Nature-Dependent Beach 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 Nature-Dependent Beach 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). Previous studies have quantified and mapped the impact of reefs on beaches at the global scale[1], as "reef-adjacent" benefits. In this study, we link these values to the beaches themselves, rather than to nearby reefs, and focus on a range of natural factors that draw tourists to these areas. Nature-dependency describes the level of dependence that any beach tourism may have on key natural values. Such values include: white sand (coral-derived); natural vegetation adjacent to, or dominating views from the beach; turquoise; and/or dappled clear water.

By integrating emerging artificial intelligence and machine learning (AI/ML) technologies, incorporating data from local sources, and engaging with stakeholders, TNC developed a novel map of nature-dependent beach tourism by combining remotely sensed habitat data with global tourism datasets cross-referenced to local sources of information. AI/ML methodologies were applied to photos and reviews kindly provided by TripAdvisor, as well as photos downloaded from the Flickr API.

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.

[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 (Nature-Dependent Beach Photos)	Flickr
PAMs (Nature-Dependent Beach Photos)	TripAdvisor
Beach Habitat	TNC
Beach Locations	TripAdvisor
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.

[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

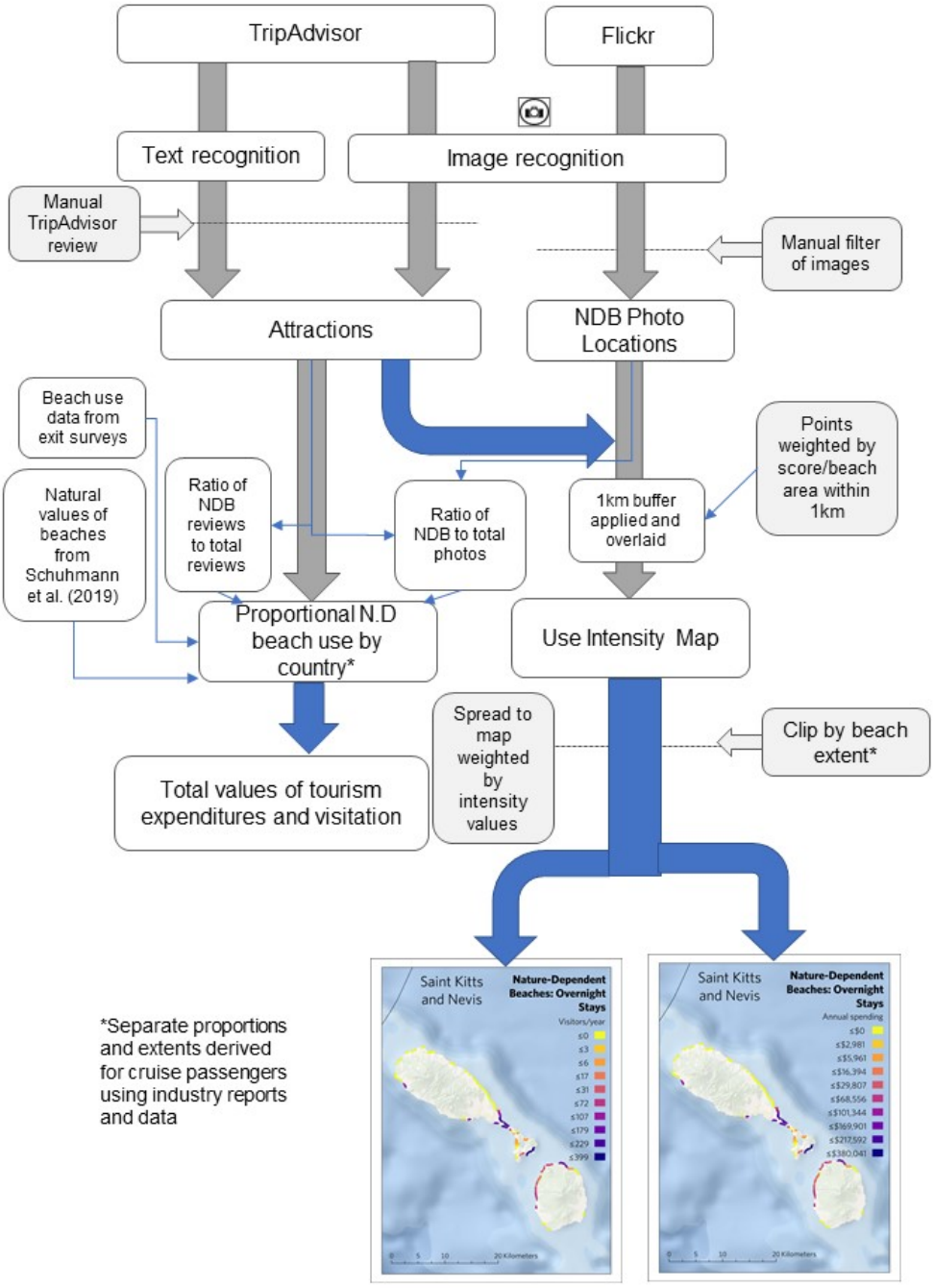

Figure 1. Conceptual overview of the Nature-Dependent Beach Tourism modelling process

Beach Habitat Map

The original beach layer was created by TNC for the CLME project in 2013 under a grant from UNESCO. These were enhanced and where available annotated with beach names from TripAdvisor where possible. This 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 nature-dependent beach activities are likely to take place.

Developing a nature-dependent beach tourism intensity map

AI/ML Methods

The primary driver of locations thought to have high nature-dependent beach values was the locations tied to photos (from TripAdvisor and Flickr) and reviews (from TripAdvisor). Microsoft's Azure Custom Vision (https://azure.microsoft.com/) service was used to classify photos from Flickr as having been taken at nature-dependent tourism beaches using artificial intelligence/machine learning (AI/ML) methodologies. While the concept of nature-dependency was somewhat subjective while examining available imagery, we trained the model to select images of beaches where natural elements were dominant (e.g., white sands, turquoise waters, vegetation) and where buildings, beach furniture and debris, and beachside infrastructure were absent. These were then mapped as points based on the attraction to which they were linked, or, in the case of Flickr photos, to the location at which the photo was taken.

For TripAdvisor reviews, we used the web-based tool LightTag to label over 2,000 TripAdvisor reviews according to activities and elements described in each review. For nature-dependent beaches, we trained the model on reviews that mentioned beaches as well as other natural elements (e.g., coral reef, turtles), beach features (white sand, clear water) or activities (snorkeling, kayaking) that indicated that the beach had a high natural value. An expert team from Microsoft then applied a random-forest regression model to automatically classify the remainder of the reviews and return a list of reviews that matched each set of criteria. These were then mapped as points based on the attraction to which they were linked.

Mapping Use Intensity

Flickr 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. Similarly, TripAdvisor photos were standardized to photos by attraction by member ("PAMs") such that if a TripAdvisor user uploaded multiple photos for an attraction, only one would be counted. Each attraction was weighted by the number of PAMs, and again by the number of relevant reviews at that location. These points were then were buffered to a 1km radius and the total value of each buffer was spread evenly across all beach areas within that buffer. The larger area of beach within a buffer, the more broadly the value would be spread. Finally, each of values per beach were summed to give total values, and this intensity layer was clipped to the beach extent.

Determining on-reef tourism expenditures and visitation values

Proxy indicators were used to develop a metric characterizing the relative importance of nature to beach tourism at the national level. These indicators were 1) estimate of overall beach utilisation for the region based on exit surveys[4]; 2) estimate of the relative contribution of natural values to beach tourism based on Schuhmann et al (2019)[5]; 3) national modifiers to indicate the variance of the importance of nature to beaches across the five CROP countries. These were based on the ratios of nature-dependent PAMs, PUDs and reviews to the total number of PAMs, PUDs and reviews for each country.

These three proxy metrics were then applied as a multiplier for the national tourism statistics to generate final value scores which were then distributed across beaches 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 particular activity-based excursions will be more limited. Based on limited industry data, we estimated values of 18-28% beach utilisation for excursion passengers. For the remainder we had no further data on activities and so we used the same proportions of beach use that we used for overnight visitors and the same modifier for natural beach value (31.2% of total beach value). These metrics were then applied to national tourism statistics specific to cruise passengers.

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, key among which that the loss of natural values would imply a direct and immediate change in tourism arrivals and expenditures. Model assumptions have been vetted by experts and other stakeholders, but establishing a quantitative basis for this, and other assumptions would be difficult to establish. 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

[4] Spalding, M. D., K. Longley-Wood, M. Acosta-Morel, A. Cole, S. Wood, C. Haberland, and Z. Ferdana. 2018. Estimating Reef-Adjacent Tourism Value in the Caribbean. The Nature Conservancy.

[5] Schuhmann, P., R. Skeete, R. Waite, P. Bangwayo-Skeete, J. Casey, H. A. Oxenford, and D. A. Gill. 2019a. Coastal and Marine Quality and Tourists' Stated Intention to Return to Barbados. Water **11**:1265.
Schuhmann, P. W., R. Skeete, R. Waite, T. Lorde, P. Bangwayo-Skeete, H. A. Oxenford, D. Gill, W. Moore, and F. Spencer. 2019b. Visitors' willingness to pay marine conservation fees in Barbados. Tourism Management **71**:315-326.

with no values don’t necessarily lack natural values, as not all values will be captured in the modelling approach used.

Suggested Citation

Spalding MD, Longley-Wood K, McNulty VP. 2020. Nature-Dependent Beach Tourism 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