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Rapid coastal benthic assessment of Sombrero Island Anguilla, British West Indies

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ABSTRACT

Sombrero Island is the most distant landmass belonging to Anguilla and an important fishing ground for many local fishers. To date, although some biodiversity work has taken place there, no quantitative benthic habitat surveys have ever been conducted. With its designation in 2010 as a Nature Reserve Marine Park, this lack of information became more significant. Taking the first steps to fill this knowledge gap, the Department of Fisheries and Marine Resources undertook a rapid assessment of the area in 2015 using an underwater towed video array technique developed recently by researchers on neighbouring islands. Analysis of over one hundred screenshots revealed the most common habitat type were sand flats (48%) followed by pavement reef (24%), rubble areas (24%), and rocky reef (8%). The most common benthic cover after sand was turf algae (30%), followed by Sargassum and/or large macroalgae species (21%). Sponge cover was recorded as 3%, with live hard coral cover low at less than 0.5%. Seagrass or *Acropora palmata* were not observed along any of the transects. The structural complexity was primarily categorised as low and/or sparse relief. Although this was a rapid assessment and as such limited in scope, it does confirm the viability of the visual census technique used, and how with some slight methodological changes it will become even better suited to surveying reef habitats. It is also hoped that this work will pave the way for further, more expansive, offshore fishing ground habitat assessments essential for making management decisions within the fisheries sector. It is recommended that these future habitat assessments are combined with fish stock assessments in order to give managers all the information necessary.

Introduction

Sombrero Island (Figure 1) is the most northerly landmass of Anguilla, located approximately 55 km (34 miles) northwest of the mainland. The uninhabited island played an important role in Anguillian history as a relatively extensive phosphate mining operation took place there. Mining was first conducted by the Americans in the mid-1850s and was later taken over by the English in the mid-1860s, with the extracted bird guano exported as fertilizer. By 1870, the mining operation was yielding 3000 tonnes of phosphate each year, but by 1890 reserves became 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.

In 2010, the island was declared a Nature Reserve Marine Park under new amendments to the Marine Parks Act: defined as the land and sea area within a 2000 yard (1.83 km) radius of designated central coordinates, giving it a total size of 10.5 km^2. Having been identified as an Important Bird Area by Birdlife International, Sombrero Island has since become the first site in Anguilla designated under the Ramsar Convention. Seabird survey work has been conducted there (Hodge et al., 2008; Lloyd and Mukhida, 2016), along with work relating to endemic lizard populations (Lazell, 1964; Daltry, 1999; Engel, 2011). However, despite its marine park status no recent in-water survey work has been conducted. The only available past report known is Ogden et al. (1985), which presented marine and terrestrial floral and faunal observations made during a two day study trip in June 1979. This early work concluded what is still considered the case today; that the waters around Sombrero Island are rich in marine life, being a favoured location for adventurous fishers from the mainland. To ensure this new protected area can be managed in an informed manner, it is essential that the Department of Fisheries and Marine Resources (DFMR) begin up-to-date in-water data collection of the area.

This knowledge gap was identified by Wynne (2015) and was the impetus behind the current work. Due to Sombrero Island's remoteness, survey work is not easy to conduct: with logistical and financial limitations work must be undertaken opportunistically using the most time-efficient assessment techniques available. This current rapid assessment was therefore conducted during a fieldtrip to Sombrero Island by the Anguilla National Trust and the Ramsar Secretariat, using Queen Conch (*Lobatus gigas*) survey equipment available from a concurrent study being conducted closer to the mainland. For this reason surveys were limited to a one day period and focused on benthic work. Although more in-depth benthic work and fish assessments will be needed to fully assess the area, the rapid assessment protocol yield data that will be essential in making initial management decisions for this new protected area.

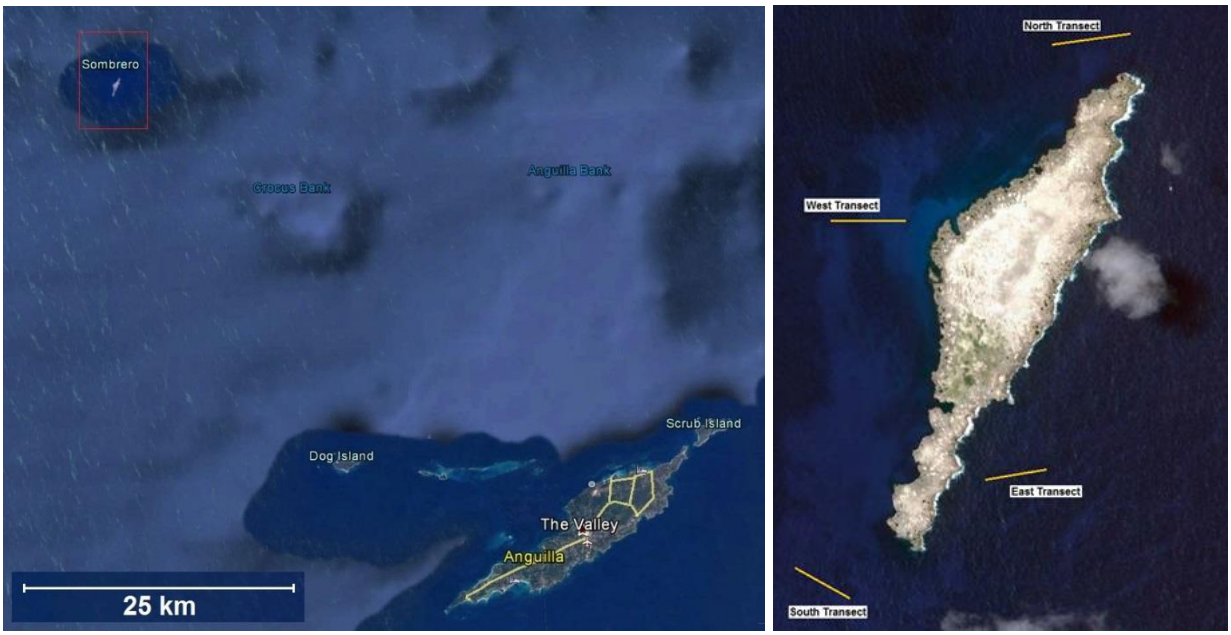


Figure 1. Anguilla and offshore cays with Sombrero Island in the North (right). Close up of Sombrero Island, with approximate transect locations illustrated (left). Images sourced from Google Earth™

Methodology

The methodology used for benthic assessments followed that described by Boman et al. (2016), a relatively new approach to surveying (Stevens, 2006; Rijn, 2013) that had previously been used to survey conch on seagrass beds in Anguilla during 2014/2015 (Kuramae Izoika, 2016). This method uses an underwater video array that is deployed and towed behind a maritime vessel for a measured distance (see Figure 2) with footage analysed subsequently in the lab. Site selection for each transect was made randomly, although stratified to ensure each side of the island was represented. One transect was located on the northern, southern, eastern, and western sides of Sombrero respectively. Transects were 1 m wide and ran for a maximum of 500 m thus giving a total potential survey area of 2,000 m^2. High complexity reef areas are not possible to survey using this methodology, so if encountered transects were cut short. Start and end points were recorded using GPS. Surveys took place in September 2015.

In the lab, video snapshots were taken at regular intervals along the four transects. First, structural complexity was assessed and general habitat types placed into four different categories: sand flat; pavement reef; rubble area; and rocky reef. Examples of these four habitat types can be found in Appendix 1. Next, the percentage of underlying substrate (sand, rubble, hard rock) was estimated. A separate analysis estimated the percentage cover of visible benthic

categories, including (but not limited to): turf algae or sediment; *Sargassum spp.* or fleshy macroalgae; cyanobacteria mats; hard corals; soft corals; sponges; and other invertebrates. Categories were relatively generic as video clarity sometimes meant identification of benthos to species level was not possible. In total, 105 video snapshots were analysed across the four transects.

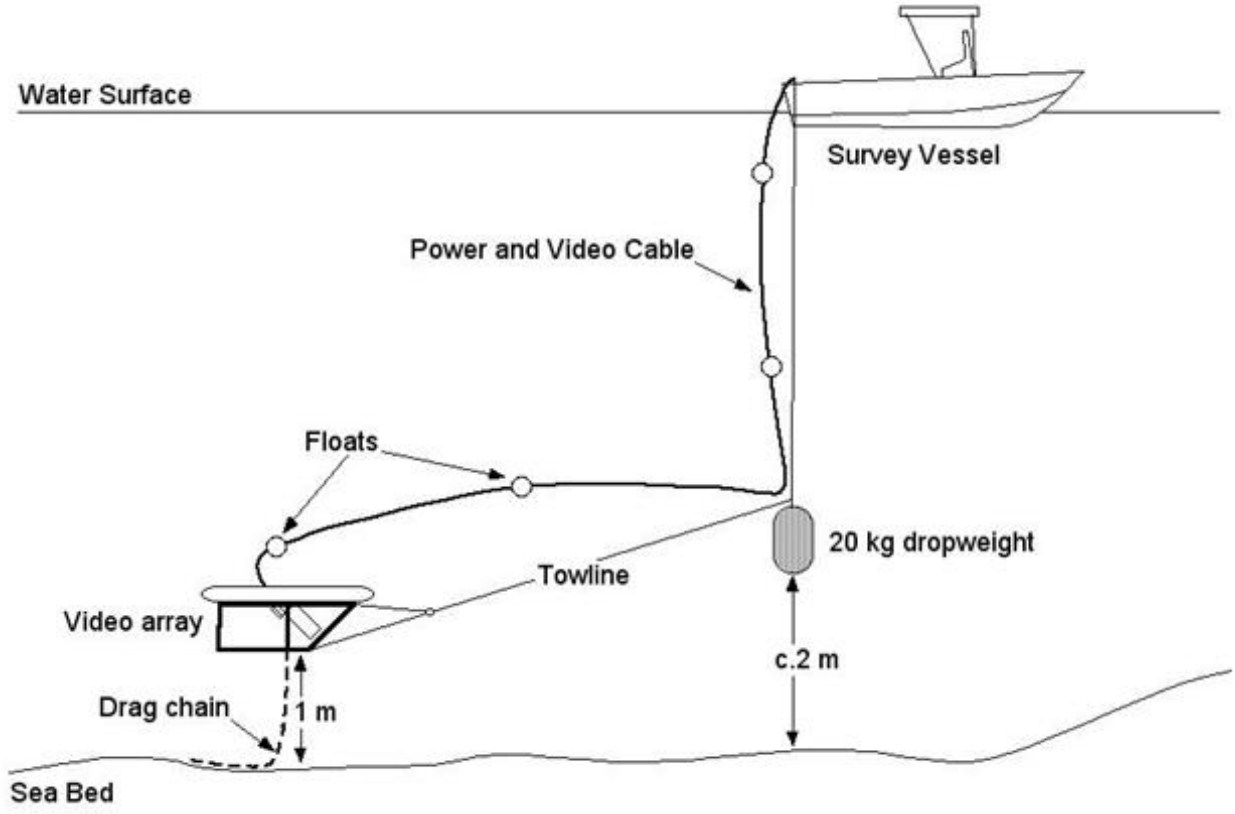


Figure 2. Illustration of the arrangement of video array deployment (Stevens, 2006).

Results

From the 105 screenshots analysed, the most common habitat type were sand flats (48%) followed by pavement reef (24%), rubble areas (24%), and rocky reef (8%). The most common benthic cover after sand was turf algae (30%), followed by *Sargassum spp.* and/or large macroalgae species (21%). Visual representations of these mean results are presented in Figure 3. Seagrass was not recorded and live hard coral was very low at less than 0.5%. Of the hard corals, *Acropora spp*. was not recorded. Although a low mean sponge percentage cover was recorded (3%), a lot of variation was present across all snapshots, with some recording cover as

high as 35% (SD = 6.1). Similar variations were recorded across other variables, especially underlying substrate: sand SD = 42.5; rubble SD = 15.6; and hard rock SD = 41.8. The structural complexity category found on the four sample sites was primarily categorised as low and/or sparse relief.

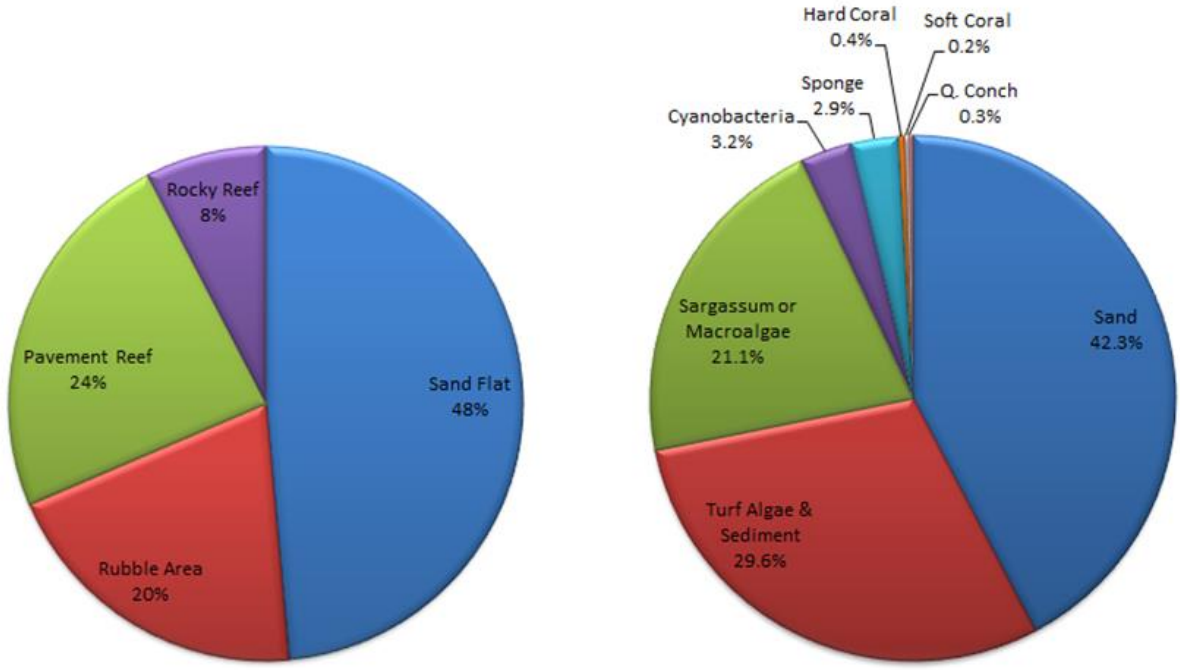


Figure 3. Results from 105 analysed points across all four transects for habitat categories (left), and mean benthic percentage cover (right).

Discussion

Overall, the four transects revealed a variable benthic habitat although it consisted predominantly of low complexity hard bottom communities or sand flats. No true 'coral reef' habitats were encountered although a small amount of rocky reef areas exist. This result may be a result of the survey methodology, as the towed video array does not allow surveying to be conducted over highly complex reef habitats and one transect (eastern coast) had to be cut short for this reason. If this transect had been competed, results would likely have varied. This suggests that reef areas of a certain degree may exist on the eastern coastal regions of Sombrero, with the southern and western areas more sandy in nature (as also reflected in the satellite image in Figure 1). This warrants further study as previous work (Ogden et al., 1985) also concluded no reef-like

accumulations, although their in-water work was limited to the northern half of the leeward side. The conclusion at the time was that coral growth would be affected by severe ground swells that toss rocks around, and thought to also be the reason for the notch cut in to the base of the island at a depth of 10 m.

The habitats found reflect the type of fishing reported in the area, where the focus is not demersal species, rather those associated with pelagic/offshore shelf areas. As Sombrero Island is effectively located on a seamount it is likely that up-wellings bring nutrients into the shallower areas thereby providing important feeding grounds of which local visiting fishers take advantage. More extensive survey work is needed however to confirm this. Such work should include another identified shallow area (c.15 m in depth) that is a short distance northwest of the island.

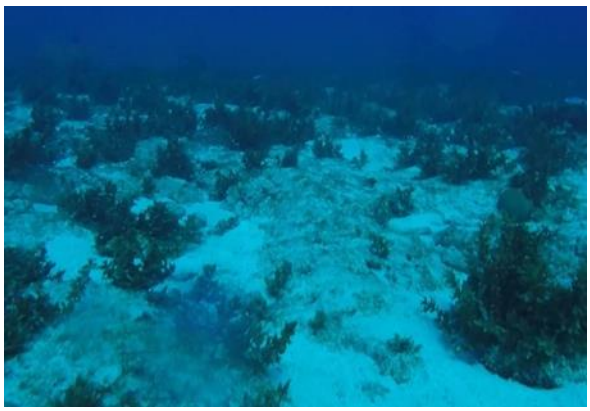
Recommendations

Although this study made the best use of the available time and study equipment and provided the first quantitative data for the waters around Sombrero Island, it only allows for limited conclusions. These conclusions are sufficient for initial management considerations, but will need to be built upon by more extensive future work. This future work should include diver orientated fish and benthic surveys to allow ground-truthing of certain features. It is recommended to continue with the underwater towed video array methodology but alter it slightly to facilitate surveying over more complex reef areas. The array used had been specifically designed for accurate *L.gigas* surveys over seagrass or similar low complexity habitats, and while much of the habitat visited for this rapid assessment was suitable for such a methodology, some areas became overly complex and restricted survey potential. To rectify this, a design has been investigated that uses heavier frame materials with depth control via a manual pulley system on the surface vessel. This removes the need for the block arrangement and drag chain, which are designed to keep the array at a specific depth and orientation. As habitat surveys generally use percentage covers and habitat categories only (i.e. no need for distance quantification), this level of accuracy is not essential. While this new design is currently being planned and tested, limited financial resources may impede procurement of the necessary live camera feed equipment. To overcome this, DFMR are developing a secondary survey methodology that uses diver controlled photo/video quadrats to rapidly survey an area. Although this means surveys are limited to safe diving depths, similar limitations exist with low-end survey equipment where only slightly deeper depths can be reached (40-60 m) before expensive housings and lighting units are needed. The photo system also allows for greater accuracy when analysing in the lab because image quality will be higher as the quadrat array is less susceptible to turbulence caused by rough sea conditions. Conversely though, the video array covers a greater distance more rapidly. Ultimately available finances will be the limiting factor, and before either method can be trialled further, financial resources will need to be secured.

Appendix 1

Images taken from surveys conducted to illustrate the four main habitat types encountered. Moving clockwise from top left overall complexity increases along with fish numbers. In the case of the Sombrero habitats observed, boundaries between classifications became blurry as changes in complexity were often very gradual and difficult to discern.

Sand Flat



Pavement Reef

Rubble Area

Rocky Reef

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