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Rapid habitat assessment of the Inner Anguilla Bank and North of the Seal Island Reef System

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ABSTRACT

When conducting fishery assessments of demersal species it is essential to have habitat information that relates to the associated fishing grounds. Over the last decade there have been a number of research projects that addressed this issue for coastal areas around Anguilla. Until recently however, no habitat data existed for deeper offshore fishing areas, with such information crucial for the future management of demersal fisheries in these regions. A methodology was tested using an underwater video array around Sombrero Island in September 2015, which yielded the first offshore fishing ground data collected in Anguilla. The results of this study were used to modify the video array design so that it may better suit underwater habitats of variable complexity. The current work built on this, using a modified underwater array to conduct habitat video transects on the inner Anguilla Bank and in the area north of the Seal Island reef system. These areas are known to be historical fishing grounds. Results from this work confirmed the viability of the new video array design, and suggested that it could also be used to survey demersal fish population during habitat transects with only minor further modifications. The results also confirmed that these historical fishing grounds are in a poor state of health with high plant/algae cover, low coral cover, and a paucity of other invertebrate species groups. Indirect data collected while surveying further suggests that fish populations are low in the areas surveyed. This likely explains why although fishing occurred in these areas historically, today most activities, aside from fishing for Spotted Spiny Lobster (*Panulirus guttatus*) via fish-traps, have moved to more distant regions offshore. Prior to this study, it was suspected that these areas were in a poor state of health because, aside from the migration of fishing activities, decreases in habitat health have recently been confirmed in all coastal areas surveyed to date. It is hoped that the results presented here will be used as a foundation over subsequent years to build a complete picture of habitat health over all Anguilla's offshore demersal fishing grounds. A current priority for the continuance of this work is the outer Anguilla Bank, an area known locally as Old England frequently visited by local fishers, and a full assessment of the Caribbean Spiny Lobster (*Panulirus argus*) fishery in all suitable offshore areas. The proposed future assessments, together with subsequent informed managerial decisions, are essential if Anguilla is to maintain these important demersal fisheries sustainably for use by future generations.

Introduction

The degradation of fishing ground habitats and declining fish stocks have become an issue of growing concern for many decades (Turner *et al*., 1999) with the collapse of various fisheries (Jahncke *et al*., 2003 and Hutchings, 1999), and the loss of marine habitats (Munday, 2004) becoming a well-documented phenomenon around the globe. Although management of these fisheries and threatened ecosystems over recent years has achieved varying successes (Côté *et al*., 2001), generally interventions have been shown to arrest or reverse declines and are therefore frequently proposed as a necessary step in the sustainability of fisheries (Williams and Russ, 1995). Before such interventions can be made, it is essential to gain a good understanding of the fisheries in question and the structure and health of their associated habitats.

In Anguilla, British West Indies, the most northerly of the Leeward Islands, concerns exist as to the sustainability of all current fisheries, both in terms of those predominantly taking place in coastal areas that are more artisanal in nature, and those in offshore regions that are operated in a more commercial manner. The coastal fisheries have been the focus of management efforts in Anguilla for more than a decade, with annual habitat monitoring beginning in 2007 (Wynne, 2008) and a marine park management plan recently developed (Wynne, 2015). This plan aimed to enhance the managerial regime of the Anguilla Marine Park System for the benefit of recreational users and the sustainability of all associated fisheries and shallow water habitats. During this time a sister document was also developed, the Anguilla Fisheries Development Plan (Gumbs *et al*., 2015), that aimed to address all active and potential future fisheries in Anguillian waters. This latter document identified the need for more research into many of the existing fisheries, with special emphasis on offshore areas where no assessment work has ever been conducted. In 2015, with this knowledge gap identified, the first such assessment was conducted around Sombrero Island (Wynne *et al*., 2016), which tested survey methodologies and represented the first offshore habitat survey work ever conducted in Anguilla.

The work conducted around Sombrero Island used an underwater video array to survey benthic transects, that had been designed to survey conch stocks on seagrass beds as described in Boman *et al*., (2016). It achieved reasonable results over hard substrata, but re-design recommendations were made to enable it to operate more effectively over high complexity reef areas (Wynne *et al*., 2016). Then, in 2016, the Centre for Environment Fisheries and Aquaculture Science (CEFAS) from the UK, gained Darwin Initiative funding for a project in partnership with the Government of Anguilla[1] that also used an underwater video array. Interestingly the design of their array reflected many of the modifications suggested following the Sombrero Island work. While CEFAS were in Anguilla, the Department of Fisheries and Marine Resources (DFMR) were able to accompany them during two of their in-water survey trips, the first of which targeted areas on the Anguilla Bank and north of the Seal Island reef system. This work enabled DFMR to achieve four goals: to test design modifications for the underwater video array to be used during offshore fishing ground habitat assessments; to justify the usefulness of

[1] Department of Environment, project title 'Mapping Anguilla's Marine "Blue Belt" Ecosystems Services Project'

this approach financially as part of a wider DFMR initiative to assess Anguilla's offshore fishing grounds; to build upon the Sombrero Island work and expand DFMR offshore habitat data archives; and to create a foundation for extensive future offshore fishing ground habitat assessments and offshore demersal fishery assessments.

To achieve these four goals CEFAS provided DFMR with the underwater video array footage obtained during their survey work. This report presents the results from subsequent DFMR analysis of the video transects from the Anguilla Bank and north of Seal Island Reef System, and makes recommendations for future work of this nature in Anguilla's offshore demersal fishing grounds.

Methods

A modified underwater video array from that used in Boman *et al*. (2016), designed by CEFAS (Figure 1), was used to conduct thirteen video transects, seven on the Anguilla Bank (inner area), and six along the outer northern edge of the Seal Island reef system. Transects were randomly distributed in the two study areas as habitat and sea conditions allowed, but followed where possible the original GPS locations selected prior to departure (Figure 2).

Figure 1: Aluminium underwater video array with lights, Bowtek live recordable feed camera and GoPro mounts for HD stills and video (source: DFMR archives).

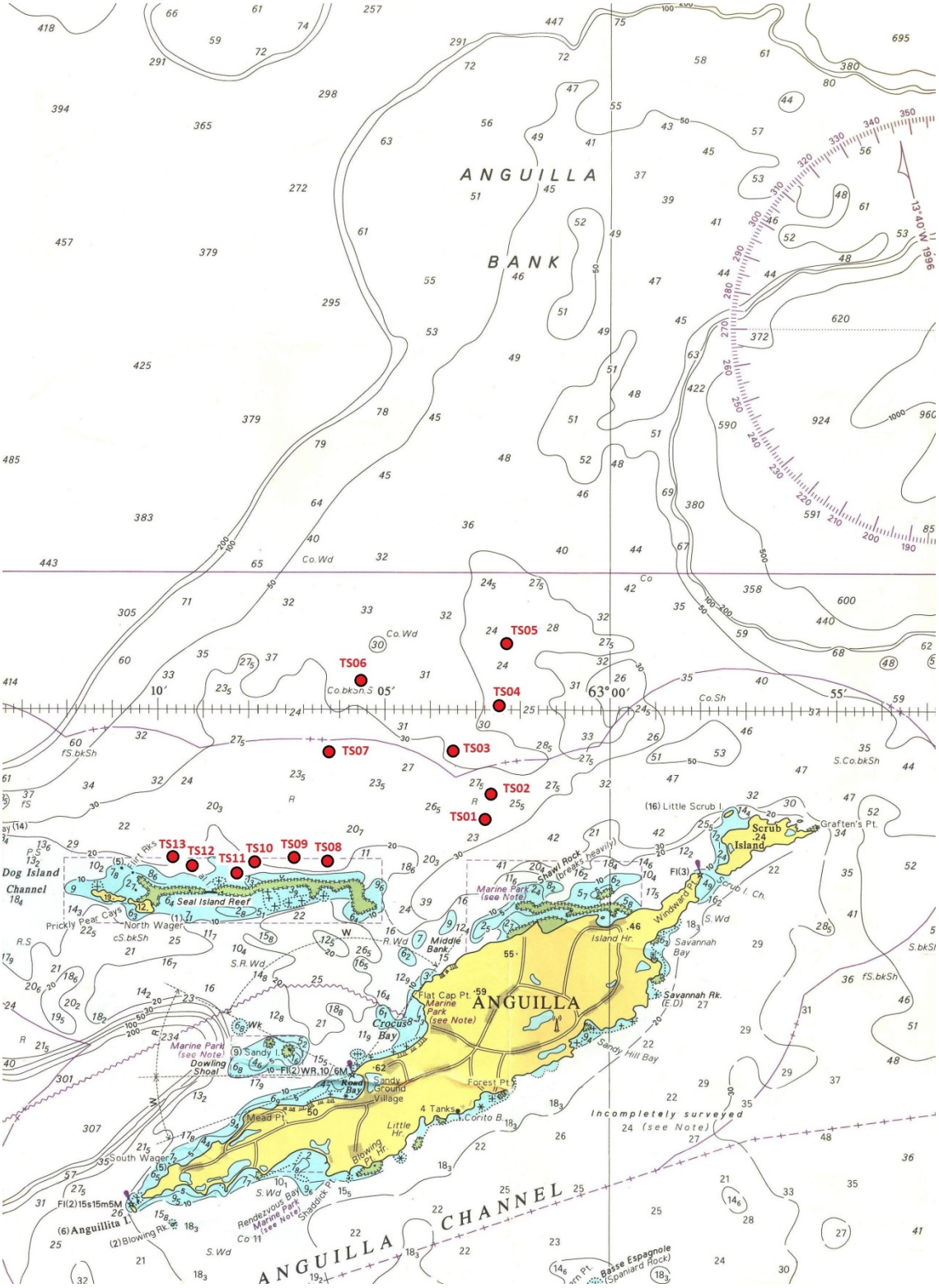

Figure 2: Location of the thirteen transects surveyed, seven in the inner area of the Anguilla Bank (TS01-TS07) and six north of the Seal Island reef system (TS08-TS13).

Transects were conducted by lowering the video array into the water, and controlling descent using a manual downline. The live video feed was used to judge the distance above the sea floor, and adjusted as needed during each transect when the topography changed or obstacles were encountered. Once orientated in a satisfactory manner, the transect start time and GPS coordinates were noted and the array allowed to drift naturally as dictated by the surface vessel as it moved naturally based on current speed and direction. Each transect was timed, with a goal length of ten minutes. Once this time had been reached the video array was manually hoisted back on board the vessel and end point GPS coordinates recorded.

When analysing the video transects back in the lab, snap shots were taken every forty to sixty seconds and underlying substrate estimated (sand, rubble, hard). Following this benthic cover was assessed and split into nine grouped categories: bare sand; bare/sediment/turf algae covered rock; *Sargassum sp*.; fleshy macroalgae; cyanobacteria; hard coral; soft coral; sponges; and other invertebrates. Species specific, and often genus specific, identification was not possible, as even though high definition video was recorded, slight camera blur often occurred due to low light levels and floating sediment. It was for this reason that generic category groupings were used (i.e. 'fleshy macroalgae' and 'hard coral').

Results

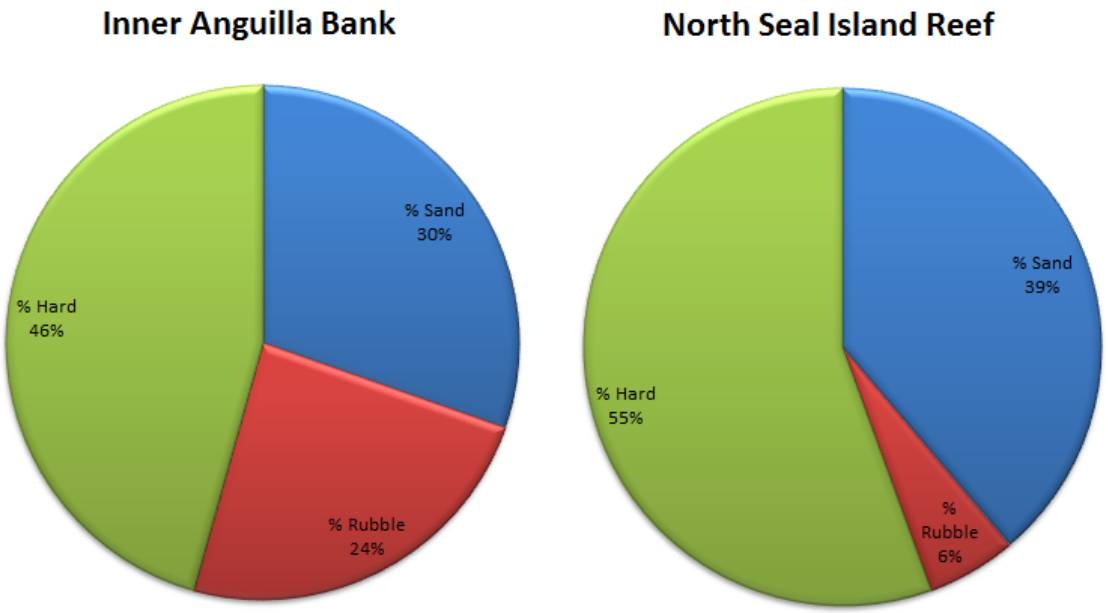

Figure 3: Underlying substrate composition for both study sites across the thirteen transects. Standard deviations for categories are: Inner Anguilla Bank (seven transects) – sand 16.5, rubble 33.8, hard 30.8; and north of Seal Island reef (six transects) – sand 42.4, rubble 8.1, hard 39.7.

Table 1: Mean characteristics of the thirteen transects across both study sites: Inner Anguilla Bank (TS01 – TS07); north Seal Island reef (TS08 – TS13).

Transect	Sand	Turf / Sediment	Sargassum Algae	Fleshy Algae	Cyano-bacteria	Hard Coral	Soft Coral	Sponges
TS01	22.3%	31.3%	45.3%	0.0%	0.0%	0.3%	0.0%	0.7%
TS02	16.7%	70.3%	13.2%	0.0%	0.0%	0.0%	0.0%	0.0%
TS03	20.3%	15.3%	5.9%	5.3%	52.7%	0.3%	0.0%	0.1%
TS04	30.7%	25.7%	39.3%	0.7%	0.0%	1.0%	0.0%	2.7%
TS05	16.7%	45.8%	35.8%	0.0%	0.0%	0.4%	0.0%	1.3%
TS06	11.3%	10.4%	20.0%	56.7%	0.0%	0.0%	1.7%	0.0%
TS07	37.9%	23.3%	29.6%	5.0%	2.5%	0.8%	0.4%	0.4%
TS08	2.3%	34.7%	1.7%	58.5%	0.0%	2.0%	0.5%	0.3%
TS09	7.5%	15.6%	0.0%	58.8%	3.9%	13.1%	1.1%	0.0%
TS10	85.0%	9.3%	0.0%	2.7%	2.3%	0.7%	0.0%	0.0%
TS11	17.7%	56.2%	14.0%	6.4%	0.0%	1.8%	3.9%	0.0%
TS12	22.5%	48.3%	24.2%	0.0%	1.3%	3.3%	0.4%	0.0%
TS13	98.7%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	0.0%

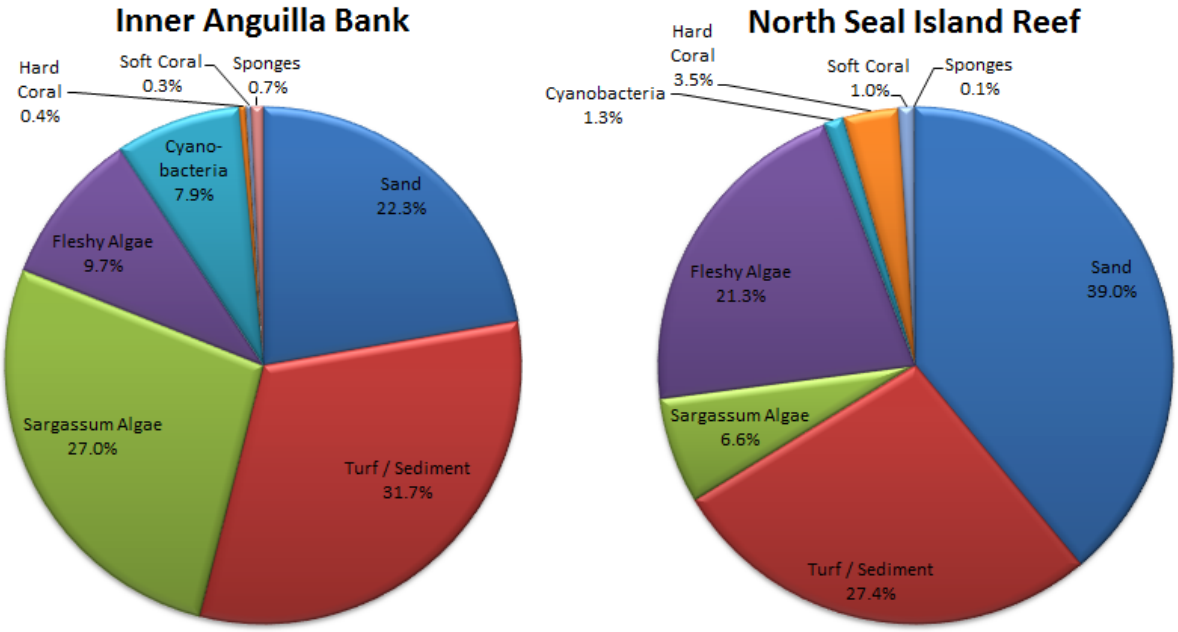

Figure 4: Benthic composition for both study sites across the thirteen transects. Standard deviations for categories are: Inner Anguilla Bank (seven transects) – sand 9.2, turf/sediment 20.5, *Sargassum sp*. 14.5, fleshy algae 20.9, cyanobacteria 19.8, hard coral 0.4, soft coral 0.6, sponge 1.0; north of Seal Island reef (six transects) – sand 41.8, turf/sediment 22.5, *Sargassum sp*. 10.2, fleshy algae 29.0, cyanobacteria 1.6, hard coral 4.8, soft coral 1.5, sponge 0.1.

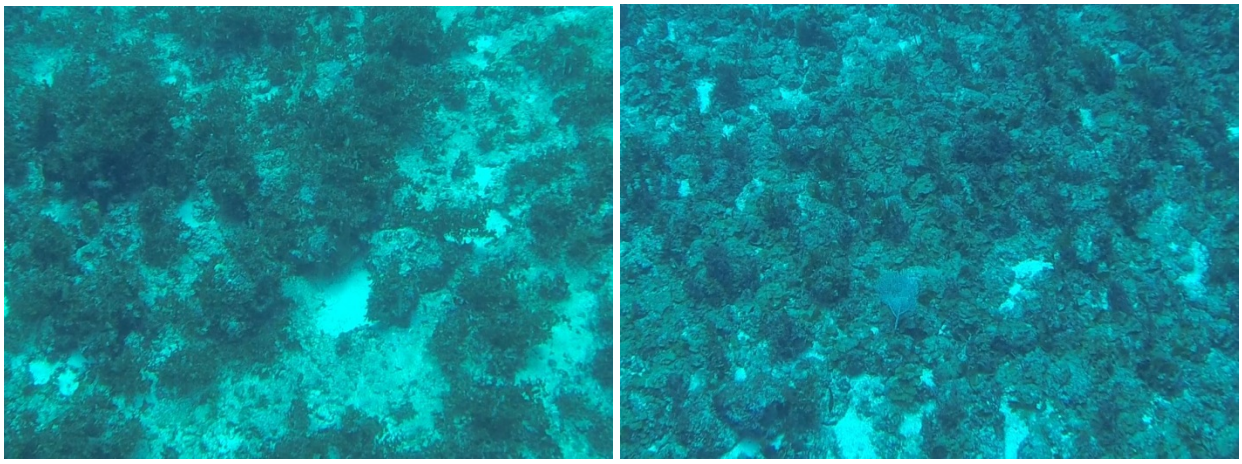

Figure 5: Example snap-shots from the inner Anguilla Bank transects TS05 (left) and TS06 (right). Both these transects, as with all surveyed in this study area, were relatively uniform in characteristics although there was variation between them. TS05 consisted predominantly of *Sargassum sp*. thickets with little other fleshy algae and a lot of sediment covered rock; whereas TS06 had high levels of fleshy macroalgae (mainly *Lobophora sp*.), moderate amounts of *Sargassum sp*. and much less bare sediment covered rock.

Figure 6: Example snap-shots from the north Seal Island reef system transects, illustrating the variation that was often observed within each. Both images are from TS08. That on the left pictures fairly standard benthic cover for this study area - thick plant/algae cover with scattered small coral colonies and dead reef remains. The image on the right however is from only three minutes later on in the transect and shows a more complex dead reef structure almost entirely covered in fleshy macroalgae, tentatively identified as *Dictyopteris jamaicensis*.

Discussion

Modifications to underwater video array design

The design produced by CEFAS mirrored most of the suggested modifications following the work conducted around Sombrero Island (Wynne *el al*., 2016). The original design, although comparatively more stable while underwater, employed a more complex buoyancy system that restricted its use over complex benthic habitats. The new design addressed this problem with minimal impact on data collection. Although its manual depth control means distance and therefore spatial/size quantifications are not possible to make, such quantifications are not necessary for benthic habitat surveys, whereas they were for the original arrays survey purpose (conch stock assessments). Furthermore, the use of a metal frame means the array needs no counterweight as in the original design, and the use of aluminium means it is not overly cumbersome.

Aside from the design of the array, another slight change made was to the survey methodology. In the original Sombrero Island work transects were undertaken for a set distance (500 m), and so if currents were slow transects could take in excess of 45 minutes to complete. This is not favourable when working in offshore areas, as when the survey vessel engines are placed in neutral and the transect begins, swells cause it to roll, pitch and yaw, which can be very unpleasant over long periods for the research staff. Keeping transects to a specific length of time minimizes this. The original methodology was useful for the original survey purpose (conch density per hectare) as it allowed easy to quantify survey results, whereas this is less important when conducting straight forward habitat assessments.

Habitat assessment

Overall, the transects surveyed did not contained healthy highly biodiverse marine habitats. In general, excluding bare sand, sediment or algae covered rock accounted for 98.5% of cover in the inner Anguilla Bank, and 95.5% of cover north of Seal Island reef. Very few demersal fish were seen during the surveys aside from small species of wrasse (Labridae), parrotfish (Scaridae), and squirrelfish (Holocentridae). It would be possible to expand future survey work to look at demersal fish species populations, but to do this it would be necessary to incorporate laser pointers as used on the original conch survey array design. These pointers, set a known distance apart and orientated directly ahead, provide a scale so that size estimations can be made.

Hard coral cover was extremely low in both study areas, with 0.4% cover on the inner Anguilla Bank, and 3.5% cover north of Seal Island reef. Although the cover is higher in this latter site, its low value is of special concern as this area used to be a healthy and extensive barrier reef system, and historically popular with local fishers. The inner Anguilla Bank on the other hand is very different to this, and would likely have always been a relatively low relief deep reef area. Having said this, fishing for demersal

species, although now taking place further off shore in the outer Anguilla Bank, historically would have taken place here and so the paucity of fish, and low numbers of coral and other invertebrates such as sponges, is still a cause for concern. The only current exception to this is fishing for Spotted Spiny Lobster (*Panulirus guttatus*) in the area north of Seal Island reef. It is likely that this fishery can still operate here because coral skeletal remains provide the complexity needed for this species to survive. With time, if coral cover does not increase and hermatypic coral species fail to rebuilt the reef, in a few decades it is probable that this fishery will no longer exist in this area.

Overall, the poor state of the two offshore benthic habitats surveyed reflects that seen during survey work in Anguilla's coastal areas also. Live coral and fish populations are in decline, and macroalgae levels continue to remain high (Wynne, 2017). Although the reasons for this are complex, and necessitates problematic multifaceted research to fully understand[2], the high levels of macroalgae and *Sargassum sp*. growing in these areas points to a level of eutrophication that would not typically be expected in tropical reef areas. This all points to a deeper regional problem rather than simply one of local overfishing or pollution, and as such local management measures may struggle to mitigate against the situation. This is not a reason for managerial lethargy however, but it is a reason for immediate action. Without definitive local action the chance of mitigating declines diminish with time, and the future of Anguilla's benthic ecosystems looks bleak.

Future recommendations

This work adds to the growing amount of evidence that Anguilla's marine ecosystems are in a declining state of health, a situation that ultimately threatens the islands economy which is built upon the tourist industry. As stated in Wynne (2017): 'If marine habitat health continues to decline, beach erosion will increase, coastal fisheries will collapse, and almost all livelihoods around the island will be negatively impacted'. Making recommendations in an attempt to mitigate this decline is a complex process beyond the scope of this report, although a detailed breakdown is given in Wynne (2015). In summary though, although not directly related to the results presented here, the following three main recommendations can be made.

1. Marine Parks should be offered the highest level of protection possible to preserve relic populations for hopeful future regeneration. Government funding is needed to ensure surveillance efforts can be sufficient to enforce regulations.

2. Minimum sizes should be introduced for all key reef fish species. Full protection should be given to rare/charismatic species that have a commercial tourist value.

[2] Often referred to as 'Umbrella Research' (Shinn, 2017)

3. Runoff from developments needs strict regulation, and all septic tanks should be routinely inspected. Any coastal properties with septic tanks older than twenty years need special consideration. Coastal setbacks should be enforced for both general construction of buildings and the location of such septic systems.

Further to this, it is also recommended that the current work be expanded to include all known demersal fishing grounds less than 60 m in depth (the functioning limit of current survey equipment). The outer Anguilla Bank should be prioritized (an area known as Old England), especially areas visited regularly by Caribbean Spiny Lobster (*Panulirus argus*) fishers. This should be combined with a full assessment of fisheries operating in these areas. This current work has proved the capacity for DFMR to conduct much of this work independently with only limited technical assistance. For this reason the Department recently purchased a SeaViewer® recordable live-feed camera, and has begun investigating the construction of an aluminium array similar to that used during this study. DFMR has also recently partnered with CEFAS in a regional lobster fishery assessment project funded under the Darwin Initiative, which will include habitat assessments of the outer Anguilla Bank. If this work is completed successfully it will close a significant knowledge gap for the Islands demersal fisheries and have helped build a robust offshore fishing ground habitat dataset that can be used for management decisions and future comparative health research for many years to come.

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