Mapping Ocean Wealth Coral Reef Recreation and Tourism Technical Summary

Overview

Under the Caribbean Regional Oceanscape Project (CROP) Subcomponent 2.1, the Organisation of Eastern Caribbean States Commission (OECSC) engaged The Nature Conservancy (TNC) to develop ecosystem service (ES) models for five countries in the Eastern Caribbean (Dominica, Grenada, Saint Lucia, Saint Kitts and Nevis, and Saint Vincent and the Grenadines) using methodologies developed under TNC's Mapping Ocean Wealth (MOW) initiative, and to develop training and resources to improve data access for decision-makers.

This document provides a technical overview of the On-Reef Coral Reef Recreation and Tourism model derived under this project. Click here to see the full technical report.

The Caribbean is highly dependent on coastal and marine tourism activities, many of them associated with coral reefs, either directly ("on-reef" e.g., SCUBA, snorkeling) or indirectly (e.g., beach-related activities, access to fresh seafood). While previous studies have quantified and mapped the value of coral reefs to tourism at the global scale[1], downscaling these analyses to the regional and local levels afford an opportunity to integrate emerging artificial intelligence and machine learning (AI/ML) technologies, incorporate data from local sources, and engage with stakeholders who can guide additional refinements to the methodologies. Under this output, TNC improved its global estimates of on-reef tourism expenditure and visitation estimates by integrating fine-scale benthic habitat data, cross-referencing global tourism datasets with local sources of information on dive sites, dive shops, and hotels, and applying AI/ML methodologies to photos and reviews kindly provided by TripAdvisor to further highlight patterns of reef-related tourism.

This dataset will enable a broad range of users from the public to industry to government to better plan and manage both the tourism industry and any other active sectors within the blue economy.

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[1] Spalding, M. D., L. Burke, S. Wood, J. Ashpole, J. Hutchison, and P. z. Ermgassen. 2017. Mapping the global value and distribution of coral reef tourism. Marine Policy **82**:104-113.

Data Sources

Data input	Source(s)
PUDs (Underwater Photos)	Flickr
PAMs (Underwater Photos)	TripAdvisor
Dive Sites	Diveboard, TNC, Saint Kitts and Nevis Department of Marine Resources/Ministry of Tourism, Saint Lucia Ministry of Fisheries, Marine Resource Management Unit
Dive Shops	Diveboard, Diveary, Saint Lucia Ministry of Fisheries, Marine Resource Management Unit, Grenada Tourism Authority, TNC, Saint Kitts and Nevis Department of Marine Resources
Hotels	Global Accommodation Reference Database (GARD, Delta Check 2019), TripAdvisor, TNC, Grenada Hotel and Tourism Association, Saint Kitts and Nevis Ministry of Tourism, Saint Lucia Hotel and Tourism Association, Dominica Hotel and Tourism Association
Coral Reef Habitat	TNC (benthic habitat maps created under the ECMMAN Project)
Tourism Arrivals & Expenditures	Eastern Caribbean Central Bank (ECCB)[2]; Averaged values for the five years up to and including 2019.
Cruise Arrivals & Expenditures	Florida-Caribbean Cruise Association (FCCA) and Business Research and Economic Advisors (BREA); A Survey Based Analysis of the Impacts of Passengers, Crew and Cruise Line Spending. Volumes I & II. 2018[3]
Cruise Activities	Port guides and other web-based cruise guides

Unless otherwise noted, all data sources were accessed in 2019.

Modelling and Geoprocessing

The methods presented below in the conceptual overview (Figure 1) and the subsequent descriptions were informed by previous efforts, adapted to the needs and data availability in the region. Methodologies and interim results were reviewed by stakeholders at in-person and virtual workshops in 2019 and 2020.

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[2] ECCB. 2020. Real Sector Statistics - Selected Tourism Statistics. Eastern Caribbean Central Bank, Basseterre, St Kitts and Nevis.

[3] FCCA, and BREA. 2018a. Economic Contribution of Cruise Tourism to the Destination Economies. A Survey-based Analysis of the Impacts of Passenger, Crew and Cruise Line Spending. Volume I: Aggregate Analysis. Florida-Caribbean Cruise Association (FCCA) and Business Research and Economic Advisors (BREA), Miami.
FCCA, and BREA. 2018b. Economic Contribution of Cruise Tourism to the Destination Economies. A Survey-based Analysis of the Impacts of passenger, Crew and Cruise Line Spending. Volume II: Destination Reports. Florida-Caribbean Cruise Association (FCCA) and Business Research and Economic Advisors (BREA), Miami.
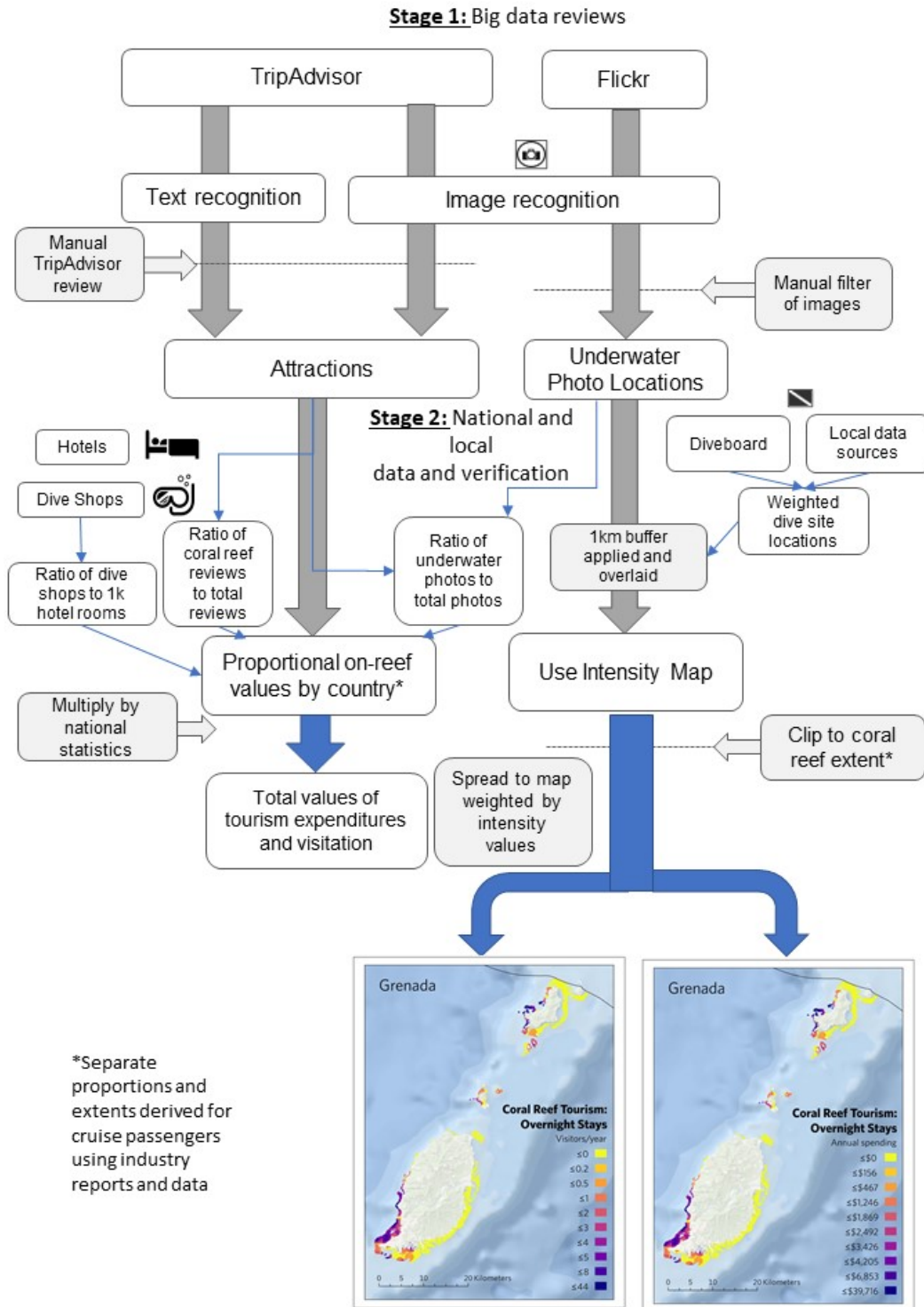
Conceptual Overview

Figure 1. Conceptual overview of the Coral Reef Recreation and Tourism modelling process

Coral reef habitat map

An initial reef map was prepared by selecting from the TNC Caribbean habitat maps all possible reef habitat types. We supplemented this map by adding all hardground habitats that were within 1km of non-wreck dive sites and by adding in additional diving habitats around Monkey Shoals in Saint Kitts and Nevis using depth contours. This habitat layer was then gridded to a 100m resolution which has the effect of greatly increasing total reef area but represents the broader area around which on-reef tourism activities are likely to take place.

Developing an on-reef tourism intensity map

Reef use intensity was based on the locations of underwater photos and the location of dive sites. Microsoft's Azure Custom Vision (https://azure.microsoft.com/) service was used to classify photos from Flickr as having been taken underwater using artificial intelligence/machine learning (AI/ML) methodologies. Underwater photos were then standardized to Photo User Days ("PUDs") such that only one image per user per day can be counted across a 500m resolution grid spread across the region. Each grid cell's centroid received a score based on the number of PUDs within that grid cell. Dive sites were scored based on the number of dives reported at that location using a standardized scale. Each point was buffered by 100 m, with any overlapping buffers summed to provide an intensity score. This layer was then clipped to the map of coral reefs such that every 100m tract of reef had a unitless intensity score.

Determining on-reef tourism expenditures and visitation values

Proxy indicators were used to develop a metric of the proportion of persons enjoying on-reef activities or their equivalent spending in each country. These indicators were 1) the ratio of dive centers to hotel rooms; 2) ratio of underwater TripAdvisor photos to total TripAdvisor photos (photos were identified using AI/ML methodologies standardized to one photo per user per attraction); 3) reviews of TripAdvisor attractions describing on reef activities (identified through AI/ML methodologies) to total TripAdvisor reviews; and 4) ratio of underwater Flickr PUDs to total PUDs.

Countries were ranked for each proxy metric and were then combined into an average rank for each country to give the final relative values. These average ranks were converted to proportional reef values by country. The spread for these values was assessed as being a range from 5% to 12% based on previous work in the region. Proportional values for the remaining countries were spread between these lowest and highest scores using a linear interpolation from the average rank scores.

These national on-reef values were then as multipliers for the national tourism statistics to generate final value scores which were then distributed across coral reefs utilising the use intensity maps.

Cruise ship vs. Overnight Passengers

As cruise ship passengers are time-limited, and do not have access to all parts of the countries they visit, it is assumed that their access to specific activity-based excursions will

be more limited. Based on limited industry data, a two-thirds reduction to the values assigned above for overnight stays for assessing likely cruise passenger participation in on-reef activities. This approach delivers estimates of 1.7 to 4%. Industry sources were translated into spatial footprint of cruise passenger activities for each country. This footprint was used to clip the intensity layer overlapping with this footprint. The modified expenditure and visitation numbers for cruise tourism was then spread to this clipped footprint.

Limitations and Caveats

These are modelled data products based on a series of assumptions, including the motivations and activity patterns of tourists. Model assumptions have been vetted by experts, stakeholders, and data where possible. The model is also heavily based on crowd-sourced data points, which may be subject to bias. As such, interpretation of statistics, especially for very small areas, should be treated with caution. Estimates will be more robust when based on larger areas. Pixels with no values don't necessarily lack tourism values, as not all values will be captured in the modelling approach used.

Suggested Citation

Spalding MD, Longley-Wood K, McNulty VP. 2020. On-Reef Tourism and Recreation Values in the Eastern Caribbean. Produced for the Organisation of Eastern Caribbean States under the Caribbean Regional Oceanscape Project.

Data Access

Click here to download data