic navigation, distress response, engine maintenance and repair, etc.), and environmental monitoring and research. However, the majority of Coast Guard effort (~80%) is spent doing random drug interdiction patrols in Antiguan and Barbudan waters. Coast Guard is also responsible for enforcement of fisheries regulations, and they work with the Fisheries Division of the Ministry of Agriculture to do so. The majority of this effort is spent in the search and recovery of missing fishing vessels and crew in distress at sea. This occurs fairly frequently as a result of fishers pushing the capabilities and fuel load of their vessels beyond the safety margin to extract more fish. There has been very limited success in illegal fishing interdiction, with the focus on catching foreign fishing vessels specifically as opposed to internal compliance to regulations. The Coast Guard also works with the Environment Protection Unit of the Ministry of Tourism, although this has mostly focused on enforcement of the Maritime Act and spot-checking for illegal sand mining.

Additionally, there is a reserve force within ABDF that can provide some added capacity, and there are volunteer organizations (mostly within the yachting community) that could potentially offer additional eyes on the water if engaged correctly. One of these organizations is Antigua & Barbuda Search and Rescue (ABSAR - www.absar.org) that operates out of Falmout Harbor in Antigua. They operate 24-hours a day all year long and operate two vessels, one of which is an impressive Protector 28 vessel that was previously used during the London Olympics. There is also a (currently inactive) “Sea Warden” program on Barbuda that focuses on citizen advocates, which will be explained later.

Coordination of enforcement efforts between Coast Guard, Barbuda police, Fisheries Division, Lagoon Park, and the Barbuda Council is critical to success.

Barbuda Blue Halo

Each of the sanctuaries offers unique challenges in regards to accessibility (both by land and by sea), size, habitat, and enforceability. These will be outlined for each individual sanctuary, followed by an island plan, and the technologies that can be employed to ensure successful enforcement. Considerations regarding the planning of the patrols and personnel will be covered once the technology baseline is set. Additionally, some thoughts about the cooperation that those on Barbuda can have with the ABDF Coast Guard and the police will be covered to ensure success of the sanctuaries.

The recommendations covered here result from a field assessment conducted during a visit to Barbuda in early October 2013. Consultations with Coast Guard Commander Nicholas, Codrington Lagoon National Park staff, Fisheries officials, and local fishers provided data essential to evaluation of the most effective options for protecting these waters. Many of the recommendations were discussed with key stakeholders on Barbuda, and some of the recommendations originated from stakeholders.

Figure 2 (below) illustrates the island-wide zoning plan, providing an overall orientation prior to detailed descriptions of the enforcement considerations for each individual sanctuary.

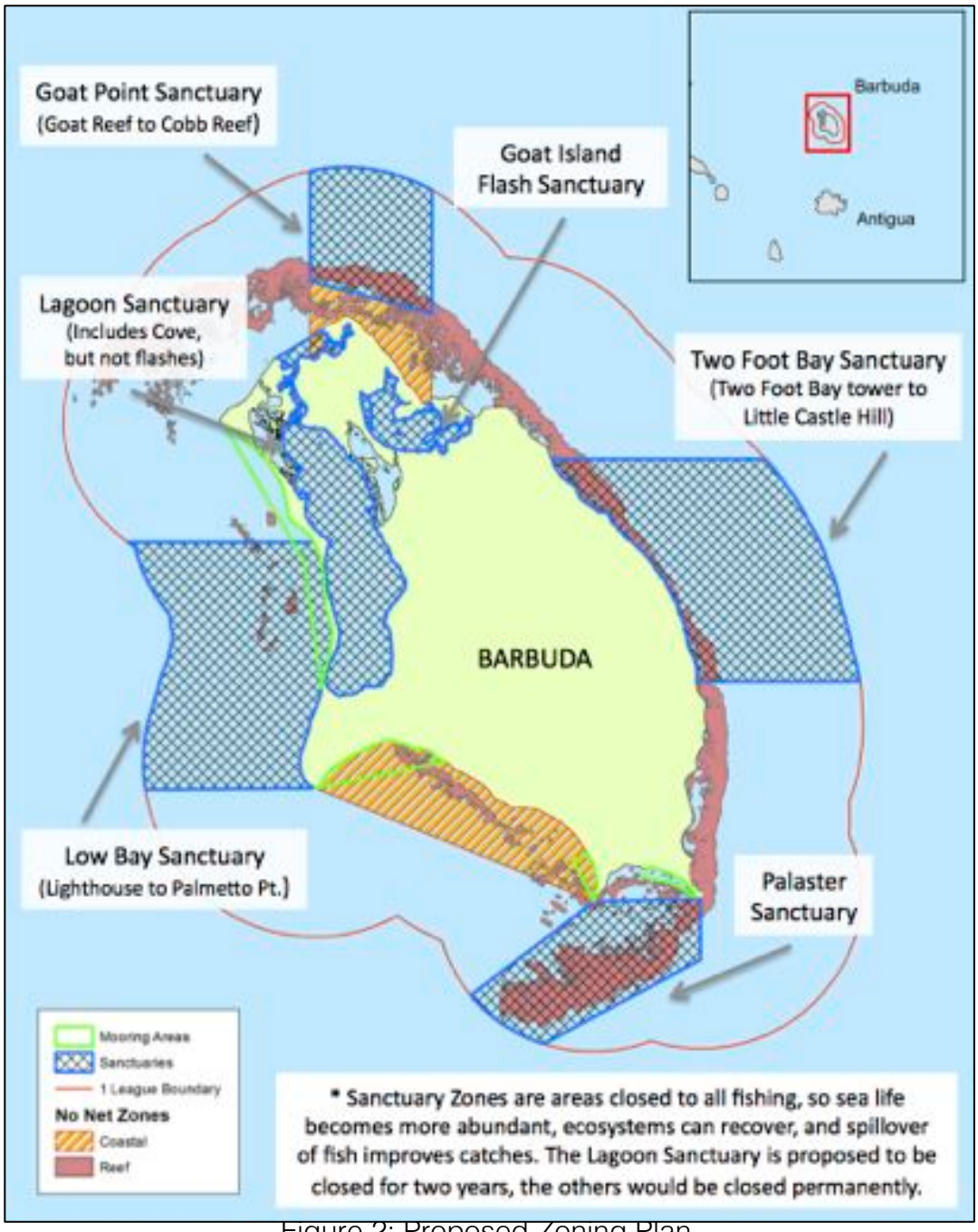

Figure 2: Proposed Zoning Plan

Lagoon Sanctuary

The Codrington Lagoon is a large (approximately 6-miles long and 1.4-miles wide) wetland lagoon that is open to the ocean through an inlet "Creek" at the north of the island. This mangrove and sea-grass ecosystem provides habitat for juvenile fish and lobster, as well as a sanctuary for the Magnificent Frigate birds. Access into and out of the lagoon by boat, and access to the Fisheries Complex in Codrington is achieved through Creek. The western boundary of the lagoon is a fairly narrow sandbar that houses Guiness' Barbuda Outback and Lighthouse Resort. The entirety of the lagoon is part of Codrington

Lagoon National Park (CNLP), which was established legally in 2005 and achieved RAMSAR status in 2006. The proposed sanctuary zone (Figure 3, below) will include the lagoon, except the flashes, and the cove (at the lagoon mouth) from Billy Point to Goat Point. The flashes are important for some traditional forms of fishing, like "running silver," which is why stakeholders chose to keep them open to fishing.

Figure 3: Lagoon Sanctuary

From an enforcement standpoint, the lagoon's landlocked nature makes enforcement much more straightforward than the other sanctuaries. The economic and recreational activities occurring at many points around the lagoon provide an opportunity for local citizens to participate in collaborative protection. Barbudan fishers are aware of the importance of the lagoon and frequently speak of a time when the lagoon was closed to fishing and lobsters were abundant. As a result of that previous closure, there is a strong understanding of the benefits of sanctuaries to the future of the fishery. Access to the lagoon by boat typically starts at the Fisheries Complex and travels north through the jetty. There is a dock at Barbuda Outback that allows access to the ocean on the west (after passing over the sand bar) but this dock is not frequently used. The lagoon is large, requiring a lengthy trip to get from one end to the other. However, this path is travelled often and would be relatively easy to ensure, with properly structured stakeholder engagement, that there are no illegal activities going on.

Goat Island Flash Sanctuary

This is the only other inland body of water that is currently proposed for protection, and it is also part of the Codrington Lagoon National Park (CNLP). It is a similar ecosystem (wetland habitat, an important area for juvenile fish and lobsters) to the lagoon, although more shallow and saline. As a result, the majority of any catch here is likely undersized.

Figure 4: Goat Island Flash Sanctuary

Difficulty of access to this sanctuary makes protection much more of a challenge, however that, and the fact that it is too shallow for many boats to enter, helps with minimizing the amount of illegal fishing that would occur. The south part of the flash is accessible by vehicle (although it is not a very well developed road, and is impassable in wet weather) or by boat through Cuffy Creek (as seen in Figure 9). Boat access is very limited as a result of the shallow depth of the flash; many vessels cannot make it far into the sanctuary. The north part of the flash is only accessible from the coast. The proximity of Goat Island Flash to Goat Point Sanctuary and northern part of the Lagoon suggests a patrol pattern that combines the three would be efficient.

Goat Point Sanctuary

This sanctuary is the northernmost reserve proposed, stretching a width of 2.4-miles but starting between 0.7 to 1.8-miles offshore and extending out to the 3.45-mile boundary (Figure 5). The protected area starts at the reef, with Goat Reef on the west end and Cobb Reef on the east, including Red Jacket (a spawning area). The southern boundary of this sanctuary follows the reef break but would require marking buoys to ensure effective compliance and enforcement for those who are “fishing the line” (i.e., fishing just outside the reserve in order to catch fish as they exit into open fishing grounds). The southern boundary has been straightened (it formerly followed the reef curve) for ease of enforcement.

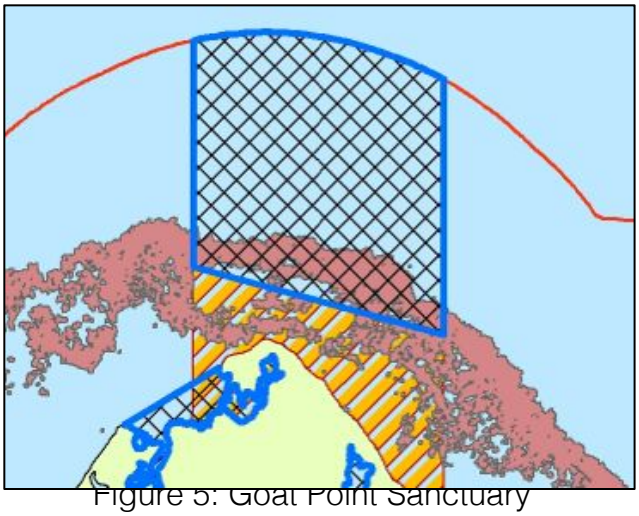

Figure 5: Goat Point Sanctuary

This sanctuary is the only one that is entirely off shore, which makes for a particular enforcement challenge. Additionally, this region has many highly desired fishing areas, so the capability to monitor this area frequently (and provide enforcement presence) is important to the success of this sanctuary. The coastal area inshore of the proposed reserve is the post popular fishing area on the island, hence this reserve leaves that area open, and does not come all the way to shore. The deployment of marking buoys would aid in clearly identifying the sanctuary boundaries. Lack of access to the northern part of the island by road is a further complication, as it creates a mandatory landing point if a patrol were to drop a lookout. The yellow hash-marked region in Figure 5 is a coastal "no net" zone, which would also need to be patrolled and enforced.

Two Foot Bay Sanctuary

The Two Foot Bay sanctuary spans the eastern side of the island, starting at the tower at Two Foot Bay and extending south until Little Castle Hill, running the full length from the coast to the edge of the 3.45-mile boundary. This sanctuary is the largest proposed from a square-mile standpoint. The transit time by boat is much slower than the other comparatively sized sanctuary due to rougher sea conditions owing to Atlantic Ocean exposure. Additionally, the remoteness of the sanctuary in relation to much of the Barbudan population makes it a unique enforcement challenge. As you can see in Figure 6, there is road access to the coast (which gets pretty rugged very quickly), however the southern roads to Castle Hill become inaccessible during wet weather. Much of the fishing that occurs here is focused on the near shore continuous reef section, and there are times of the year where the waters are so rough that they are unfishable.

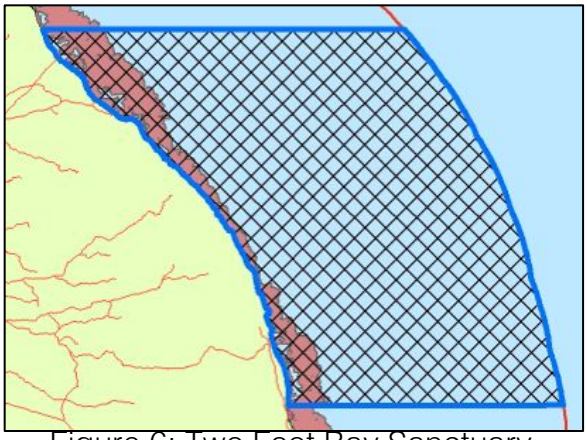

Figure 6: Two Foot Bay Sanctuary

From an enforcement perspective, the options for this sanctuary are much more obvious. Terrestrial landmarks delineate the north and south borders, (Two Foot Bay and Little Castle Hill, respectively), so they are easily discernable from boat. The east-to-west borders at the northern and southern sanctuary boundaries make it straightforward to determination of whether an activity is occurring with the sanctuary boundaries. The geological layout of the eastern coast has a cliff that runs nearly the entire length of the island. The cliff height of approximately 125 feet above sea level provides a great vantage point from which to perform shore-based observations.

Palastar Sanctuary

A portion of the proposed Palastar Reef Sanctuary is currently protected as a national Marine Park. Though fishing there is illegal, that is not currently enforced. The proposed sanctuary includes the Marine Park area as well as the rest of Palastar Reef. To maintain access to important fishing grounds in the hard-bottom areas east of the reef, the sanctuary boundaries follow the curvature of the reef with the boundary of a quarter-mile off that edge. The beach areas around this reserve are popular campgrounds for Barbudans, and people fish in the coastal waters while they are camping. To accommodate this traditional activity, the boundaries of this proposed sanctuary leave the cove between Coco Point and Spanish Point (yellow hash-marked region) remains open to fishing. However, use of nets on the coastal reefs would be prohibited here, as on all reefs, which is an enforcement consideration. Additionally, there are two proposed mooring/anchoring areas (green outline) that also need enforcement with some potential for revenue generation (through mooring/anchoring fees). Figure 7 outlines the unique boundary of this sanctuary.

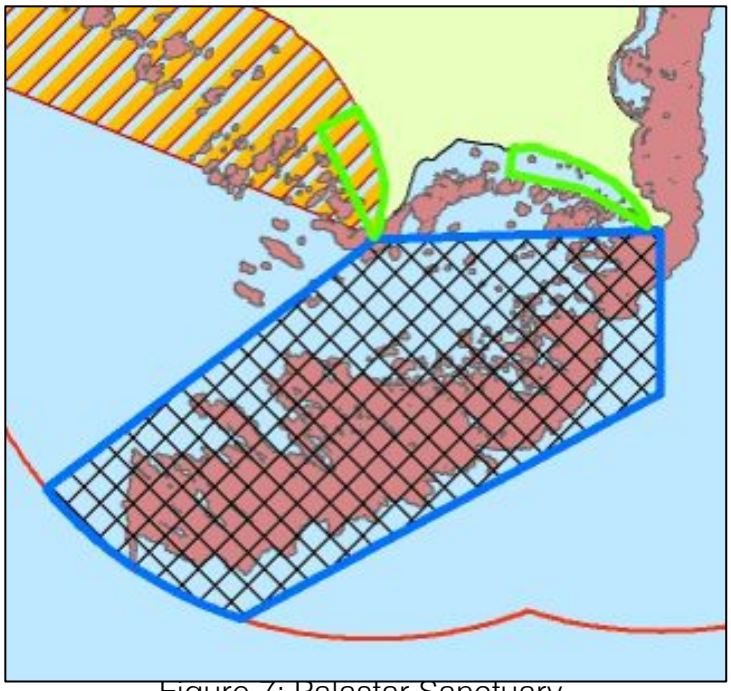

Figure 7: Palastar Sanctuary

Due to the shape of the Palastar Sanctuary boundaries, enforcement of this region is more complicated than for other sanctuaries, making extensive use of marking buoys important. The southern boundary has been straightened (formerly it followed the curve of the reef) for ease of enforcement. Any illegal fishing activity that is caught in this area would need to be irrefutable regarding location to ensure that ambiguity of the zone boundaries doesn't create prosecution difficulties. An advantage of this sanctuary is its location and the proximity to the campsites and the Coco Point Lodge. This proximity allows for ample visibility to this region and provides some enforcement resources (docks, roads, etc.) that can be used. There is a general public understanding that this reef is in poor shape and requires protection. During consultations with fishers, there seemed to be consensus for the need to better protect of this area.

Low Bay Sanctuary

This sanctuary runs along the western coast of the island, from Palmetto Point up 5.3-miles to the Lighthouse Resort. The northern and southern boundaries run straight west from those two landmarks, making it easy to determined whether one is inside or outside, while out at sea. The entire area from the coast to the end of the 3.45-mile boundary is contained within the sanctuary. There is some patch reef in this region, however most the ecosystem is dominated by sea grass and sand habitats. There is a mooring area along the western coastline from Cedar Tree Point, all the way down to the Canal. This does not run the full length of the reserve, so there may be some ambiguity as you head south towards Palmetto Point.

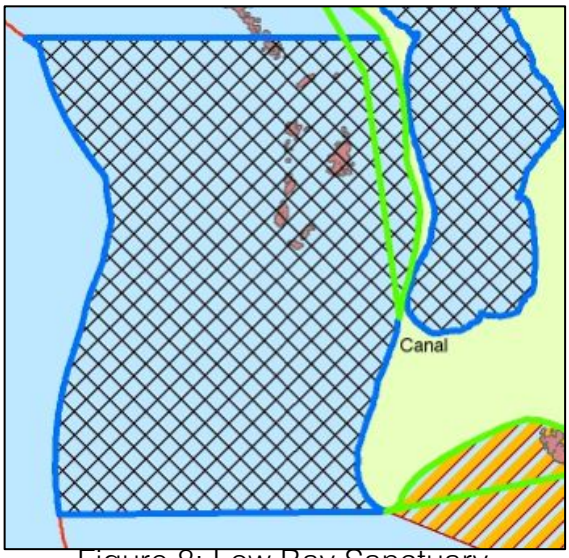

Figure 8: Low Bay Sanctuary

The enforceability of this proposed sanctuary is much better than that of several of the other sanctuaries outlined. The area's boundaries are easily defined and it is in close proximity to the majority of the Barbudan population. There is a dock on the lagoon-side of Guiness' property that can provide easy access to the western coastline for use in shore-based patrols. Additionally, there is access via road to Palmetto Point, and River harbor is close to the southern part of the sanctuary.

Barbuda Island Enforcement Plans

The scope of these efforts and the near-shore nature of these reserves make enforcement planning straightforward for selection of options and their associated technologies. When evaluating enforcement approaches and technologies, it is best to look at all these sanctuaries as a single system to help to identify how certain approaches can help to fill the gaps between zones. This will influence the overall decision on placement of the enforcement bases and specific monitoring approaches for each of the sanctuaries. Additionally, there are mooring areas and no net zones that require a system-level view to determine the best opportunities to support those areas. The goal is to create a plan that would allow for the most coverage without being overly expensive or operationally difficult.

The entire network of sanctuaries is shown in Figure 9, with marking to demonstrate location names, proposed sanctuaries (blue hash-marked area), mooring areas (green outline), no net zones (yellow hash-marked area), roads (red lines), and reef habitat (coral area).

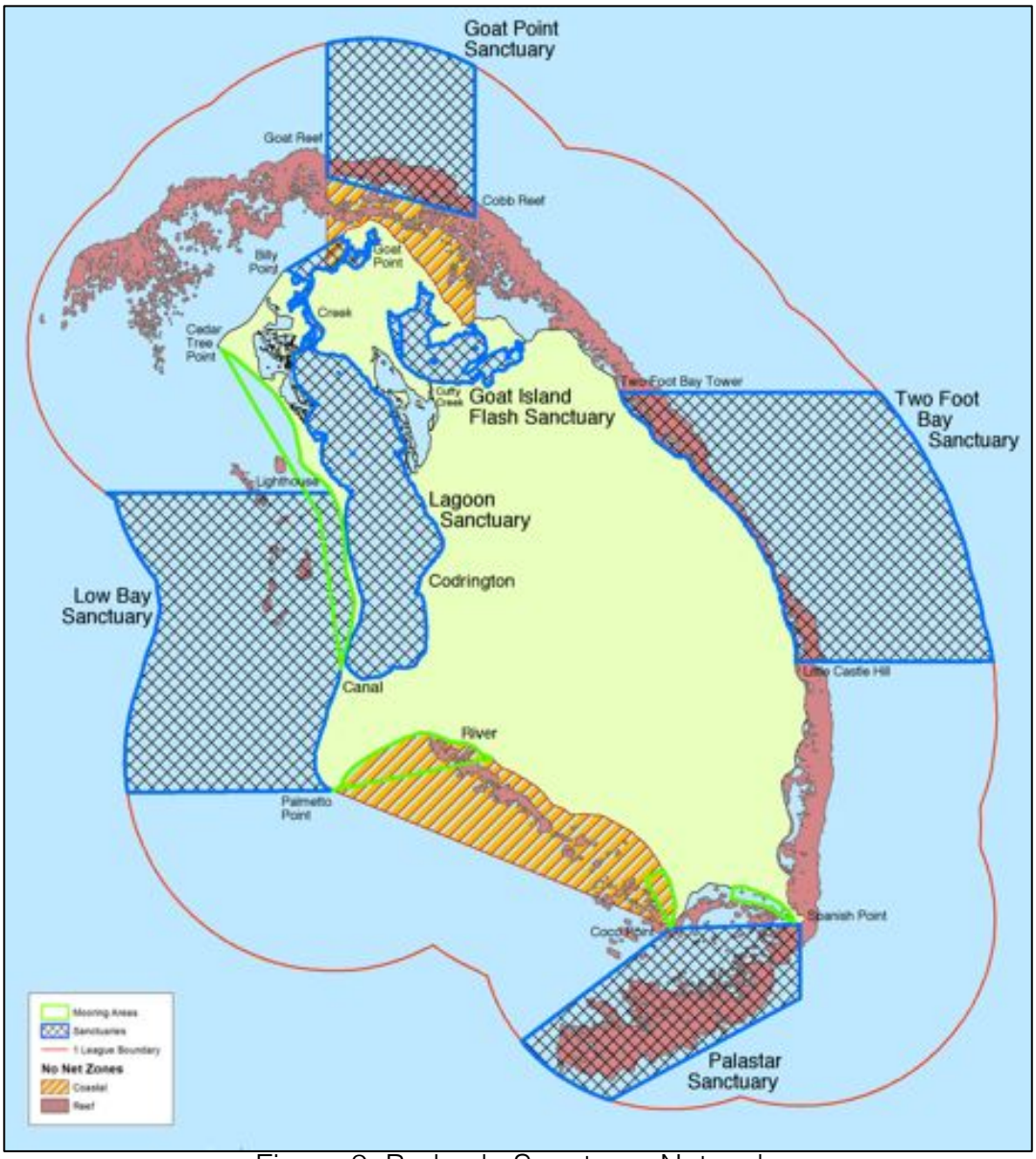

Figure 9: Barbuda Sanctuary Network

This report is drafted against the current baseline that assumes the enforcement capacity on Barbuda will be shared between the Fisheries Department and the CLNP ranger staff. As currently stands, there is a single boat available for patrols, owned by CLNP and stationed at the Fisheries Complex. There is an expectation that this vessel will be used in patrols and that the CLNP staff will assist in the enforcement. Additionally, the Fisheries Complex will function as one of the bases for enforcement coordination and a patrol launch point. This has a clear advantage as it is situated in Codrington and is well equipped to support operations such as this.

Base of Operations

As previously mentioned, the layout of the sanctuaries would make effective single-base operations out of the Fisheries Complex very difficult. The Fisheries Complex in Codrington is currently the main base of operation, but travel time to some of the reserves is lengthy and will likely be prohibitively expensive in fuel costs. The transit time from Fisheries out of the Lagoon hinders prompt operations for any of the southern or eastern sanctuaries. There exist two favorable options for a supplemental base of operations. Both options consider the Fisheries Complex as the primary base, so it will be labeled as "Base A" on the following figures. Patrol of Lagoon, Goat Point, Goat Island Flash, and Low Bay sanctuaries can be handled out of Base A.

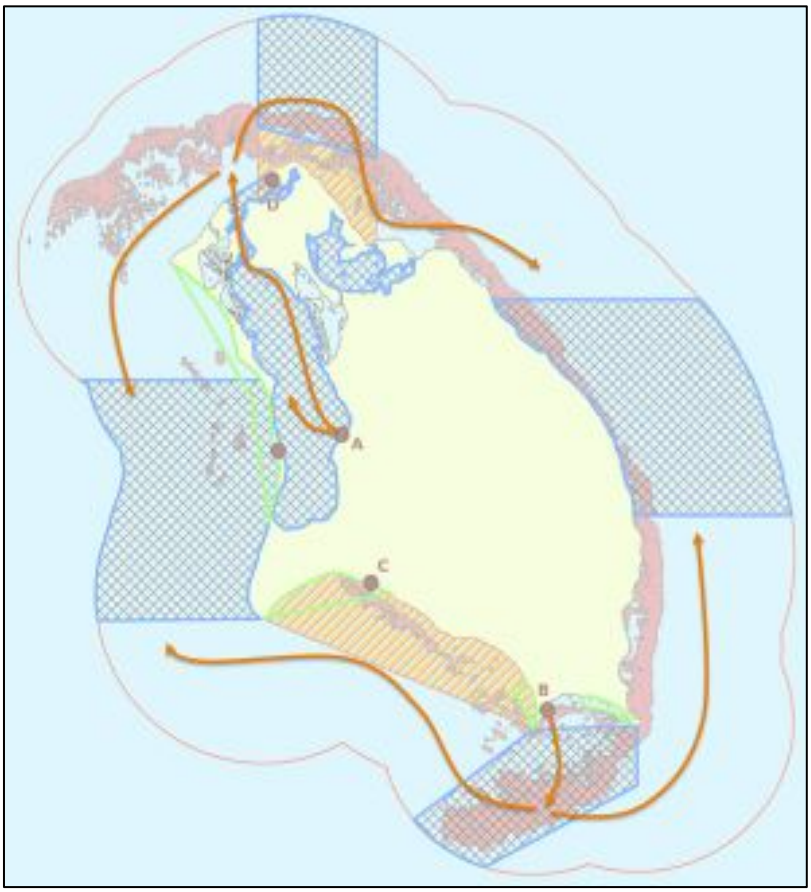

Figure 10: Base Operation Option 1

The first option for a second base would be to maintain a vessel at the dock at Coco Point, labeled as "Base B" in Figure 10. That dock is used by the Coco Point Lodge and selected fishers, and it would be a suitable launch point for enforcement patrols. Road access allows for quick approach to the patrol vessel and the orange arrows demonstrate the ability to visit Palastar, Two Foot Bay, and Low Bay sanctuaries. It also allows for close access for monitoring of the "no net" area between Coco Point and Palmetto Point and multiple mooring zones. For a two-base operation, using the Fisheries Complex and Coco Point would provide the lowest response times in the event of a tipoff of illegal fishing. The security around the dock at Coco Point (as a result of the lodge) would be beneficial to enforcement operations to ensure that there isn't tampering with the vessel in off hours.

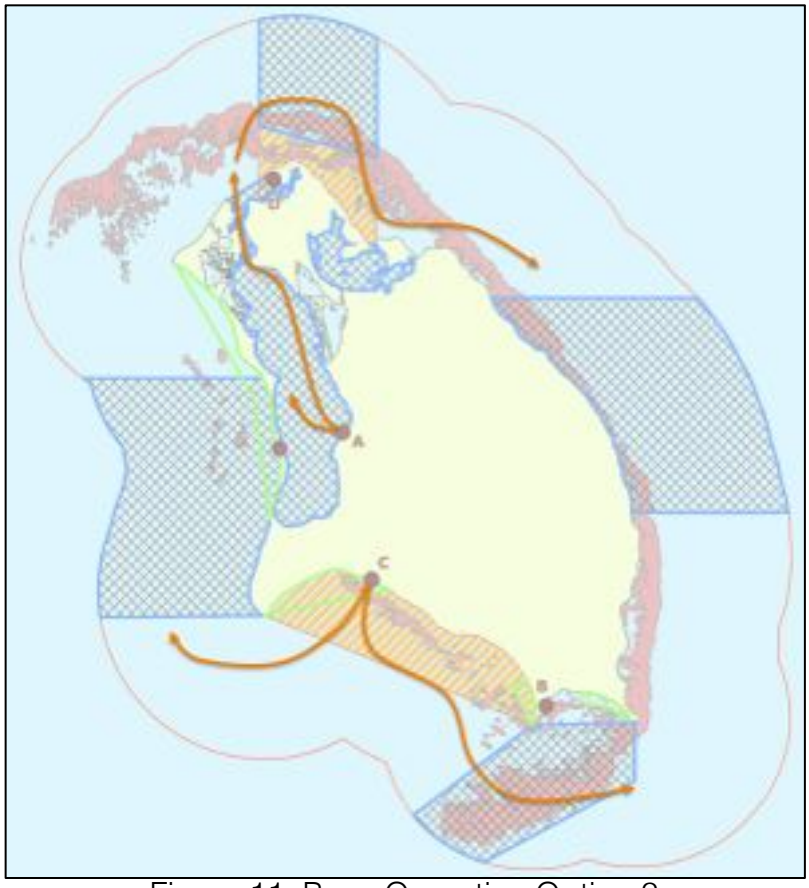

Figure 11: Base Operation Option 2

The second option would have the southern base utilize the River Wharf as an operational starting point. This is labeled as “Base C” in Figure 11. River Wharf was the original plan for the ABDF Coast Guard base, however a lengthy proposed jetty of 150-feet led to a reevaluation of that option (but it hasn’t been ruled out). River is the current landing place for the Barbuda Express Ferry and any cargo vessels that come from Antigua. There is much economic activity in this area and it would provide another useful option for a second base. The orange arrows in Figure 11 demonstrate the paths needed from this two-base operation to access all the reserves. Note that placement of the second base at River would reduce ease of access to the Southern part of the proposed Two Foot Bay Sanctuary, compared to the placing a base at Coco Point.

There is also an opportunity for additional “part-time” bases for use by patrol operations. These are suggested to be used only part of the time as a result of their inherent inaccessibility that would impede regular usage. Also, their layout is less strategically important to overall protection of the reserves as they are more directly tied to specific sanctuaries. The first of these is “Base D” identified in Figure 11. There is an old dock there that may be of some use, as its location provides quick access to the cove outside of the lagoon (part of the Lagoon Sanctuary), Goat Point and Goat Island Flash Sanctuaries. Since access to this area can only occur by boat, it makes for a less useful permanent base. However, this would be a great starting point for targeted operations in the north as it could reduce transit time through the lagoon.

Figure 12: Low Bay Supplementary Base Operation

The other part-time base could be located by Guiness' Barbuda Outback to provide quick observation access to the Low Bay Sanctuary. As mentioned previously, there is a dock on the lagoon-side, which is a short transit from the Fisheries Complex (demonstrated in Figure 12). This dock allows for access to the ocean side by a short walk over the sandbar. Once there, an enforcement official can make use of the balcony on the second floor of Barbuda Outback to get a good vantage point on the activities in that protected area. Use of this property for enforcement has been offered by the leaseholder. Additionally, there may be the opportunity to store a smaller craft (like a jet ski) to provide ocean access to the enforcement official. This would also be beneficial in collection of mooring/anchoring fees from boats on that western coastline.

Sanctuary Marking

As a result of the unique boundaries that a few of the sanctuaries possess, marking buoys will be needed in order to successfully identify the boundaries. The final number of buoys is subject to final assessment of the area areas, including water depth area, ease of boundary identification (through landmarks or easily noticed ocean features), and behavior of the currents. Initial recommendations for buoy locations were made for both the Goat Point and Palastar Sanctuaries to give an idea of what that could look like. These recommendations take into consideration the complexity of the boundary and the popularity of fishing nearest that boundary (more popular fishing areas would require more marker buoys).

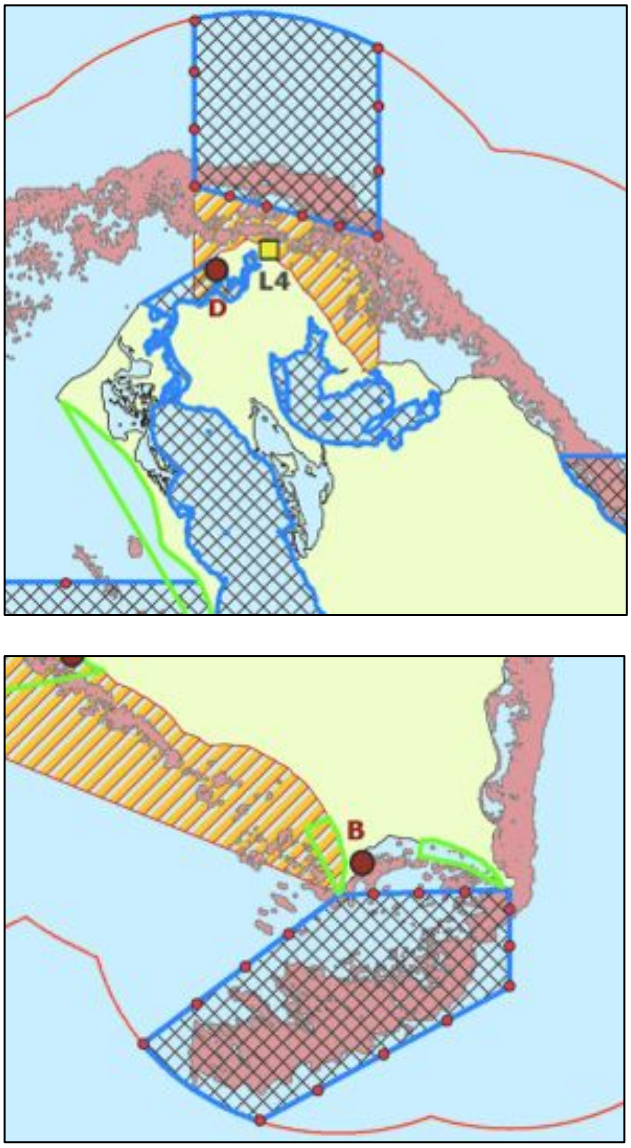

Figure 13: Initial Marker Buoy Recommendations (Red Dots)

Buoys are a platform technology, essentially any anchored floating units, which can be used in either passive or active ways. They can get very sophisticated with a variety of scientific sensors, communication equipment, and navigational aids. The buoys being discussed here are very basic as they are only means of marking a territory. Moreover, buoys are at high risk of damage from weather or vandalism. Often times they function effectively as fish aggregating devices (FADs), which attracts fishers and creates the opportunity of damage during that fishing process. These buoys would be simple and low cost designs, much like the version used by the Nature Conservancy in Jamaica. Those were made using PVC pipe, old tires, concrete, nylon rope, and rebar. A variation on this would work nicely for marking sanctuary boundaries in Barbuda and their construction and deployment could be used as a way to get the community and fishers involved in the protection of these no-take zones.

Figure 14: Nature Conservancy South West Cay Fish Sanctuary Buoys

Shore-based Lookout

As a result of the layout of these zones, there are a number of sanctuaries that could be effectively monitored through shore-based lookouts. This is the act of placing an enforcement official on the ground, with a pair of binoculars and a radio or cellular phone to report any peculiar activity. As a form of surveillance, this method is relatively low cost and fairly discrete in that the fishing vessel may not realize they are being watched. Considering that none of the protected areas extend beyond 3.45-miles, this approach can be a very effective form of monitoring.

At sea level, an unobstructed view will allow visual monitoring to occur until the curvature of the Earth takes over, which is approximately 2.9-miles. The higher that observer is from sea level, the longer that range is extended. This is the benefit behind a lookout tower, as the added height is helpful in extending that range. The tower also provides a structure that can shield the enforcement official from the weather and provide them a location to store equipment (binoculars, VHF radio, desk, solar panels, etc.). There would need to be an open communication link to a base where there is access to an enforcement vessel. If the lookout notices any potentially illegal behavior, they will not be able to investigate unless there is access to a boat. Without that, evidence collection for prosecution becomes difficult as a result of the distances involved.

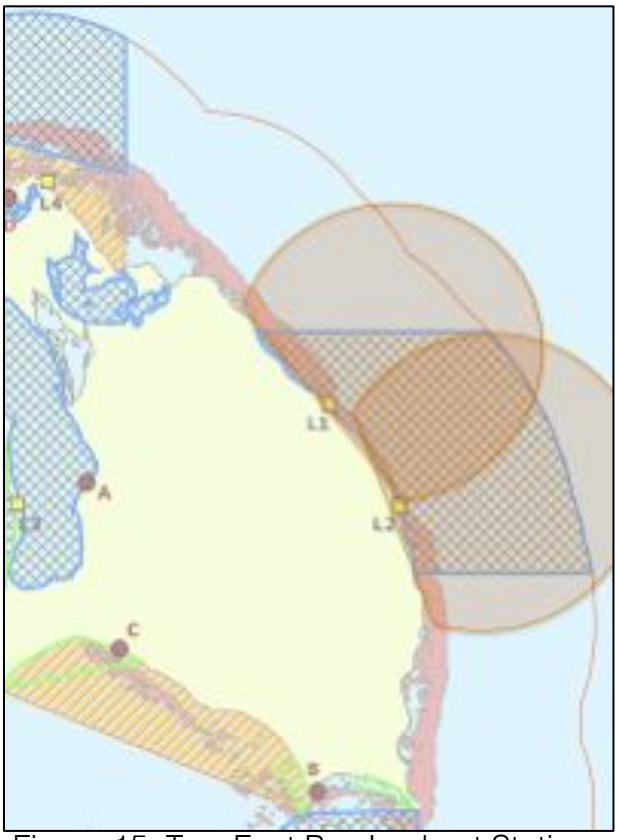

Figure 15: Two Foot Bay Lookout Stations

The Two Foot Bay Sanctuary has the most to gain from dedicated lookout stations. Figure 15 demonstrates the minimum range (orange semicircles) that would be achieved from lookouts posted at the top of the cliff that runs along the coast. The “L1” point is a location as far south as the northern road will allow you to travel. The “L2” point is through taking the southern road to as close to Pigeon Cliff that you can access. This southern route is not accessible during the rainy season, so a pure reliance on that location as the main lookout would be a significant limitation. It should be noted that visibility is greatly reduced in rain conditions, so the effectiveness of a shore-based lookout may not be as high as in nicer weather. Furthermore, the considerable height of the cliff above sea level simplifies the need for a tower structure, since the range gained through that cliff is more than what is necessary to effectively monitor that sanctuary. All that would be required is some weather protection.

These stations could also function as remote camera lookouts, where the enforcement official is replaced by a camera system. These would need to transmit the data real-time to the enforcement office for monitoring and analysis. Since there are considerations for theft and vandalism that need to be taken into account, this approach can be considered for a future phase of the project. If the personnel are currently available to staff this role, then the resources required to purchase and configure an automated camera system may be better spent elsewhere.

Figure 16: Additional Lookout Stations

There are two additional lookout locations that could function as effective spots, even if they do not have the same range as the Two Foot Bay stations (as shown in the orange semicircles). These locations were selected because they have the most favorable cost-to-benefit ratio of all the spots on the island. The "L3" point could make use of the area by Barbuda Outback and the ease of accessibility that location has to the Fisheries Complex (as explained above). This is an effective method of Low Bay Sanctuary protection as it is a quick ride across the lagoon and the area allows for cellular communication with those at Fisheries (Base A).

A second useful lookout station would be in the far north at Goat Point, as indicated by "L4" in Figure 16. This would be helpful in addressing the remote nature of that part of the island and the enforcement complexities associated with the Goat Point Sanctuary and coastal no net zone. Any lookout that was posted in that location would require dropping off and picking up by boat. There is an opportunity to also monitor the Goat Island Flash Sanctuary, however the demands of Goat Point monitoring and the physical geography of the region may make that more complicated than it needs to be. The island geography and popularity of fishing in this region make this point as an important lookout.

Equipment Needs

To support a multi-base, multi-lookout framework to enforce fisheries and zones, some critical equipment needs will need to be met. As it currently stands, the individuals who would be performing surveillance duties have a single boat (belonging to the CLNP staff), cellular telephones, and some GPS units. The costs outlined here are rough estimates based on preliminary research and will require further adjustments to provide a more accurate estimate of the price of things in Barbuda.

One of the most fundamental equipment needs in order to effectively protect these reserves is an additional enforcement vessel or two. The amount of time and fuel required to patrol the island from the Fisheries Complex is not sustainable (it cost us $500 in fuel and the better part of a day to circle the island by boat). Also, it creates an easily known and defined enforcement path for the vessel that can be easily out-smarted by illegal fishers. Single patrol boat enforcement operations are typically beaten by fishers through setting up a lookout that will call the illegal fishers once they see the boat leave or arrive. By the addition of another boat stationed at Base B or C, patrols can be quicker and smarter. Without that added boat, this enforcement problem gets considerably more difficult and it puts the entire sanctuary network at risk. The ideal boat would be something in the class of a Boston Whaler with a secure hull, better seagoing capabilities, some weather protection, and a faster motor. Realistically, it seems like the best option is to look at what boats are for sale in Antigua and the neighboring islands. There is likely a deal to be found in a better patrol boat that requires some repairs but still has a good backbone. It is important that there is a revenue model in place, from licensing fees and fines, that allows for fuel and maintenance costs to be included. Far too often, enforcement vessels are donated to countries, just to be permanently docked as a result of no funds for fuel or maintenance.

An additional vessel that was proposed was the option of finding a jet ski that can be used for supplemental enforcement operations, specifically on the western coast where it can be used to collect mooring fees. While this would be an effective way to solve the problem of ocean mobility once on the sandbar by Low Bay Sanctuary, it creates another vessel to store, maintain, and fuel from time to time. If there are additional funds that are available after purchase of the boat, it is suggested that these go into the fund for future costs. For the time being, the money spent on a jet ski would likely be better spent procuring a better patrol boat. Although, if there were a jet ski that was donated as an enforcement vessel, it could be easily worked into the patrol plan for Barbuda (with the assumption that it is in sufficiently good condition as to not require considerable repairs).

There is additional equipment also necessary for the patrols to ensure that the officers can communicate effectively and are able to properly gather evidence of infractions. This includes VHF radios, GPS devices, and cameras (at least one per patrol vessel). If the camera has GPS functionality, then this is an added benefit because the photograph will have embedded information to act as a secondary validation of GPS coordinates. It is also important that the enforcement officials have some sort of a uniform. In dealing with individuals in those types of interactions, it helps to maintain the highest level of professionalism possible. This can have a considerable impact on the outcome of monitoring and enforcement interactions.

For the lookout stations, some basic construction supplies are necessary to construct the structure or tower. This includes lumber, hardware, roofing, concrete, and locks. The cost assumptions will need to be validated against actual building costs in Barbuda. It helps for this structure to be enclosed, if possible. This will keep fishers from easily determining if the station is currently manned or not. All that is really required is binoculars, some weather protection, and an ability to communicate with the enforcement bases (via VHF radio or cellular telephone).

Community Engagement

In Barbuda, the level of cellular penetration is high with both regular cell phones and smart phones common among the population. This creates a potential to provide an extension on traditional monitoring methods. By creating a mechanism for anyone with a cell phone to report illegal activity at the citizen level, you could effectively extend the "eyes" and the "ears" of those in charge of enforcement. A system can be set up to allow anyone to send text messages (SMS) confidentially from their phones to the enforcement officials and let them know about illegal fishing. Text messaging can be used to provide a means of community engagement and ownership in the protection of the areas outlined in the zoning plan. You can imagine this as a similar model to how law enforcement has used Neighborhood Watch programs. This specific SMS model has been shown to work in other parts of the world, where both fishers and civilians have contributed to stopping damaging forms of illegal fishing happening all around the world.

Operationally, the easiest way to implement this would be in working with the regional cellular network provider to provide a memorable short code to allow for this crowdsourced reporting of IUU activities. SMS messages to the short code should be free and confidential to encourage reporting. There are a number of software platforms available to nonprofits (like FrontlineSMS or Twilio) that help to manage the information that comes in. There can also be an incentive structure in place for verifiable information that leads to enforcement action (which would also reduce the likelihood of false reports). This could be in the form of small cash rewards, or something more substantial integrated into a revamp of the Sea Warden program. The incentives should be structured to outweigh the potential negative stigmas for reporting (or "snitching") or any cellular fees that would discourage participation.

The Blue Halo Initiative has done extensive community engagement, and the proposed restrictions regarding fishing within the sanctuary zones seem to be pretty well understood. This knowledge can be supplemented through providing the precise GPS coordinates of the sanctuaries for those individuals who have a GPS (mostly the fishers). There would be costs associated with the short code and with any signage and information that needs to be distributed to let people know about the code to send SMS reports to. The near-shore nature of the sanctuaries also allow for fairly solid cellular reception when out on the water (with the exception of a few areas). Use of SMS for enforcement tips can be a tool that not only fishers use, it can be extended to all Barbudans, charter fishing operations, yacht groups, SCUBA operations, cargo companies, and any other entity that finds themselves on the shore or coastal water near Barbuda. Moreover, the information collected via SMS can be mapped using free internet-based tools and result in helpful information for developing targeted enforcement operations. These tools allow creation of simple metrics, validation of reports, and analysis of collected data. This can result in smarter patrols targeted at the areas that are frequently reported. Taking this step will help move Barbuda towards the inevitable path of digitizing its data, starting at the community-sourced reports of activities taking place in the sanctuary.

Recommendations

For the most effective enforcement of the new sanctuaries and other zones that are in the process of being finalized, below are some tiered recommendations driven mostly by available funding. It is recommended that the baseline improvements involve the addition of:

- Two additional patrol boats,
- A second base at Coco Point,
- Lookout stations for the Two Foot Bay, Low Bay, and Goat Point sanctuaries,
- Marking buoys delineating the boundaries of all sanctuary zones, and with a higher density of buoys for both Goat Point and Palastar sanctuaries,
- SMS based tip line, and
- Evidence collection equipment (binoculars, cameras, GPS, and VHF radios).

These baseline improvement recommendations are outlined in Figure 17. The estimated cost of this baseline "Level One" improvement, outlined in Table 1 (page 24), is approximately $95,781 with a majority of that cost driven by the boat purchases. Some additional configurations were considered to see how enforcement plans could be altered or augmented if additional funds became available. "Level Two" improvement would involve better patrol boats and the addition of a second and third lookout station, as outlined in Table 2 (page 25). "Level Three" again included better patrol boats, but also added a patrol jet ski (Table 3, page 26).

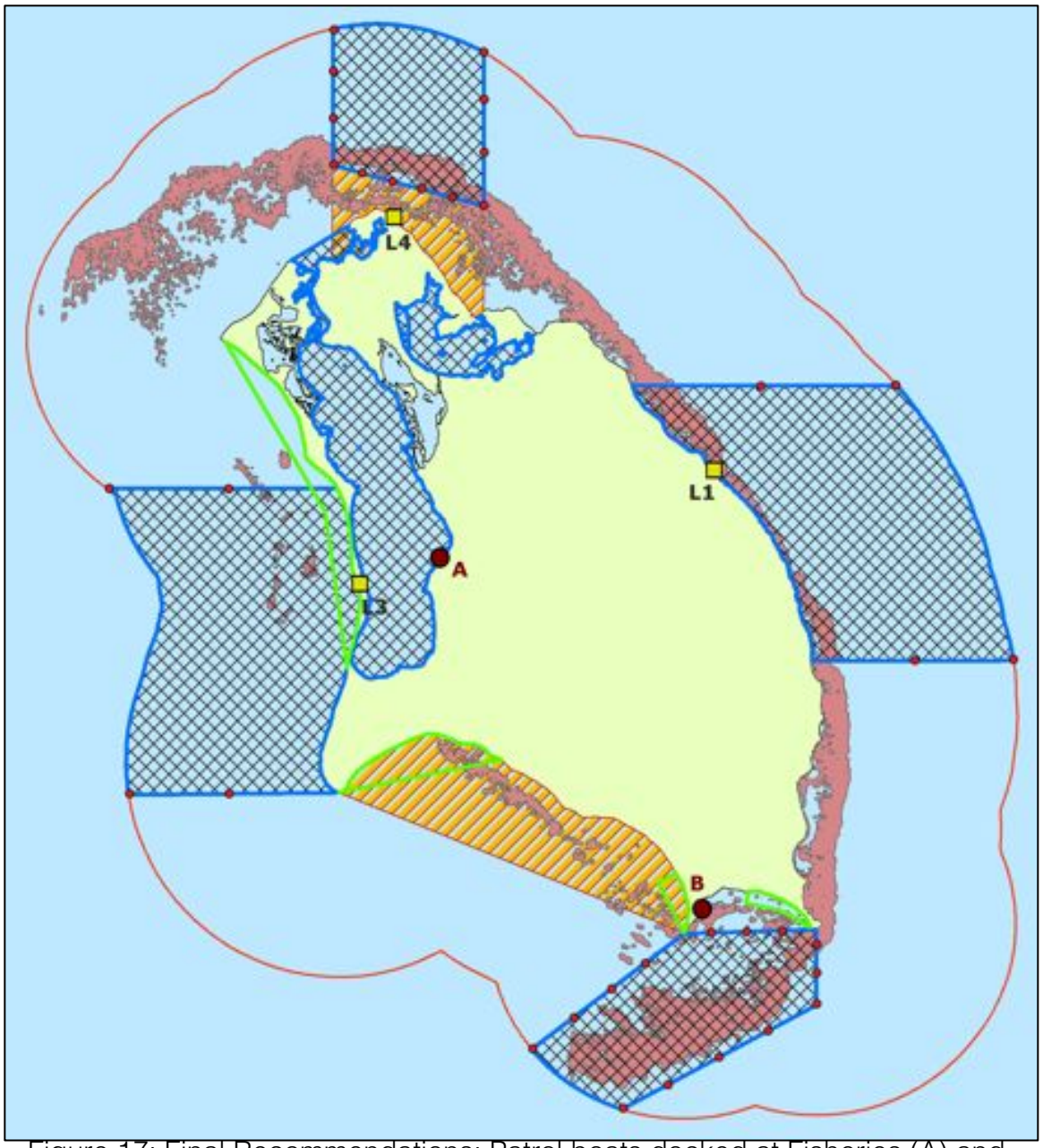

Figure 17: Final Recommendations: Patrol boats docked at Fisheries (A) and Coco Point (B). Lookout points at Gun Shop Cliff (L1), Goat Point (L4), and Low Bay (L3).

Table1: Enforcement Improvement Level One

Barbuda Blue Halo Enforcement Costs

	DESCRIPTION	INITIAL COSTS ($)	MONTHLY COSTS ($)	OTHER COST ($)	TOTAL
PATROL VESSEL	Second Patrol Vessel	$10,000.00	$25.00	$0.00	$10,300.00
	Third Patrol Vessel	$15,000.00	$25.00	$0.00	$15,300.00
	Repairs	$5,000.00	$183.33	$0.00	$7,200.00
	Onboard VHF Communication System	$400.00	$0.00	$0.00	$400.00
	Various Boating Expenses	$600.00	$20.00	$0.00	$840.00
	Boat Trailer	$1,200.00	$0.00	$0.00	$1,200.00
	Fuel Costs	$0.00	$2,250.00	$0.00	$27,000.00
	Subtotal	**$32,200.00**	**$2,503.33**	**$0.00**	**$62,240.00**
LOOKOUT STATION	L1 Construction (lumber, nails, roof, etc.)	$1,200.00	$5.00	$0.00	$1,260.00
	2nd Station: L3 Construction (lumber, nails, roof, etc.)	$200.00	$5.00	$0.00	$260.00
	Binoculars (3 pairs)	$600.00	$0.00	$0.00	$600.00
	VHF Radio (four handheld)	$320.00	$0.00	$15.00	$335.00
	Desk and chair	$80.00	$0.00	$0.00	$80.00
	Fuel Costs (for commute)	$0.00	$60.00	$0.00	$720.00
	Subtotal	**$2,400.00**	**$70.00**	**$15.00**	**$3,255.00**
MISCELLANEOUS ITEMS	Camera (2 cameras)	$500.00	$0.00	$45.00	$545.00
	GPS Units (2 units)	$600.00	$0.00	$15.00	$615.00
	Uniforms	$1,400.00	$0.00	$0.00	$1,400.00
	Marker buoys (34 buoys)	$1,750.00	$0.00	$0.00	$1,750.00
	SMS Shortcode Registration	$500.00	$500.00	$0.00	$6,500.00
	Tipline Signage and Outreach	$200.00	$10.00	$0.00	$320.00
	Subtotal	**$4,950.00**	**$510.00**	**$60.00**	**$11,130.00**
	Subtotals	**$39,550.00**	**$3,083.33**	**$75.00**	**$76,625.00**
	Barbuda cost multiplier	1.25	1.25	1.25	1.25
	Total (Estimated)	**$49,437.50**	**$3,854.17**	**$93.75**	**$95,781.25**
	Mooring buoys (20 buoys)				
	Subtotal	$40,000.00	$0.00	$0.00	$40,000.00

Table 2: Enforcement Improvement Level Two

Barbuda Blue Halo Enforcement Costs

	DESCRIPTION	INITIAL COSTS ($)	MONTHLY COSTS ($)	OTHER COST ($)	TOTAL
PATROL VESSEL	Second Patrol Vessel	$15,000.00	$25.00	$0.00	$15,300.00
	Third Patrol Vessel	$20,000.00	$25.00	$0.00	$20,300.00
	Repairs	$5,000.00	$225.00	$0.00	$7,700.00
	Onboard VHF Communication System	$400.00	$0.00	$0.00	$400.00
	Various Boating Expenses	$600.00	$20.00	$0.00	$840.00
	Boat Trailer	$1,200.00	$0.00	$0.00	$1,200.00
	Fuel Costs	$0.00	$2,250.00	$0.00	$27,000.00
	Subtotal	**$42,200.00**	**$2,545.00**	**$0.00**	**$72,740.00**
LOOKOUT STATION	1st Station: L1 Construction (lumber, nails, roof, etc.)	$1,200.00	$5.00	$0.00	$1,260.00
	2nd Station: L3 Construction (lumber, nails, roof, etc.)	$200.00	$5.00	$0.00	$260.00
	3rd Station: L4 Construction (lumber, nails, roof, etc.)	$2,200.00	$5.00	$0.00	$2,260.00
	Binoculars (3 pairs)	$600.00	$0.00	$0.00	$600.00
	VHF Radio (six handheld)	$480.00	$0.00	$15.00	$495.00
	Desk and chair (x2)	$160.00	$0.00	$0.00	$160.00
	Fuel Costs (for commute)	$0.00	$120.00	$0.00	$1,440.00
	Subtotal	**$4,840.00**	**$135.00**	**$15.00**	**$6,475.00**
MISCELANEOUS ITEMS	Camera (2 cameras)	$500.00	$0.00	$45.00	$545.00
	GPS Units (2 units)	$600.00	$0.00	$15.00	$615.00
	Uniforms	$1,400.00	$0.00	$0.00	$1,400.00
	Marker buoys (34 buoys)	$1,750.00	$0.00	$0.00	$1,750.00
	SMS Shortcode Registration	$500.00	$500.00	$0.00	$6,500.00
	Tipline Signage and Outreach	$200.00	$10.00	$0.00	$320.00
	Subtotal	**$4,950.00**	**$510.00**	**$60.00**	**$11,130.00**
Subtotals		**$51,990.00**	**$3,190.00**	**$75.00**	**$90,345.00**
Barbuda cost multiplier		1.25	1.25	1.25	1.25
Total (Estimated)		**$64,987.50**	**$3,987.50**	**$93.75**	**$112,931.25**
	Mooring buoys (30 buoys)				
	Subtotal	$60,000.00	$0.00	$0.00	$60,000.00

Table 3: Enforcement Improvement Level Three

Barbuda Blue Halo Enforcement Costs

	DESCRIPTION	INITIAL COSTS ($)	MONTHLY COSTS ($)	OTHER COST ($)	TOTAL
PATROL VESSEL	Second Patrol Vessel	$20,000.00	$25.00	$0.00	$20,300.00
	Third Patrol Vessel	$25,000.00	$25.00	$0.00	$25,300.00
	Repairs	$5,000.00	$266.67	$0.00	$8,200.00
	Onboard VHF Communication System	$400.00	$0.00	$0.00	$400.00
	Various Boating Expenses	$600.00	$20.00	$0.00	$840.00
	Boat Trailer	$1,200.00	$0.00	$0.00	$1,200.00
	Fuel Costs	$0.00	$2,450.00	$0.00	$29,400.00
	Jet Ski	$7,500.00	$62.50	$0.00	$8,250.00
	Subtotal	**$59,700.00**	**$2,849.17**	**$0.00**	**$93,890.00**
LOOKOUT STATION	1st Station: L1 Construction (lumber, nails, roof, etc.)	$1,200.00	$5.00	$0.00	$1,260.00
	2nd Station: L3 Construction (lumber, nails, roof, etc.)	$200.00	$5.00	$0.00	$260.00
	3rd Station: L4 Construction (lumber, nails, roof, etc.)	$2,200.00	$5.00	$0.00	$2,260.00
	Binoculars (3 pairs)	$600.00	$0.00	$0.00	$600.00
	VHF Radio (six handheld)	$480.00	$0.00	$15.00	$495.00
	Desk and chair (x2)	$160.00	$0.00	$0.00	$160.00
	Fuel Costs (for commute)	$0.00	$120.00	$0.00	$1,440.00
	Subtotal	**$4,840.00**	**$135.00**	**$15.00**	**$6,475.00**
MISCELLANEOUS ITEMS	Camera (2 cameras)	$500.00	$0.00	$45.00	$545.00
	GPS Units (3 units)	$900.00	$0.00	$15.00	$915.00
	Uniforms	$1,400.00	$0.00	$0.00	$1,400.00
	Marker buoys (34 buoys)	$1,750.00	$0.00	$0.00	$1,750.00
	SMS Shortcode Registration	$500.00	$500.00	$0.00	$6,500.00
	Tipline Signage and Outreach	$200.00	$10.00	$0.00	$320.00
	Subtotal	**$5,250.00**	**$510.00**	**$60.00**	**$11,430.00**
	Subtotals	**$69,790.00**	**$3,494.17**	**$75.00**	**$111,795.00**
	Barbuda cost multiplier	1.25	1.25	1.25	1.25
	Total (Estimated)	**$87,237.50**	**$4,367.71**	**$93.75**	**$139,743.75**
	Mooring buoys (40 buoys)				
	Subtotal	$80,000.00	$0.00	$0.00	$80,000.00

Cost Analysis Assumptions

1) The *Barbuda cost multiplier* was applied to account for uncertainty regarding costs in Barbuda versus the US. This multiplier should be reevaluated based on actual price data from Barbuda.
2) The additional patrol vessels could be found on Antigua or a neighboring island for a deal and renovated/repaired. Differences in patrol boat cost between options come from better vessels being available at higher budget levels.
3) Monthly costs associated with the vessel are miscellaneous fees or needs that may come up. All monthly vessel maintenance is covered in the *Repairs* section. The *Various Boating Expenses* includes all auxiliary items that would be needed associated with having a patrol boat.
4) Monthly costs associated with the Lookout Towers are any small repairs that may be needed for the structure.
5) The 1st Lookout Station is the one at Gun Shop Cliff that would be used in the monitoring of Two Foot Bay.
6) The 2nd Lookout Station would be the one at Low Bay making use of the upper level of Barbuda Outback, with perhaps some minor physical improvements.
7) The 3rd Lookout Station would be at Goat Point. The added cost here is in the need to build a taller structure, since the station cannot account for the height of the cliff. The cost of this would be driven by the height that is selected.
8) Number of units for the camera, GPS devices, and VHF radios are listed for each option. Any *Other Cost* captured is to account for batteries or memory cards, which would be required for operation.
9) Uniforms are assumed to be $200 each for seven individuals. Final costs for this are subject to change based on what the number of officials and the details associated with the uniforms.
10) Marker buoys can be made (in bulk) for approximately $50 per buoy assuming a free used tire and assumptions on bulk pricing for PVC pipe, concrete, rebar, rope, and the miscellaneous items to pull it all together.
11) Mooring buoys are listed as an additional cost, with an assumption of 20 to 40 buoys at a unit cost of $2,000 per buoy.

In drafting a patrol plan based on these improvements, there needs to be collaboration with ABDF Coast Guard and the Police on Barbuda to ensure that they participate in determining the final enforcement approach and are aware of the types of operations taking place. During discussions with Coast Guard Commander Nicholas, he mentioned that they would be interested in providing training to the individuals who end up working enforcement on Barbuda. At a minimum, this training should include boat handling skills, marine safety, nautical navigation, tactical interception procedures, evidence collection, and boarding preparations and procedures. These would be beneficial to providing high quality operational support and ensuring the safety of the enforcement officials.

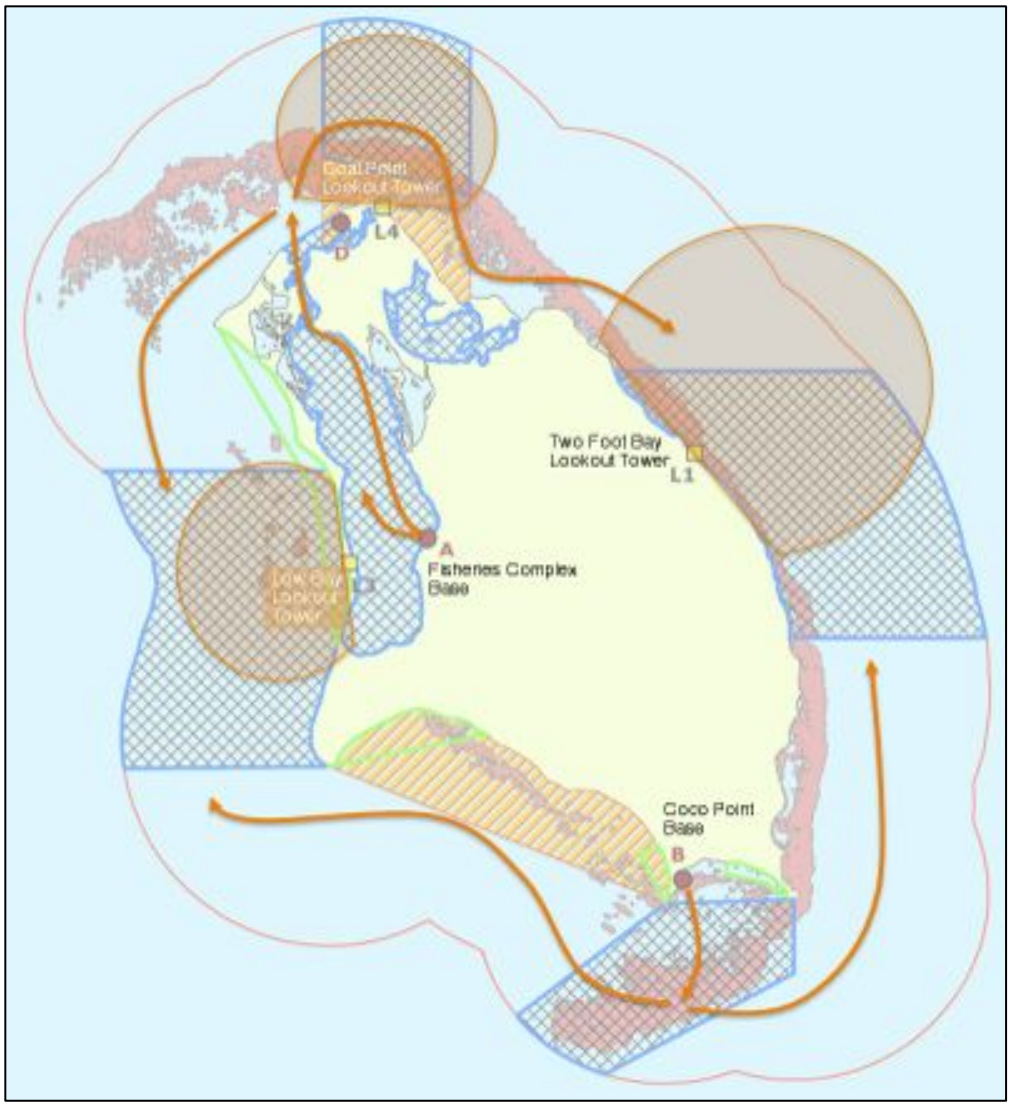

Figure 18: Patrol Recommendations

Once the zone boundaries are finalized, a detailed patrol plan can be developed. This plan will cover the frequency of patrols, paths to take, sanctuaries of focus, and required personnel. This planning should pay careful attention to the fishing seasons and the times of the year when the fishers will be

out in the area, as to not waste resources. Patrols that follow a seemingly random order are typically better at catching illegal fishers.

The updated patrol plan should include a reevaluation of the Sea Warden program. That program intended to engage fishermen in monitoring and enforcement; however, interviews with stakeholders indicated that this program was not very effective. There is no written documentation of this progam, but it seems to have involved approximately eight fishers being appointed as Sea Wardens and receiving a monthly stipend to fill out logs of what they saw at sea. The interviewees mentioned that few reports were filled out and that there was no relationship between the number of reports and the stipend. Further, when reports were filled out documenting illegal activities, enforcement action was rarely, if ever, taken. This resulted in the Wardens stopping the completion of these logs, though a few of them are still getting paid. Fishers can indeed be a valuable part of enforcement, and the Sea Warden program could be restructured with revised incentives and re-launched.

Additionally, the national fishing regulations, and new Barbuda fishing regulations (currently in draft form) should be enforced both during the patrols and during fish landings at the Fisheries Complex. Catch size should be closely watched to ensure that juveniles aren't being collected prematurely. GPS coordinates and maps must be distributed to all the fishers to ensure that they know where they can and can't fish, and what all the fisheries regulations are.

It should be stated that, for this solution to be truly successful, it is necessary to engage all the key stakeholders in Barbuda. These enforcement efforts will need to firmly target the types of illegal, unregulated, and unreported fishing that occurs within Barbudan waters. It is critical to have support for enforcement and for enforcement officials from the political level and from the community, so that infractions are fully and fairly prosecuted.

The primary focus of this report was to provide some recommendations on surveillance and enforcement-enabling technologies and procedures that would prove useful in the incorporation into the Blue Halo initiative. As was stated, this list of recommendations can be expanded upon if there is a specific interest in exploring other options, and if additional funding becomes available. However, implementing the "Level One" recommendations would be a big and important step towards creating the capacity to enforce the coastal waters around Barbuda.