

**Developing an Adaptive Management Plan for  
Anguilla's Marine Park System and Associated  
Shallow Water Habitats and Fisheries  
(2015-2025)**



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'Developing management strategies against regional eutrophication in Caribbean small island nations with limited financial and logistical resources'*

*A condensed working version of this document will be produced periodically for wider distribution*

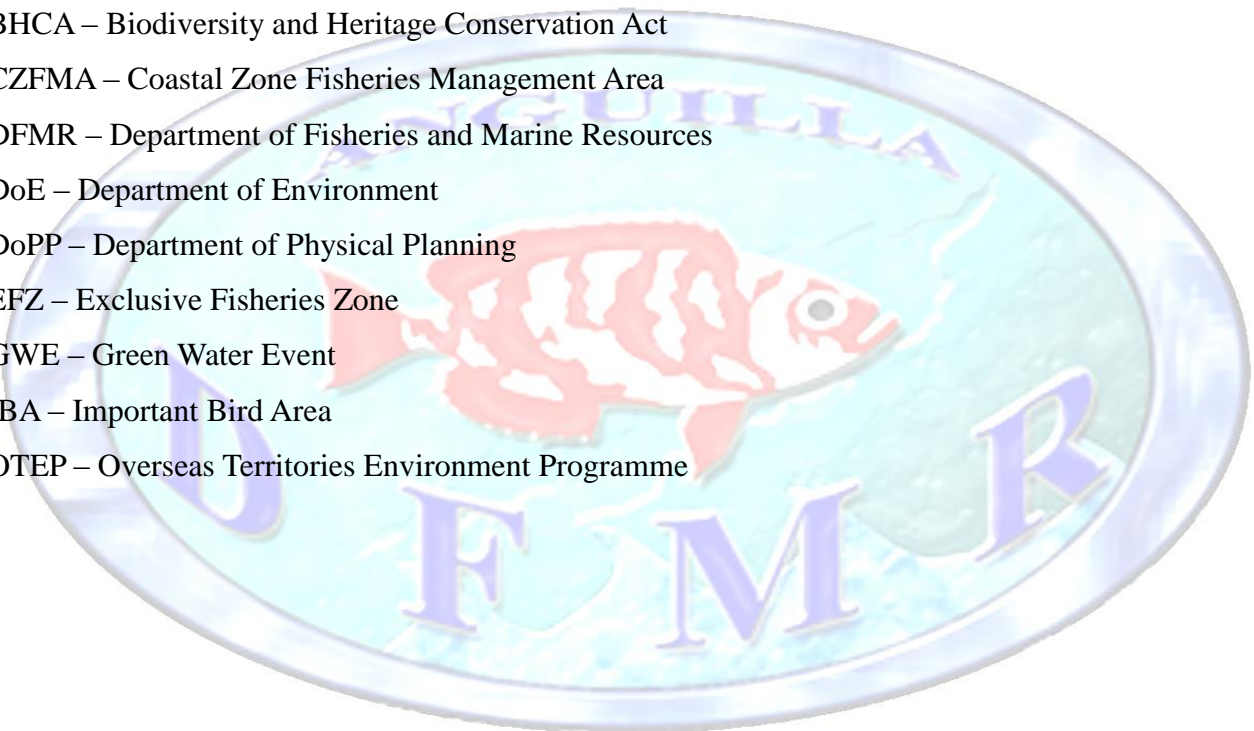
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### List of Acronyms Used

- ACRAMAM - Anguilla Coastal Resource Assessment Mapping and Monitoring Project
- AFDP – Anguilla Fisheries Development Plan
- AMMA – Anguilla Marine Management Area
- AMMP – Anguilla Marine Monitoring Programme
- ANT – Anguilla National Trust
- ARDP – Anguilla Resources Development Project
- AXA CRIS – Anguilla Coastal Resource Information System
- BHCA – Biodiversity and Heritage Conservation Act
- CZFMA – Coastal Zone Fisheries Management Area
- DFMR – Department of Fisheries and Marine Resources
- DoE – Department of Environment
- DoPP – Department of Physical Planning
- EFZ – Exclusive Fisheries Zone
- GWE – Green Water Event
- IBA – Important Bird Area
- OTEP – Overseas Territories Environment Programme



## Executive Summary

Anguilla's Marine Park System was officially established in the early 1990s, but to date no management plan has been implemented to facilitate the reaching of the marine parks intended goals. Despite the production of a draft management plan in 2001, unaddressed legislative insufficiencies ultimately led to it not being officially adopted and continued managerial stagnation. These legislative inadequacies have been identified as:

- No officially designated managerial agency.
- Incorrect and/or ambiguous designation of which areas are true marine parks.
- Insufficient regulations within the Marine Parks Act and other legislation.

Since its establishment, the Department of Fisheries and Marine Resources (DFMR) has assumed an *ad-hoc* role in the management of these areas, working within the limited legislation as it currently stands. Despite limited financial and logistical resources, DFMR has spent over a decade filling the knowledge gaps necessary to produce a comprehensive management plan. It has also developed a strategy to overcome the legislative road block that has prevented the success of past initiatives, in the hope that it will kick-start the long overdue managerial process essential for the success of the Anguilla Marine Park System.

The strategy put forward is for DFMR to continue its assumed management role for the marine parks until they are named legally as such, but to do so in a more assertive manner by taking the lead role in the design and implementation of this management plan. Headed by DFMR, other members from key government agencies, non-governmental organisations, and stakeholder group representatives will be involved to ensure the cross-disciplinarian nature of this initiative is addressed effectively. Through this means DFMR will strive to effectively achieve the administrative success of this plan and ensure, to the best of its ability, that all necessary legislative changes are made to allow this.

The management plan has been designed to allow Anguilla's Marine Park System to reach its originally intended potential, that being 'To protect fish, flora and fauna found in the park areas while preserving and enhancing the natural beauty of such areas' (statement first published in Policy Statement on Marine Parks for Anguilla, Government of Anguilla, c.1978). The overall goal is to

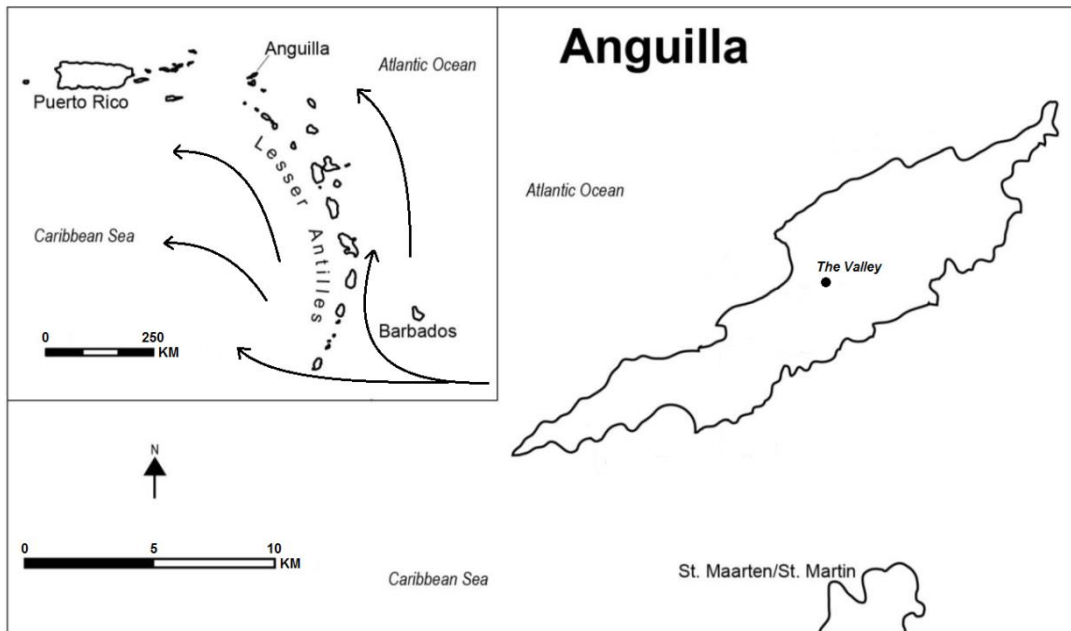
reduce anthropogenic pressure on the degraded nearshore ecosystems through effective management of visiting tourists, coastal developments and extractive fishing activities. In terms of this latter pressure, a long term strategic plan is to encourage the development of offshore fisheries resources, a goal that this plan aims to achieve in combination with a sister document, the Anguilla Fisheries Development Plan (Gumbs *et al.*, 2015). For this reason, and due to the inherent intricacies and interactions between marine areas, the management of marine parks also needs to consider surrounding marine environments, and (at least in part) their associated fisheries. Key management actions identified within this plan include:

- Unification of all current marine protected areas around Anguilla into the Anguilla Marine Park System.
- Fishing restrictions to be imposed within park boundaries.
- Protection of dive sites and other important tourist attractions both within park boundaries and in surrounding areas.
- Tourism enhancement within the marine parks to attract more paying visitors, combined with a review of the marine park user permit fee structure.
- Production of outreach materials aimed at education and awareness of the marine parks and their role in livelihood sustainability.
- Additions made to fisheries legislation outside of the Marine Parks Act, including (but not limited to) the introduction of closed seasons for Lobsters and Conch and minimum size limits for certain fish species and/or amendments to existing size limits. These changes will apply to all marine areas, not just those within the marine park system.
- Strict enforcement of Fishery Protection Act in nearshore regions (Coastal Zone Fisheries Management Area) to create a buffer zone that will link the marine parks with surrounding coastal regions.
- Based around current financial and logistical constraints, the area that can realistically be regularly patrolled by the marine police and/or DFMR to become known as the Anguilla Marine Management Area (AMMA).
- A ten year initial structured plan of action with annual revised editions of this plan produced bench-marking adaptive management intervals.

## Section 1: Introduction

Anguilla (18°12.80N and 63°03.00W), is the most northerly of the Lesser Antilles leeward island chain and forms part of the British West Indies (Figure 1), with a comprised area of 91 km<sup>2</sup>. It is a flat, low-lying island formed mainly of uplifted fossil corals surrounded by a variable shelf with several uninhabited offshore cays. The largest of these cays include Sandy Island, Dog Island, Prickly Pear Cays, Seal Island, Anguillita Island, Scrub Island, Scilly Cay, and the distant Sombrero Island. These islets support a variety of reef habitats, the majority of which are fringing, with the largest of which running from Prickly Pear Cays almost parallel to the mainland north coast for a distance of approximately 10 km. The crest of this reef breaks the surface in a number of places and runs down to a depth of 15 m or more. The northern leeward coast of Anguilla is characterised by extensive patch reefs interspersed with sand flats and seagrass beds. The south coast historically housed extensive fringing *Acropora spp.* reefs, the vast majority of which are now severely degraded. There are also extensive seagrass beds in the area. There are over forty beaches around the island and its offshore cays, most of which consist of white sand derived from fine ground coral remains and *Halimeda spp.* fragments. Seven marine parks are currently recognised in Anguillian waters, five of which form the Anguilla Marine Park System: Three of these parks surround the offshore cays of Dog Island, Prickly Pear Cays and Sandy Island, one encompassing the patch reef system of Shoal Bay and Island Harbour, and one in the seagrass regions close to Little Bay. Areas around Sombrero Island and Junks Hole are also legally marine parks, but are more important as heritage sites rather than of ecological significance. An eighth protected area not legislated officially as a marine park is at Rendezvous Bay. This important seagrass area has recently been adopted by DFMR as a marine park but has yet to be fully encompassed in the Marine Park System. A number of dive sites, including seven purposefully sunk ship wrecks, exist around the island but are under no official protection. Currently no formally adopted management plan exists for these areas, although it has long been recognised that this is a management gap that urgently needs filling. It is the objective of this report to do just this, not just for a fully unified Marine Park System, but also for the associated fisheries and other shallow water habitats. The legislative situation is clarified further in the following paragraphs.





**Figure 1:** Anguilla situation map, illustrating geographical location and prevailing currents.

### *A Brief History of Anguilla's Marine Park System*

Although the original Marine Parks Ordinance was produced in 1974, with draft regulations produced c.1978 (Gov Axa, c.1978), it is usually documented that Anguilla's marine parks (Figure 2) were originally designated under the later Marine Parks Ordinance of 1982 (Lum Kong, 2008). This Ordinance was again superseded by the Marine Parks Act (2000) which was revised again in 2010 following previous amendments in 2007. However, the parks actual designation is more officially cited as occurring in 1993 (CaMPAM, 2010) when the Marine Parks Regulations came into force. Under the regulations one marine park was listed for demarcation, the Junks Hole Marine Park - the waters surrounding the site where the wreck of the Spanish Galleon El Buen Consejo is situated. Notwithstanding this, the Junks Hole Marine Park is not usually cited as part of Anguilla's Marine Park System as it is more recognised as a heritage site rather than being of ecological importance.

The five areas usually cited as being part of Anguilla's Marine Park System were not designated under the Marine Parks Act until the amendments made in 2007. Instead, four (Dog Island, Sandy Island, Little Bay and Prickly Pear) were listed within the Cruising Permit Act (1980, later superseded in 2000) as areas with anchoring restrictions. Also listed in this Act is Rendezvous Bay



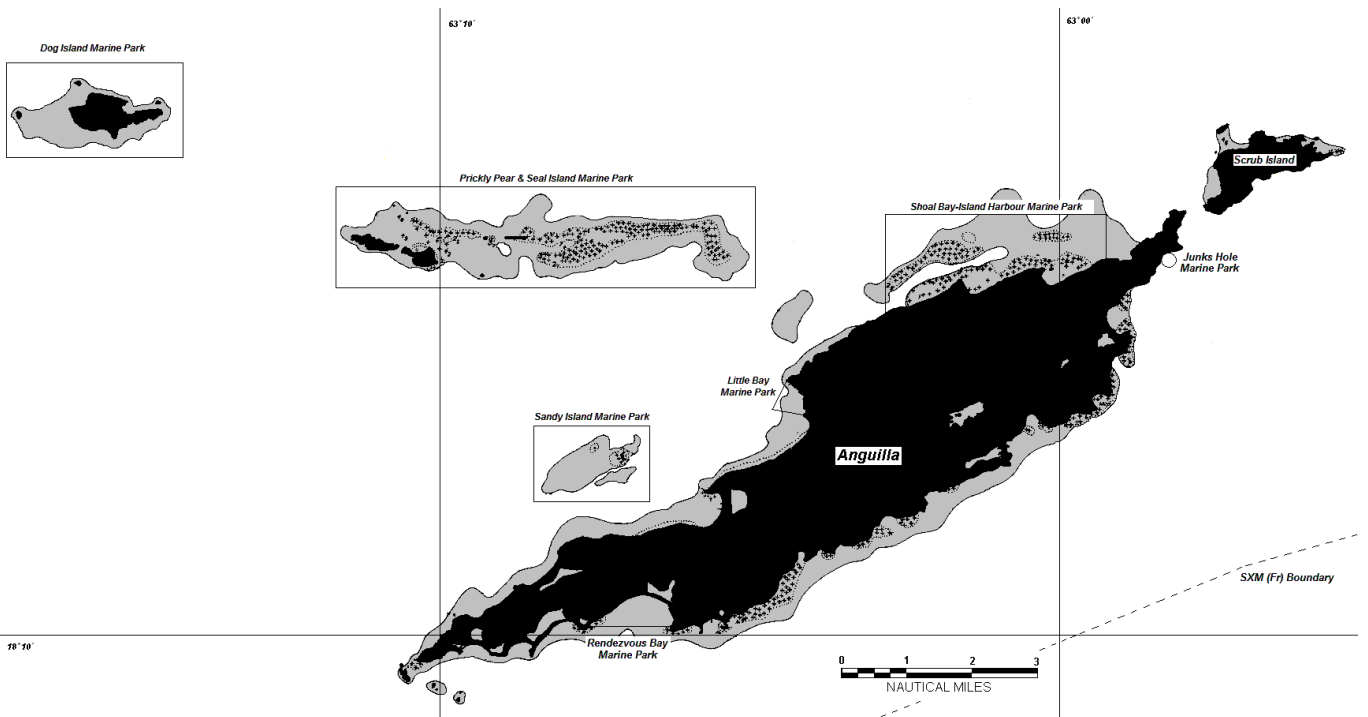
which, until recently, was not considered a marine park and thus not part of the Anguilla Marine Park System. These five areas would therefore have been better described as marine protected areas until 2007, rather than marine parks as they were technically only under anchoring restriction. Shoal Bay-Island Harbour has never been listed under the Cruising Permits Act and so only became a true protected area when it was listed under the amended Marine Parks Regulations in 2007. Despite this Shoal Bay-Island Harbour has always been considered part of the Anguilla Marine Park System. It remains unclear how this area was originally designated as no mention of it has been found in the legislation prior to the 2007 amendment. It is thought this area was instead listed in the Government of Anguilla's official Gazette, although confirmation and publication date of this has not been able to be obtained. In 2010 the revision of the Marine Parks Act added Sombrero Island to the list of marine parks. Currently Rendezvous Bay is the only area listed in the Cruising Permit Act that is not listed in the Marine Parks Act.

This legislative confusion has led to it sometimes being cited that (prior to 2007) Anguilla did not have any marine protected areas (Lum Kong, 2008) even though the areas listed under the Cruising Permits Act were afforded some protection and Junk's Hole Marine Park was designated under the Marine Parks Act. Furthermore, these areas, as with all of Anguilla's marine systems, were also subject to the generic protection afforded by the Fisheries Protection Act (2000). Such restrictions under this legislation include (but are not limited to) fish pot mesh size, size limits for the *Panulirus argus* and *Strombus gigas*<sup>1</sup> fisheries, and controls on all turtle fisheries.

For the purpose of this document, Anguilla will be considered to have eight marine parks: six designated for ecological purposes; one (Junk's Hole) designated for heritage purposes; and one (Sombrero Island) for heritage and potential ecological purposes, pending marine survey work. As a final clarification, until only a few years ago, Rendezvous Bay was not considered a marine park but rather an area under special management, and so not included in Anguilla's Marine Park System. This is no longer the case however as it has now been adopted as an unofficial marine park and hence included within this management plan. To avoid future confusion, one of the main recommendations under this management plan will be to unify the legislation governing marine systems and to ensure all these areas are correctly listed under the Marine Parks Act.

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<sup>1</sup> Now reclassified as *Lobatus gigas*



**Figure 2:** Map of Anguilla illustrating locations of marine parks, including Rendezvous Bay and shallow water areas (<10m). The distant Sombrero Island is not illustrated. The shallow areas are proposed to become the Coastal Zone Fishery Management Area (CZFMA), a buffer zone and link between the marine parks and surrounding coastal regions where surveillance efforts will be concentrated. The entire area depicted on the map, excluding that which belongs to French St. Martin, will become the Anguilla Marine Management Area (AMMA). Future enhanced surveillance will focus on this area should resources allow (i.e. area practical for one vessel to patrol on a daily basis).

*Note on future legislation:* The Biodiversity and Heritage Conservation Act (2010) is reportedly set to supersede the Marine Parks Act. The regulations for the BHCA have yet to be finalised and so the potential for this remains unclear. The BHCA states under Section 90(2) that ‘the marine parks existing on the coming into force of those [BHCA] regulations are deemed to have been established as protected areas under [the BHCA]’; and under Section 90(3) that the Governor in Council may repeal the Marine Parks Act and the Marine Parks Regulations.

### *Management of the Marine Park System*

Current management of the Marine Park System, including Junks Hole Marine Park and Rendezvous Bay, is the responsibility of the DFMR, not because it is the official managing agency (none has yet been designated), but rather due to the Department's general mandate of promoting sustainable use of the marine environment. Furthermore, DFMR's quasi-managerial role has necessitated an *ad hoc* approach as no official management plans exist for these areas (OTEP ANG402, 2007). As part of this assumed management role DFMR installs and maintains mooring fields in three of the marine parks (Prickly Pear, Sandy Island and Little Bay), with plans to extend this to Shoal Bay-Island Harbour. In a similar way, on top of its regular mandated work, DFMR also conducts regular beach monitoring surveys, which although technically (or at least partially) outside of their jurisdiction, they conduct for similar reasons as they do the management of marine parks.

This lack of designation of an official management agency is largely due to the inevitably complex political nature of small island developing states such as Anguilla, especially when considering the management of areas with jurisdictional cross-overs and their multi-disciplinary nature. For example, DFMR is mandated to manage marine and coastal resources only up to the high water mark, with other agencies responsible for terrestrial areas (for example the Department of Environment, Anguilla Air and Sea Ports Authority, etc.). For this reason, it is likely that for the successful management of these areas, new legislation or amendments to existing legislation will be needed. This appears to be one of the functions behind the Biodiversity and Heritage Conservation Act, which deals with the multi-disciplinary nature of marine and coastal systems by jointly assigning the administration of this Act between the Minister of Fisheries and Marine Resources and the Minister of Environment. This is the first jointly administered Act in Anguilla and potentially paves the way for more unified and successful management of protected areas: where the Minister of Fisheries and Marine Resources is the competent Minister with respect to aquatic species, their habitats, and protected areas that are established and maintained to primarily protect aquatic species and their habitats; and the Minister of Environment is the competent Minister with respect to terrestrial species, their habitats, and protected areas that are established and maintained to primarily protect terrestrial species and their habitats. Until the production and enactment of the BHCA regulations the full implications of this Act remains unclear, although problems relating to the lack of an official management agency may be resolved. Prior to this taking place, or prior to the Marine Parks Act naming DFMR as the lead agency, their *ad hoc* role will continue.



### *Historical Record of Marine Management Plans*

Although management plans have been produced in the past, none have officially been adopted for Anguilla's Marine Park System, or indeed any of Anguilla's Marine habitats and/or fisheries. According to Oxenford & Hunte (1990), the Anguilla Resources Development Project (ARDP) conducted in 1980 was one of the first steps towards the management of coastal resources and habitats in Anguilla. This work, initiated by the Government of Anguilla and the Eastern Caribbean Natural Area Management Programme resulted in three reports: Salm (1980); Olsen & Ogden (1980); and Jackson (1981). This latter report proposed a preliminary management strategy for Anguilla's critical marine resources and essentially became Anguilla's first marine management plan. This plan also contained the first recorded management zonation map for Anguilla's immediate marine areas and cays, and proposed national marine parks at Sandy Island and Shoal Bay East together with a number of other multiple use zones with varying degrees of protection and/or management (see Appendix 1). As a side note, a policy statement on marine parks for Anguilla (Gov Axa, 1978), which was probably still being discussed while Jackson collected his field data, although not a management plan, did suggest four areas around Anguilla be established as marine parks: the reefs around Sandy Island; the waters around Prickly Pear Cays; the reefs and waters at Little Bay in the Flat Cap Point region; and the reefs around Shoal Bay East.

The work by Jackson, combined with reports of habitat degradation in other parts of the Caribbean, led to an increasing recognition of the urgent need to manage Anguilla's coastal resources (Oxenford & Hunte, 1990). Indeed, the importance of protecting coastal marine resources was stressed further in the 1987-1997 Fisheries Development Plan for Anguilla (Stephenson, 1987). Thus a program was initiated to establish a number of marine protected areas around the island, and an action plan produced by Jackson (1987) laid out a road map for the development of marine parks. This action plan used the same zonation plan as his earlier 1981 paper, which was again used (Goodwin, 1989 – Appendix 1) in a simplified form by in what appears to be a sister project conducted by the Caribbean Conservation Association, the same body who requested the action plan produced by Jackson (1987). Goodwin cites a number of unavailable reports that appear to have been assessing the various areas around Anguilla being proposed as protected areas (namely: Dog Island; Sombrero Island; Seal Island; Prickly Pear Cays; Scrub Island; Shoal Bay East; Sandy Island; Corito Bay; and Little Harbour).

The marine park areas that were eventually established in 1993 were only partially complimentary to those proposed by Jackson (1981) and Goodwin (1989), and as such the zonation plan became somewhat outdated. At the same time though, Jackson's rationale was still being used as a general guideline for the development of management approaches for the coastal resources of Anguilla up until Oxenford and Hunte (1990), and on into the mid-late 1990s. The work conducted by Oxenford and Hunte does give detailed descriptions of Jackson's recommendations and contributes a number of suggestions as to how to update the work based on the ecological monitoring they conducted. Despite this, and their recommendations for management of marine resources at their study sites, Oxenford and Hunte did not describe a detailed management strategy for the island and thus no up-to-date management plan was in effect during the establishment of the marine parks in 1993. Regardless, it is generally agreed that the marine parks are located in optimum locations, although it may have been beneficial to have included additional areas in the Marine Park System (Scrub Island and Anguilla Island-Blowing Rock, for example).

A decade later in 2001 a new management plan was produced for Anguilla's marine parks (Hoggarth, 2001). It was prepared for the Organisation of Eastern Caribbean States Natural Resources Management Unit in St Lucia, under a project funded by the Department for International Development in the Caribbean. No known record exists of the Government of Anguilla directly requesting the production of this plan although acknowledgements of help are given to members of DFMR and other stakeholders. The plan, based on seven days of research in Anguilla and those data available at the time, is a thorough attempt at organising action towards the management of Anguilla's marine parks, although the plan itself was never formally adopted. The plan is cited as being a draft interim management plan only, and states that "this management plan should be regarded only as a first attempt at describing the status and management of Anguilla's marine parks". It goes on to say that "As guided by the terms of reference, the main focus was placed on assessing needs for monitoring the status of marine habitats. In this and other areas, much further analysis, consultation and design remains to be done", and "This interim plan should be upgraded to a first full management plan upon completion of a further participatory planning process as described in the following sections. Anguilla's marine resource stakeholders need to agree the future goals and institutional arrangements for the marine parks system, and the objectives, zonation, and regulations specific to existing parks and any new parks" (Hoggarth, 2001, page 6).

At the time of its writing, the 2001 management plan was based on the ecological data collected by Oxenford and Hunte (1990) and recognised the fact that these data were in need of updating and as such that the initiation of a long-term monitoring scheme be of immediate and utmost importance. Thus, although this interim plan was not upgraded directly as recommended, it may have contributed to the priority that DFMR placed on collecting such data five years later (see following Section). Furthermore, the relative completeness of the plan means it is an ideal foundation for the current management plan being developed and, as such, this plan may be viewed as the upgraded version that Hoggarth recommended.

### *Historical Record of Ecological Data Collection*

The earliest known report specifically aimed towards fisheries management in Anguilla was authored by Camacho R.V. (1974). As no known copies of this report were able to be located it is unclear whether any data were collected as part of its production. It is, in fact, unlikely that they were as a later report by Olsen and Ogden (1980), the earliest known surviving report orientated towards fisheries management in Anguilla, states that “there has been little previous work in Anguilla” and that “These fisheries are poorly known since they have been largely overlooked by the United Nations Development Project of the 1960's and have not been visited by the Western Central Atlantic Fisheries Common which has recently produced many useful analyses of the fishery potential of many of the Caribbean Islands” (Olsen & Ogden, 1980, page 3). As fisheries were themselves of prime concern back then, and little attention given to the habitats that they existed in, it is unlikely any ecological data had, at that time, been collected. Indeed, as Olsen and Ogden (1980) were part of the ARDP that also yielded the preliminary management strategy put forth by Jackson (1981), it is also highly probable, albeit not possible to confirm, that the zonation map proposed was not based on any ecological data either, although it did describe the nearshore marine resources and recommend a system of marine parks (Oxenford & Hunte, 1990). Also falling under the umbrella of the ARDP, the surveys conducted by Salm (1980) and outlined in his associated report, although representing the first known work on Anguilla's reefs, are believed to have contained mainly qualitative descriptions with only limited quantitative data. Reef Watch (1989, page 1) writes “Both the north and south coasts have fringing and patch reefs, together with coral assemblages on limestone terraces (Salm, 1980). The terrace assemblages are more extensive in the south, forming a 17 km reef area which was considered by Putney (1982) to be one of the



most important largely unbroken reef areas in the Eastern Caribbean. These southern reefs are however more exposed to hurricane generated damage as is evidenced by the higher percentage of dead and broken coral recorded by Salm (1980). From the limited published information available, the northern reefs seemed to support a higher percentage cover of living coral with fields of intact *Acropora palmata* and *Acropora cervicornis*".

Based on the recommendations from the ARDP, the Government of Anguilla selected a number of candidate sites for consideration in the management scheme. These sites included Prickly Pear/Seal Island, Sandy Island/Dowling Shoal, Shoal Bay, Island Harbour, Black Garden Bay, Crocus/Little Bay, Little Harbour, Corito Bay, Forest Bay, Sandy Hill Bay, Dog Island, Scrub Island, and Sombrero Island (Oxenford & Hunte, 1990). This led, in 1989, to a Cambridge-Anguilla Expedition that was mounted to examine marine habitats, initiate permanent monitoring sites and make management recommendations for the first three of these areas. This expedition collected data at these sites (Shoal Bay, Sandy Island & Prickly Pear/Seal Island), although surveys were relatively generic in nature (Reef Quality Index; Environmental Impact Index; substrate type by depth and by site; grouper species abundance; surgeonfish abundance; angelfish abundance; and butterflyfish abundance). The report from this work only presents analysed data and hand drawn maps and so only limited quantitative temporal comparisons are possible.

The Government subsequently requested assistance from the British Development Division to carry out a 'Coastal Inventory and Analysis Project' to examine the remaining candidate sites and to develop a management strategy. The project administered by the then Department of Agriculture and Fisheries, and conducted by the Bellairs Research Institute of McGill University in Barbados (Oxenford & Hunte, 1990), is the result of this request and represents the most rigorous known surviving marine and coastal ecological data for Anguilla during this period. Surveys were conducted at eight of the candidate sites (Black Garden Bay; Crocus/Little Bay; Little Harbour; Corito Bay; Forest Bay; Sandy Hill Bay; Dog Island, and Scrub Island), which diverged somewhat from what appeared to be the general site consensus of the time. Unfortunately this work did not cover Shoal Bay, Sandy Island or Prickly Pear, a fact that may be due to the Cambridge Expedition having surveyed these areas the year earlier. As it appears that this expedition was less rigorous in data collection than Oxenford & Hunte, information at these sites from the time is more limited. It is unknown if more detailed data were presented in a final report of this 1989 expedition as only an informal draft is currently known to exist. For these reasons it is only the Oxenford and Hunte data

that were used by Hoggarth (2001) to develop the first detailed management plan for Anguilla, which means significant knowledge gaps were present as only two of the five marine parks (Little Bay and Dog Island) had any detailed available data. These Oxenford and Hunte data are still used today for temporal analysis of those sites surveyed during the study (Wynne, 2010).

Following Oxenford and Hunte, in 1995 the coastal and sub-littoral habitats of the islands and reefs were surveyed and mapped under the Anguilla Marine Resources Inventory Project by rapid ground truth data collection using aerial photography from 1991 (Blair-Myers *et al.*, 1995). The output of this project provided the most accurate map of Anguilla's benthic environments at that time and was used extensively during the following two decades as the definitive reference material for planning decisions. In 1995 Hurricane Luis hit Anguilla and, according to an impact assessment study (Bythell & Buchan, 1996), significant damage to the coral reefs and seagrass beds occurred. This study used a methodology identical to that of Blair-Myers *et al.* (1995) so to allow realistic continued use of the benthic habitat map. The scale of these two projects, combined with the necessary rapid approach to surveying, does however mean that no detailed quantitative data were produced.

Early the following decade limited survey work that formed part of the Reef Check initiative was conducted on a reef 100m north of Blackgarden (Hoetjes *et al.*, 2002) and yielded a small amount of data. Additional surveys elsewhere around Anguilla do not appear to have been conducted. Following this, the Anguilla Coastal Resource Assessment Mapping and Monitoring Project (ACRAMAM) was conducted during 2004-2005, which aimed to use a similar methodology as Blair-Myers *et al.* (1995). Once completed the collected habitat data were rendered into a Geographical Information System (GIS), which became known as the Anguilla Coastal Resource Information System (AXA CRIS). The rapid assessment methodology yielded only generic ecological data but produced an important resource for future planning purposes. For a number of years this intranet resource was available to Anguilla Government employees for work related purposes. Unfortunately, glitches with the coordinate system used meant data were not always reliable, which ultimately lead to the systems discontinuation. During this time other ecologically based studies were conducted by visiting overseas students indirectly yielding data for various areas around Anguilla. The most notable of these were conducted on the Spotted Spiny Lobster (*Panulirus guttatus*) in 2004 (Wynne, 2004; Wynne & Côté, 2007) and reef fish surveys conducted during 2003-2004 as part of a wider ranging Ph.D. thesis (Molloy, 2006).

The first detailed ecological data collected for the Anguilla Marine Park System were obtained as part of a project entitled 'Enhancing marine protected areas management in Anguilla – Phase 1'<sup>2</sup> funded by the Overseas Territories Environment Programme (OTEP), where stationary point counts, roving diver surveys and benthic habitat quadrats were used to survey thirty sites within five of the marine parks. Rendezvous Bay was not surveyed at that time as it was not considered a marine park but rather an area under special management. This survey work was undertaken jointly by the Anguilla National Trust (ANT) and DFMR and produced a dataset that serves as a baseline from which future temporal comparisons can be made (Wynne, 2007). Following this project DFMR initiated a Government funded permanent monitoring scheme known as the Anguilla Marine Monitoring Programme (AMMP). This project, which started in 2007, ultimately established fifteen monitoring sites around the island, ten at coral reef sites and five at seagrass sites. Sites were located in certain areas within the marine park system as well as within non-marine park sites, thus expanding Anguilla's ecological dataset to include representative sites within other shallow water habitats. These data, combined with that collected at the thirty OTEP sites, form the basis of the current management plan.

In 2010 DFMR began its first detailed fish catch data collection and analysis, although these data are currently used to provide fish landing statistics to requesting agencies, with no dedicated official report yet produced. Ultimately, these data will fill an important gap in marine ecological data for Anguilla, and be used as reference materials for fisheries related management decisions and report writing.

A second important gap in ecological information that needs filling is that for benthic habitats and fish populations around Sombrero Island. Based on its inclusion within the Marine Parks Regulations (2010), this area needs to be encompassed by this management plan, but until ecological data are collected no informed management recommendations can be made. To date, the only evidence of survey work conducted around Sombrero Island is an unavailable and undated report produced by Christoph Grueneberg, an overseas student working in collaboration with the Anguilla National Trust entitled 'Survey of the Fish & Coral Fauna on Sombrero Island' (Wynne, 2010). It is probable that Sombrero Island will in fact be more relevant to the Anguilla Fisheries Development Plan (AFDP) currently in production (Gumbs *et al.*, 2015). The AFDP will serve as a

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<sup>2</sup> OTEP Ref: ANG402-2007



sister document to this management plan. Overlap intentionally occurs between these two plans to link them together, but the AFDP is more relevant to deeper offshore areas where pelagic fish stock are potential targets (see following Section). It is the aim of both plans combined to steer fishing in Anguilla more towards these offshore resources to protect shallow coastal areas. This common goal, but difference in ultimate focus, is the reason the AFDP has not been included as part of this plan, yet will be developed in unison with it.

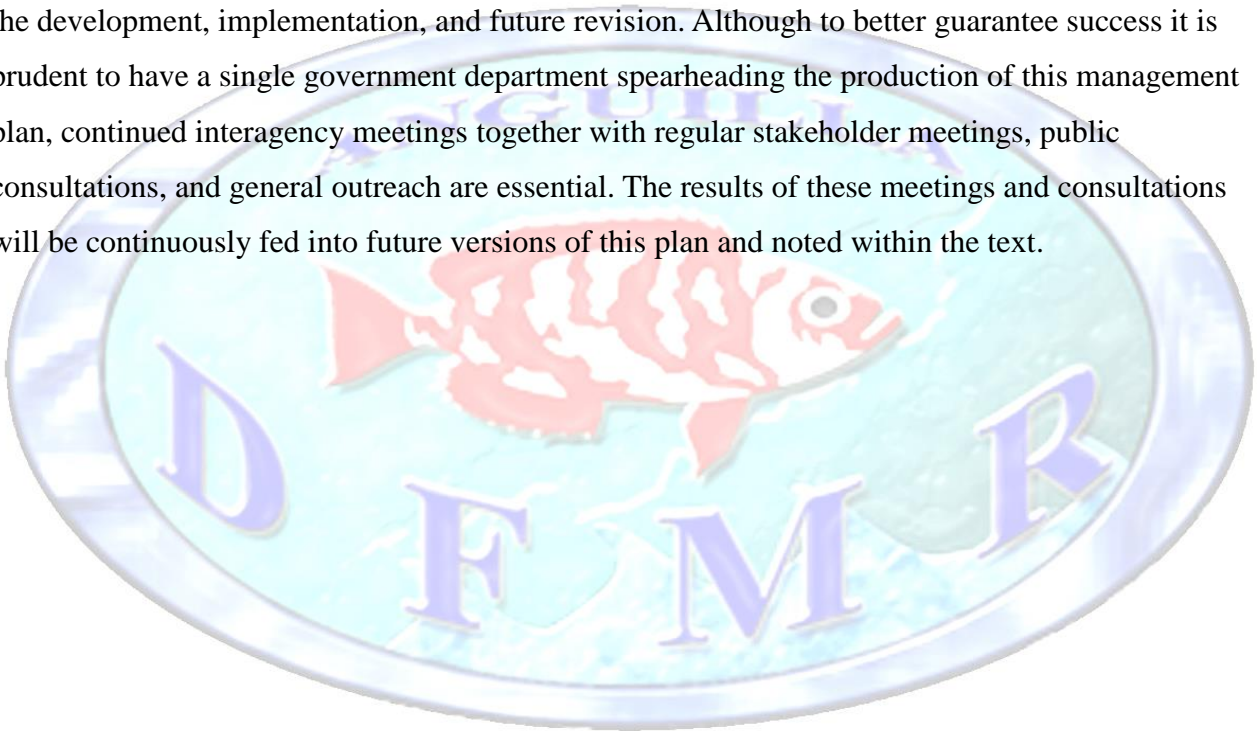
### *Scope and Successful Implementation of this Management Plan*

This current plan sets out to be a comprehensive management breakdown not just for Anguilla's marine parks, but also for nearshore shallow water habitats and associated fisheries. These latter facets will serve to link the marine parks together into a true network with an all-encompassing nature that will hopefully aid the management plans official adoption. As mentioned earlier areas that are not included within this plan are more distant deeper offshore regions and the pelagic fisheries that they may contain. These areas will be covered by the AFDP although additional studies may be required to clarify pelagic stocks and include fishing grounds not yet surveyed (for example: Old England, that lays 20 km northeast of mainland Anguilla; and Tuna Bank, that lays a similar distance to the West). Pelagic fisheries that cross-over into the Marine Park System (or the proposed Anguilla Marine Management Area – AMMA) will be mentioned in this plan, but again be more relevant to the AFDP. Examples of such include sport fishing and trolling for pelagic species in nearshore areas. As mentioned above, one of the over-arching purposes of this management plan to compliment the AFDP and help steer the Anguillian fishing industry towards offshore fisheries resources in order to help mitigate known degradation of nearshore reefs and other fishery resources (Wynne, 2016; Chapter 2). Due to the wide ranging nature of this report legislation governing its success falls under the Fisheries Protection Act as well as the Marine Parks Act (or BHCA once it's regulations are produced. Efforts have been made throughout this report to clearly identify which legislative amendments fall under which Act in order to clearly steer its developmental progress.

This plan uses baseline data for the marine parks collected and reported in Wynne (2007), and current up-to-date monitoring data that were collected as part of the AMMP (2007-2010). AMMP has continued beyond 2010, but these data will only be used for subsequent revisions to this plan as

they have yet to be fully organised and analysed. These revisions will allow adaptive management to be undertaken, which is characterised by a flexible approach to management, where both environmental and socio-economic conditions change over time. As stated by Hoggarth (2001, page 7) 'What is appropriate today may not be appropriate tomorrow or in ten years time. An adaptive approach is thus recommended, that recognises the complexity of natural resource management and develops management strategies based on learning and feedback'. This feedback system is illustrated in Chapter 4 (Wynne, 2016), which is the framework this plan will follow.

Finally, to ensure the successful adoption of this plan it is essential that it is based on an integrated and multi-disciplinary approach, and one that is fully participatory in terms of those involved with the development, implementation, and future revision. Although to better guarantee success it is prudent to have a single government department spearheading the production of this management plan, continued interagency meetings together with regular stakeholder meetings, public consultations, and general outreach are essential. The results of these meetings and consultations will be continuously fed into future versions of this plan and noted within the text.







## Section 2: Habitat Descriptions

### *General Areas and Data Sources Used*

The current plan seeks to unite the Marine Park System with other identified management areas and objectives around the island. The largest of these areas, Anguilla's exclusive fishery zone (EFZ), stretches 200nm north of mainland Anguilla. Very little data currently exists for this area, but anywhere beyond Sombrero Island depths exceed 1 km and as such any fisheries would be pelagic in nature and benthic communities unknown. The EFZ is that which DFMR hope to encourage the use of to reduce pressure on the nearshore reefs, a plan laid out in more detail within the AFDP (Gumbs *et al.*, 2015). Within a small southern portion of the EFZ lays AMMA, which despite its size, is where most current fishing activity takes place. It is depicted in Figure 5 in the following Section, and can be generally defined as the region of coastal ocean that surrounds mainland Anguilla and its offshore cays, excluding Sombrero Island. In the extremities of AMMA are regions reaching over 500m in depth, although the majority rarely exceed 50m. AMMA is realistically the maximum size that DFMR could effectively patrol in combination with the Marine Police. To patrol the entire EFZ would require substantially larger vessels and more man power than is currently available. The habitat within AMMA is better understood than that in the extended EFZ, but few quantitative surveys have been conducted. Collaborative Conch studies undertaken by DFMR in 2014 & 2015 filled this gap somewhat, where an underwater video array was used to survey a cross Section of sites within AMMA. Results of this study have yet to be published but will form a valuable resource for subsequent versions of this document.

Scaling down a level is the CZFMA and Marine Park System. Aside from a small portion in the northern edge of Shoal Bay and Island Harbour Marine Park, depths within the CZFMA and Marine Park System do not exceed 30m. For this reason they are the best understood marine areas within Anguillian waters. As mentioned in the previous Section, data collected by Wynne (2007) will serve as baseline information for the five established ecologically based marine parks. These data will be used in combination with those collected as part of the ongoing AMMP initiative. This initiative serves to fill the long-term monitoring gap identified in past studies (Hoggarth, 2001), and data spans not just the marine parks but also other areas of interest (for example Rendezvous Bay and some other shallow water habitats within the CZFMA). These data will form the critical quantitative backbone of this management plan, as well as being used extensively within other

DFMR objectives. This plan also encompasses data outputs from Chapters 1 – 4 (Wynne, 2016), and will be cited as such within the text. Further data used as reference materials for this plan will relate to fisheries management aspects and be derived primarily from fish catch data collected by DFMR over the last five years. Any other data sources will be cited within the text. A map of generalised marine habitats around Anguilla (based on the ACRAMAM project) and the location of AMMP sites is presented in Figure 3, with boundary coordinates and general habitat types for Anguilla's marine parks in Table 1.

### *Marine Park Areas*

Below can be found basic descriptive details of the park areas as they currently are, including, aside from habitat descriptions, summarised recreational uses and fishing that occurs in the area. The overall vision and goals for these parks can be found in Section 5 and comprises the core managerial unit of this document in combination with Section 6 (implementation and outcomes).

Junks Hole Marine Park: Surrounding the area within a radius of 500 yards (457 m) from GPS coordinates marking the location of the wreck of the Spanish Galleon El Buen Consejo. This area (c. 0.65 km<sup>2</sup>) is not of ecological significance, being protected instead as an important heritage site. For this reason it is not considered part of Anguilla's Marine Park System. The overall area of this park should also be given.

Dog Island: The second most distant park from mainland Anguilla, lying approximately 15 km north-west of mainland Anguilla, Dog Island Marine Park, which includes three smaller cays and other scattered rocky outcrops has an overall area of c.10 km<sup>2</sup> (c.4.5 km x 2 km). The island itself comprises 207 ha of limestone and is recognised as an Important Bird Area (IBA) by Birdlife International (since 1999). Much of the marine habitat consists of sand patches and flat pavement, low complexity, hard bottom communities. The most ecologically diverse area exists between Dog Island and West Cay, where topologically complex subsurface rocks are encrusted with a large variety of sponges, soft corals and hard corals. There is a wide diversity of fish species in the area, with pelagic and reef species coexisting throughout the area. This leads to favourable fishing in the area, although again, its distance from mainland Anguilla serves to restrict this activity somewhat. Sharks are relatively common and turtles are often sighted making this an attractive area for

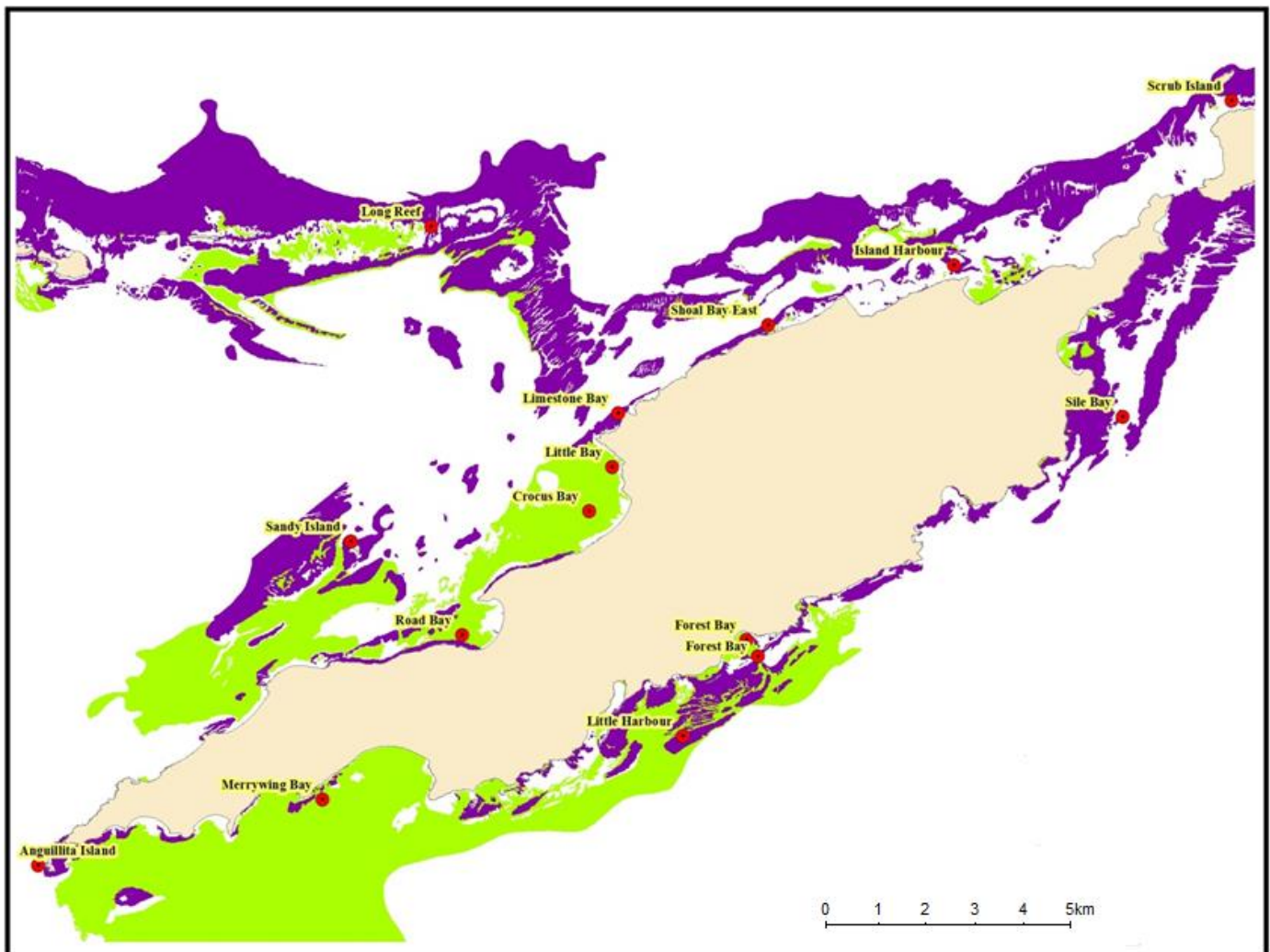
recreational diving. Great Bay is also an important sea turtle nesting site. Sea conditions and strong currents mean survey work can be problematic to conduct here, thus only three baseline 2007 sites could be surveyed and despite a number of efforts it is not included within current AMMP monitoring. Lobster, snapper and conch fishing occur in the area as well as trap fishing for reef fish species, spearfishing, and seasonal 'rounding of the jacks'.

Prickly Pear Cays and Seal Island Reefs Marine Park: This park, the largest within the Marine Park System, lies approximately 9 km north-west of mainland Anguilla and consists of three main cays with an overall park area of c.33 km<sup>2</sup> (c.12.5 km x 2.5 km). Prickly Pear East, with an area of 31 ha of dense scrub, with Hoggarth (2001) recognising it as an IBA due to 180 pairs of nesting Bridled Terns (*Onychoprion anaethetus*). Up-to-date bird counts are presented in Lloyd & Mukhida (2014). Extensive sand and rubble patches are present around the cays, with a number of small rocky outcrops and a chain of barrier reefs stretching c.10 km eastwards. This barrier reef has extensive hard and soft coral communities together with a wide variety of reef fish species. Juvenile turtles frequent the area, both Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata*) Turtles, with a small amount of nesting known to occur on certain beaches. Although little data exists to corroborate as such, it is believed that this reef system has degraded markedly over recent decades due to fishing impacts, coral diseases, and hurricane damage. One sign of this is that the area, although still important for fishing, is not visited by fishers in the numbers once reported (S.Wynne, pers. obs.). No recreational diving regularly occurs in the vicinity although the cays are a very popular snorkelling spot with dozens of tourists descending on the reefs closest to shore on a daily basis. Eight sites were surveyed for baseline data collection in 2007, and one AMMP site is located towards the more pristine eastern end of the barrier reef system. Trap fishing for local 'crayfish' (*Panulirus guttatus*) occurs extensively along the barrier reef system as well as spearfishing and trap fishing for reef fish species.

Sandy Island Marine Park: One of the smallest offshore cays within the marine park system, situated only a few km north-west from mainland Anguilla. The cay is made entirely of sand and coral fragments/rubble, with the park itself having an overall area of c.5 km<sup>2</sup> (c.3 km x 1.5 km). The habitats around Sandy Island are varied, with sand/rubble areas, seagrass beds, patch reefs and fairly extensive deep reefs. Dowling Shoal is one such example which has variable hard and soft coral communities and a wide variety of reef fish species. It is an important juvenile turtle habitat for both Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata*) Turtles, with a small



amount of nesting known to occur on the cay. Relatively high levels of fishing occur in the area (mainly trap fishing with some spearfishing also) and it is popular with snorkelers visiting by boat. Two or more recreational dive sites exist within park boundaries. Four study sites were surveyed for baseline data collection in 2007. The eastern most of these sites became a long term monitoring site as part of AMMP.



**Figure 3:** Generalised marine habitats around Anguilla's shallow coastal regions. Green areas represent those dominated by plants and algae (seagrass beds, algal flats etc) and purple areas are those dominated by corals and sponges (hard coral reefs, soft coral pavement reefs etc). Locations of AMMP monitoring sites are also marked. Dog Island and other further offshore areas are not included. (Map modified from version taken from Gumbs, 2012).

Little Bay Marine Park: This triangular shaped coastal protected area is the smallest within the marine park system (<1 km<sup>2</sup>, c.1 km x 1 km x 1 km triangle), extending from Pelican Point (southern tip) to Flat Cap Point (northern tip). The bay has extensive seagrass and is considered to be an important nursery area for reef fish species and spawning ground for Yellowtail Snapper (Hoggarth, 2001). The small size of this park, combined with the fact that it attracts a lot of visitors, mean user conflicts are reportedly high. It is a very important juvenile turtle habitat for both Green (*Chelonia mydas*) and Hawksbill (*Eretmochelys imbricata*) Turtles, with occasional nesting activity on the beach. Some hard and soft corals are present in the submerged rocky coastal regions together with a variety of reef fish. Snorkelling is very popular here but no diving occurs aside from the occasional training course. A small number of fish traps can occasionally be found within the park area, but fishing is mainly hook and line from the sea rocks, spearfishing, or seasonal seine netting for species of Jacks (Carangidae).

Shoal Bay and Island Harbour Reefs Marine Park: The largest of the marine parks bordering Anguilla's mainland coastline at c.19 km<sup>2</sup>, this area flanks one of the longest stretches of white sand beaches in Anguilla. The northern limit of the park runs for c.7 km at approximately the same latitude as the southern end of Scrub Bay. This northern boundary lies 3.5 km offshore at the western end of the park past Lower Shoal Bay East and 1.75 km offshore at the eastern end of the park beyond the important fishing community of Island Harbour (that includes Scilly Cay). Habitats, and therefore resources in the area, are varied ranging from extensive patch reefs to fringing *Acropora palmata* reefs and mixed seagrass beds. The area is important for virtually all marine species including juvenile sea turtles that forage in the area, and adults that regularly nest on the beaches from March through November. It is a popular snorkelling spot although diving, which was once popular in the area, no longer regularly occurs due to reported degradation and travel distances for dive operators. Fishing is common and ranges from spearfishing to lobster fishing for *Panulirus spp.* Twelve sites were surveyed for baseline data collection in 2007. One of the most westerly of these became a long term monitoring site as part of AMMP, with a second site eastwards close to Island Harbour. An important socio-economic study was conducted for this park in preparation for the development of a management plan which highlighted the challenges that this area will face (Mukhida & Gumbs, 2007). This report played an important role during the development of the current management plan.

Sombrero Island Nature Reserve Marine Park: This park encompasses the land and sea areas within a 2000 yard (1.83 km) radius of GPS coordinates marking its central point, giving it a total size of 10.5 km<sup>2</sup>. Historically, this island played an important role in Anguilla as it was the site of relatively extensive phosphate mining derived from bird guano that was exported as fertiliser. This mining was conducted first by the Americans in the mid 1850's and later by the English who took over operations in the mid 1860's. By 1870 the mining operation was yielding 3000 tonnes of phosphate each year, but by 1890 reserves were exhausted and operations ceased. There are still ruins on the Island that remain from this time and as such Sombrero Island is considered an important heritage site. The first lighthouse on the island was erected in 1868 which was replaced in 1962 after hurricane damage. The Lighthouse was manned until 2001 when an automated system was put in place. The Ministry of Infrastructure, which DFMR falls under, is still responsible for the maintenance of this navigational aid, and visits the island with the Marine Police sporadically. Today the island is visited only occasionally by fishers, biologists, divers and Government staff. The island has been identified as an IBA by Birdlife International due to a number of breeding seabird species, and is being nominated by the Government of Anguilla as a Ramsar site. One short report (Grueneberg, undated) is the only evidence of any past survey work being conducted there. One dive was undertaken by DFMR staff in the southern coastal area in 2009 that classified it as a rocky pavement reef habitat in some ways similar to that found at Dog Island, with an abundance of pelagic fish species. Quantitative data of the marine habitats around Sombrero were collected during four underwater video array transects in 2015 by DFMR (report in preparation). Further survey work is recommended before management measures can be proposed.

Rendezvous Bay: Although not yet officially a marine park, the area has extensive seagrass beds and as such listed as a no anchoring zone. Its boundary transects the bay from Shaddick Point to Cove Bay Point, and includes the smaller Merrywing Bay. As a seagrass habitat it is considered to be an important nursery area for reef fish species and Hoggarth (2001) notes that it is a spawning ground for Yellowtail Snapper (*Ocyurus chrysurus*). It is also important for juvenile foraging Green Turtles (*Chelonia mydas*) and as a nesting site for adult sea turtles. No diving occurs here and snorkelling is relatively uncommon due to the overall sand/seagrass benthic nature of the area. The beach is relatively busy in the tourist season due to surrounding coastal developments. A small number of fish traps can occasionally be found within the bay, but on the whole fishing does not regularly take place here. The area includes one AMMP monitoring site at Merrywing Bay.



**Table 1:** Boundary coordinates and general habitat types for Anguilla's marine parks as listed in the Marine Parks Regulations (2010). The coordinates listed for Sombrero appear to be erroneous as they relate to a central point out as sea, the 2000 yard radius of which only partially encompasses the Island – as it is listed as a 'Nature Reserve Marine Park' this suggests that the entirety of the island was intended to be included. New coordinates have been suggested in the legislative amendment Section.

Marine Park Name	General Habitat Type	North Western Corner	North Eastern Corner	South Eastern Corner	South Western Corner
Junks Hole Marine Park	Coast and Shallow Rocks	18° 15'74"N 62° 58'29"W	500 yard radius from central point	500 yard radius from central point	500 yard radius from central point
Dog Island	Offshore Islands	18° 17'17"N 63° 16'32"W	18° 17'17"N 63° 14'00"W	18° 16'07"N 63° 14'00"W	18° 16'07"N 63° 16'32"W
Prickly Pear and Seal Island	Offshore Islands & Reef	18° 16'46"N 63° 12'07"W	18° 16'46"N 63° 05'05"W	18° 15'24"N 63° 05'05"W	18° 15'24"N 63° 12'07"W
Sandy Island	Seagrass and Reefs	18° 13'00"N 63° 08'25"W	18° 13'00"N 63° 06'49"W	18° 12'06"N 63° 06'49"W	18° 12'06"N 63° 08'25"W
Little Bay	Seagrass	18° 13'54"N 63° 04'26"W	Triangular Area	18° 13'21"N 63° 04'09"W	18° 13'20"N 63° 04'38"W
Shoal Bay and Island Harbour	Coast & Reef	18° 16'45"N 63° 03'12"W	18° 16'45"N 62° 59'20"W	Sea Rocks at 63° 03'12"W	Sea Rocks at 62° 59'20"W
Sombrero Island	Offshore Islands	18° 36'00"N 63° 26'30"W	2000 yard radius from central point	2000 yard radius from central point	2000 yard radius from central point
Rendezvous Bay	Coast & Seagrass	Coast Line Curvature	Coast Line Curvature	18° 10'06"N 63° 07'40"W	18° 10'04"N 63° 06'16"W

*Shallow Water Areas <30m (that fall under the CZFMA and AMMA)*

North coast regions: The north coast comprises a diverse range of habitats from extensive patch, fringing and barrier reef systems, seagrass beds, and sand/rubble areas. The reefs are largely incorporated as part of the Marine Park System, although a number of these habitats do occur outside these areas. Beginning in the eastern-most area, Scrub Island has relatively extensive reef areas and is popular among fishers from Island Harbour fishing port. These reef areas continue

along the coast to Shoal Bay-Island Harbour Marine Park with scattered sand patches and pavement areas. Further westwards, and of particular significance, is the coastal region between Shoal Bay East and Flat Cap Point, especially the area offshore from Limestone and Blackgarden Bay. These areas, including a reef dubbed 'Anchor Reef' (no previous name recorded) that lies offshore from Flat Cap Point beyond a deep sand channel, house a wide variety of hard and soft corals and a diversity of reef fish. Fishing is common in the area, with extraction method being predominately via traps. Juvenile Hawksbill Turtles (*Eretmochelys imbricata*) forage in the area and nesting adult turtles of various species are known to nest on the beaches. There are a number of dive sites along this stretch of coast were previously visited by dive operators on an almost daily basis. Today, most of these sites are not used, reportedly due to habitat degradation combined with travel distance for dive operators. Westwards from Flat Cap Point to Road Bay the habitat becomes more dominated by seagrass with charter yachts and private boats being regular visitors, not just to Little Bay Marine Park, but also to Crocus Bay where there are no anchoring restrictions. Mega yachts also anchor in this area during high season. Road Bay is an important commercial and recreational area with numerous private moorings, many beach bars and other tourist developments, and a relatively large container port. The bay is predominantly seagrass. Further westwards beyond Road Bay, seagrass begin to dominate less and the habitat becomes sandier in nature with algae flats and/or pavement/rocky areas prevailing. At the western end of the island lies Anguillita which is surrounded by pavement/rocky reefs and drop-offs with a good variety of both reef fish and pelagic species. It is a popular fishing area and includes a regularly visited dive site. Other northern shallow offshore areas, aside from a few scattered rocky outcroppings, are comprised mainly of sand/algal flats, pavement areas and seagrass beds. AMMP sites exist at Limestone Bay (reef), Crocus Bay (seagrass), Road Bay (seagrass), and Anguillita Island (reef).

South coast regions: The south coast is far less diverse than the north coast with few extensive reef systems aside from heavily degraded fringing *Acropora palmata* areas. An exception to this is Blowing Rock which lies to the south-east of Anguillita. This small exposed rocky outcrop is surrounded by relatively diverse reef areas. Eastwards from Blowing Rock sand and seagrass areas dominate until Blowing Point where hard bottom communities and fringing reef systems begin. These areas, with scattered seagrass regions in sheltered bays (i.e. Little Harbour, Forest Bay, Sandy Hill Bay) are often characterised by coral rubble berms and rocky shores. The ferry terminal at Blowing Point is located here, with petroleum shipment mooring buoys located a little further east at Corito Bay. Corito Bay is also where Anguilla's landfill site is located. The sites proximity to the

coast is the reason for a number of anecdotal reports relating to leeching into the sea, although no research has yet confirmed this. Pavement/rocky reef areas become more dominant eastwards towards Scrub Island, although rough sea conditions in the area mean survey work is often problematic. Sile Bay and Savannah Bay house some extensive *Acropora palmata* reefs although degradation levels are high and overall coral cover low. Away from the coast into the St Martin Channel, the habitat becomes dominated by sand/rubble algal flats and sometime diverse soft coral communities. Many areas in the channel are important Queen Conch (*Strombus gigas*) grounds, and are visited frequently by conch fishers based out of Cove Bay. AMMP sites exist at Merrywing Bay (seagrass), Little Harbour (reef), Forest Bay (reef and seagrass), and Sile Bay (reef).







## Section 3: Anguilla's Marine Resources

### *Uses*

Beaches and sand: Over forty beaches surround Anguilla and its offshore cays, which are mainly comprised of picturesque white sand and very important for Anguilla's tourism sector as well as nesting sea turtles. Some of these beaches are considered the most beautiful examples of such in the Caribbean. Particularly in the Western end of the island, many of these beaches have large hotel and villa development which support Anguilla's economy. Beaches are an important buffer zone for wave action and their protection is essential. Sand extraction used to occur extensively with early development relying on it as a raw material. Sile Bay, for example, has been entirely depleted, and Windward Point Bay heavily degraded. In 1994 sand extraction was prohibited from most beaches although it was still 'unofficially' permitted at Windward Point Bay. In the past consideration has been given to sand extraction from offshore areas, although most proposals were not accepted. Currently the only area where this takes place is a short distance offshore from Barnes Bay, where sand dredging is permitted under special licence by Viceroy (large hotel development) for beach nourishment purposes.

Reefs: Shallower reefs serve as an important natural defence against storm surges and associated wave action and thus protect against coastal erosion. The reefs are also an important source of protein and a livelihood for up to 500 fishers (including subsistence). Boats are generally outboard powered vessels ranging in size from 18-32ft with two or three crew members. The fishing industry can be broadly split into two main sectors: finfish fisheries and lobster fisheries. Both of these fisheries sectors use fish pots/traps that can be broadly described as being an Antillean Arrowhead design. Finfish fisheries also use lines and seine nets, and although an extensive feasibility study was conducted into developing a long-line industry to reduce reliance on fish traps (R.Hodge pers.comm.), to date little development has occurred. The two lobster fisheries (*P. argus* and *P. guttatus*) operate mainly from the north-eastern harbours and target individuals in and around north coast reef areas. A growing *P. guttatus* hand capture fishery has also been identified that targets individuals all around the island in close to shore regions, often by opportunistic residents on a sporadic basis (Wynne, 2004). Diving is also an important service provided by reef areas with three operators currently in business on the island.

Seagrass: These habitats serve as important nursery areas for certain species of reef fish, feeding grounds for sea turtles, and important for the Queen Conch (*Strombus gigas*) fishery. Although the conch fishery is small, it provides a much sought after protein source, also being conducted on a more recreational basis by snorkelling residents. Another important function of seagrass is sand fixation, where the plants' root systems restrict sand movement during storm surges or times of increased wave action.

Mangroves: Limited mangrove stands exist around Anguilla, with most fringing salt ponds rather than coastal zones. Those present, however, do contribute to coastal stability and trap sediments and nutrients that may otherwise enter the marine system. They also provide important nursery areas and feeding grounds for many marine species.

Mud and bat/bird guano: Although not technically a marine resource this material has been included as it occurs in the cliffs and small caves of Little Bay. The mud especially is collected and used as face-packs, and as the area in question is quite small, even limited extraction can lead to increased erosional processes and thus affect the park. Bird Guano, the source of the phosphate mined on Sombrero Island is no longer extracted and is believed to be exhausted. Terrestrial survey work would be needed to confirm this.

Open water: Often overlooked as a marine resource, open water areas are important recreational sites that also house pelagic species which can be an important source of protein and lucrative livelihood for local residents.

### *Threats & Impacts (local)*

The local threats detailed below have impacts that, at times, cross-over into different habitats, or have multiple impacts affecting multiple habitats. Details for some of these interactions can be found in Wynne (2016). These cross-overs have been highlighted below but are grouped together for ease of reference. Figure 4 illustrates areas where some of these threats have been identified as a cause of concern.



Sand mining: The removal of beach material was once a common practice in Anguilla, but has been heavily restricted for a number of years. It still occurs throughout the island, but most notably at Windward Point, Junks Hole and Forest Bay (F.Mukhida, pers.comm.). The impacts of this practice ultimately lead to the complete loss of any recognisable beach, as can be illustrated by Sile Bay. Windward Point Bay is also heavily depleted of beach material. Erosional processes are evident and appear to be leading to land loss. Areas affected also become less aesthetically pleasing and less attractive to tourists and residents. For example, Sile Bay was once one of the more popular beaches for local residents to visit during weekends. It is now virtually always deserted. This historical context can be corroborated with tourist maps of the area that depict it as a sunbathing beach. Sand mining also passes on a message of irresponsibility: Anguilla's economy depends on tourism which, in turn, depends on its beaches. Tourists cannot understand why a local population that directly thrives on this industry would allow the practice to continue.

Removal of beach flora and coastal development: Vegetation on beaches helps maintain their stability and restricts erosional processes. In the past mangroves were harvested for fire wood and construction purposes (principally fish traps). More recently however coastal vegetation is removed for tourism purposes - to make way for building or to 'enhance' the area for sunbathing/recreational activities. Erosional processes and the role beach vegetation plays in its mitigation can be currently observed at the east end of Shoal Bay East. After a period of accretion, erosion began again (c.2008) on the Upper Shoal Bay side of Shoal Bay Point. The beach itself disappeared rapidly, but erosion was slowed by palms, sea grapes and other vegetation. Many of these palms eventually washed away, and can now be seen underwater a short distance offshore. Erosion has continued to this day, but the vegetation line has slowed it dramatically. Without this vegetation, it is probable that Shoal Bay Point would have eroded away almost entirely. Sand accretion devices have been attempted in the past but overall were unsuccessful.

Beach vegetation is also essential for nesting sea turtles that rely on it to provide a range of internal sand temperatures. Sand temperatures affect sea turtle hatchling sex ratios where males develop at cooler temperatures than females. The removal of flora, and thus cool nesting spots, can therefore lead to an over-production of females and an overall drop in turtle population fecundity (Broderick, *et al.*, 2000). Coastal developments are often the drivers that lead to the removal of beach flora. In addition, if conducted in an inappropriate way and/or location these developments can also lead to cliff instability which may increase land based sediment input due to collapse or rainwater runoff.

This will lead to increased water turbidity and impact benthic marine communities through decreased light penetration or smothering. Coastal developments can also pose a pollution risk if undertaken in close proximity to the shore. Pollution as a threat is, however, discussed under a separate heading.

Anchor damage: Inappropriate and careless anchor placement can cause extensive damage to all habitat types, especially during times of increased swells/currents. This can especially be the case in seagrass areas where an anchor may have to be set multiple times before it catches. Dragging anchors can rip long gouges into seagrasses and, if unnoticed, can also pose a danger to the vessel using the anchor. In reef areas anchors can similarly drag across the bottom while seeking a hold thereby damaging small hard/soft corals, sponges and other benthic life. Once secured, if under excessive pressure during swells, entire coral heads can be snapped off. Even large coral heads can be ripped up by large enough vessels. This situation is especially problematic in areas of 'reef' that are in fact rocky areas encrusted by corals, and the rocks, not being directly fixed to underlying solid substrate, can move if sufficient force is placed on them. Anchor lines can also tangle around coral heads and snap, causing damage over time to coral polyps through rubbing.

Overfishing and removal of herbivorous species: The harvesting of fish species is essential for local livelihoods and the tourist trade but, if carried out unsustainably, can have long-term negative effects on these industries and overall ecology. Creating the correct balance of this resource use versus negative impacts can be one of the biggest challenges faced by managerial agencies. Reduced fish numbers can lead to fishing practices becoming less economically viable and an overall reduction in fish availability as a food source. Depleted reef areas are less attractive for divers and snorkelers and lead to a negative image of the managing agencies. Spearfishing on reef areas can actively target fish species in such an efficient manner that areas of patch reef can be rapidly depleted if this practice takes place in an unregulated fashion. Often in Anguilla, many of the fish targeted by spearfishers do not end up being used as a direct protein source, and are instead utilised to bait lobster pots. Lobsters, the most economically valuable fishery resource by weight, are much sought after in the tourism industry. In addition, the removal of herbivorous fish species can lead to under-grazing of macroalgae, affecting the coral-algae balance. It is especially important to promote the sustainable use of herbivorous species as regional/locally sourced eutrophication can increase algal growth rates.

Fish trap damage: If placed directly onto the reef, fish traps can cause severe damage to the benthic life underneath or adjacent to them. When retrieving the trap it can drag along the bottom snapping off small coral heads and other encrusting species, especially during rough seas. Trap lines easily become entangled around coral heads and can either lead to damage of the head or loss of the trap entirely. Lost traps continue catching fish (ghost fishing) until they finally degrade sufficiently. This process can take a number of years especially when zinc anodes are used by fishers on their traps to reduce mesh corrosion.

Boat groundings and engine damage: During times of adverse weather conditions navigating the shallow reef areas can be problematic, especially for fishers who need to place their fishing gear close to the reef to target their desired species. This can be an increased problem for fishers targeting the lobster species *P. guttatus* via traps, as they need to be placed very close to the reef in often the shallowest of areas. Larger boat groundings do not happen regularly, but when they do occur can cause extensive damage to the local area, especially when attempting to retrieve the vessel. Outboard motors may also strike the reef, but vessel owners, wanting to avoid expensive damage, do their utmost to avoid this. In shallow seagrass regions however, when throttling away at speed, outboard engine propellers can gouge out strips of vegetation without causing engine damage and, as such, it is likely that less care is taken by vessel owners in these areas.

Recreational damage and disturbance: It is possible for virtually all recreational activities to be conducted in a non-destructive manner, but unfortunately this is rarely the case. Even the most responsible divers, swimmers, and snorkelers can inadvertently kick corals or disturb sediment. Water sports such as kite surfing may cause collision damage in a similar way to boats and pose a danger to swimmers. Currently jet-skiing is banned in Anguillian waters, but due to pressure from various agencies, this ban may be lifted in the future and a zoning scheme introduced. If this happens it will also be wise to include other water sports/activities within this zoning plan to avoid conflicts.

Boat pollution – oil and grey water: There is a heightened potential threat level of oil pollution originating from boats in the commercial areas of Sandy Ground, Blowing Point, and Corito Bay (see figure 4), with reported incidents occurring at these sites over recent years. This type of pollution can be damaging to marine life (including sea birds), beaches, and recreational users. Grey water pollution originates mainly from charter and/or private yachts, and may also include the



dumping of raw sewage at sea. It is of most concern in areas of high usage by such vessels, and especially within the marine parks. Raw sewage is a serious public health concern. Dumping of grey water increases the potential nutrient load of local waters and adds to the regional eutrophication concern.

Land based nutrient input and point source pollution: This threat is complex in nature as it may arise from a number of sources, and be indirectly linked to other threats already cited. For example, salt pond leaching and terrestrial run-off can cause an increased nutrient load in coastal waters and thus add to regional eutrophication concerns. In many cases, however, it can be worse in areas where beach flora has already been removed (see previous threat). Storm surges may also cause salt pond breaches, which may be of increased concern in the future should reef areas begin to offer less storm surge protection. Linking salt ponds directly to the ocean can also increase nutrient input, as has occurred in Cove Bay where underwater pipes from a salt pond within the golf course development area exit near the fishing jetty. Other sources of pollution, some of which may include leaching from old septic tanks, are thought to be of concern, especially in older developed areas such as Sandy Ground and Rendezvous Bay. This poses a serious health concern and also again increases the potential nutrient load in local waters. Leaching may also occur from the Corito Bay landfill site. Land based nutrient input may also be heightened by the use of fertilizers or other horticultural products. It is not believed that this is of significant concern in Anguilla though as agriculture is limited and usually takes place inland.

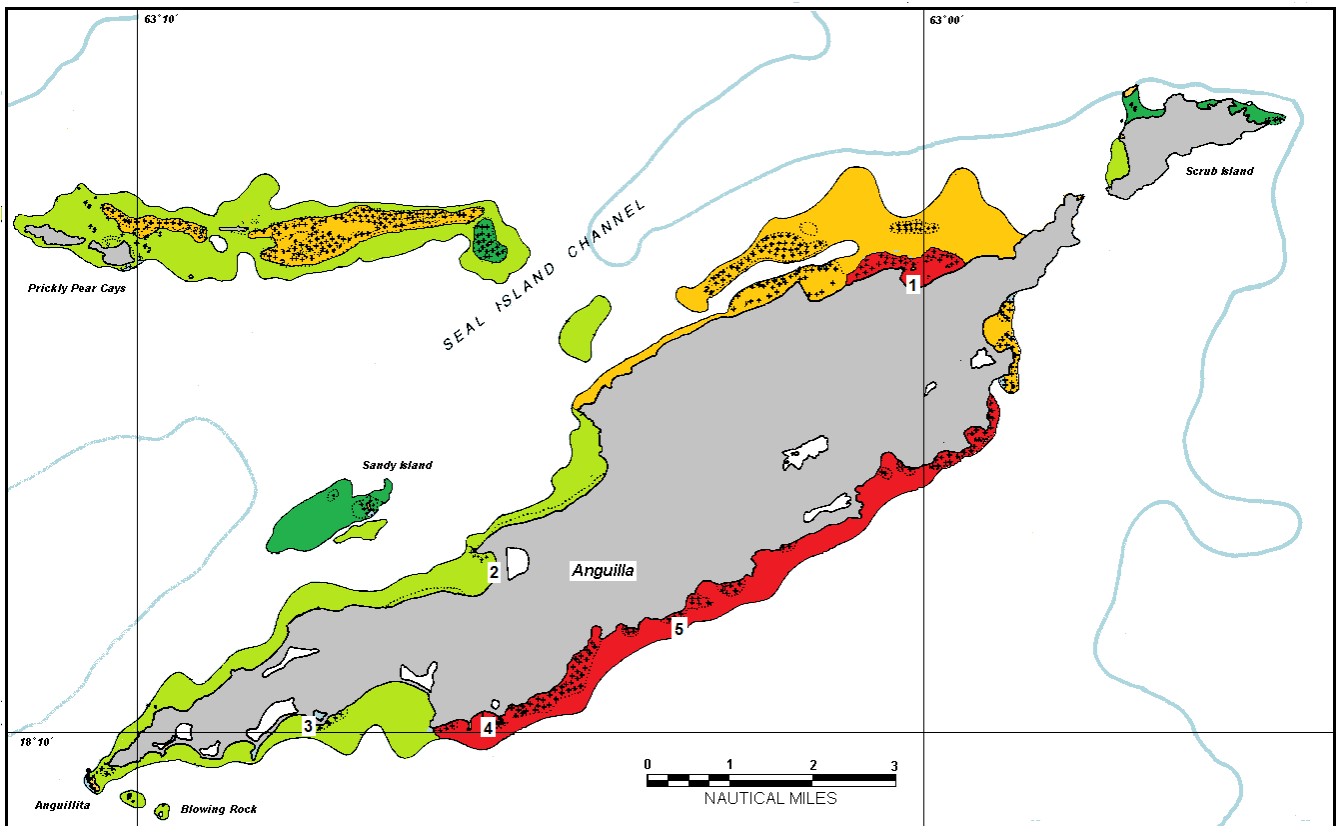
Disease and mortality events: Both of these threats are for the most part caused by other factors detailed in this Section, or by regional stresses. A number of coral diseases threatening certain coral species are due to cyanobacteria growths which can be partly attributed to increased nutrient levels either from local or regional sources. Coral bleaching, which can cause significant coral mortality during periods of high sea surface temperatures also poses a threat, although to date in Anguilla severe events have not been reported/documented. Hurricane damage can also inflict severe damage to reef areas, although it is documented to aid dispersal of certain species through fragmentation. This however may not be the case with potentially increasing hurricane frequency and reduced reef resilience through algal dominance and coral diseases. Other mortality events may come from unknown sources or recognised pathogens acting in unknown ways. Examples of this include other reported coral diseases and the mass mortality event that almost entirely wiped out populations of the important grazing species of sea urchin, *Diadema antillarum* in the early 1980's. Populations of

the urchin are still undergoing a patchy recovery even after thirty years. The exact mechanism behind this remains unclear. It is widely recognised that reduced populations of urchins have allowed algal growth to dominate certain reef areas in a similar way to the removal of herbivorous fish species. This, in combination with the regional/local eutrophication discussed within this Section suggests an over-riding reason for continued reductions in reef resilience and an associated increase in degradation.

Invasive species: The Red Lionfish (*Pterois volitans*) is currently the only known invasive marine species in Anguilla. First introduced into the Caribbean from the Indo-Pacific in the early 1990s, *P. volitans* was initially reported in Anguilla in 2010, and has since spread to virtually all reef areas around the island (S.Wynne, pers.obs). This species is a voracious hunter and can consume large numbers of juvenile reef fish, detrimentally effecting adult population numbers. With limited amounts of known and/or common predators in the Caribbean, its own population can proliferate and potentially lead to dramatic decreases in numbers of native fish. This will ultimately have negative impacts on certain livelihoods.

Litter/marine debris: Although not considered a significant problem along beach fronts in Anguilla, this is, at least in part, due to clean up efforts by resorts and community activities facilitated by the ANT. If unmanaged, underwater impacts of such debris can be significant. Marine debris can wrap around coral heads causing polyp damage and clog the digestive tract of certain marine species, especially sea turtles. Of the marine debris in Anguilla, the largest threat is posed by discarded fishing gear, most notably old nets and line. These can continue to entangle species long after having been discarded, and thus pose a 'ghost fishing' threat. This discarded gear also poses a threat to boats and swimmers who may become similarly entangled.

Removal of cliff mud/bat guano: Reportedly having therapeutic properties, cliff mud is, from time to time, removed by visitors to Little Bay. Such activity has led to a small amount of cliff instability and erosion (which may be accentuated by grazing goats). Eroded materials can increase sediment loading and raise water turbidity, in turn affecting light penetration.



**Figure 4:** Map illustrating local sources of pollution/stress overlain with relative habitat threat levels (Wynne, 2016; Chapter 2), where dark green represents healthiest/lowest threat level, up through light green and orange to red which represents least healthy/most threatened areas. Numbered locations are: (1) Island Harbour – fishing port and petrol station; (2) Sandy Ground – commercial container port and fishing port; (3) Cove Bay – fishing port and golf course salt pond pipe connections; (4) Blowing Point ferry port and fishing port; and (5) Corito Bay – petroleum port and landfill site.

### *Threats & Impacts (regional)*

As detailed in Wynne (2016; Chapter 1) regional sources of ecological stress can have potentially catastrophic environmental impacts and are inherently difficult to manage against on a local level. Threats include (but are not limited to): increased hurricane frequency; coral bleaching; ocean acidification; and eutrophication. The first three of these are essentially climate related, and aside from attempting to increase overall habitat resilience little can be done on a local level. For this reason these threats, despite their high levels of impacts (particularly to coral reefs) have been left



largely unmentioned later in this document. The latter stress however, that of regional eutrophication, can be somewhat mitigated against on a local level, as local threats can contribute to its effect even beyond the level of habitat resilience. The impacts of eutrophication include (but are not limited to): increased macroalgal growth that can out-compete hard coral species; increased cyanobacterial growth that can increase incidences of coral diseases; increased macrophyte growth on seagrasses that limit photosynthetic potential; and increased water turbidity leading to lower light penetration and affecting photosynthetic potential of both seagrasses and coral zooxanthellae.

Increased hurricane frequency: Although it may be cyclical in nature, hurricanes are reported to be increasing in number and severity in the Caribbean. Hurricanes, which causes coral fragmentation and therefore asexual dispersal of certain coral species (Lirman, 2000), can also inflict severe damage to reef areas and the coastal zone. Damage to beaches can be extensive and, if occurring above a certain frequency, may not allow natural recovery of the effected systems. One such example of this potentially occurring in Anguilla was revealed through DFMR's beach monitoring programme established in 1992. Certain beaches that were showing recovery after Hurricane Luis in 1995 were once again affected by Hurricane Lenny in 1999. Following this second hurricane, recovery occurred more slowly. By the next severe hurricane event, Omar in 2008, some beaches still had not built themselves back to pre-Luis levels. This trend continued post Hurricane Earl in 2010, and then again Gonzalo in 2014. As mentioned elsewhere, this erosion can be accentuated by reef degradation and lead to increased and unprecedented loss of beach material. This may potentially be the cause of, or a contributor to, the unusually high levels of erosion at the eastern end of Shoal Bay East over the last seven years. Hurricanes may also interact with other stressors in this Section, where, for example, decreased reef resilience (caused by, for example, eutrophication) combined with increased hurricane frequency, leads to reefs being unable to recover after such disturbance events.

Coral bleaching events: Primarily caused by increased sea surface temperatures during hurricane season, coral bleaching tends to be intrinsically linked to increased hurricane activity. It should be noted however that bleaching can also occur when corals are placed under alternative sources of stress. Regardless of its cause, coral bleaching has become a serious threat to Caribbean corals over the last decade. A major bleaching event in 2005 led to between 20-50% coral loss at many locations around the region and up to 90% at the worst hit areas (Wilkinson & Souter, 2008). Although not on the same scale as the 1998 bleaching event that occurred in the Indo-pacific region,

it did bring to the forefront the threat that coral bleaching poses in the Caribbean. No region-wide events have taken place since 2005, although sporadic localised bleaching has occurred.

Ocean acidification: While the effects of a decreased pH in the world's oceans through increased carbon dioxide absorption has yet to be quantified, it is still recognised as a realistic threat. If it continues, there will be wide-ranging detrimental effects on species that rely on carbonate precipitation as part of their life cycle, for example hermatypic coral species (Freely *et al.*, 2004). It is reasonable to conclude that this acidification will lead to decreased resilience of coral species and increased reef degradation. Anthony *et al.* (2011), for example, conclude that reefs already subjected to herbivore overfishing and eutrophication are likely to be more vulnerable to increasing carbon dioxide in the water. Effects will likely be complex, and impacts uncertain, but may include, but might not be limited to: depressing metabolic rates and immune responses; triggering coral bleaching events; and decreasing oxygen levels as algae are killed off. The overabundance of algal growth currently observed in the Caribbean however means this latter effect will unlikely be a cause for concern in the foreseeable future.

Eutrophication: Although local land-based local nutrient sources can accentuate the impacts of this threat, there has been growing recognition over recent years that regional eutrophication is a significant threat to Caribbean marine ecosystems. Wynne (2016, chapter 1) discusses this in detail and concludes that although nutrient sources are wide ranging, from cumulative build-up of local run-off and sewage, to larger scale inputs from entire ecosystems such as the Florida Everglades, one of the most seasonally significant sources is the combined output from the Amazon and Orinoco river plumes. These plumes appear to be the contributing factor behind recent Green Water Events (GWE) in the Caribbean during 2009 and 2010. The GWE signify high levels of nutrients in the water column that increases productivity and reduces light penetration, thereby affecting coral survival. At the same time, GWE also bring with it increased numbers of fish and top predators that feed on these fish. The algal bloom metabolises the nutrients, and over time nutrient/algal levels are reduced to a less noticeable background level. After the event, increased turbidity can still persist through excreted metabolites and other waste products. These slowly sink to the bottom, thus increasing sedimentation rates. Even after this, remaining background nutrients are still elevated enough to promote higher than expected algal growth and overall eutrophic conditions. It is believed that recent inundations of Sargassum recorded in the Caribbean during 2011 and 2014/2015 are also due to nutrients from these river plumes (Gower *et al.*, 2011), although other

sources have been put forward (for example, Saharan dust from the west coast of Africa). Once the Sargassum washes ashore, it signifies the removal of nutrients from the marine ecosystem, especially if the plant matter is not allowed to rot on the beaches. In tourist areas this is usually the case as developments tend to remove the unsightly material from bathing beaches. Notwithstanding this, leaving the rotting Sargassum in place reportedly increases beach stability once buried by accreted sand. More of a threat to the marine ecosystem however is the promotion of algal growth directly on the reefs, especially if overfishing or other factors have removed herbivorous species. Where this is the case algal species can outcompete coral and smother entire reefs. This has been observed at a number of locations around Anguilla. If the situation persists Anguilla's important reef systems will gradually degrade and erode away. This will affect remaining fish populations, but more importantly for the island as a whole, will increase beach erosions as the reefs can no longer afford protection from wave action and storm surges.



*Status*

Beaches: Long-term beach profiling by DFMR has documented changes that have occurred over time at certain beaches in Anguilla (Wynne *et al.*, 2016). Generally results illustrate that these changes are usually cyclical in nature providing that beach material and flora are not removed by human activity, for example through sand mining. Sand mining has historically occurred (and continues to occur) at a number of sites, for example, Sile Bay and Windward Point Bay), where removal of dunes for construction materials has led to the loss of the beach. Other beaches appear to be suffering from similar losses although no notable sand mining has occurred, for example Shoal Bay West. Instead, times of high erosion levels coincided with hurricane events. Recovery of beaches post hurricane appears to now only be happening partially. This may be due to increased hurricane frequency and the inability of beaches to recover within more limited time frames. At the same time, reasons may also be more complex in nature and result from a knock-on effect of sand mining in other areas, or offshore dredging that has begun to occur in other areas around the island.

Another beach that has been exhibiting high levels of erosion over recent years is the eastern end of Shoal Bay East. This loss does not appear to tie in so succinctly with hurricane events and may be either due to the nature of the area, or possibly be the first signs of reef degradation and the associated loss of protection that occurs. Most of the other beaches around Anguilla appear



relatively pristine, suffering only from cyclical losses and/or recovering from hurricane events given sufficient time. The examples in the previous paragraph, however, illustrate the need for caution when removing sand from an area, and the potential for more permanent erosion events to occur that may threaten coastal developments. Additional studies are also required to better understand potential causes for erosion so that appropriate restorative and mitigative measures may be applied.

Reefs: Studies conducted in 1990 (Oxenford & Hunte) reported that although there were signs of human impacts in certain reef areas, Anguilla reefs were generally considered to be in good condition. Recent studies comparing present day surveys with this work, as detailed in a threat assessment conducted by Wynne (2016; Chapter 4) show that this is no longer the case. Reduced hard coral cover and varying reductions in fish numbers suggest that Anguilla's reefs are now suffering from variable amounts of degradation. This is especially the case for south coast reef regions, despite the fact that this area has been noted as more susceptible to damage since early reports from the 1980's (Reefwatch, 1989). Macroalgal levels however, although currently high, were also recorded as such in the 1990 study and were attributed to low *D.antillarum* numbers. Although *D.antillarum* numbers have partially recovered in certain areas, continued high macroalgae cover is likely being accentuated by removal of herbivorous fish species and increased availability of organic nutrients. Interestingly, both 1990 and present day surveys recorded low levels of macroalgae at Dog Island. This may be due to strong currents restricting growth and associated rapid movement of potentially nutrient-poor water, as other areas dominated by strong currents often share this characteristic (S.Wynne, pers.obs.). Thus of all areas surveyed, those at Dog Island are considered to be the most 'pristine'. Figure 4 presented previously illustrates the perceived status levels of Anguilla's reef areas based on all available survey work. These status levels also take into consideration what the assumed natural state of these areas would be. Although subjective in nature, such consideration is important when comparing a variety of habitat types in this way.

Seagrass: Although seagrass areas represent a relatively small area in relation to Anguilla's national waters, they are nonetheless an important habitat for a wide variety of marine species, especially foraging Green Turtles (*Chelonia mydas*), Queen Conch (*Strombus gigas*) and a number of juvenile fish species. The most notable of these areas in shallow coastal regions include, but are not limited to: Forest Bay; Little Harbour; Rendezvous Bay; Road Bay; Crocus Bay; and Island Harbour. Of

the seagrass sites studied by Oxenford and Hunte (1990) most were considered to be in good condition with a high plant percentage cover. Today, percentage covers remain high, although both anecdotal reports suggest that overall size of these areas may have reduced over time. Indeed, Bythell and Buchan (1996) recorded a reduction in frequency of seagrass beds following Hurricane Luis, and it is likely that similar reductions have occurred during subsequent hurricanes. Quantifications of this are not possible however, and it is probable some level of recovery took place during the interim periods. Increased hurricane frequency over recent years may have hindered this recovery somewhat and so caution is recommended in terms of seagrass bed management. Higher than expected levels of sedimentation and epiphytes were observed on seagrass fronds during monitoring (although not reliably quantified) which, if sustained, may affect future seagrass growth. This increase in sedimentation/epiphyte cover, as mentioned earlier, might in part be due to increased nutrient levels, and illustrates how eutrophication may affect these areas in ways other than light penetration reducing photosynthetic potential.

Mangroves: Considering Anguilla's size and low lying nature, only limited mangrove stands exist around the island. The most notable of these are around coastal salt ponds, for example at Little Harbour and Blackgarden. Historically it is believed mangroves were more extensive, but fell prey to the need for fuel and fish trap construction as other wood resources were limited. Bythell & Buchan (1996) reported that mangroves were not abundant in Anguilla prior to Hurricane Luis, and those stands which were present were virtually all eliminated with mortality rates (relative to 1994) of between 68 and 99%. Buttonwood (*Conocarpus sp.*), a more inland species, was not as effected. Unfortunately, as with the other habitats listed, lacking historical records mean longer term comparisons are not possible. The mangrove stands that do remain today however appear to be in relatively good condition, and their protection is encouraged as they are an important habitat for juvenile fish species and coastal stability/sediment entrapment.

Fisheries: Of those present in Anguilla, the fisheries considered to be of greatest significance to DFMR and fisherfolk are currently: the finfish fishery (which may be subdivided into reef fish, pelagics and sharks/rays); the lobster fishery (which may be subdivided into *Panulirus argus* and *Panulirus guttatus*); and the Queen Conch (*Strombus gigas*) fishery. Although other groups/species may be locally targeted they are considered more artisanal/recreational in nature and not a formal fishery - for example the West Indian Sea Egg (*Tripneustes ventricosus*) and the West Indian Top Shell (*Cittarium pica*). Of these main fisheries, reef fish, lobster, and conch are considered by

DFMR to be currently in a status of decline and in need of enhanced management. This conclusion is based on the monitoring efforts of DFMR (Wynne, 2010), interviews with fishers, anecdotal historical reports and many unquantified in-water observations by staff (S.Wynne, pers.obs.). For example: throughout all in-water surveys, fish abundances and overall population size class structure were concluded to be much lower than would be expected historically; fishers report lower catch rates of various species in many areas, such as *P. guttatus* in Seal Island Reef (R.Webster pers.comm.); many retired fishers report that historically there appeared to be much higher densities of key species such as Nassau Grouper (*Epinephelus striatus*) and Red Hind (*Epinephelus guttatus*); and Queen Conch (*S. gigas*) and reef fish are at times difficult to purchase at local retail outlets on the island (although exports to St Martin may be partially to blame for this). Extrapolating on this latter point, five years ago reef fish were much more widely available on the island although often they were undersized or undesirable species (S.Wynne, Pers. Obs.). Although many of these reports are qualitative they do point to decreasing fishery stocks, a conclusion that is supported by field data collected by DFMR. The status of pelagic fisheries, which currently mainly consist of sport fishing vessels, remain unclear due to a lack of available data. At the same time, they are likely under exploited due to their larger spatial dispersion and fewer fishers. Status of the shark and ray fishery is also presently unknown. It is hoped that by considering aspects of these fisheries within this management plan, combined with a more thorough analysis in the AFDP, managerial enhancement can be achieved.

The Red Lionfish (*Pterois volitans*) is now established in Anguillan waters, but due to localised removals by DFMR and promotion of it as a food source, their numbers are currently considered to be relatively low. During the past five years 'hot spots' have been noted at some of the offshore cays, Crocus Bay and Meads Bay. Populations are more problematic to control in the more offshore areas such as Dog Island and so special effort will be needed to address this. For the time being most regions close to mainland Anguilla appear to be effectively managed by current practices. At this time, a population study is being conducted by DFMR to confirm this.



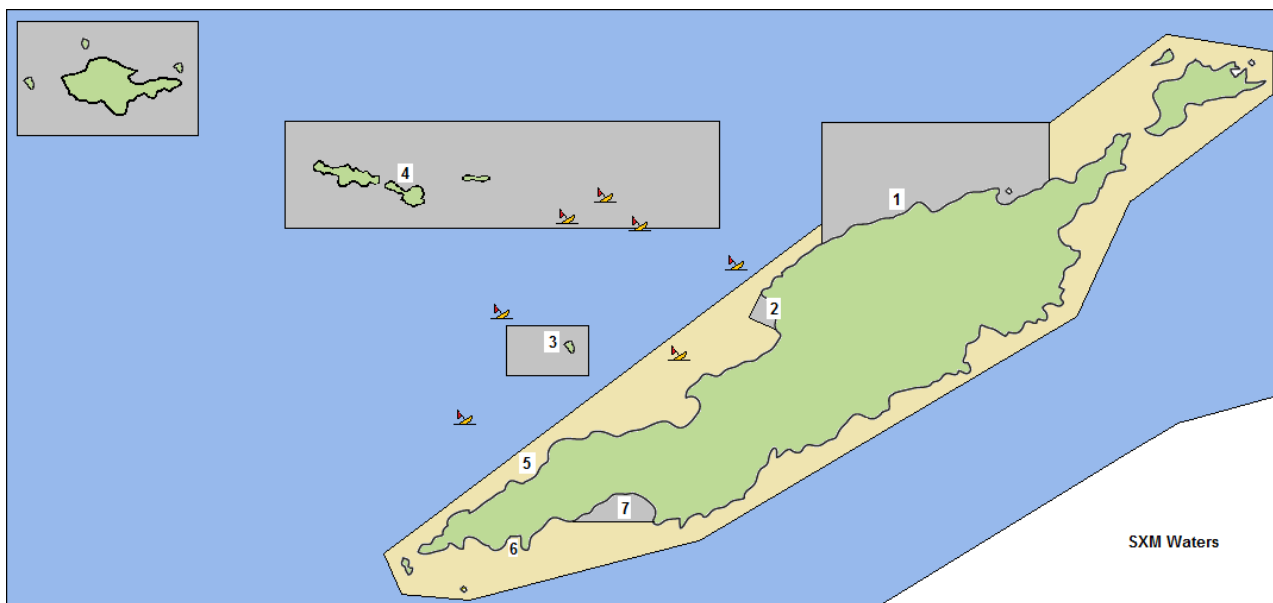
### *Mitigation of Degradation*

The following management plan will put forward mitigation measures for all of the impacts and threats identified above. It is recognised that in many marine management areas, complex zoning plans are often proposed to allow effective use of multiple purpose regions. Indeed, such a plan was proposed by Jackson (1981) – see Appendix I. Zoning offers an effective way of achieving the multiple objectives required of protected areas by defining discrete areas for specific uses and/or purposes as described by Kelleher (1999). Examples of these purposes include (but are not limited to): providing protection for critical species and/or representative habitats; separating out and directly managing detrimental and/or conflicting human activities; preserving and directly managing areas for particular human uses; protecting areas from as many anthropogenic stress sources as possible; and allowing for scientific research and/or education.

The implementation of any zoning plan should be fully participatory and introduced in phases to allow acclimatisation and education of all resource users. Care needs to be taken to not isolate specific stakeholder groups or regions. For example, as identified by Oxenford and Hunte (1990), the zonation plan proposed by Jackson (1981) discriminates against north coast fishers by suggesting the creation of a large 'multiple use reserve' that would encompass all of Anguilla's north coast and the offshore cays from Scrub Island to Dog Island (see Appendix 1), with most of the south coast being only under generic fisheries management legislative control. It was suggested that to avoid this, the multiple use area should either be expanded to encompass the whole island shelf, or the principle be abandoned entirely. The current management plan has been based on an evolved principle of the former, and hence is not just a management plan for Anguilla's Marine Park System, but also for associated fisheries and shallow water habitats (that is, those on the whole island shelf). It is proposed that the Marine Park System forms the backbone of this multiple use approach, with marine parks afforded the highest levels of protection. The coastal zone, that being under the greatest threat outside of the marine parks from tourism and fishing, should be placed second to this.

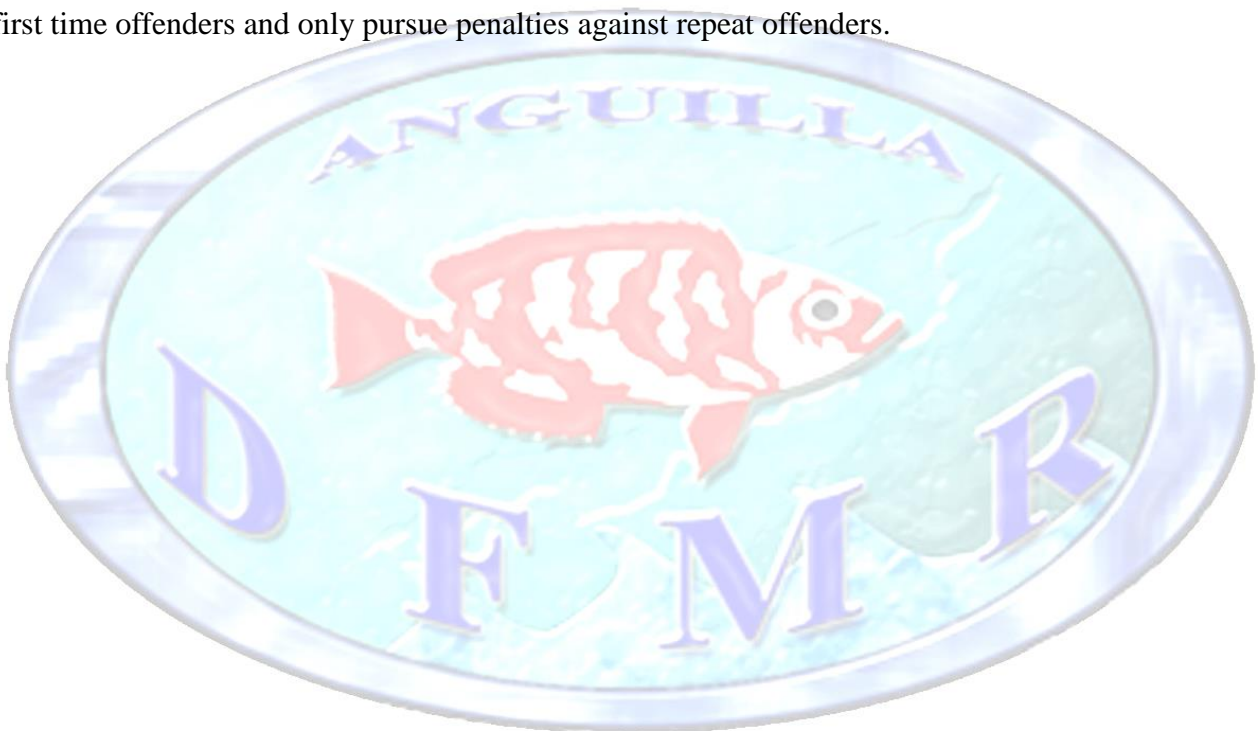
The danger posed by zoning plans is over complication leading to associated user confusion. This appears to have been recognised by Goodwin (1989) – see Appendix I, who simplified Jackson's original proposal. This is a view shared within the current management plan, where simple zonation

is recommended, using the marine parks as the foundation for this. Figure 5 illustrates this plan, which in many respects reflects the zones proposed by Jackson, but in a simplified form. As mentioned in Sections 5 and 6 it may be necessary however to assess and introduce other small demarked areas for water sports. To help simplify zonation, boundaries have been placed in areas that loosely follow habitat boundaries and the proposed activities closely follow the usage that has already naturally evolved in different areas. It is hoped that this approach will allow acceptance of the management plan by all stakeholders and/or resource users, while offering an effective way of managing and/or keeping control of these uses.



**Figure 5:** Map (not to scale) depicting the Anguilla Marine Management Area (blue) that contains, the Coastal Zone Fisheries Management Area (yellow), and the Anguilla Marine Park System (Grey). Also shown are wreck dive sites (wreck symbol) and potential swimming/snorkelling areas (numbers): (1) Shoal Bay East; (2) Little Bay; (3) Sandy Island; (4) Prickly Pear; (5) Meads Bay; (6) Maundays Bay; (7) Rendezvous Bay. These numbered areas will need further zoning or restrictions if water sports and swimming activities are to not conflict. Although the AMMA and the CZFMA are governed under the same legislation (Fisheries Protection Act) they have been differentiated as zones because, being close to land, it will be possible to patrol the CZFMA regularly and thus enforce regulations effectively. It is proposed that this is the area, outside of the marine parks, that management efforts are initially focused on. The AMMA on the other hand, although still possible to be under active management will only realistically be patrolled on a weekly basis, so enforcement would be less stringent.

Zone simplification is of special importance as it is very difficult to physically demarcate areas in the ocean environment. Fences are not possible as they are in terrestrial protected areas and signs can only be placed for user referral on beaches or at ports/jetties. This can lead to user confusion if plans are overly complex and the increased ability for persons contravening regulations to plead ignorance to infringements. Thus presents the dilemma for surveillance and enforcement: how to police areas without being overly heavy-handed, the breeding of resentment among users for the management of marine resources, or the failure of park management. Community support is absolutely essential. For this reason it is recommended that enforcers of regulations be lenient on first time offenders and only pursue penalties against repeat offenders.







## Section 4: Legislative & Managerial Structure

In order to facilitate the adoption of this management plan, the aim is to create a framework that relies on, where possible, existing legislation or minor amendments to existing legislation. Although ultimate managerial goals may be more wide reaching, a primary aim is for other measures to be introduced, at least in the initial stages, via public awareness initiatives/education. This will encourage a community based approach and aid public acceptance and future support.

Complementing this approach, much of the legislative backbone needed for this plan has either already been enacted (although in some cases not enforced), drafted but yet to be enacted, or proposed but not yet added as amendments. The main pieces of legislation as they relate to this plan have been listed below:

- **Beach Protection:** The Beach Control Act (2000). Earliest known version is the Beach Control Ordinance 1961. This Act makes provision for the control of beach usage and the need for a license to build on a beach or the sea floor. It states that the Act will not be used to affect fishing rights. The Beach Protection Act (2000) is a statute Act which makes provision for the Governor to declare a particular beach as protected. Under this, the Beach Protection Orders name eighteen beaches as protected. It also prohibits against sand mining. The Access to Beaches Act (2000) aims to ensure that all beaches remain public, but also affords protection in terms of (for example): littering; damaging plants; driving on the beach (unless it is an established custom).
- **Cruising Permits Act (2000):** Earliest known version is the Cruising Permits Ordinance 1980. This Act falls under the jurisdiction of Customs and provides provisions for cruising permit fees and no anchoring zones in Little Bay, Sandy Island, Prickly Pear Cays and Seal Island Reef, Dog Island and Rendezvous Bay.
- **Fisheries Protection Act (2000):** Earliest known version is the Fisheries Protection Ordinance 1986, with amendments in 1990 and 1995. This Act was due to be updated in 2008 together with a newly drafted set of 2010 Regulations. To date, this has not yet happened. The current 2000 Act legislates all current legal fishing practices and licensing, including (but not limited to): legal size of lobster and conch; molestation of lobsters exhibiting reproductive activity; marking of fish trap buoys with fishing licence number;

molestation of other fishers traps; minimum mesh size for fish trap mesh; prohibition of taking or being in possession of a turtle (to remain in force until 15-12-2020), either whole or a portion of the meat; and prohibition of using gillnets. The Act also makes provisions for: closed seasons (schedule 3); closed areas (schedule 4); minimum size of marine products (schedule 6); minimum mesh size of nets (schedule 7); and designated fish aggregating devices (schedule 8).

- Marine Parks Act (2000): Earliest version is the Marine Parks Ordinance 1974 (revised 1982). Amendments to the regulations under this act were made in 2008 and 2010. No controlling agency has been appointed but DFMR act in this capacity by default. In Section 15 of this Act however, Customs Officers are included as having powers to arrest persons and seize vessels. Regulations include restrictions on (but not limited to): Fishing by non-belongers; diving by unauthorised dive operators; camping; damaging flora and fauna; water skiing; discharging sewage; building fires; and installation of moorings. Provisions are also made so that the Governor in Council may designate any portions of the marine areas of Anguilla as a marine park where it is considered special steps are necessary for: the protection of fish, the flora and fauna and wrecks found in such areas; preserving and enhancing the natural beauty of such areas; the promotion of the enjoyment by the public of such areas; the promotion of scientific study and research in respect of such areas. Currently Rendezvous Bay is not listed under this act although it is demarked as a no anchoring zone under the Cruising Permits Act.
- Land Development (Control) Act (2010): Earliest version is unknown. This Act is relevant in situations where marine parks include privately owned land within their boundaries, or if future beach set-back regulations may be required. For example, Dog Island is privately owned and therefore any form of development on the island must be approved by the Land Development Control Committee. Set-back recommendations are made when developments are proposed but no legally-binding set-back legislation currently exists above the vegetation line.
- Trade in Endangered Species Act (2010): This Act is relevant in terms of certain endangered species, for example the Hawksbill Turtle (*Eretmochelys imbricate*), although the Act does not have direct implications within this management plan. The Department of Environment



are the management authority, with the Act's primary purpose to compliment the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) regulations and Appendices.

- Biodiversity and Heritage Conservation Act (2010): This new Act is poised to become one of the most relevant pieces of legislation to this management plan (in combination with the Fisheries Protection Act), although as its governing regulations have yet to be produced the full implications remain unclear. As described earlier both the Minister of Fisheries and the Minister of Environment have joint authority under this Act, as delegated by their competency. Once the regulations are produced this Act will likely replace the Marine Parks Act, and so it is fundamental that the regulations contain all that is already in the Marine Parks Act, together with the relevant amendments suggested within this plan. The BHCA also provides provision for buffer zones, and so compliments the proposed creation of the Coastal Zone Fisheries Management Area (CZFMA). As these regulations have yet to be produced, for the purpose of this management plan, the Marine Parks Act will be cited as the current governing legislation unless stated otherwise.



### *Management and Managerial Structure*

Currently management of the Marine Park System, although limited, is conducted by the Department of Fisheries and Marine Resources by default. DFMR is ideal for the role of management agency as it has: over twenty years experience managing Anguillian waters; a sea going vessel; seven dive certified staff, five of which are competent in underwater survey work and can identify at least 95% of Anguilla's marine species; complete sets of equipment including those needed for diving, all in-water survey work, and mooring buoy installation/maintenance.

Notwithstanding this, because the management of the marine parks involves an integrated approach across many sectors and also encompasses certain terrestrial habitats, DFMR will rely on input from other agencies and, at times, likely seek support from owners of land that falls within park boundaries.

DFMR will assume the lead role in implementing this management plan until it is named officially as lead agency within the Marine Parks Act. In the initial stages of management plan development

DFMR will hold public consultations to gauge acceptance of proposed management. Once completed a final draft management plan will be produced and circulated within the relevant areas of Government. Aside from high level approval of the document, it will be important to get feedback from both the ANT and Department of Environment (DoE) due to their expertise in the management of the terrestrial habitats falling within the marine park boundaries. Following this the management plan will be circulated more widely to other agencies/stakeholders for their comment. These will include:

- Department of Lands and Surveys
- Department of Physical Planning
- Department of Environmental Health
- Anguilla Hotel and Tourism Association
- Anguilla Tourist Board
- Anguilla Fisherman's Association(s)
- Anguilla Sea Turtle Conservation Group
- Owners of land within/bordering the marine parks
- Charter Boat Operators
- Dive Operators

Through public consultations and private meetings with fishers and other stakeholders, the roots of this management plan will be founded within the local community. This community based approach will continue throughout the development process and be essential when revising this document as necessitated under the adaptive management approach. An overall goal is to produce this updated document on an annual basis at the end of each year, based on progress made and information gained over the previous twelve months. Stakeholders are welcomed to participate in the process by visiting the DFMR office on Crocus Hill to discuss any aspects of it.

## Section 5: Management Plan and Legislative Amendments

The overall vision for the Anguilla Marine Park System to be achieved through this management plan is to enhance tourism and recreational use of these areas while protecting the important habitats that they house: specifically to begin encouraging fishers to move away from these depleted areas and into the more lucrative deeper offshore regions. By doing this it is hoped to increase revenue through tourist user fees and provide sanctuary areas for marine species that, via spawning and/or migration, will help populate surrounding areas and the Caribbean region as a whole. The management actions within this plan also aim to promote livelihood diversification, either through tourist related activities or by encouraging the utilisation of new and/or under exploited fisheries resources.

The secondary purpose of the managerial actions proposed within the plan is to mitigate against a number of the identified threats/stressors to Anguilla's marine environment (Wynne, 2016; Chapters 1-4). It is suggested that the Anguilla's Marine Park System be used as the core units behind this protective undertaking, but in the same way as past zonation maps have suggested (the earliest being Jackson 1981 – Appendix I), to use other shallow water areas and associated fisheries as integral units also. This means legislative amendments will be necessary not just within the Marine Parks Act, but also the Fisheries Protection Act. DFMR consider that isolating the marine parks in a management effort is not the most efficient and/or effective way to achieve overall managerial goals, and recognise that an integrated approach to management is a far better means of doing so (Crowder and Norse, 2008). This is especially important when dealing with a range of habitats, a range of stakeholders, and thus a range of economic activities (Elliot, 2014). Bearing in mind a number of the Marine Parks contain within their boundaries privately owned islands (for example Prickly Pear Cays) it will be essential to actively involve these owners using a grassroots approach whenever possible. For the purpose of this current plan however only the marine portions and immediate coastal areas of the marine parks will be taken into consideration. If an integrated grassroots approach is possible through land owner cooperation it is suggested that separate managerial documents be produced in direct combination with the other terrestrial management agencies.



Until land owner cooperation can be guaranteed, it was also felt that to better serve Anguilla all of the marine parks should be treated, as far as possible, as one managerial unit, with only slight variations between overall goals of each area. Currently, the situation is already orientated favourably in this way, with all parks known collectively as the Anguilla Marine Park System. Zoning has only been used in terms of complete areas, and variations between areas kept to an absolute minimum. As discussed earlier, forming complex zoning regimes or overly differentiating areas can clog the legislative process and stall managerial progression. Such complex plans also lead to increased confusion among stakeholders. To keep in line with an ideology based around simplicity, the shallow water regions outside of the marine parks that fall within this plan will also be considered as one unit. These will encompass those areas less than 10m in depth and form a buffer zone that will link the marine parks with surrounding coastal regions (the CZFMA). AMMA encompasses the Marine Park System (with the exception of Sombrero Island) and the CZFMA, and can be generally described as those marine areas <30m in depth (Figure 5).

The backbone of this plan is a list of legislative amendments to be put forward by DMFR as lead agency that fall primarily under the Marine Parks Act and the Fisheries Protection Act. The amendments that relate directly to this plan are listed under group headings following the individual park goal descriptions. The first round of public consultations took place in November 2015 and the below goals have been modified from those presented originally to take into account general opinion.

*Breakdown of Goals for Each Park<sup>3</sup>*

Junks Hole Marine Park: heritage conservation. Restrictions to the use of the area are concluded as sufficient to preserve site from damage and/or looting. The area is shallow and sea conditions generally rough, which naturally restricts access to the park.

Dog Island Marine Park: fisheries and habitat conservation. The island is privately owned and is important for sea birds and nesting sea turtles. Restrictions on anchoring exist under the Cruising Permits Act that helps preserve rocky reef habitat integrity and other benthic life. Anchoring is permitted in Great Bay (although a typographical error in the Cruising Permits Act labels it incorrectly). The area is not heavily visited by tourist charters and so a mooring buoy field is not

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<sup>3</sup> Table 2 gives a visual synopsis of these managerial goals

deemed necessary. There are no developments of the island, although it has been put up for sale a number of times in the past. Diving takes place at some locations in the park, mostly close to West Cay. It is proposed that the area becomes a pelagic fish and reef species reserve, including conch and lobster. A lot of fishing takes place in the area, but following public consultations it appears that most occurs outside of park boundaries: more discussions with fishers will be needed to confirm this, but the amount of suitable habitat outside the park should mean livelihoods are not significantly affected. Spearfishing and trap fishing should be prohibited in the park.

Prickly Pear and Seal Island Reefs Marine Park: fisheries and habitat conservation; recreational enhancement. The main islands are privately owned and important for sea birds and nesting sea turtles. The land owners have spoken of an interest in integrated management, which will be pursued together with the ANT. Restrictions on anchoring exist under the Cruising Permits Act that help preserve rocky reef habitat integrity and other benthic life. Anchoring is permitted in two sandy areas around Prickly Pear East where DFMR also maintain small mooring fields. The area is heavily visited by tourist charters and popular with snorkelers. Two restaurants operate here also. Diving takes place at three wreck sites located close to the border of the eastern end of the park. It is proposed that the area becomes a pelagic fish and reef species reserve, including conch and lobster, but fishing for Crayfish (*P. guttatus*) be permitted: a lot of fishing takes place along the main Seal Island reef system, but following public consultations it appears that most of this is for Crayfish only. As virtually all trap fishing for Crayfish occurs within the Marine Park System some concessions will be needed to accommodate this. Spearfishing should be prohibited in the park.

Sandy Island Marine Park: fisheries and habitat conservation; recreational enhancement. The main island is privately owned and relatively important for nesting sea turtles. Turtles also forage in the surrounding waters. Restrictions on anchoring exist under the Cruising Permits Act that help preserve rocky reef habitat integrity, seagrass areas, and other benthic life. Anchoring is permitted in two sandy areas in front of the western side of the island where DFMR maintain a relatively large mooring field. The area is heavily visited by tourist charters and popular with snorkelers. One restaurant operates here also. Diving takes place on a number of the reefs within the park. It is proposed that the area becomes a pelagic fish and reef species reserve, including conch and lobster. A lot of fishing takes place in the area, but following public consultations it appears that most of this is for Snapper using hook and line and so would still be permitted in the park: discussions with fishers are needed to confirm this. Spearfishing and trap fishing should be prohibited in the park.

Little Bay Marine Park: fisheries and habitat conservation; recreational enhancement. The area is adjacent to privately owned areas of mainland Anguilla. Under the Cruising Permits Act anchoring is not permitted anywhere in the park in order to protect seagrass integrity. DFMR maintain a number of moorings in the area, some further away from the bay for vessels <55ft and others close to the bay for vessels <35ft. The area is heavily visited by tourist charters and popular with snorkelers. Some small developments can be found on the cliff tops overlooking the park. The area is one of those being put forward by DFMR for a tourist/fisheries enhancement project: sculpture garden; coral nursery; lobster casita; artificial reef; or a combination of these. Recreational diving does not take place in the park, aside from the occasional training session during rough sea conditions. The area is very important for foraging sea turtles. It is proposed that the area becomes a reef and seagrass species reserve, including conch and lobster. Hook and line fishing takes place from the sea rocks but this would still be permitted in the park. Following public consultations it became apparent that spearfishing is also popular within the park, although this, together with trap fishing, should be prohibited.

Shoal Bay and Island Harbour Reefs Marine Park: fisheries and habitat conservation; recreational enhancement. The region is important for both foraging and nesting sea turtles. The area is adjacent to privately owned areas of mainland Anguilla with a number of hotel developments and small restaurants operating close to or on the beach. The area is one of those being put forward by DFMR for a tourist/fisheries enhancement project: sculpture garden; coral nursery; lobster casita; artificial reef; or a combination of these. The park is not listed under the Cruising Permits Act and so anchoring is currently permitted throughout the region. It is suggested that anchoring be prohibited in all areas to help preserve rocky reef habitat integrity, seagrass areas, and other benthic life. Two moorings were installed at the request of stakeholders in Shoal Bay and one in Island Harbour that are maintained by DFMR. Prior to anchoring being prohibited it will be necessary for DFMR to install more moorings in the area, pending research into stakeholder requirements. The shallow reefs mean that the area is not heavily visited by tourist charters (access is dangerous unless familiar with the waters), but the beach is busy almost year round with visiting tourists. Diving used to take at a number of sites within the park, but habitat degradation and distance needed to travel to the sites by dive operators mean it no longer commonly occurs. It is proposed that the area becomes a pelagic fish and reef species reserve, including conch and lobster, but fishing for Crayfish (*P. guttatus*) be permitted: a lot of fishing takes place along the outer Madeariman reef system of Shoal Bay and eastwards towards Island Harbour but, following public consultations, it appears that most



of this is for Crayfish. As virtually all trap fishing for Crayfish occurs within the Marine Park System some concessions will be needed to accommodate this. Spearfishing should be prohibited in the park.

Sombrero Island: heritage and fisheries/habitat conservation. Management of the marine portion of the park is currently uncertain pending habitat survey reports and review of fisheries data. The coordinates listed in the Marine Parks Act need amending so that they include the whole of the land portion of the island. Sombrero's distance from mainland Anguilla (and therefore it lying outside of AMMA) mean surveillance and enforcement of any regulations would be problematic based on current logistical resources. The area however has great potential as a pelagic fish species, lobster and conch reserve. Spearfishing and trap fishing should be prohibited.

Rendezvous Bay: fisheries and habitat conservation; recreational enhancement. The area is not listed under the Marine Parks Act, but is demarked as a no anchoring zone under the Cruising Permits Act (although this law is currently not enforced). If anchoring were to be prohibited throughout the whole bay it would be necessary for DFMR to install and maintain a mooring field in the bay as it is very popular with visiting tourist vessels. Due to this popularity, and combined with both the moon splash festival that takes place here annually, and the bay's use as a safe harbour in times of adverse weather conditions, it is not recommended for it to remain officially a no anchoring area. Instead it is recommended that an anchoring zone be placed in the eastern end of the park. The bay is adjacent to privately owned areas of mainland Anguilla with a large hotel development come golf resort, two smaller hotels, and a number of small restaurants operating close to or on the beach. The area is one of those being put forward by DFMR for a tourist/fisheries enhancement project: sculpture garden; coral nursery; lobster casita; artificial reef; or a combination of these. It is proposed that the area becomes a reef and seagrass species reserve, including conch and lobster. Following public consultations few disagreed with the overall goal of the area, although anchoring restrictions were of some concern.

#### *Other Managerial Units*

CZFMA & AMMA: fisheries surveillance and enforcement enhancement. Governed under the Fisheries Protection Act the CZFMA area will serve as a corridor or buffer zone between the marine park areas. This will be the region DFMR focuses its surveillance and enforcement efforts for the

time being, although in combination with the Marine Police, DFMR will conduct weekly patrols around AMMA whenever possible.

Wreck dive sites: fisheries conservation; recreational enhancement. Most of these seven wrecks were sunk in the 1990's as part of a Road Bay clean-up effort and artificial reef initiative. Today, in light of habitat degradation, they are the most visited dive sites in Anguillian waters and as such very important to conserve. Currently they are afforded no level of protection. Differing from reef dive sites as they were established originally for conservation and recreational purposes, these wrecks should be strictly protected as no take areas. It is suggested that a 50m circumference be used as a boundary from the published coordinates of these sites. Consideration should also be given to prohibiting spearfishing and trap fishing on all registered dive sites.

**Table 2:** Breakdown of the overall goals for the areas within the Marine Park System.

Marine Park Name	Junks Hole	Dog Island	Prickly Pear	Sandy Island	Little Bay	Shoal Bay Island Harb.	Sombrero Island	Rendezvous Bay
Anchoring Prohibited	X				X	X	X	
No Anchoring Areas		X	X	X				X
Spearfishing Prohibited	X	X	X	X	X	X	X	X
Conch Fishing Prohibited	X	X	X	X	X	X	X	X
Trap Fishing Prohibited	X	X	Crayfish Only	X	X	Crayfish Only	X	X
Hook and Line Allowed	X	X	X	X	X	X	X	X
Seine Netting Allowed	X	X	X	X	X	X	X	X
Enhancement Proposed					X	X		X

*Proposed Amendments to the Marine Parks Act and/or the BHCA*

- Clarification of lead management agency: Under the Marine Parks Act no administrative agency has been listed. Instead it states that “The Governor may appoint any person as Controlling Officer”. This role has been assumed by DFMR since the park’s creation, but a Controlling Officer has yet to be appointed. In the new BHCA, The Department of Fisheries and Marine Resources, through the Minister for Fisheries, have been indirectly named as lead management agency for the marine areas under the Act. Until the BHCA officially supersedes the Marine Parks Act DFMR will continue to assume the lead role and begin implementing this management plan. The Marine Parks Act will continue to be viewed as the guiding legislation for the marine parks until this time. As such, the Governor needs to officially state that the Director of Fisheries and Marine Resources (or Minister of Fisheries) is the Controlling Officer under the Act, or the Act needs to be amended to state that DFMR (or the Minister of Fisheries) is responsible for administering the Act.
- Enforcement and ticketing: In order for DFMR to be able to fulfil their managerial role under the Marine Parks Act, Fisheries Officers will need official enforcement capabilities. This should include the ability to issue on-the-spot fines (ticketing system) and confiscate fishing equipment infringing on legal fishing practices. Provision for this has been made under the BHCA, but as with the lead management body, until regulations are produced under the Act, the Marine Parks Act is still the governing legislation. No enforcement capabilities are listed under the Marine Parks Act. NB. Under the Fisheries Protection Act fisheries officers are given some limited enforcement powers, but these mainly relate to boarding and seizing vessels, and do not directly relate to enforcing legislation. It is currently prudent for Fisheries Officers to conduct patrols together with Police Officers for this purpose.
- Official designation of marine parks: All park areas within this management plan need to be correctly listed under the Marine Parks Act, together with their anchoring restrictions as detailed currently in the Cruising Permits Act. These restrictions can simply be transferred across, or remain in the Cruising Permits Act and simply be updated: one small alteration to correct a typographical error stating that Great Bay (Dog Island) is a no anchoring area; Shoal Bay and Island Harbour is not listed in the Cruising Permits Act, and it is proposed to



make it a no anchoring zone to protect its extensive reef and seagrass areas, as is already the case in Little Bay; Rendezvous Bay also needs to be listed in the Act as a marine park and its anchoring restrictions reviewed; the coordinates given for Sombrero Island in the 2010 revision of the Marine Parks Act appear incorrect as they fall quite a distance out to sea, rather than being placed centrally on the island as would be expected. DFMR owns, but has yet to install, fifty marine park boundary marker buoys that should be placed in appropriate locations along the demarcation boundaries.

- Fishing restrictions in marine parks: An overall aim for the marine parks is for them to house healthy populations of marine species that will migrate to other areas and be viable catch for fishers. To enable this, fishing restrictions within the parks will be needed. To gain community support it would not be wise to prohibit all types of fishing in the marine parks at this time. Instead it is suggested to allow all types of fishing that involves the use of a hook and line (rod and reel, trolling, vertical long-line etc) or seine nets. Hook and line methods do not remove herbivorous species, and can directly target certain species of certain sizes through gear choice. It is also arguably less damaging to the habitat, although nylon line entanglement can cause minor problems. Seine netting is also proposed as permitted in marine parks at this time as it, for the most part, targets pelagic species that migrate between areas rather than species that live 'permanently' in one place. However, an exception to this is trap fishing for Crayfish which will be permitted still in Shoal Bay-Island Harbour and Prickly Pear-Seal Island Marine Parks. The remaining marine parks, where Crayfish fishing will be prohibited, will be considered closed areas to this practice, and thus will be dealt with under the Fishery Protection Act amendments in the next subsection. Under the Marine Parks Act, as it makes better sense to keep regulations under this Act generic to all marine parks, only spearfishing and removal of conch will be prohibited. Sports fishing should also be prohibited in marine parks, although current sport fishing licences stipulate this as a regulation so in effect it is already in force.
- Marine pollution fines: A fining system should be developed where the dumping of grey water, black water and/or oil based substances be prohibited within the marine parks. These fines should be graded based on the severity of the pollution event. It may however be prudent to include such a fining system for all marine areas and, if so, would be necessary to make the legislative amendment under the Fishery Protection Act rather than the Marine

Parks Act. Notwithstanding this, the Merchants Shipping Act (2010) already makes provision for such regulations under section 66(1)(c). Thus this Act might better serve as the legislative origin for such a fining system.

- Fee for tourist enhancement features: The tourist enhancement features suggested for Little Bay, Rendezvous Bay and/or Shoal Bay will need moorings and maintenance to keep them running effectively (these features will be underwater and not affect the above water beauty of the areas they are in, being only visible via diving or snorkelling). In order to pay for this maintenance small visitor fees will be needed. Under the Marine Parks Act section 7 (1)(h), the Governor may make a regulation regarding to “the charging of fees for any of the services provided in marine parks”. All visitors to the underwater features (not the marine park as a whole) will be charged this fee (suggested as EC\$5.00 per person per day). As a method of implementing the collection of these fees it is proposed to make bracelets available for purchase at local outlets. Spot checks will be conducted by DFMR to check those snorkelling or diving around the feature are in possession of one. These spot checks will aid compliance although it is not proposed to have a fine in place for those without a bracelet: they will only be asked to leave the area.

#### *Proposed Amendments to the Fisheries Protection Act*

- Enforcement and ticketing: As mentioned under the amendments for the Marine Parks Act, Fisheries Officers need to be given greater powers when it comes to enforcing relevant legislation. Currently under the Fisheries Protection Act powers are generally limited to boarding and seizing vessels. This needs to be extended to, for example: seizing of fishing gear being used in a way that contravenes the Act; and spot fining of offenders.
- Fishing restrictions: *Trap Fishing* should be conducted with fish traps that are fitted with an easily erodible escape door; traps should only be placed on sand areas and not directly on the reef; netting of deep water pelagics (i.e. Coryphaenidae) and spawning aggregations of Snapper (Lutjanidae) or Grouper (Serranidae) should be prohibited; existing legislation should be enforced as it relates to marking fish trap buoys with licence numbers. *Spearfishing* should be permitted by licence, not by default. *Seine net fishing* should only be permitted with minimum stretch mesh size of 3 inches. This can be provided for under

schedule 7 of the existing legislation. *Hook and line fishing* should be permitted without restriction (recreationally) but with a licence (commercially). Minimum landing sizes should be imposed for certain species as detailed below (note: these regulations apply to all areas, not just the marine parks, hence their inclusion in the Fisheries Protection Act rather than only in the Marine Parks Act).

- Minimum landing sizes: To protect juveniles of certain fish species and encourage the recovery of their stocks. Under schedule 6 of the Fisheries Protection Act (thus relevant to all marine areas, not just the marine parks) key targeted fish species need to be legislated for in terms of a minimum landing size. Species to focus on primarily are those targeted by fishers that belong to the families Serranidae (seabass), Lutjanidae (snapper), Scaridae (parrotfish), Carangidae (jacks), and Acanthuridae (surgeonfish). Minimum size recommendations are presented in chapter 4 (Wynne, 2016) and also detailed within the AFDP. It is also recommended that while these changes are taking place public awareness posters be produced detailing the rationale behind these minimum size limits with some life size examples of key species. It would also be beneficial to produce a ruler like scale for fishers that depict recommended sizes for each species. This will facilitate compliance with the legislation once it comes into force.
- Conch legislative revision: Current Queen Conch (*S. gigas*) legislation is insufficient to protect immature individuals from harvest. Based on research over recent years it is recommended to update legislation to take into account the thickness of the flared lip, as detailed in Chapter 4 (Wynne, 2016). This will work in combination with the marine parks being closed areas to harvest conch and thus promote the sustainability of this important fishery.
- Lobster legislative revision: Insufficient legislation relates to *P. guttatus* (local name crayfish) as no minimum landing size exists for this species as it does for *P. argus*. Chapter 3 (Wynne, 2016) makes recommendations for a minimum size based on extensive local research. This is especially important to protect immature individuals, which cannot be readily captured by trap, from the expanding night-time hand capture fishery. Introduction of a closed season for both species, as closing certain marine parks to harvesting these species may not be sufficient to allow stocks to remain economically sustainable. This is especially the case for *P. argus* where offshore grounds are reportedly much less productive than they



were a decade or two ago (W.Harrigan, pers.comm.). It is suggested for this species to have a closed season between 1<sup>st</sup> June and 1<sup>st</sup> November each year. For *P. guttatus* a closed season between 1<sup>st</sup> Jan and 1<sup>st</sup> June each year is suggested. This will work in combination with the marine parks being closed areas to harvest both lobster species and thus promote the sustainability of these important fisheries. Closed seasons can be legislated under schedule 3 of the Fisheries Protection Act.

- Closed areas: All marine parks except Shoal Bay-Island Harbour and Prickly Pear-Seal Island are to be closed to all types of trap fishing. Schedule 4 of the Fishery Protection Act allows prohibited areas to be named in such a way. Dive wrecks should also be named under this schedule, but to all types of fishing entirely. These wrecks are extremely important with the diving/tourism industry. Acting as marine species aggregation structures, these wrecks house not just fish populations but also lobsters, turtles and many other marine species. These species are what many of the divers pay to observe. It is easy, especially for foreign vessels, to fish out the wrecks because a dive buoy advertises their locations and provides a mooring that can be used while fishing takes place. Reports have been made of these vessels stripping a wreck of its lobster inhabitants in a matter of minutes. Strict protection of these wrecks is therefore of utmost importance. It is suggested to prohibit fishing of any kind with 50m of the red buoy installed and maintained by DFMR to mark a wreck. As a long-term goal all dive sites marked with a red DFMR buoy should be completely protected, but until their locations are properly standardised this will not be possible.

*Other and/or Non-Legislative Management Actions*

- Coastal Zone Fishery Management Area (CZFMA) and other areas: The purpose of the CZFMA is to create a buffer zone that will link the marine parks with surrounding coastal regions and encourage sustainable fishing methods that will preserve fishery livelihoods for generations to come. This zone will be under the regulations governing all areas within the Anguilla Marine Management Area (AMMA), the Fisheries Protection Act, but will be designated as a buffer zone under the BHCA. DFMR will initially concentrate its surveillance and enforcement efforts within the CZFMA until more logistical and financial resources become available to allow it to patrol AMMA more inclusively. The CZFMA is designed to be a specially managed area used to compliment the Marine Park System, and

includes (but is not limited to) all coastal areas less than 10m in depth (see figure 4).

AMMA, despite its size, still forms an area that can (depending on resources) be realistically patrolled jointly by DFMR and the Marine Police, and therefore can be effectively managed.

It is also encouraged that the aquaculture potential be fully explored within this area. A number of such projects have been proposed in the past, but to date none have been successfully established. DFMR will also encourage pelagic fishing in Anguillan waters in an effort to move away from more ecologically damaging reef fishing practices currently used. Some of these proposed activities will likely occur further offshore in Anguilla's EFZ and thus be more relevant for inclusion within the AFDP rather than this document.

- Fee structure revisions: Some fees are included in the legislation, while others are not. Revision of the fee structure is suggested in order to provide revenue for the marine parks and relevant authorities. This is important for the longevity and successful management of the Marine Park System. Suggested fee structures that need review include (but are not limited to): *Dive Fee* - currently set at \$1US per person per dive. This fee has not changed since its introduction in the early 1990's and is based on an honour system where dive operators pay every three months. Previously, diver operators had agreed to change this fee to a one off \$10US fee per diver; *Marine Park Mooring Buoy User Fee* - currently collected when vessels check in at Customs and as such is not recorded as revenue created by the Marine Park System. This revenue needs to be recorded separately, and the fee structure increased for foreign vessels. These vessels are usually larger in size with a much higher number of visitors on board, therefore they put more pressure (wear and tear) on the moorings and the natural environment; *Sport Fishing Fee* - currently set at \$30US per person (not per vessel) for three months. It is known that many operators do not pay this, reportedly because it is seen as unfair to have to buy a three month licence for charter clients who only want to fish for one day. It would be fairer to increase the three month fee but for it to cover a maximum of three fishing charter passengers at any one time on the registered vessel. Most sport fishing occurs primarily in the deeper water parts of AMMA, although it is still known to sometimes take place within marine park boundaries.
- Tourism and fisheries enhancements: Enhancements should attract more paying visitors and help fund the Marine Park System, without harming the ecosystems the parks are designed to protect. Snorkelling trails incorporating underwater fisheries enhancement features (lobster casitas, sculpture gardens etc) in Little Bay, Shoal Bay and/or Rendezvous would be

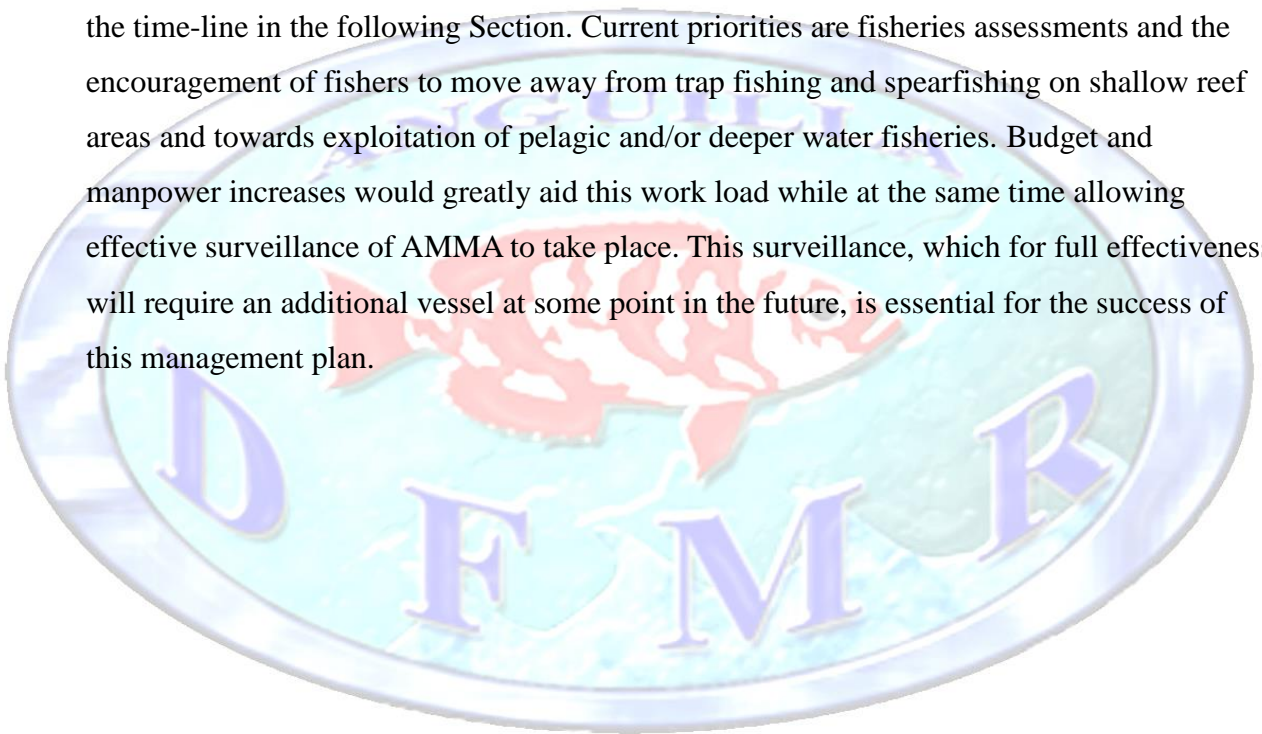
educational and prove popular among visitors. Underwater sculptures, as well as being attractive to visitors, can be designed to encourage coral growth and attract fish and other marine species. Equally, a sunken wreck, if placed at a suitable depth (and therefore in a carefully selected location) can be visited by snorkelers and divers alike, while again attracting and sustaining fish populations. Lobster casitas too can be designed in an attractive manner and placed in large groups within park boundaries and form 'Lobster Sanctuary Villages' to enhance local and regional recruitment. Swimming areas will also need to be established in locations with high levels of boat activity to protect bathers from collisions. If conflicting user groups arise, agreements and/or buoyed swimming zones (or similar) will need to be created (potential areas where such conflicts may arise have been identified in Figure 4). Notwithstanding this, water-skiing is already banned in marine park areas, and it is recommended that this be mirrored by prohibiting any other 'collision-risk' water sports. This is especially relevant if the current ban on jet-ski's is lifted, as the majority of marine parks are popular swimming/snorkelling areas and so collision risk is heightened.

- Fishing methods outreach campaign: The campaign should encourage fishers to move away from the more laborious, environmentally damaging and economically limiting fishing methods. Sport fishing and long-lining/trolling fishing methods yield a catch more favourable to sell to the tourist industry, thus commanding higher prices. These practices also do less damage to the environment as they do not involve setting traps, negotiating shallow reef areas, or setting nets. Sport fishing can offer the greatest return for fishers as no catch is required to earn a living, only a paying client. Catch can either be returned to the ocean or sold to client/restaurant for extra earnings. An outreach campaign should also include materials on: the damage traps do when placed directly on the reef; why unregulated spearfishing is harmful to the marine ecosystem; and why juvenile fish do more good in the ocean than they do on someone's plate. Due to the restrictions to be placed on fishing within the marine parks these aspects will only be relevant to other areas within AMMA. It is also recommended that workshops be held and DFMR demonstrate the use of alternative fishing methods not widely practiced in Anguilla, such as floating fish aggregating devices for pelagic fishing and vertical long-line fishing rigs for deep water snapper species and Diamond Back Squid (*Thysanoteuthis rhombus*) fishing.



- Terrestrial areas, coastal setbacks and pollution: The ridge-to-reef management approach adopts the principle that all habitat types are interlinked and so terrestrial area management is integral to the health of the marine habitats that surround them. Such an approach however involves cross agency cooperation and so is predominantly beyond the scope of this management plan, although recommendations for other agencies to follow can be made. The development of terrestrial areas is currently legislated under the Land Development (Control) Act (2000). Other legislation is relevant here also, with responsible agencies including, but not limited to, DoE, DoPP, and the ANT. All current policies should be adhered to, and the following is strongly recommended: development of official set-back legislation, especially within the marine parks and other sensitive coastal habitats; introduction of beaching lighting regulations to protect nesting sea turtles; working to ensure current legislation that protects natural beach flora and dunes is enforced; conducting regular septic tank inspections to ensure leeching into marine systems is limited; protection of mangroves and salt ponds important for sediment/nutrient entrapment; a full assessment of terrestrial pollution sources, especially the Corito Bay landfill site; and regulations that relate to connecting salt ponds to the ocean via subterranean pipes. Some of these factors/issues will need to be incorporated into new legislative revisions, and be the subject of separate management plans that should incorporate the goals laid out in the current document. Furthermore, the ANT and DoE will be encouraged by DFMR (in terms of help offered) to continue with any enhancement/rehabilitation programs within marine park terrestrial zones conducted in the past, for example: recent rat eradications on Dog Island (ANT, 2012); and bird/salt pond research island wide (Johnson *et al.*, 2014; Lloyd & Mukhida, 2014). If cooperation is possible with land owners a fully integrated management model is beneficial to be adopted
- The Cruising Permits Act: Although not under DFMR jurisdiction it will be necessary to make some minor amendments to the Cruising Permits Act in order for it to harmonise with the Marine Parks Act and the recommendations within this management plan. The typographical error naming Great Bay as a no anchoring zone needs to be updated, and it is suggested that, due to how circumstances have developed over the years, Rendezvous Bay no longer be classified as a no anchoring area, with anchoring merely restricted in the western end of the bay.

- Continuation of DFMR work: The importance of the work conducted by DFMR as it relates to this management plan cannot be overstated and as such all of their current programmes should continue. Aside from day-to-day Departmental duties these include, but are not limited to: annual seagrass and reef monitoring at fifteen sites; installation and maintenance of mooring fields within the marine parks; quarterly beach monitoring at over sixty sites; collection of fish catch data from landing sites around Anguilla; weekly in-water turtle population assessments; lionfish eradication from reported hot-spots; and at least one other independently conducted research project per year. These latter annual projects are chosen depending on perceived prioritisation by the Department with considerations given to logistical and financial constraints. Suggested projects for the coming years can be found in the time-line in the following Section. Current priorities are fisheries assessments and the encouragement of fishers to move away from trap fishing and spearfishing on shallow reef areas and towards exploitation of pelagic and/or deeper water fisheries. Budget and manpower increases would greatly aid this work load while at the same time allowing effective surveillance of AMMA to take place. This surveillance, which for full effectiveness will require an additional vessel at some point in the future, is essential for the success of this management plan.







## Section 6: Implementation Time-line: 2015-2025

This time frame has been chosen as it ties in with the vision developed by DFMR for the fisheries sector in Anguilla 'Vision 2025' is “a respected fisheries sector with informed fishers, fishing in a sustainable manner utilising improved fishing facilities and boats, supported by a Department of Fisheries and Marine Resources that impacts positively on all publics and manages the sector, in a participatory way, for the benefit of all stakeholders.” (from Fisheries Management Training Workshop 28<sup>th</sup> April 2008). It is believed the Marine Park System is an integral part of achieving this vision.

At the end of each year a review of the management plan progress will take place. Using new information gained over the past year, lessons learned, and stakeholder feedback, an updated version of the management plan document will be produced. Previous versions will be listed in the front matter for ease of reference. The time-line below will be similarly updated to represent the present situation. This will provide a documented chronology on the development of the management plan, its successes and/or failures, and pave the way for improved decisions making capacity in the future.

2015	Lead Agency	Outcome/Progress
Produce initial draft management plan for review by the Director of DFMR. Update management plan as necessary.	DFMR	Initial draft started early 2015. Submitted and returned with comments August 2015. Updated
Draft and submit legislative amendments as they relate to marine parks and associated fisheries and shallow water habitats.	DFMR	Departmental discussions held early 2015. Submitted to Ministry in September 2015
Fish trap distribution study and collection of data via DFMR fish catch data through landing site patrols to establish general understanding of numbers of fishers who currently fish within marine park boundaries.	DFMR	Surveys began July 2015, due for completion early 2016
Conduct island-wide Lionfish ( <i>Pterois volitans</i> ) population studies and reassess Lionfish Response Plan.	DFMR	Surveys began July 2015, due for completion early 2016
Queen Conch ( <i>Strombus gigas</i> ) fishery assessment to be conducted by DFMR, including population assessments and collection of targeted landing data.	DFMR	Surveys conducted between July and December 2015. Report currently in production
Rapid assessment of Sombrero Island marine habitats and report produced with management recommendations.	DFMR	Surveys completed in September 2015. Report in production.

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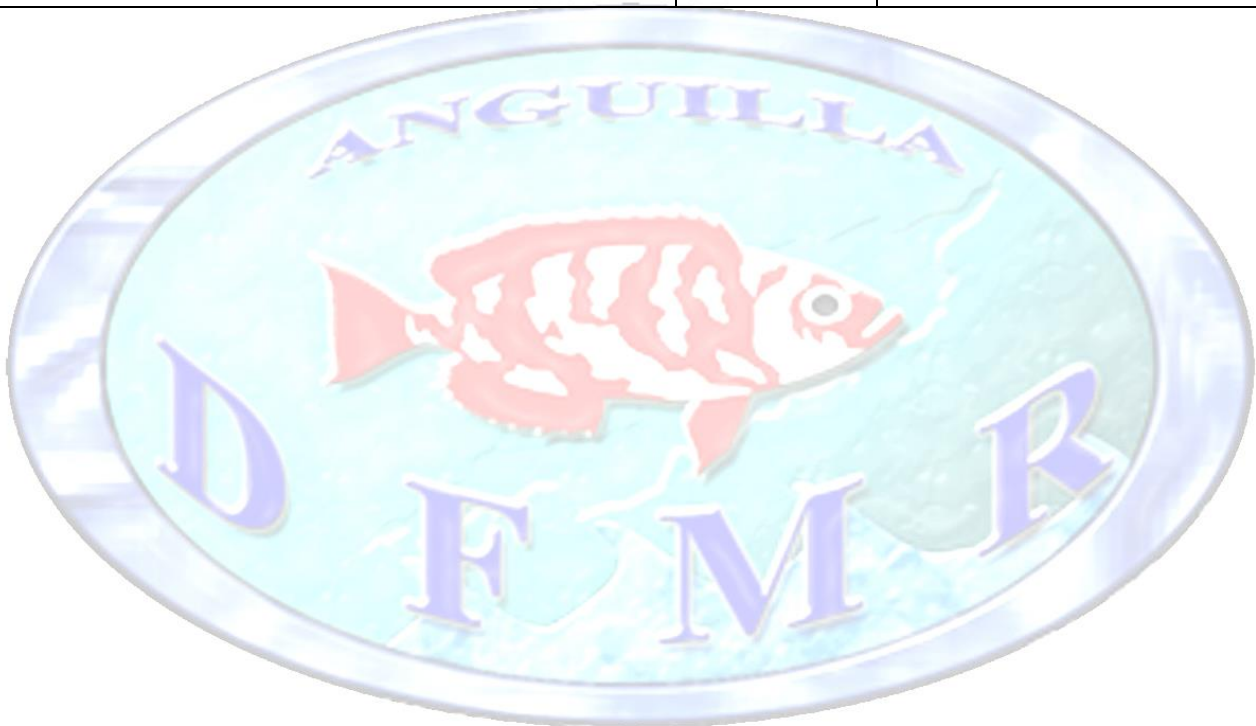
Distribution of new draft of management plan to former Director of Fisheries, Mr James Gumbs.	Independent Consultant	Completed in October 2015
Presentation to Ministry & public consultations on MPA development strategies and legislative amendments. Feedback fed into final draft of management plan.	DFMR	Public consultations held around the island in November 2015
Studies and/or funding proposals for the development of underwater attractions for both tourism enhancement and fisheries enhancement within the marine parks, for example wrecks, lobster casitas, underwater sculptures etc.	DFMR	A number of proposals submitted. Other funding sources also currently being investigation. Results due early 2016
First workshop to demonstrate fishing methods that do not rely of reef fish fisheries .	DFMR/FAO	FAD demonstration workshop conducted November 2015
Radio presentations and phone ins relating to legislative amendments.	DFMR	Three programmes scheduled for December 2015 and early 2016
Production of public awareness materials to desensitise against new legislation: for example, posters depicting recommended minimum landing sizes for all relevant species and explanation how minimum landing sizes can help sustain fish populations for future generations.	DFMR	Recommended minimum fish size posters and Anguilla marine life posters designed, printed and distributed island wide December 2015.
Production of the Anguilla Fisheries Development Plan which will act as a sister document to this management plan	DFMR	First draft completed December 2015
Production of final draft of management plan ready for presentation to Ex-Co for approval (along with Marine Parks Act legislative amendments and AFDP) prior to distribution around other Government agencies/NGOs.	DFMR	Being worked on in December 2015, due for submission early 2016
<b>2016</b>	<b>Lead Agency</b>	<b>Outcome/Progress</b>
Finalise plan and present to ExCo. Distribution round DoE, ANT, DoPP etc.	DFMR	Waiting on review of final draft
Research/demonstrations and outreach produced to publicise vertical long-line fishing method to develop deep water snapper fishery, plus other deep water/pelagic fisheries.	DFMR	In planning stages
Installation of marine park boundary marker buoys, primarily around Prickly Pear, Sandy Island and Little Bay Marine Parks. These three areas have been identified as a priority due to high tourist boat traffic.	DFMR/ANT	In planning stages
New legislative amendments for Fishery Protection Act – minimum sizes, closed areas, closed seasons etc.	DFMR	In planning stages
Support other Departments as needed with regards to action plans for terrestrial areas (set-backs, septic tanks etc).	DFMR, DoE, ANT, DOPP	n/a

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Spiny lobster ( <i>Panulirus argus</i> ) fishery assessment to be conducted by DFMR including population assessments; map of lobster grounds visited by fishers; and collection of targeted landing data (including CPUE). Include stakeholder opinion surveys on closed season and closed areas.	DFMR	In planning stages
Meeting to discuss if there is the need for water activity zones within the marine parks (or elsewhere in AMMA). Initial zones to be discussed are swimming areas where bathers are safe from other water craft within the marine parks. The areas are not to be legislated, just buoyed. First to be considered is Shoal Bay East.	DFMR, DoE, ANT	n/a
Production of public awareness materials to desensitise against new legislation: posters depicting Anguilla's Marine Park System and associated shallow water habitats, together for recommended practices to conserve these resources for future generations.	DFMR	n/a
<b>2017</b>	<b>Lead Agency</b>	<b>Outcome/Progress</b>
Undertake a ten year re-evaluation of the thirty baseline sites within the Marine Park System, if possible using original survey team (DFMR & ANT). Report produced and new management recommendations made.	DFMR	n/a
Continue pushing for new legislation if the necessary changes still haven't been made.	DFMR, DoE, ANT	n/a
Training of Fisheries Officers and other officials to prepare them for surveillance and enforcement of new legislation.	DFMR	n/a
<b>2018-2020</b>	<b>Lead Agency</b>	<b>Outcome/Progress</b>
Begin increased surveillance & enforcement of new/existing legislation to begin within Marine Park System in combination with public awareness campaigns and stakeholder meetings.	DFMR	n/a
Continued monitoring and assessments including the consideration of other areas being afforded increased protection: Suggested locations include Scrub Island, Limestone-Black Garden Bays and Anguillita-Blowing Rock.	DFMR	n/a
Habitat mapping of offshore areas (for example Old England fishing grounds) to facilitate their potential inclusion within future adaptations of the AFDP.	DFMR, DoE	n/a



2021-2025	Lead Agency	Outcome/Progress
Assessment of compliance rates of new legislation and socio-economic monitoring of positive/negative effects and opinions.	DFMR	n/a
Establishment of new management areas within AMMA based on the results of area assessment conducted previously.	DFMR	n/a
Continued monitoring and assessment of all management plan facets with stakeholder meetings to discuss progress and suggestions.	DFMR	n/a
Development of a 2025-2035 AMMA management plan encompassing all the progress made over the last ten years and directions for future goals.	DFMR	n/a



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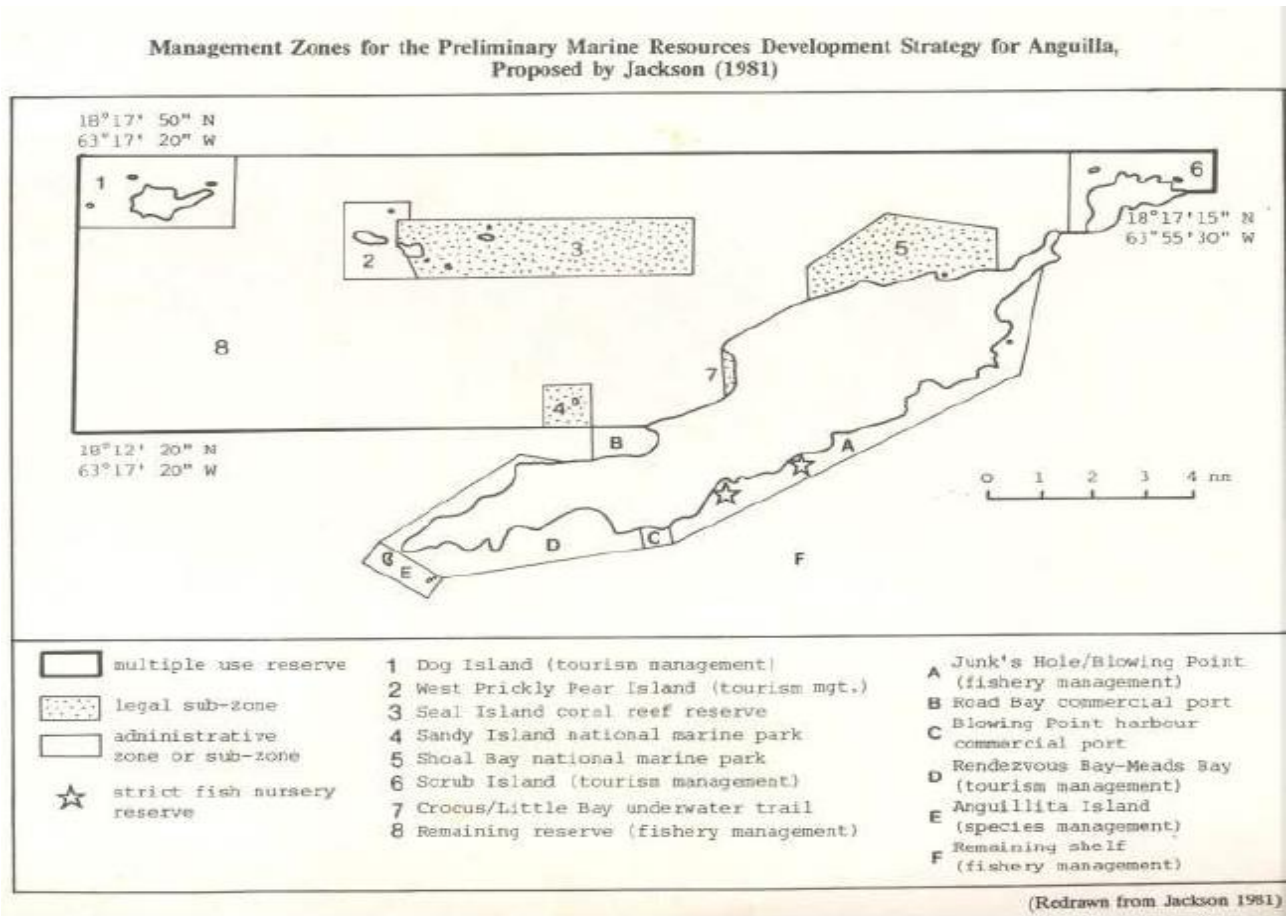
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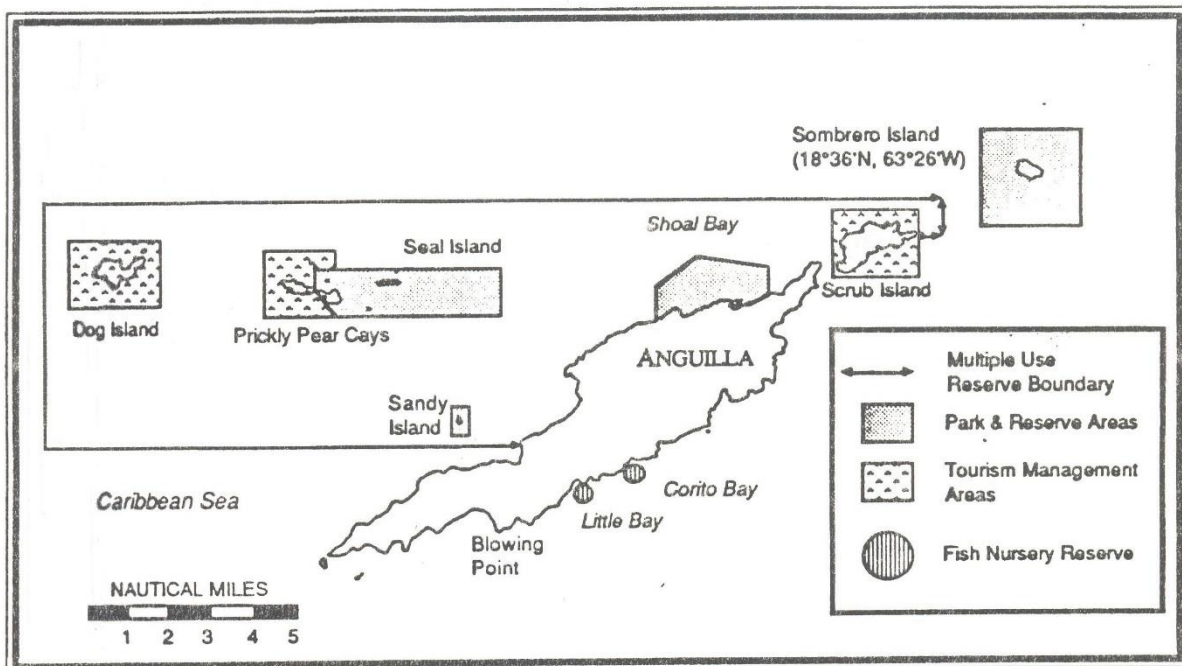




## Appendix 1 - Zonation maps from 1980's



### Proposed Marine Resource Management Zones, Anguilla



Taken from Goodwin M. (1989)





## Appendix 2a – Baseline Habitat Data for Anguilla's Marine Park System (Wynne, 2007)

Site	Physical Attributes			Percentage Cover			Percentage Cover (Biotic & Barren)														
	Depth (m)	Relief (cm)	Rugosity	Underlying Substrate			Barren		Algae				Plants	Other	Corals			Sponges		Other Inverts	
				Solid	Rubble	Sand	Sand	Turf / Sed	Fleshy	Calcereous	Coraline	Other	Turtle Grass	Cyanophyta	Hard	Soft	Fire	% Cover	No.	% Cover	No.
DG01	8.1	6.4	88.4	32.0	1.5	66.5	50.5	17.0	18.5	0.0	1.0	0.0	0.0	0.5	6.7	0.5	3.0	2.5	0.3	0.0	0.4
DG02	6.5	9.3	57.9	77.5	17.0	5.5	4.0	37.5	0.0	0.0	8.5	0.0	0.0	3.8	8.8	12.5	7.3	13.0	1.0	5.5	2.1
DG03	8.7	5.3	57.2	48.0	41.0	11.0	9.0	30.5	10.5	0.0	9.3	0.0	0.0	2.5	7.6	11.0	10.5	8.7	1.0	1.7	2.3
Mean	7.8	7.0	67.8	52.5	19.8	27.7	21.2	28.3	9.7	0.0	6.3	0.0	0.0	2.3	7.7	8.0	6.9	8.1	0.8	2.4	1.6
LB01	7.5	4.8	83.5	0.0	0.5	99.5	14.5	5.0	0.0	13.5	0.0	0.5	63.8	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.1
LB02	10.2	3.1	94.2	0.0	0.0	100.0	23.5	3.5	0.0	14.0	0.0	1.3	54.5	2.0	0.2	0.0	0.0	0.3	0.2	1.1	0.5
LB03	8.9	4.6	95.7	0.0	0.0	100.0	14.5	4.0	1.4	13.0	0.0	1.2	65.0	0.0	0.1	0.0	0.0	1.7	0.6	0.7	0.3
Mean	8.9	4.2	91.1	0.0	0.2	99.8	17.5	4.2	0.5	13.5	0.0	1.0	61.1	0.7	0.1	0.0	0.0	0.7	0.3	0.6	0.1
PP01	6.9	8.8	61.4	41.5	15.5	43.0	30.0	12.5	2.5	0.0	6.8	0.0	0.0	1.8	7.5	13.0	7.5	14.0	1.4	4.5	1.3
PP02	7.0	12.9	53.7	25.5	40.0	34.5	30.0	15.5	11.0	8.0	0.0	0.0	0.0	4.5	15.5	9.0	4.7	0.5	0.1	1.2	0.5
PP03	6.1	12.8	74.5	34.0	25.5	40.5	37.5	14.0	0.0	0.0	6.5	0.0	0.0	0.0	13.5	7.5	6.0	10.0	0.9	5.5	1.7
PP04	7.8	9.4	75.5	60.0	2.0	38.0	36.5	26.0	15.5	0.5	0.5	0.0	0.0	6.0	6.5	2.0	2.0	3.5	0.4	0.0	0.0
PP05	7.6	7.5	70.3	20.0	20.0	60.0	27.0	9.5	11.5	13.5	3.0	0.0	0.0	10.0	15.5	7.5	1.5	1.4	0.4	0.0	0.2
PP06	8.6	10.4	56.0	20.0	24.5	55.5	36.3	15.0	0.5	10.5	3.0	0.0	0.0	6.4	17.3	4.8	2.9	3.7	0.7	2.5	0.5
PP07	7.5	12.6	47.9	31.5	24.0	44.5	21.5	11.5	0.0	7.8	6.7	0.0	0.0	7.5	24.5	10.5	4.5	5.0	0.6	1.2	0.8
PP08	5.9	8.9	55.6	52.5	41.5	6.0	4.5	32.2	0.0	6.2	4.6	0.2	0.0	0.0	2.0	7.7	6.3	4.5	0.5	31.4	3.7
Mean	7.2	10.4	61.9	35.6	24.1	40.3	27.9	17.0	5.1	5.8	3.9	0.0	0.0	4.5	12.8	7.8	4.4	5.3	0.6	5.8	1.1
SA01	6.5	13.2	71.7	33.5	26.5	40.0	24.0	20.5	6.0	0.0	3.0	0.0	0.0	0.0	12.0	15.0	4.0	13.5	0.9	1.5	0.3
SA02	5.3	10.9	66.9	27.5	26.0	46.5	23.8	23.0	6.5	0.0	3.9	0.0	0.0	0.0	7.5	19.0	5.0	9.5	0.9	1.5	0.6
SA03	7.9	12.2	59.3	19.0	42.0	39.0	25.5	17.5	11.0	0.5	6.8	0.0	0.0	0.0	13.5	11.5	2.5	10.5	1.5	0.3	0.3
SA04	7.9	8.9	65.0	45.0	21.0	34.0	19.0	14.5	15.7	0.2	6.0	0.0	0.0	1.5	11.0	17.5	9.0	5.5	0.7	0.7	0.3
Mean	6.9	11.3	65.7	31.3	28.9	39.9	23.1	18.9	9.8	0.2	4.9	0.0	0.0	0.4	11.0	15.8	5.1	9.8	1.0	1.0	0.4
SB01	9.2	8.8	58.6	94.0	2.7	3.3	19.5	12.8	25.6	1.3	5.9	0.0	0.0	6.8	6.8	8.9	3.0	9.1	0.9	0.3	0.2
SB02	8.9	10.8	58.1	56.3	34.1	9.6	16.4	9.9	17.7	9.1	10.3	0.0	0.0	3.1	13.7	9.6	2.4	2.8	0.4	5.5	1.2
SB03	6.6	28.9	45.6	50.0	25.0	25.0	21.0	12.4	13.9	16.6	4.9	0.7	0.0	2.5	11.8	5.2	4.0	5.1	0.5	1.8	0.9
SB04	7.0	24.6	55.5	68.1	26.7	5.2	8.2	19.9	30.0	12.4	4.4	0.0	0.0	2.1	8.3	6.4	2.0	4.7	1.1	1.8	0.7
SB05	9.2	15.4	49.9	22.0	74.3	3.8	8.6	35.0	20.9	7.9	4.4	0.0	0.0	4.6	7.3	6.4	1.8	3.0	0.4	0.2	0.1
SB06	5.0	13.0	58.8	45.6	33.9	20.6	21.3	22.9	10.1	12.5	4.3	0.1	0.0	5.2	10.5	6.3	3.4	2.4	0.6	0.9	0.6
SB07	7.5	15.7	59.0	58.1	15.4	26.4	26.4	16.9	11.4	12.0	3.5	0.0	0.0	7.9	7.6	5.3	2.7	5.5	1.1	0.4	0.5
SB08	6.8	14.1	60.9	64.8	27.2	8.0	10.9	50.1	6.3	6.8	6.1	0.3	0.0	6.1	4.3	4.1	0.3	4.0	1.0	0.5	0.4
SB09	6.7	9.9	40.9	65.5	23.1	11.4	11.9	58.7	11.2	1.6	2.2	0.5	0.0	0.1	2.8	2.6	1.9	5.5	0.9	1.0	0.4
SB10	6.1	12.8	33.1	49.0	45.5	5.5	7.8	52.5	17.8	5.3	4.1	0.1	0.0	1.7	2.4	3.6	1.7	3.3	0.5	0.3	0.3
SB11	4.5	5.4	42.4	69.9	20.4	9.8	10.1	47.8	13.8	3.1	1.9	0.3	0.0	0.7	3.1	4.4	3.6	8.8	0.8	2.2	0.8
SB12	6.1	8.5	25.3	83.7	14.0	2.3	4.3	23.9	34.1	5.8	20.2	0.0	0.0	4.2	0.5	2.3	0.0	2.1	0.1	2.1	0.3
Mean	7.0	14.0	49.0	60.6	28.5	10.9	13.9	30.2	17.7	7.9	6.0	0.2	0.0	3.7	6.6	5.4	2.2	4.7	0.7	1.4	0.5

## Appendix 2b – Baseline Fish Data for Anguilla's Marine Park System (Wynne, 2007)

Site	RDT Surveys			Stationary Point Counts: Size Class (cm) Total Count										
	Mean Fish Survey <sup>-1</sup>	Number of Species	Fish Hectare <sup>-1</sup>	<5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	50>
DG01	817	39	10886	11.8	9	10.4	22	30.4	22.6	0.6	0	0.2	0.2	0
DG02	1387	52	18494	1.8	1.8	31.2	51	36.6	33.6	25.8	13.8	0.6	0.6	0.2
DG03	1278	48	17040	8.2	5.8	9.6	12.6	14.2	6.2	6.8	2.2	0.6	0.4	0
<b>Mean</b>	<b>1161</b>	<b>72</b>	<b>15473</b>	<b>7.3</b>	<b>5.5</b>	<b>17.1</b>	<b>28.5</b>	<b>27.1</b>	<b>20.8</b>	<b>11.1</b>	<b>5.3</b>	<b>0.5</b>	<b>0.4</b>	<b>0.1</b>
LB01	476	25	6340	12.2	1.2	0	0	0	0	0	0	0	0	0
LB02	301	20	4007	15	1.2	0	0	0	0	0	0	0	0	0
LB03	163	18	2173	7.8	1.4	0	0	0	0	0	0	0	0	0
<b>Mean</b>	<b>313</b>	<b>35</b>	<b>4173</b>	<b>11.7</b>	<b>1.3</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
PP01	1335	48	17800	1.4	3.2	4.6	33.2	12.2	8	0.6	0.2	1.2	0.2	0.4
PP02	820	47	10926	9.8	5	4.2	11.8	10.2	0.8	1.6	2	5.2	2.4	0
PP03	786	51	10473	8.4	2.6	4.2	11.2	9.6	4.2	1	1.6	0.4	0.6	0
PP04	683	39	9100	17.8	10.4	6.8	26.4	28.8	10	11	15	8.8	3.4	0.4
PP05	869	52	11586	23.6	25.6	14.4	4	2.8	1.8	2.2	1.4	0.4	0.4	0
PP06	752	43	10020	10.4	18.2	24.8	10.6	3.2	0.6	1.4	0.4	1.4	0	0
PP07	1177	50	15686	3.6	16.4	14.4	13.6	6.6	1.6	1.8	0.4	0	0.6	0.8
PP08	900	47	12000	5	14.4	17.4	34.8	6.8	2.6	2.2	2.2	1.8	1.6	0
<b>Mean</b>	<b>915</b>	<b>94</b>	<b>12199</b>	<b>10.0</b>	<b>12.0</b>	<b>11.4</b>	<b>18.2</b>	<b>10.0</b>	<b>3.7</b>	<b>2.7</b>	<b>2.9</b>	<b>2.4</b>	<b>1.2</b>	<b>0.2</b>
SA01	1109	45	14786	3.6	17	18.6	10.8	10.2	3.2	1.8	0	0	0	0.2
SA02	761	35	10140	2.4	12.6	13.4	10.8	7.4	2	0.2	0.2	0	0	0.2
SA03	1205	50	16060	11.8	8.8	14.2	4.4	0.4	1	0.4	0	0	0	0
SA04	840	49	11193	11.8	7	10.6	12.2	7.4	2	0.6	1.4	0.4	0.8	0.2
<b>Mean</b>	<b>978</b>	<b>71</b>	<b>13045</b>	<b>7.4</b>	<b>11.4</b>	<b>14.2</b>	<b>9.6</b>	<b>6.4</b>	<b>2.1</b>	<b>0.8</b>	<b>0.4</b>	<b>0.1</b>	<b>0.2</b>	<b>0.2</b>
SB01	785	52	10460	40	37.4	12.2	3.6	0.6	0	0	0	0	0	0
SB02	1080	50	14400	31	55	48.4	7.6	0	0	0	0	0	0	0.2
SB03	1049	47	13980	22	61	43	2	0	0	0	0	0	0	0
SB04	585	45	7793	9	26.2	44	12.4	5.8	2.2	0	0	0	0	0
SB05	1141	52	15213	8	17	16.4	49	17	3	0.6	0	0	0	0
SB06	1073	62	14300	2	15.4	22.4	31.8	14.4	2	0	0	0	0	0
SB07	510	59	6800	5.4	9.4	12.2	12	4	0.6	0	0	0	0	0
SB08	742	55	9893	11.4	23.4	35.8	23.2	19	6.4	1.6	0	0	0	0
SB09	727	46	9693	30.2	9.6	12.2	12.4	1.6	1	0.4	0	0	0	0
SB10	738	53	9840	0	6.8	7.2	9.4	2.2	4	0.4	0.2	0.2	0	0
SB11	599	37	7986	10.2	11.4	12.6	5.4	1.6	0.2	0	0	0	0	0
SB12	661	55	8806	4	19.6	8.6	24.8	28.4	5.8	1.4	0.2	1	0.8	0.2
<b>Mean</b>	<b>807</b>	<b>100</b>	<b>10764</b>	<b>14.43</b>	<b>24.35</b>	<b>22.92</b>	<b>16.13</b>	<b>7.88</b>	<b>2.10</b>	<b>0.37</b>	<b>0.03</b>	<b>0.10</b>	<b>0.07</b>	<b>0.03</b>