Organisation of Eastern Caribbean States

Nature-Dependent Tourism: Wildlife Viewing Technical Report

CARIBBEAN REGIONAL OCEANSCAPE PROJECT (CROP)

Dominica, Grenada, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines

Component 2; Subcomponent 2.1

Expanding Marine Data Aggregation and Analytic Tools


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Executive Summary

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 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 report outlines the activities under Output 7 of the project.

The Caribbean is more dependent on the travel and tourism sector than any other region worldwide. This sector is almost entirely focused on coastal areas, notably through beach-based activities, cruise tourism and in-water activities including sailing, and diving, and other vessel-based activities. In the Caribbean wildlife tourism is considered a niche market with a diverse consumer base and a high potential for growth. Stakeholder feedback at the inception of the project indicated that wildlife tourism around birds, turtles, and marine mammals (i.e., whales and dolphins) were an important draw for tourists visiting the CROP countries, and also warranted consideration from the perspective of sustainable tourism development.

The region's interesting and diverse avifauna provides a unique selling point for certain visitors choosing between various destinations, and the Caribbean has a significant opportunity to tap into the growing interest in birdwatching, especially from US-based tourists. The opportunity to see whales and dolphins in the wild is a clear draw for many of the CROP countries, especially Dominica, where sperm whales inhabit the country's deep offshore canyons. Despite this, like many aspects of nature-dependent tourism, map-based data depicting the distribution of these activities across the region have never been generated. Addressing this gap is a primary purpose of this report.

Under this output, TNC addresses the spatial gap associated with these activities using crowd-sourced data, namely from eBird, TripAdvisor, and Flickr, complemented by participatory mapping and survey data from charter vessel operators, as well as other stakeholder information and guidance. The results are maps of birdwatching and whale and dolphin watching intensity for CROP countries, as well as several complementary summary statistics intended to further emphasize the importance of these sectors to the region's economy. Originally, we had planned to include observations of turtle-nesting in the current work, however, a lack of consistent data spanning the region, and concerns about sustainability and potential habitat degradation made any quantification of this activity a challenge. Instead of a map, we provide a short qualitative overview of turtle watching in the report.

In order to map and quantify birding activity, we developed 3 separate metrics. **Birder footfall** captures birdwatching effort, based on eBird observation data, and the total scores capture only one record per observer per day. **Key species** are intended to characterize birds that would be of particular interest to birdwatchers, and are defined as birds that are rare, endemic, endangered, and/or otherwise charismatic (as defined by stakeholders). The **Species Importance Score** is a sum of each of the four key species metric applied to each species. When this score is multiplied by the number of observations of each species, and these totals are summed, this provides a total species importance metric for each country, protected area, or other spatial unit. Summaries of these scores by country are as follows:

	Birder Footfall	**Species Importance Score**	**# of Key Species**
Dominica	2,084	16,448	66
Grenada	1,512	9,341	70
Saint Lucia	2,289	23,234	74
St. Kitts and Nevis	781	4,761	41
St. Vincent and the Grenadines	811	5,897	57

Our maps of birdwatching activity show a predominance of activities in coastal areas, with a likely correlation with accommodation density, but these maps still show observations recorded from offshore waters to wetlands and mountain areas. The patterns of species importance underline the particular value of these locations away from the tourist accommodation, notably mountainous and forest areas. Many of these important species depend heavily on the existence of a relatively large and intact ecosystem and for this reason we have shown the protected areas and Important Bird areas in the report.

Both our maps and the expenditure estimates highlight the particular importance of whale and dolphin watching activities in Dominica and Saint Lucia, with St. Vincent and the Grenadines also having a nascent whale and dolphin watching industry. In all cases, activities extend out predominantly from the western shores, from coastal areas (where dolphins are more likely to be observed) out to deeper waters favoured by whales.

While the financial assessment is drawn from a relatively small sample size and were not inclusive of Grenada or St. Kitts & Nevis due to insufficient data, the results indicate a direct expenditure of over $US 6.3 million per year. On a per country basis, the estimated expenditures are as follows:

Dominica	$1,843,625
Saint Lucia	$3,808,476
St. Vincent & the Grenadines	$672,000

These figures capture payments from tourists to the operators themselves; however, there are likely to be many associated expenditures, and future iterations of this model would be strengthened by an effort to incorporate indirect expenditures as well.

The information and maps in this report for a valuable addition to the data already released in earlier reports which, combined, provide the most comprehensive review of nature dependency in tourism we are aware of, not only for the CROP countries, but likely anywhere in the world. The data have a role to play not only in raising awareness, but in direct management responses. In large part the maps are of sufficient resolution to be used in marine spatial planning and in future exercises to prioritise the development of protected areas or other management interventions.

Given the current impact of Covid-19 on tourism in the Caribbean, and especially the likely changes in demands coming from a recovering tourism sector it is highly likely that future tourism will have, if anything, a greater dependency on natural values and lower density locations and so our sites of high natural value will likely show an increasing proportional relevance for the recovering sector.

Introduction

Overview

Ocean resources in the Caribbean have the potential to make a much greater contribution to poverty reduction and shared prosperity for the region's growing population of 40 million than they do currently, and to increase the resilience of people to climate change. The Caribbean region has been at the forefront of a movement towards the development of the blue economy and a growing number of developing states that share the Caribbean Sea have embraced the concept as the centerpiece of future growth strategies.

Given the value of the region's marine space and its resources, with support from the Global Environment Facility (GEF), the Organisation of Eastern Caribbean States (OECS) Commission, in partnership with the World Bank, is implementing the Caribbean Regional Oceanscape Project (CROP) to improve systems and put relevant structures in place in an effort to foster a Blue Economy and to promote greater consideration of the ecosystem functions and services, which the ocean provides for member states.

Under this project, The Nature Conservancy (TNC or "the team") is using the Mapping Ocean Wealth (MOW) approach to develop ecosystem service models and maps at the scale of the Eastern Caribbean in support of the CROP. The theory of change behind the MOW approach is that accurate and spatially explicit maps and metrics of the value of natural ecosystems provide a critical tool in encouraging efforts to use nature sustainably, and work towards its protection, maintenance or restoration.

These data will support the CROP countries (Dominica, Grenada, Saint Lucia, St. Kitts & Nevis, and St. Vincent & the Grenadines) in ongoing and future marine spatial planning through the direct provision of spatially explicit information on their ecosystem service values, particularly relating to fisheries and nature-based tourism. This will include existing information, new information generated locally, and the provision of both tools and training to enable practical use and application of ecosystem services values into planning. This report constitutes the first primary deliverable associated with Output 7 of the consultancy, providing a first full summary of the approach and results of a modelling exercise to describe the extent, intensity, and, to a certain degree, value of nature-dependent tourism activities, with a focus on wildlife tourism.

Wildlife Tourism

Wildlife tourism is estimated to contribute $120 billion and 21.8 million jobs to the global economy (WTTC, 2019). The value of wildlife tourism represents an

opportunity to secure, diversify and enhance local economies, whilst simultaneously protecting wildlife and preserving key habitats.

The Caribbean is more dependent on the travel and tourism sector than any other region worldwide, accounting for over 10% of GDP, and 15.2% of jobs in the region (WTTC 2018). This sector is almost entirely focused on coastal areas, notably through beach-based activities, cruise tourism and in-water activities including sailing, and diving.

A 2008 analysis (CTO) identified wildlife tourism as a niche market in the Caribbean, meaning that it has a specific, well-defined product that can be tailored to meet the needs of the consumer. In this report, wildlife tourism was identified as a sector with a diverse customer base and a high potential for growth. There do not appear to be any region-specific estimates on the economic importance of wildlife tourism to the Caribbean; however, there are more detailed studies on tourism related to specific taxonomic groups (e.g., whales, birds), which are described below.

This report considers tourism related to birds and marine mammals (or cetaceans, i.e. whales and dolphins), based on stakeholder feedback highlighting their particular importance. We focus only on activities where tourists can view animals in their natural habitat, and therefore we do not include zoos, aquariums, or other captive viewing facilities in our analysis. It should be noted that underwater wildlife observations, both from snorkeling and scuba-diving, are covered elsewhere under this project. Originally, we had planned to include observations of turtle-nesting in the current work, however, a lack of consistent data spanning the region made any quantification of this activity a challenge. On-beach turtle watching is popular in just a few locations, where it can lead to direct conservation benefits. However, it is also an activity that requires very strict regulation and management to avoid disturbance to animals and their eggs, nests and beaches, without such control, it risks being unsustainable and undermining the fragile recoveries that many marine turtles have been undergoing in recent years. While habitat degradation and other environmental impacts are a concern in nearly every type of nature-dependent tourism, the highly site-specific and sensitive nature of turtle habitats in the Caribbean led us to omit this element from our mapping analysis, though we will describe the sector qualitatively in the results section.

Birdwatching

The Eastern Caribbean is home to interesting and diverse avifauna, with many species of potential interest to experienced birdwatchers, and many more that are enjoyed by occasional or opportunistic birdwatchers. These include endemic species, only found in the lesser Antilles, or even restricted to individual islands, but also rare, exotic, or spectacular species. While some species are widespread and easily seen, even in hotel gardens, many are restricted to the rainforests of island interiors including four species of endemic amazon parrots: two found only in

Dominica (the Jaco or red-necked amazon and the imperial amazon), and two other single-island endemics, the Saint Lucia amazon and the St. Vincent amazon (Gerbracht & Levesque, 2019). Low-lying coastal wetlands, including freshwater and salt ponds and mangrove forests, are home to many waders, even flamingos, and are used by many seasonal migratory species. The Lesser Antilles fall on the path of the American flyway, and therefore see migrants from both North and South America. The transboundary small islands of the Grenadines, including areas from both Grenada and St. Vincent & the Grenadines are globally important for seabird conservation and are known for their seabird colonies (Coffey & Ollivierre 2019), although tourism around seabird watching is still largely underdeveloped (pers. comm., Juliana Coffey and Natalia Collier, EPIC).

While the overall numbers of tourists whose use birdwatching as their primary motivation for destination choice may be low, many more may consider it a positive contributing factor. Both tourist agencies and many hotels already draw attention to birds and birdwatching (Figure 1), recognizing that, even beyond regular birdwatchers, the presence of "exotic" or interesting birds may provide a unique selling point, while for other visitors an unplanned but enjoyed experience can provide a "memorable tourism experience", seen within the industry as a critical component of influencing tourist experience, return likelihood and word-of-mouth recommendations (e.g. Kim, 2018). As such, while there is value in recognizing the current value and distribution of tourist-based birdwatching (avitourism), there is also an opportunity to promote birdwatching as an activity that can be done as part of a larger itinerary of nature-dependent tourism.

In 2015, the Center for Responsible Travel (CREST) suggested that the Caribbean has a significant opportunity to tap into the growing interest in birdwatching, especially from US-based tourists, who spend $41 billion dollars on birdwatching related expenses (namely, travel and equipment), annually. In the Bahamas, birdwatchers spend $300 - $400 per day on birdwatching tours, suggesting that at a national-level birdwatching could represent millions of dollars' worth of revenue. The reports suggest that countries can promote birdwatching as part of a broader suite of sustainable tourism by facilitating access to bird habitats through improved infrastructure and knowledgeable guides (CREST 2015).

CaribbeanBirdingTrail.org lists 15 birdwatching guides operating in all CROP countries except for St. Kitts & Nevis. Many of these guides are employed by tourism organizations that offer birdwatching as one of many tour options.

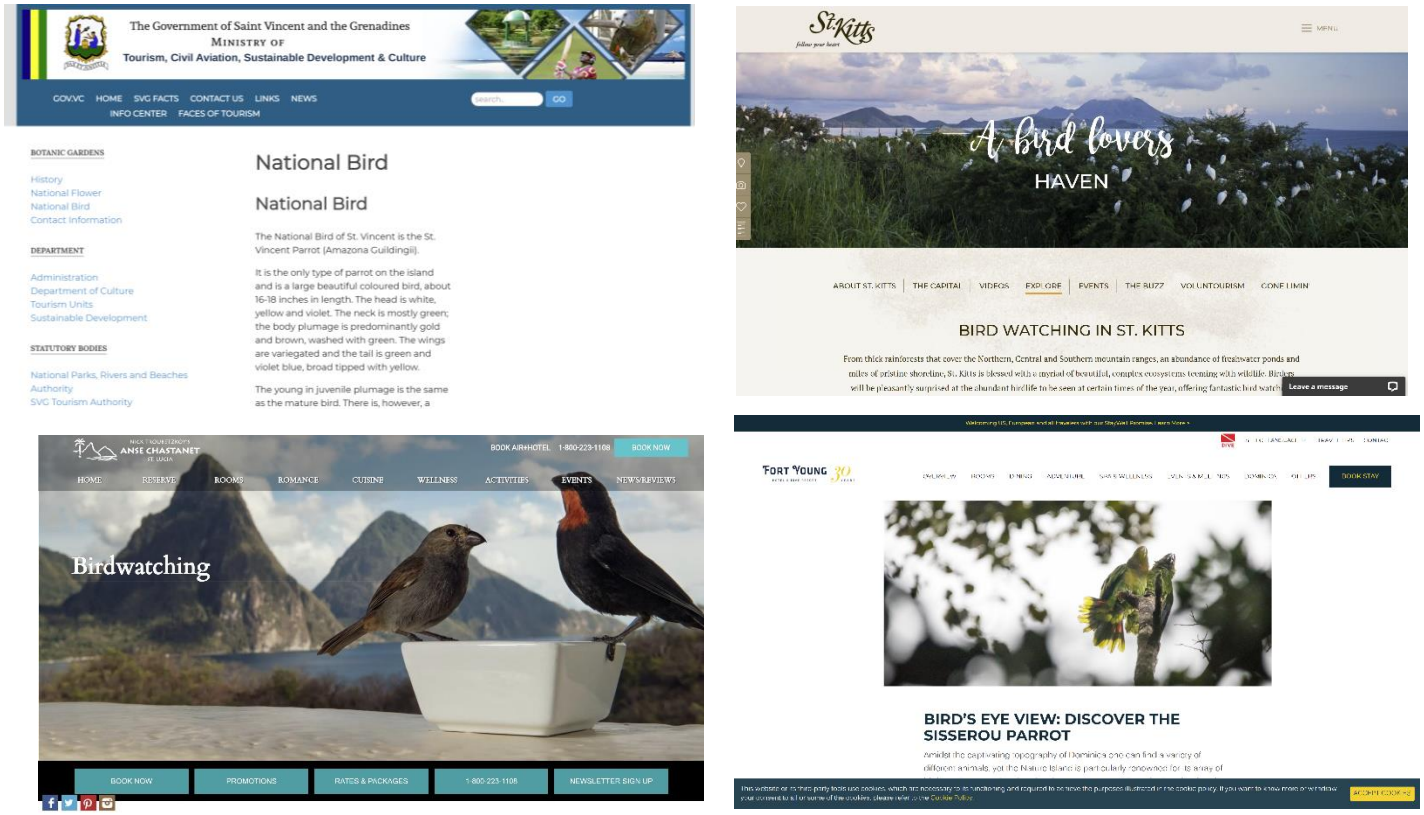

Figure 1. *Websites illustrating that birds and birdwatching are already a feature of some tourism promotion both by governments (upper images) and hotels (lower images).*

Whale and Dolphin Watching

The promotion of whale and dolphin watching as a tourism activity in the Eastern Caribbean began to take hold in the late 1980s, with Dominica leading the way (Hoyt 1999). The sperm whales in Dominica provide a clear draw for visitors to the island; other CROP countries, particularly Saint Lucia, have followed suit, offering visitors the opportunity to see whales and dolphins in their offshore natural habitats.

Globally, whale and dolphin watching was estimated to be attracting 13 million people annually as far back as 2008, generating over $2.1 billion in tourism revenues and supporting 13,000 jobs (O'Connor et al. 2009). For the CROP countries, total expenditures (indirect and indirect) for this activity were estimated at over $6 million in 2008. A more recent study estimated a yearly revenue of $3 million for Dominica alone (Gerst et al. 2020).

In some countries, the emergence of whale and dolphin tourism was part of an intentional shift away from whaling. In Dominica for example, a change in government in the year 2000 led to a change in the country's historically pro-

whaling stance, and whaling is no longer permitted. Between 1998 and 2008, Dominica saw an 11% increase in the number of whale watchers visiting the country (O'Connor, 2009). In St. Vincent & the Grenadines, whaling is still practiced on a small scale and the community on the island of Bequia have a permitted catch under the "aboriginal subsistence hunt" criteria of the International Whaling Commission of up to four humpback whales per year. This has been posed as a possible reason for the lack of expansion of whale and dolphin tourism in this country, despite a relatively high sighting success rate of whale and dolphin tours (O'Connor et al. 2009); however, there is currently an effort by local NGOs to further promote whale watching as an alternative to whaling (pers. Comm., Russell Fielding).

In addition to sperm whales, Dominica's deep offshore canyons draw Cuvier's beaked whales, short-finned pilot whales, false killer whales, and other species of dolphin, and, seasonally, humpback and Bryde's whales. Dominica has one of the largest boat-based whale-watching industries in the Caribbean, and is also notable for its strong promotion of education and conservation (O'Connor, 2009), with at least one tour operator running a 5-day educational programme which incorporates watching and swimming with whales. Dominica issues permits for both local and international guides to lead swim-with-whale tours, where tourists can swim with sperm whales. Permits cost $3,000 and typically include groups of 6 – 8 people; this sub-sector of whale watching may account for up to $2.2 million dollars in net profit annually (Gerst et al. 2020). Unfortunately, the sperm whale population off Dominica is witnessing a slow and poorly understood decline which could endanger this small but high-value industry (Gero & Whitehead 2016).

In 2009, Saint Lucia was fifth on a global list of fastest growing whale watch industries, noting a 74% annual growth rate since 1998, and has benefited from the growth in the cruise industry, especially since the cruise port in Castries is a relatively close distance to locations where whales are typically seen. As in Dominica, sperm whales are a draw, especially between October and January, and humpback whales can also be seen between January and April. Other commonly-observed species include spinner dolphins and bottlenose dolphins (O'Connor 2009).

In Grenada, St. Kitts & Nevis, and St. Vincent & the Grenadines, also benefit from a cruise season that coincides with humpback migration season, though smaller whales and dolphins, especially spinner and bottlenose dolphins can be seen year-round. Indeed, the industry in these countries has historically been sensitive to fluctuations in cruise tourism, both benefiting from growth, and declining during years of decreased tourism (e.g., hurricane damage in St. Vincent & the Grenadines in 2008) (O'Connor 2009).

Approaches to understanding and mapping wildlife tourism

The opportunity to see birds and marine mammals offers a specific attraction for many tourists visiting the region and generates highly memorable experiences for many more. Despite this, like many aspects of nature-dependent tourism, map-based data depicting the distribution of these activities across the region have never been generated. Addressing this gap is a primary purpose of this report.

We created maps using crowd-sourced data, namely from eBird, TripAdvisor, and Flickr, complemented by participatory mapping and survey data from charter vessel operators, as well as other stakeholder information and guidance. By applying a series of geospatial processing techniques, the team has developed maps of birdwatching and whale and dolphin watching intensity for CROP countries, as well as several complementary summary statistics intended to further emphasize the importance of these sectors to the region's economy.

Similar to the recreational fishing study undertaken under CROP sub-component 2.1, this mapping effort represents a slight divergence in technique from previous MOW projects, which typically link values to a specific, discrete habitat (e.g., coral reefs, beaches).

Likewise, it was felt that there was insufficient existing data on the economic values of these activities to be able to derive useful values or generate maps showing the spread of such values, and this assumption was validated during stakeholder review workshops. The resulting maps thus depict relative intensity of activity which, although unitless, represent the first such maps of wildlife tourism intensity for the region, providing substantial value in informing management and decision-making in the region.

Overall, the results of this project are intended to support CROP priorities of strengthening capacity for ocean governance, and coastal and marine geospatial planning in the participating countries. The project team also anticipates that the maps and data may have broader scale utility for the tourism industry and to help advance sustainable practices for these industries that enhance the overall value of the tourism in the region.

Methods

General data sources, data collection, and preparation

Birdwatching

Our key sources for birdwatching are summarized in Table 1, with further details below.

Table 1. Summary of data input sources for the birdwatching model.

Data Layer	Source
Bird Observations	eBird Combined from all years to 2018
Birdwatching locations	Consultations with Environmental Protection in the Caribbean (EPIC), Caribbean Birding Trail, The Nature Conservancy Personal communications with Stephan Durand, Forest Officer at the Forestry Division, Dominica, & Vaughn Francis, Tropical Adventures
Important Bird Areas	BirdLife International
Protected Areas	The Nature Conservancy (developed from WDPA and information from local partners and governments)
Reviews	TripAdvisor
Species-specific information	BirdsCaribbean's Birds of the West Indies Checklist (Gerbracht & Levesque 2019)

The key single data source for modelling the intensity of birdwatching and understanding key species was eBird (Levatich & Padilla 2019). This is a citizen science data repository for birdwatchers managed by Cornell Lab of Ornithology, with more than 100 million bird sightings contributed annually by "eBirders" around the world (https://ebird.org/). eBird observation points were accessed through the Global Biodiversity Information Facility (GBIF) online data portal (GBIF 2019). Further understanding of the importance of different species, including aspects of rarity, endemism, and interest was developed using data from BirdsCaribbean and IUCN Red List**.**

To inform and guide our work, as well as to provide additional information we undertook further stakeholder and partner consultations. Through workshops and consultations with local stakeholders and partners in the region we gathered information on popular birdwatching areas and obtained review and feedback on early map drafts.

In order to provide a broader framework for understanding spatial patterns and we decided to highlight areas of conservation importance. These include places with recognized ecological integrity, for which we used BirdLife International's Important Bird Areas (IBA) layer (BirdLife International 2020) as well as areas currently under a legal framework for conservation management, for which we used The Nature Conservancy's Caribbean protected areas (PA) layer.

Some additional information was gleaned from TripAdvisor data. Initial data were kindly provided by TripAdvisor for all attractions (points of interest, tour operators, hotels, holiday rentals, and restaurants), including both member reviews and uploaded images. The former were analyzed using AI/ML methods described below, with direct (human) review for some aspects, as explained in the details below.

Marine Mammal Watching

Our key sources for marine mammal watching are summarized in Table 2, with further details below.

Table 2. Summary of data input sources for the whale and dolphin watching model.

Data Layer	**Source**
Participatory-mapped points	The Nature Conservancy and local partners, enhanced with bathymetric contours and shoreline data previously generated by The Nature Conservancy in the Caribbean
Observations	iNaturalist & Diveboard via GBIF
Operators	TripAdvisor
Photos	Flickr

Although our original intention had been to use user-generated content for this work, we found that the key sources for such work had only limited data points. AI based image recognition was effective in locating images of marine mammals from Flickr; however this approach only returned 62 images.

Other user-generated content was derived from iNaturalist and Diveboard, both of which have contributed data into the Global Biodiversity Information Facility (GBIF) online data portal (GBIF 2020). Unfortunately, this was another very small dataset (13 points total). While other locational data are available through GBIF, these are not derived from public participation and represent research data which may not be representative of tourism patterns and so these data were not included.

A manual search of TripAdvisor data and other regional directories was then undertaken, identifying an initial list of 30 charter vessel operators offering whale and dolphin tours. Of these, 15 had one or more reviews that mentioned marine mammal watching. We used these reviews as a proxy metric for frequency of activity (use intensity), grouping them into quartiles and scoring between 1 and 4.

Figure 2. *Example output of participatory mapping exercise in St. Vincent. Red dots indicate whale/dolphin watching points of importance. Green dots represent recreational fishing points of importance (used in a separate analysis)*

For the other fifteen operators with no TripAdvisor reviews or no scores we assigned a score of 2.

This listing of operators gives a direct indication of the key points of spending, and hence local socio-economic influence. At the same time, although they do not show where whale/dolphin watching activities are taking place, they can nonetheless give an indication, with weighted use intensity, for departure points for whale and dolphin watching.

Given the paucity of user-generated content from online sources, local input was a critical element. In February 2020, members of the project team travelled to each of the CROP countries in order to conduct informational interviews and participatory mapping exercises with charter operators who lead sportfishing and/or whale watching tours. 31 operators, 17 of whom offer whale and dolphin watching trips participated. Most participants (n = 29) filled out both the surveys and participated in the mapping exercise. In the structured survey, most participants (n = 22) provided data on the number, length, and cost of trips, as well as departure points, target species, and other information influencing the features of their trips. The questionnaire template and responses can be found in Appendix A. In the participatory mapping exercise, participants were also asked to place adhesive dots on a map to indicate significant locations for their activities (Figure 2). These points were annotated with qualitative or other descriptive information. The points were georeferenced and digitized using ArcGIS software, and in some cases underwent further processing (e.g., connecting points to describe a route; buffering a point to widen the area) based on the annotations.

Modelling and geospatial processing

Image and Text Analysis

In our initial work, AI/ML techniques and methodologies were applied to Flickr and TripAdvisor photos for marine mammals, as well as to TripAdvisor reviews for both birds and marine mammals. Under these approaches, we developed training datasets by selecting images (from Flickr and TripAdvisor) and text (from TripAdvisor reviews) that best represented the elements we wished to capture in our models. For example, we selected pictures of whales or dolphins seen from vessels to represent the types of images that we wanted the tool to identify. We also created a negative training dataset to help the tool avoid false positives,

including, for example, photos taken on a vessel where no animal was present. We employed Google image searches to supplement the training imagery. Once sufficient training photographs had been compiled, the team used Microsoft Lobe, a free, desktop AI/ML tool to classify the remainder of the photos from Flickr and TripAdvisor and return a list of photos that best matched the criteria from the training data. Photos from Flickr were standardized to photo user days (PUDs) and plotted on a map. The PUD approach only allows the counting of one image per user per 500m grid cell on any day (Wood et al. 2013). This approach helps to avoid bias from a single person posting many similar images in the same location. We did not use marine mammal photos from TripAdvisor in the final analysis due to the low number of photos returned by the AI/ML tools.

Similarly, we used the web-based tool LightTag to label over 2,000 TripAdvisor reviews according to activities and elements described in each review. As we were using these approaches to develop data for several different nature-dependent tourism models, each review might have had multiple labels. For example, a review describing a chartered boat trip where bottlenose dolphins were seen, followed by a snorkeling excursion would be classified as both "whale/dolphin watching" and "on-reef" tourism. 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 could then be mapped as points based on the attraction to which they were linked.

For birdwatching there were some concerns that the training data, and hence the final algorithms, were too broad and were returning any and all observations of birds, including many reviews that did not specifically cover birdwatching. As a result, and because the eBird data were providing such a rich data source, we decided not to use TripAdvisor data in the final model.

Likewise, the output metrics from Lobe on the whale and dolphin image analysis model were of only partial use. Although they returned several hundred images, subsequent review revealed numerous false positives. Consequently, the decision was taken to visually inspect each of the returned images and to manually remove all false positives.

More details on these AI/ML methods and outputs can be found in Appendix B.

Developing use intensity maps

Birdwatching Intensity

The data from eBird was a rich source with relatively high spatial precision. In total there were over 1400 observers, between them generating over 73,000 birdwatching locations for 212 species (Table 3). eBird data has already been used in other academic studies (e.g., Johnston et al. 2020, Zhang 2020), and while there are some weaknesses in its use as a precision tool for mapping bird species and

abundance, our intention was to use it to map where birdwatchers go. In this manner, it is likely to be a more powerful tool. Even so, we should be aware that the users of eBird are a subset of birdwatchers, and that their spatial patterns may not fully capture the more casual observers who nonetheless enjoy seeing wild birds. Four distinct layers were developed to understand intensity of birdwatching in these 5 countries: (1) Birder footfall, (2) Species importance, (3) Areas of conservation importance, and (4) Birding hotspots.

Table 3. Summary of eBird data by country included in the birdwatching models.

Country	# of eBird data points	# Species	# Observers	# Observation Days
Dominica	16,348	135	254	1,161
Grenada	16,395	131	257	622
Saint Kitts & Nevis	7,822	101	253	398
Saint Lucia	24,409	140	492	1,119
Saint Vincent & the Grenadines	8,581	118	158	457
Total	**73,555**	**212**	**1,414**	**3,757**

Birder footfall visualizes birdwatching tourism density within each country. This map was developed from eBird observation data. This dataset was first cleaned with the removal of points that had non-specific locality names (e.g. 'Dominica', 'Saint Lucia'), if these points fell near the centroid of the island or otherwise appeared to be associated with a random location, rather than a likely area to record a bird observation. A grid of 500 x 500m cells was then generated spanning the entire region, from Saint Kitts and Nevis to Grenada. Using this grid, eBird observations were then summarized to "total observer days" (TOD), representing a count of the number of days in which observers had reported birds from that grid cell. Within each cell, only one observation was counted per observer per day, preventing double-counting where there were multiple observation uploads in a cell. The birder footfall layer shows the total observer days over the full time-period of the dataset (with 93% of observations from 2000 to 2018, and the remainder representing historical observations or non-dated observations,).

As might be expected, birder footfall includes a heavy use intensity close to the accommodation centers, a not unexpected observation as many people enjoy seeing birds in hotel grounds and many even select hotels because of these opportunities. At the same time, we were aware that there are a number of "must see" birds that will have a higher perceived value for many tourists. To capture these, we developed a weighting of species importance, scoring species importance based on key metrics that might encourage birdwatchers to travel to see.

Four broad attributes were used to select and weight species importance (Table 4): charismatic interest, abundance, threat status and endemism. For the purpose of this study, birds of charismatic interest were identified based on input from local stakeholders and partners, such as Environmental Protection in the Caribbean (EPIC), as well as information from Caribbean Birding Trail – although lacking a clear definition these are the species that are most frequently listed both by birdwatchers and in site or country descriptions, and are intended to capture birds that are likely to be a draw for birdwatchers. The remaining three categories were based on BirdsCaribbean's *Birds of the West Indies* Checklist (Gerbracht & Levesque 2019), with IUCN status obtained from the IUCN Red List (www.redlist.org). Each species was assigned a score of one or zero (Table 4), while an overall score of "species importance", was obtained by assigning and summing these scores for each species. Final scores (0-4) indicate species importance to the birdwatching industry. A species such as a parrot, may be charismatic, internationally rare, endemic, and uncommon even within its range, getting a score of 4 while others, such the brown pelican, simply score 1 as charismatic. In the following paragraphs, any species with a total species importance score of at least 1 is considered a "key species".

Table 4. Species importance: importance scores, with simple attributes for inclusion/exclusion listed.

	Score of 1	Score of 0	Source
Abundance	Uncommon, rare, very rare, extinct, or extirpated species	Common or fairly common	BirdsCaribbean's Birds of the West Indies Checklist
Charismatic Species	Identified as a species of charismatic interest	Not identified as such	Local experts, Environmental Protection in the Caribbean (EPIC), Caribbean Birding Trail
Endemism	All species that are endemic to the region (either West Indies, Lesser Antilles, or a specific country)	Not endemic	BirdsCaribbean's Birds of the West Indies Checklist
IUCN Status	All threatened species (Vulnerable, Endangered, or Critically Endangered)	Near Threatened or Least Concern	BirdsCaribbean's Birds of the West Indies Checklist & IUCN Red List of Threatened Species (www.iucnredlist.org/

In total some 127 birds were considered "key species" with 53 of those species considered as charismatic birdwatching species based on guidance from local

partners and stakeholders. Key species are listed in Table 5, together with their importance scores and their presence in each country.

Table 5. Key species, their species importance scores, and whether they were observed in eBird observation points in each country. ('X' indicates presence). Bolded bird species indicate those species identified as charismatic by stakeholders and other expert guidance.

Common Name	Species importance scores	Dominica	Grenada	St. Kitts and Nevis	Saint Lucia	St. Vincent and the Grenadines
African collared dove	1		X			
American black swift	2	X	X	X	X	X
American flamingo	1		X	X		X
American golden plover	1	X	X		X	
Antillean crested hummingbird	2	X	X	X	X	X
Antillean euphonia	2	X	X		X	X
Antillean nighthawk	1	X				
Baird's sandpiper	1		X			
Belted kingfisher	1	X	X	X	X	X
Black-necked stilt	1		X	X	X	
Black skimmer	1		X			
Black tern	1	X				
Black vulture	1		X			
Black-headed gull	1			X	X	
Black-necked stilt	1		X	X	X	
Black-whiskered vireo	1	X	X	X	X	X
Blue-black grassquit	1		X			
Blue-headed hummingbird	3	X				
Bobolink	1	X		X		
Bonaparte's gull	1			X		
Bridled quail-dove	3	X		X	X	
Bridled tern	1	X	X		X	X
Broad-winged hawk	1	X	X	X	X	X
Brown booby	1	X	X	X	X	X
Brown noddy	1	X	X		X	X
Brown pelican	1	X	X	X	X	X
Brown trembler	3	X		X		X
Caribbean elaenia	1	X	X	X	X	X
Caribbean martin	1	X	X	X	X	X
Cattle egret	1	X	X	X	X	X
Chestnut-sided warbler	1			X		
Cliff swallow	1	X	X		X	
Cocoa thrush	1		X			X
Cocoi heron	1					X
Collared plover	1		X			
Common black hawk	1	X	X		X	X
Eurasian spoonbill	1				X	
Eurasian teal (duck)	1		X	X	X	X
European bee-eater	1				X	

Common Name	Species importance scores	Dominica	Grenada	St. Kitts and Nevis	Saint Lucia	St. Vincent and the Grenadines
Forest thrush	3	X				
Fork-tailed flycatcher	1		X			X
Glossy ibis	1	X	X	X	X	
Gray kingbird	1	X	X	X	X	X
Great egret	1	X	X	X	X	X
Great shearwater	1	X			X	
Green-throated carib	2	X	X	X	X	X
Grenada dove	4		X			
Grenada flycatcher	2		X			
Grey heron	1					X
Grey trembler	2				X	
Grey-rumped swift	1		X			
Hooded warbler	1	X				
Hook-billed kite	2		X			
Jaco (red-necked amazon)	4	X				
House wren	1	X	X		X	X
Hudsonian godwit	1					X
Jabiru	1		X			
Kentucky warbler	1			X	X	
Large-billed tern	1		X			
Leach's storm petrel	2				X	
Least grebe	1		X			
Lesser Antillean bullfinch	1	X	X	X	X	X
Lesser Antillean flycatcher	3	X		X		X
Lesser Antillean pewee	2	X			X	
Lesser Antillean saltator	1	X			X	
Lesser Antillean swift	1	X			X	X
Lesser Antillean tanager	3		X			X
Magnificent frigatebird	1	X	X	X	X	X
Masked booby	2	X			X	X
Masked duck	1		X		X	
Northern parula	1			X	X	
Northern pintail (duck)	1					X
Osprey	1	X	X	X	X	X
Parasitic jaeger	1	X				
Pearly-eyed thrasher	1	X		X	X	X
Pectoral sandpiper	1	X	X	X	X	X
Plumbeous warbler	3	X				
Pomarine jaeger	1	X			X	X
Prothonotary warbler	1	X	X			
Purple-throated carib	2	X	X	X	X	X
Red-billed tropicbird	1	X	X		X	X

Common Name	Species importance scores	Dominica	Grenada	St. Kitts and Nevis	Saint Lucia	St. Vincent and the Grenadines
Red-eyed vireo	1				X	X
Red-footed booby	1	X	X		X	X
Red-legged thrush	1	X				
Red-tailed hawk	1			X	X	
Ringed kingfisher	1	X				
Roseate spoonbill	1				X	
Roseate tern	1	X	X		X	X
Rose-breasted grosbeak	1				X	
Rufous nightjar	1				X	
Rufous-breasted hermit	1		X			
Rufous-throated solitaire	2	X			X	X
Saint Kitts Bullfinch*	N/A					
Saint Lucia amazon	4				X	
Saint Lucia black finch	4				X	
Saint Lucia oriole	4				X	
Saint Lucia warbler	3				X	
Saint Vincent amazon	4					X
Sand martin	1	X	X		X	
Scaly-breasted thrasher	2	X		X	X	X
Scaly-naped pigeon	2	X	X	X	X	X
Scarlet ibis	1		X			
Scarlet tanager	1		X		X	
Scopoli's shearwater	1	X			X	
Semper's warbler	4				X	
Short-tailed swift	1				X	X
Sisserou (imperial amazon)	4	X				
Sooty Tern	1	X	X		X	X
Southern lapwing	1		X			X
Spectacled thrush	1	X	X		X	X
Stilt sandpiper	1	X	X	X	X	X
Striated heron	1		X			
Summer tanager	1		X			
Tropical kingbird	1		X			
Upland sandpiper	1	X	X			
Western reef heron	1				X	
Western sandpiper	1	X		X	X	X
Whistling warbler	4					X
White-breasted thrasher	4				X	
White-cheeked pintail	1			X		
White-collared swift	1		X			
White-rumped sandpiper	1	X	X	X	X	

Common Name	Species importance scores	Dominica	Grenada	St. Kitts and Nevis	Saint Lucia	St. Vincent and the Grenadines
White-tailed tropicbird	1	X			X	X
Wilson's snipe	1	X	X	X	X	X
Wilson's storm petrel	1		X			
Yellow oriole	1	X				
Yellow-bellied elaenia	1		X			X
Yellow-bellied seedeater	1		X			X
Total Charismatic Species	53	36	29	24	38	32
Total Key Species	127	66	70	41	74	57

*none found in eBird data

The species importance map was then developed similarly to the birder footfall map, using the eBird observation data and the same 500 x 500m grid, but instead using species importance scores to develop a map of key species observation intensity. Similar to footfall, observations were counted once per species per day from a single observer in any grid cell (i.e. if one person saw 5 species in one location in one day, it would count as 1 TOD but 5 species observation counts; if one person saw 5 of the same species of parrot, it would be 1 TOD and 1 species observation count). The species observation counts were then multiplied by the weighted species scores to generate a total species importance score per grid cell. The resulting species importance map is thus quite different, still showing areas of importance for birdwatching, but strongly weighted towards these key birdwatching species. Where a single observer would only score "one" in a cell for total observation days, if that observer saw 5 species with a score of 4 each, that cell would receive a total score of 20, whereas cells with common or less interesting species may not score anything.

To give further context for birdwatching, we developed two additional maps: areas of conservation importance and birding hotspots from alternative sources. Areas of conservation importance were compiled in order to summarize the tourism value of key areas in terms of birder footfall and species importance. This layer includes Important Bird Areas from Birdlife International and protected areas from The Nature Conservancy's Caribbean Protected Area data layer. Summary statistics were developed for each of these areas.

Birding hotspots are known areas that birdwatching is occurring, independent of the eBird analysis. These areas were compiled from workshops and consultations with stakeholders and partners in the region (see Table 1) and manually digitized using protected area data layers, Open Street Map, and Google Maps as guides. This layer was further enhanced to bring in data from the TripAdvisor birdwatching-related reviews (see Appendix B). There was some concern that this text-based analysis had been too broad, capturing almost all mentions of birds as opposed to positive

and interest based observation and so these locations were filtered to capture only natural areas – trails, gardens, parks, etc… using keywords for inclusion ('beach', 'garden', 'park', etc.) and keywords for exclusion ('airport', 'bar', etc.). Areas were also considered natural if they were found within protected areas or offshore (see Appendix C for details).

Whale and Dolphin Watching Intensity

Each of the whale/dolphin viewing or departure points is indicative of a larger area of whale/dolphin watching, and a range of approaches was developed to expand these points into appropriate extents and to develop weightings. Two types of data were compiled: (1) onshore operators and (2) offshore locations of tours. Since the intent of this model is to show highlight the habitats that support whale and dolphin watching, the model only has an offshore footprint. Onshore operators were compiled from TripAdvisor data, as previously described. Offshore data included participatory mapping points, Flickr PUDs, and iNaturalist citizen science and Diveboard trip log points accessed through the Global Biodiversity Information Facility (GBIF). Dolphin watching data points were removed near known artificial dolphin parks, as the model aims to capture natural wildlife viewing. Participatory mapping points were converted to lines where applicable (i.e. if a participant's note for a point described that the tour takes place along the 3000m bathymetric contour, that contour was included in the offshore data layer), using bathymetric data previously digitized by TNC from British Admiralty nautical charts and shoreline data derived by TNC from PlanetScope Dove satellite imagery.

Table 6. Summary of data inputs by country included in the whale & dolphin watching model.

Country	# of Flickr Photos	# PUDs	# Reviews	# Mapping Exercise Participants	# Onshore Operators
Dominica	28	15	345	6	7
Grenada	0	0	85	0	2
Saint Kitts and Nevis	0	0	19	0	1
Saint Lucia	32	7	1,450	5	15
Saint Vincent & the Grenadines	2	2	65	6	5
Total	**62**	**24**	**1,964**	**17**	**30**

As with the recreational fishing model, an expert assumption was made that vessels on tourist trips would reach to 20km from departure points on half-day trips and to 40km on full-day trips. To utilize the onshore data, the weighting for each

departure point (see above) was spread to the offshore footprint with these 20km and 40km buffers (see Table 7 for details). The two resulting maps, developed from onshore data and offshore data, were combined into one layer of offshore use intensity.

Table 7. Whale/dolphin watching buffers and weights.

Layer	Buffers	Weights
Onshore operator data	20 & 40km buffers	Weighted informed by the numbers of reviews (scoring 1-4 for each operator, see above).. An offshore footprint for the likely reach of boat trips was generated by selecting all offshore areas within 40km of any onshore operator (with some exceptions based on expert opinion). Scores from the operators were then spread to this offshore footprint using 20km and 40km buffers. The 20km buffers received the full weight, whereas the 40km buffers received half of the weight. This is because we expect that half day tours, closer to shore, are much more common than full day tours that venture farther offshore.
Offshore data	All offshore data points and lines were buffered by 5km.	All given an equal weight of 1. Weights were assigned by counting overlaps.

Economic value – Whale and Dolphin watching

Data gathered during the participatory mapping exercise also enabled us to generate approximate data on tourism spending for whale and dolphin watching. From the survey results, we calculated for each country the average # of trips per week in both the high and low seasons and the number of months in the high and low seasons. By multiplying these values, we estimated the number of trips/year/operator. We then multiplied these by the average cost/trip recorded from the survey, and then that number by the number of operators by country (from the totals in Table 6), in order to estimate the annual charter marine mammal watching expenditure, in $USD. The results are reported in the following section. It was decided that not to distribute these values across the intensity maps, both due to uncertainty of the values, but more importantly because the use intensity maps are approximate and cover extensive areas. Any resulting spread of these economic values would return very low values per unit area, but this may be misleading. Such values, and the species which drive them, are dependent on very large spaces, but there may also be key dependency on particular oceanographic or benthic features that remain largely unknown. Stakeholder consultations confirmed that this approach was appropriate.

Results

Birds

The final maps for the region are presented on the next page, with individual maps for each country presented in Appendix D.

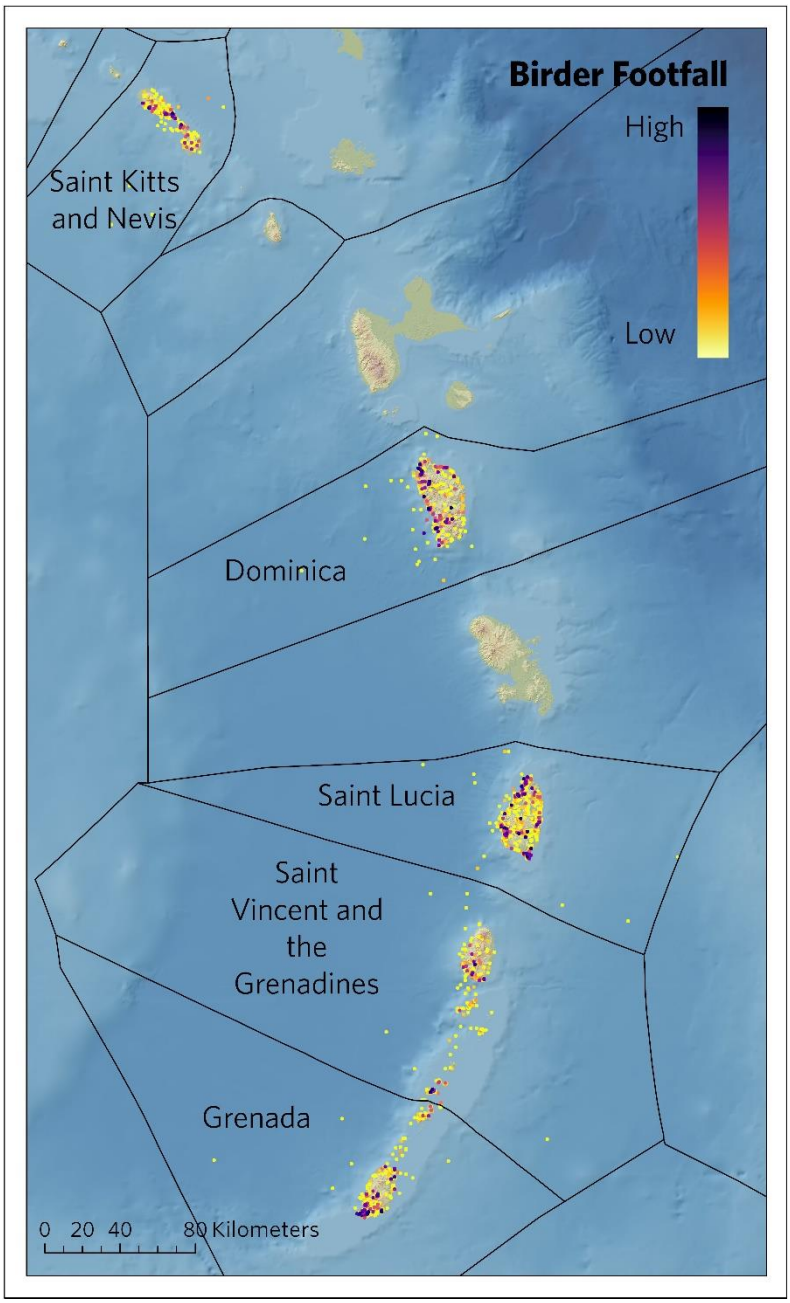

Figure 3. Birder footfall in all 5 OECS countries.

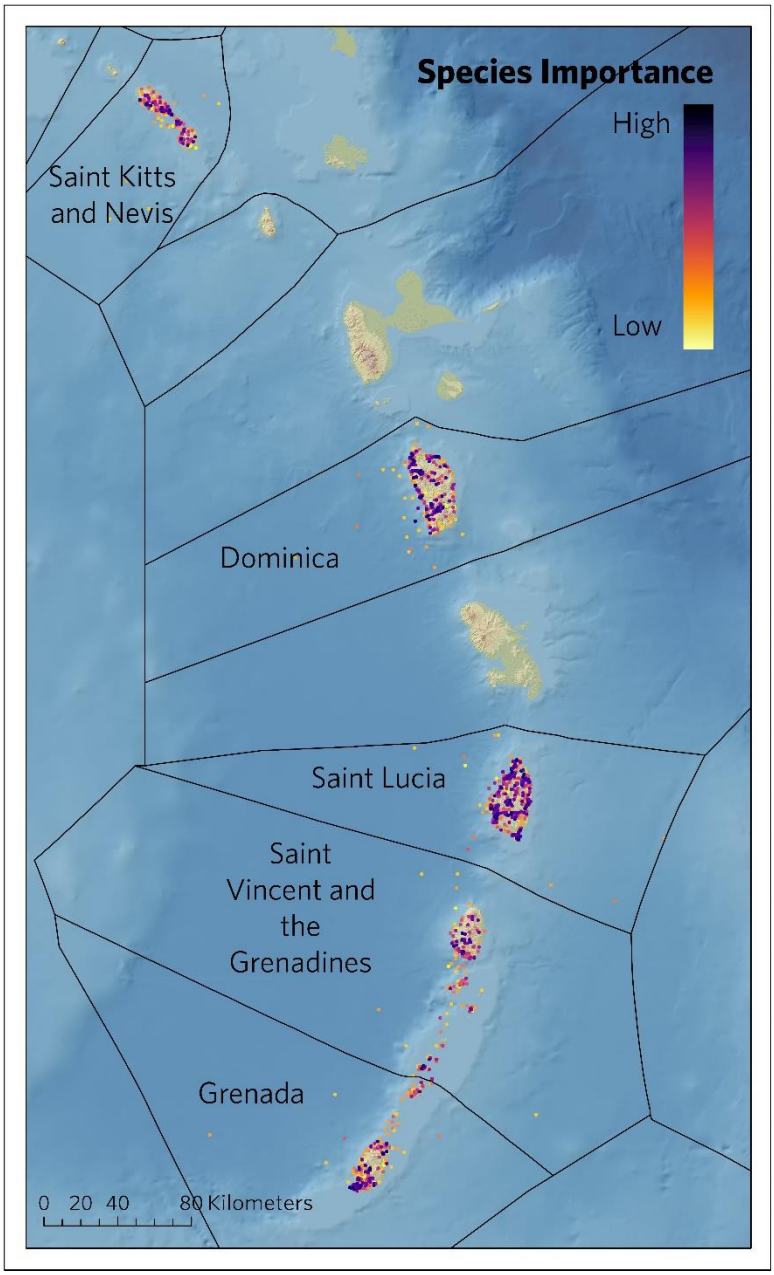

Figure 4. Species importance to birdwatching tourism in all 5 OECS countries.

As described in earlier sections, the birder footfall map and the species importance map tell very different stories. Birder footfall, which aims to depict the birdwatching tourism intensity, tends to be higher around coastal areas and around concentrated areas of tourist attractions and hotels. When accounting for key species (i.e. rare, endemic, endangered, or otherwise charismatic species) in the species importance map, the picture looks quite different, with more intensity occurring in inland areas.

Using the country-specific maps in Appendix D, it is often possible to see the correlation between the areas of high species importance and areas of conservation importance. Table 9 summarizes the birding metrics by these areas.

Table 8. Highest scoring species for birdwatching per country (score of 3-4).

Species Importance Score	Dominica	Grenada	Saint Lucia	St. Kitts & Nevis	St. Vincent & the Grenadines
4	Imperial amazon Red-necked amazon	Grenada dove	Saint Lucia amazon Saint Lucia black finch Saint Lucia oriole Semper's warbler White-breasted thrasher	None	Saint Vincent amazon Whistling warbler
3	Blue-headed hummingbird Bridled quail-dove Brown trembler Forest thrush Lesser Antillean flycatcher Plumbeous warbler	Lesser Antillean tanager	None	Bridled quail dove Brown trembler Lesser Antillean flycatcher	Brown trembler Lesser Antillean tanager

Table 9. Areas of Conservation Importance (PAs and IBAs) birdwatching statistics.

Country ISO Code	Area Name	PA or IBA	Number of Species recorded in eBird	Birder footfall score*	Sum of species importance scores**
DMA	Cabrits National Park	PA	63	65	631
DMA	Morne Diablotin National Park	Both	69	233	6,013
DMA	Morne Trois Pitons National Park	Both	65	61	633
DMA	Northern Forest Reserve	PA	56	9	227
DMA	Point Des Foux	IBA	5	1	4
DMA	Soufriere/Scott's Head Marine Reserve	PA	25	20	61
GRD	Annandale Forest Reserve	PA	6	2	7
GRD	Grand Anse MPA	PA	38	12	44
GRD	Grand Etang Forest Reserve	Both	53	99	1,000
GRD	Mount Hartman	IBA	71	153	1,783
GRD	Perseverance	IBA	44	9	91
GRD	Perseverance Protected Area	PA	45	11	97
GRD	Ronde Island Group Proposed MPA (identified by EPIC as an important area for birds)	Proposed PA	13	9	24
GRD	Sandy Island-Oyster Bed MPA	PA	14	9	20
GRD	Woburns-Clarks-Court Bay MPA	PA	30	2	19
GRD	Woodlands of Grenada	IBA	28	3	14
KNA	Basseterre Valley Aquifer (east)	PA	21	2	9
KNA	Basseterre Valley Aquifer (west)	PA	21	1	8
KNA	Booby Island	IBA	8	5	9

Country ISO Code	Area Name	PA or IBA	Number of Species recorded in eBird	Birder footfall score*	Sum of species importance scores**
KNA	Brimstone Hill Fortress	PA	38	24	118
KNA	Marine Managed Area (1 of 6)	PA	66	1	6
KNA	Marine Managed Area (2 of 6)	PA	66	29	93
KNA	Marine Managed Area (3 of 6)	PA	66	5	23
KNA	Marine Managed Area (4 of 6)	PA	66	37	148
KNA	Marine Managed Area (5 of 6)	PA	66	18	77
KNA	Opal Boundary	PA	57	38	270
KNA	Ponds of the Southeast Peninsula	IBA	86	96	418
KNA	Saint Kitts Central Forest Reserve	IBA	81	67	730
KNA	The Narrows Marine Reserve	PA	1	2	2
KNA	Wingfield Watershed	PA	60	99	1,224
LCA	Castries and Dennery Waterworks Reserve and Marquis	IBA	83	181	4,022
LCA	Forest Reserve	PA	83	185	4,090
LCA	Iyanola and Grande Anses, Esperance and Fond D'ors	IBA	69	96	1,334
LCA	Mandelé Protected Landscape	IBA	55	105	1,444
LCA	Mankote Marine Reserve	PA	18	2	9
LCA	Maria Islands Wildlife Reserve	PA	28	13	52
LCA	Pitons (Qualibou and Canaries)	IBA	101	421	4,513
LCA	Point Sables	IBA	106	222	1,055
LCA	Pointe Sable Environmental PA	PA	96	112	534
LCA	Savannes Bay Marine Reserve	PA	8	1	3
LCA	West Coast MMA (1 of 4)	PA	48	8	46
LCA	West Coast MMA (2 of 4)	PA	48	15	74
VCT	Bequia Marine Conservation Area	PA	18	5	15
VCT	Canouan Marine Reserve	PA	22	5	23
VCT	Cumberland Forest Reserve	PA	24	3	65
VCT	Mustique Marine Conservation Area	PA	13	3	5
VCT	Parrot Reserve	PA	59	10	210
VCT	Petit Saint Vincent Wildlife Reserve	PA	17	4	20
VCT	South Coast Marine Conservation Area	PA	15	1	10
VCT	Tobago Cays – Mayreau	PA	57	35	139
VCT	Union-Palm Island Marine Conservation Area	PA	64	153	814

PAs with no eBird data – [DMA: Central, Jaco Flats], [GRD: High North Forest Reserve, Moliniere-Beausejour MPA, Mount Saint Catherine, Pearls], [KNA: MMA (6 of 6), The Narrows Fishing Priority Area], [LCA: Caesar-Mathurin Marine Reserve, Moule a Chique Marine Reserve, Scorpion Island Marine Reserve, The Maria Islet Reef Marine Reserve, West Coast MMA (3 of 4), West Coast MMA (4 of 4)], [VCT: Allwash Island Wildlife Reserve, Battowia Island Wildlife Reserve, Big Cay Wildlife Reserve, Catholic Island Wildlife Reserve, Catholic Rocks Wildlife Reserve, Chateaubelair Islet Wildlife Reserve, Frigate Island, Isle Quatre Marine Reserve, King's Hill Forest Reserve, La Paz Rock Wildlife Reserve, Milligan Island Wildlife Reserve, Petit Canouan Wildlife Reserve, Pigeon Island Wildlife Reserve, Sail Rock Wildlife Reserve, Savan Island Wildlife Reserve, West Cay Wildlife Reserve, Young Island Wildlife Reserve]

IBAs with no eBird data – [DMA: L'Ilet], [GRD: Beausejour/Grenville Vale, Woodford]

Other areas of importance for birds (identified by EPIC) with no eBird data – [GRD: South Carriacou Islands Proposed MPA], [VCT: Pillories, Petit Mustique, Dove Cay]

* Total number of observations submitted by eBirders (only one record per observer per day).

** Total of the number of species observed per unique eBirder per day multiplied by each specie's importance score.

Whale and Dolphin Watching

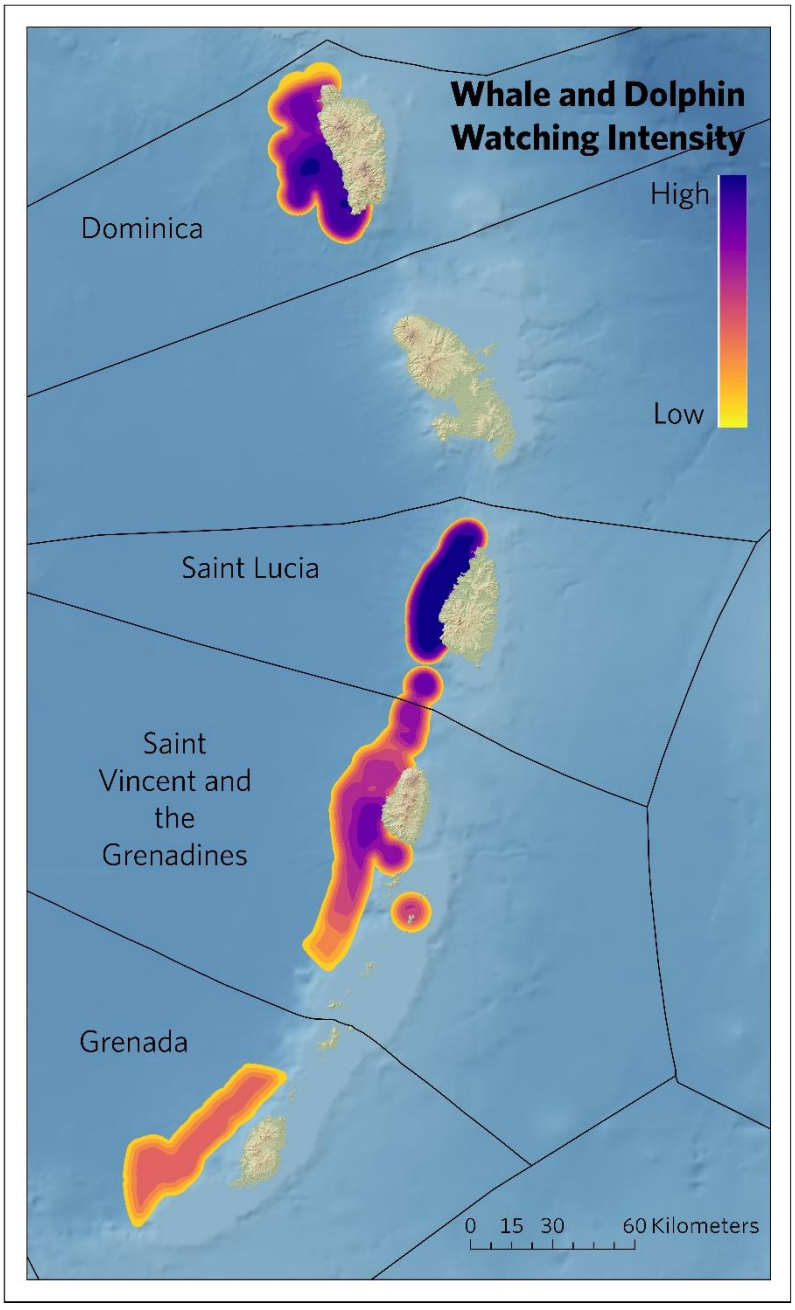

Figure 5. Whale and dolphin watching in the OECS region

No mapped data have been prepared for St. Kitts and Nevis. Although we were aware of a single operator located in the port of Basseterre, we had no additional data (e.g., PUDs, participatory mapping points) that we could use to spread the

likely footprint of marine mammal watching operations offshore. Unsurprisingly, the highest intensity of activity was located off the western, leeward coasts of Saint Lucia and Dominica, with a particularly high intensity area in Dominica corresponding with the locations of deep offshore canyons, habitats in which sperm whales are likely to be seen. In Saint Lucia, with operators mostly originating from the ports at Castries or Soufriere, the spatial footprint of the activity is consistently high along the west coast.

An estimated calculation of tourism expenditure for each country is given below in Table 10. As no operators from either Grenada or St. Kitts and Nevis provided data on number or costs of trips, we were not able to estimate expenditures for these countries.

Table 10. Estimated annual tourism expenditures on whale/dolphin watching

Country	**Cost/trip ($USD)**	**#Trips/year /operator**	**# Trips/year**	**Estimated Tourism Expenditure ($USD)**
Dominica	875	301	2,107	$1,843,625
Grenada	No Data			
Saint Lucia	889	286	4,284	$3,808,476
St. Kitts & Nevis	No Data			
St. Vincent & the Grenadines	600	224	1,120	$672,000

Beach-Based Turtle Viewing

Turtles are another highly charismatic species regularly enjoyed by tourists. Most turtle encounters are in-water, and while there are some key locations, such as the Tobago Cays Marine Park, marine turtles are found in many locations, and many of these are likely to have been mapped in our on-reef mapping work. An additional attraction is visiting sites where turtles can be seen nesting on beaches, and we investigated the possibility of mapping these locations.

After some initial research, it was decided not map sites where turtle nesting can be watched due to sparse, inconsistent datasets across the study area and concerns about potential negative impacts. Here, we present a qualitative summary of findings on this activity based on conversations with stakeholders and regional experts.

Relative to the rest of the region, organized tours to see these turtles are limited and sometimes short-lived. In Grenada, there are guided tours to see nesting leatherbacks on Levera Beach from April – July. While not strictly a tourism operator, Ocean Spirits, a non-profit organization focusing on sea turtle research,

conservation, and education programs, offers organized opportunities for visitors to volunteer with their data collection efforts. Similarly, on Carriacou, the KIDO Foundation offers sea turtle volunteer opportunities and training for nature guides.

In Saint Lucia and Dominica, organized turtle watching tours are limited to non-existent, though the Dominica Sea Turtle Conservation Organization (DomSeTCO) is a resource for information on community-based Turtle Watches that follow best practices. There has been some interest in trying to further develop tourism around turtle watching in Saint Lucia, notably at Grand Anse, but to date these efforts have not fully materialized.

In Saint Kitts & Nevis, the northern coast of Nevis is the primary locations for turtle watching. Oualie Beach, Lovers Beach, Cades Bay, and Jones Bay were identified by stakeholders as areas that are attracting tourists hoping to see sea turtles.

There was some indication from stakeholder consultations that turtle watching represents an opportunity to further develop ecotourism opportunities in the region, and there are several organizations working to promote sustainable practices for turtle watching in the Caribbean. The Wider Caribbean Sea Turtle Conservation Network (WIDECAST) consists of a network of experts who work closely with in-country stakeholders on a wide variety of scientific initiatives to promote the conservation and protection of sea turtles and their habitats. They have produced guidebooks and other resources to help promote sustainable practices for turtle-related tourism. WIDECAST works closely with Wildlife Friendly Enterprise Network, an organization that can certify hotels and other tourism operators as Sea Turtle Friendly through their organization if they meet established criteria.

The following organizations are expert-identified resources for more information on sustainable turtle-related tourism:

Ocean Spirits
KIDO Foundation
Tobago Cays Marine Park
DomSeTCO
Saint Lucia National Trust
Nevis Turtle Group
St. Kitts Turtle Monitoring Network

Discussion and Conclusions

As with our earlier work on on-reef activities, beach-dependent tourism, kayaking and seafood restaurants, the current work has developed the most detailed maps we know of for two important tourism activities in the CROP countries. These maps show not only the distribution of these activities, but also their relative intensity.

All those working in the tourism sector should consider the relevance of this work, pointing as it does to the importance of nature-watching. The maps highlight places that deserve attention from governments and the industry. Well-managed, such places will continue to deliver benefits in terms of income and employment, as well as health and well-being for tourists and many local people. Further to this, potential benefits may merit consideration for future planning: there is value in safeguarding existing benefits, but there may also be opportunities to expand these benefits.

As with all nature dependent tourism, the sensitivity of nature must remain a paramount consideration in any efforts to secure sustainable benefits. Our maps do not capture the risks or impacts that tourism may be having on birds or marine mammals. Nor can they take into account wider issues of threat or declining conditions for these animals, which may be impacted by many other human impacts. Tourism can be a powerful force for conservation as governments and others come to realise their value, but sustainable management of these activities is critical. Two examples illustrate this point – firstly the mapping of locations for watching nesting turtles was initially encouraged and then repeatedly accompanied by expressions of concern due to the very high vulnerability of this form of tourism to abuses that diminish the turtle populations and ultimately drive the industry itself out of business. Secondly it has been recorded that the sperm whale population off Dominica is undergoing a slow decline (Gero and Whitehead, 2016) – there is no clear evidence that this is linked to tourism, but given the value of this industry it should be a considerable concern for government and industry, both to prevent future disturbance and to try to understand any other possible human-causes for this decline.

Our approach in this report, as with the previous work, began with the utilization of user-generated content (UGC) to ascertain locational and use-intensity information. In this regard we found that automated review of TripAdvisor was only of limited value – our methods for reviewing both text and images were effective, but the data returns were too small to be of value without further enhancement. Further value was nonetheless obtained from TripAdvisor through direct expert review and filtering. Meanwhile, for birdwatching, a second UGC source – eBird – proved a highly valuable source.

In both cases the utilization of nationally-derived information, including participatory mapping was of considerable value, becoming a primary source for marine mammal watching information.

With both birds and marine mammals our work is not strictly linked to any specific ecosystems. With the former, birdwatching is often highly dependent on healthy natural areas, but in fact it benefits from a broad range of different habitats. For marine mammals, many species are considered pelagic and found in open waters offshore, but again the locations are not always linked to particular seabed or pelagic habitats. Thus our maps remain as maps showing patterns of use intensity and do not directly show the habitats which are generating these values. With

birdwatching, the areas of high use intensity appear tightly defined, often representing prime bird viewing locations, however it is important to realise that birds enjoyed in these locations depend on much larger surrounding areas. With marine mammal watching the use intensity maps highlight very large areas, which probably do reflect the fact that these species are indeed wide-ranging, although as mentioned there may be critical habitat components within these large spaces that are especially important, such as submarine canyons off the coast of Dominica for sperm whales.

Birdwatching as an activity is perhaps the most spatially widespread of any nature-dependent tourism in the CROP countries. Simple birder footfall shows a predominance of activities in coastal areas, with a likely correlation with accommodation density, but these maps still show observations recorded from offshore waters to wetlands and mountain areas. The patterns of species importance underline the particular value of these locations away from the tourist accommodation, notably mountainous and forest areas. Many of these important species depend heavily on the existence of a relatively large and intact ecosystem and for this reason we have shown the protected areas and Important Bird areas. It is these larger tracts of land that may be responsible for maintaining the populations of birds highlighted in eBird.

While there is widespread agreement that birdwatching can be important in generating tourism revenue (see for example Steven et al. 2015), very few studies have converted this to monetary values. Likewise in the CROP countries, the development of reliable monetary values would require a novel research effort to understand and quantify the full range of destination selection, choice parameters and spending patterns for all those who enjoy birds during their visits. This would not be limited to the highly committed birdwatchers for whom destination choice is a direct function of birdwatching potential. There will be many more for whom a single day trip or interaction with a highly charismatic species may provide a memorable tourism experience and play a unique role in influencing return likelihood and word-of-mouth promotion.

In reviewing our maps related to birdwatching we would encourage several considerations. Firstly of course is the importance of birdwatching across multiple locations, including many that are beyond the regular path of many tourists. Such areas should be safeguarded and could potentially be promoted through the expansion of visitor facilities, trails and protected areas. As mentioned, the highly focused nature of observation points may be misleading and in many cases the protection and encouragement of this industry will also require continued or improved efforts to protect the entire functioning natural habitats in adjacent areas required by birdlife.

In many cases protected areas have already been designated around these areas, however there are other hotspots which appear to be unprotected, for example in north-east Grenada, central Nevis, and north-west Saint Lucia. Additionally, the concentration of birdwatching in many areas where hotels predominate should not

be overlooked. Birds in these areas are likely benefitting from extensive green-space, water and gardens. Acknowledging this value, there may be further arguments on development policy, as intensification of building density, or the widespread use of chemicals on gardens and golf courses, for example, could strongly impact bird populations in these areas.

Whale and dolphin watching is another niche sector, although unlike birdwatching, it is perhaps less widely a dedicated, single-focus activity for individual tourists, and more widely undertaken as an opportunistic experience for a very large numbers of travellers. Our mapping efforts have sought to go beyond the specialist whale and dolphin watching cruises to capture all boat trips that draw attention to the possibility for seeing whales and dolphins and incorporate these into wider itineraries.

Both our maps and the expenditure estimates highlight the particular importance of these activities in Dominica and Saint Lucia, with St Vincent and the Grenadines also having a nascent whale and dolphin watching industry. In all cases, activities extend out predominantly from the western shores, from coastal areas (where dolphins are more likely to be observed) out to deeper waters favoured by large whales.

In terms of economic values, it is important to note that these numbers represent direct expenditure by tourists on these trips. They do not, of course, capture ancillary expenditure, or the role that such experiences may have had in destination choice, return likelihood or indeed word-of-mouth encouragement of other visitors. Thus the expenditure figure for Dominica represents 1.8% of all tourism expenditure, but if the ancillary expenditure could be factored in, it may be double that. Although numbers are highest for Saint Lucia, it should be noted that, as a proportion of visitors and expenditure, it is likely that this industry represents a far more critical element of tourism expenditure in Dominica which has fewer visitors and even lower expenditure overall.

In this work we have not explored the potential impacts of whale and dolphin watching in the CROP countries (New et al. 2015). Nor do we consider the potential opportunities to expand these industries. We do however feel this work shows all too clearly that this is an important component of tourism, with a large spatial footprint. It will be important for governments and tour operators to consider this industry and to manage it for sustainability.

The importance of nature in tourism extends way beyond cetaceans and birds. Underwater observation of marine life was covered in a separate report, but even on land there are many other aspects. These include other wildlife experiences, ranging from enjoying small creatures such as butterflies, geckos, and iguanas, to enthusiasm for feral mammals such as monkeys and agoutis. Plant-life is also important, both curated in hotel and botanic gardens, and in wild habitats. Rainforests, cloud forests, wild rivers and mangroves provide a particular draw, providing unique experiences for many visitors from colder climes. Adventure

activities such as hiking, horse-back riding, zip-lining, canyoning, even off-road driving are an important and rapidly growing part of visitor experiences, and are often completely dependent on the presence of wild areas. To some degree our birdwatching map may capture some of these natural values, but governments and the industry should be aware of their dependence on nature for these values too. All are vulnerable to threats from the application of pesticides; from pollution of rivers; from the impacts of spreading urbanization reducing the sense of wilderness; as well as the direct impact of forest clearance. Once lost, these habitats are extremely difficult to restore.

The information and maps in this report for a valuable addition to the data already released in earlier reports which, combined, provide the most comprehensive review of nature dependency in tourism we are aware of, not only for the CROP countries, but likely anywhere in the world. The data have a role to play not only in raising awareness, but in direct management responses. In large part the maps are of sufficient resolution to be used in marine spatial planning and in future exercises to prioritise the development of protected areas or other management interventions.

The tourism industry, worldwide, is suffering greatly from the global pandemic caused by Covid 19, and while it is still early to predict recovery trajectories, it is important to consider options. It is clear that the CROP countries have a remarkable natural heritage which forms a key component of their tourism industry. Nature underpins the value of beach tourism and seafood, but also generates revenue and key experiences in a more direct manner from fishing, diving, kayaking and wildlife watching. In many future recovery scenarios, destinations will benefit considerably from promoting nature, natural values, space and a lack of crowds as key aspects to attract returning visitors.

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Appendices

Appendix A. Stakeholder Survey Data

Survey responses from charter operators are provided below. Due to its size, the table is broken up into multiple table, with the Participant ID field in the first column allowing for the linkage of responses among separate tables. Some of the data collected in this survey was used to estimate national tourism expenditures on recreational fishing; however, the small sample size may lead to bias.

1. Survey Instrument & Responses

Participant ID	**Location**	**3. Please select the activity your business offers**	**4. How many days of the week do you operate?**	**5. How many vessels are in your fleet?**
1	St. Vincent and the Grenadines	Whale watching tours, snorkeling, coastal cruise	3	2
2	Dominica	Whale watching tours, swimming with whales. diving, snorkeling, sea tours	2	1
3	St. Vincent and the Grenadines	Whale watching tours, snorkeling, island tours, scuba diving	6	1
4	Dominica	Recreational/sport fishing, Whale watching tours, swimming with whales, snorkeling, day charters	3	1
5	Dominica	Recreational/sport fishing, Whale watching tours, snorkeling	7	3

6	Dominica	Whale watching tours, diving, snorkeling	7	5
7	St. Vincent and the Grenadines	Whale watching tours, snorkeling, land and sea tours, coastal cruises	2	3
8	Grenada	Recreational/sport fishing, water tours, snorkelling, free diving	3	1
9	Grenada	Recreational/sport fishing, Water Tours, snorkelling	4	3
10	Grenada	Recreational/sport fishing	2	2
11	Grenada	Recreational/sport fishing	5	1
12	Saint Lucia	Recreational/sport fishing, Whale watching tours, coastal tours	7	7
13	Saint Lucia	Recreational/sport fishing, Whale watching tours, Private coastal charters	5	3
14	Saint Lucia	Recreational/sport fishing	7	1
15	Saint Lucia	Recreational/sport fishing, Whale watching tours, snorkeling, sunset cruise. sailing, charters	7	7
16	Saint Lucia	Recreational/sport fishing, snorkeling, charters, catch, clean and cook	2	3
17	Saint Lucia	Recreational/sport fishing, Whale watching tours, snorkeling, sunset cruise, interisland tours	3	1

18	St. Kiits and Nevis	Recreational/sport fishing	4	2
19	St. Kiits and Nevis	Recreational/sport fishing, snorkeling, water taxi	4	1
20	St. Vincent and the Grenadines	Whale watching tours	2	2
21	St. Kiits and Nevis	Recreational/sport fishing	2	1
22	St. Kiits and Nevis	Recreational/sport fishing	3	1
23	St. Kiits and Nevis	Recreational/sport fishing, snorkeling, coastal tours	4	1
24	St. Kiits and Nevis	Recreational/sport fishing	3	1
25	St. Vincent and the Grenadines	Recreational/sport fishing	3	1
26	St. Vincent and the Grenadines	Recreational/sport fishing, snorkeling, water taxi	5	1
27	St. Vincent and the Grenadines	Recreational/sport fishing, Whale watching tours, snorkeling, land and sea tours, semi-commercial fishing	1	2
28	Dominica	Whale watching tours, snorkeling, land tours	4	1
29	St. Vincent and the Grenadines	Recreational/sport fishing, Whale watching tours, snorkeling, coastal cruise	3	1

Participant ID	**6. How many persons are employed with your organisation? (including yourself)**	**7. Where do you depart from?**	**8. What is the average distance (miles) you travel to get to the fishing site(s)?**	**9. What is the average length of your trip? (from your departure to return)**

1	2			
2	6			
3	4			
4	6	Newtown Fishery Roseau Ferry Terminal	7 - 10 miles	4 hrs - 1/2 day 8 hrs - full day
5	6	Roseau, Portsmouth	5-8 miles	4 hrs (1/2 day) 6 hrs (3/4 day) 8 hrs (full day)
6	14			
7	3			
8	3	Windward	2-10	4- 6 hours
9	5	Harvey Vale, Hillsbourough	5	4
10	2	The Grenada Yacht Club, St. George's	10	full day (6-8hrs) 50 miles half day (4-6hrs) 30 miles
11	2	Port Louis Marina and St. George's	5 mile usually but up to 20-25 miles	1/2 day - 4 hr 3/4 day - 6rs full day - 8 hrs
12	21	Vigie Marina Rodney Bay Marigot Soufriere	2 -10	half day - 4 hrs full day - 8 hrs
13	11	Vigie Marina, Ganters Bay	2	3-4 hrs
14	2	Laborie	1/2	2 1/2 hours
15	22	Soufriere Marigot Marina Rodney Bay Marina Castries Port	3 - 12	4 hrs 6 hrs 8 hrs
16	3	Vieux Fort Port Laborie	5	4 hrs - half day 7 hrs - full day
17	4	Vieux Fort Soufriere Castries	5 - 7	half day - 4.5 hrs full day - 8.5 hrs
18	5	Oualie Beach Four Seasons Park Hyatt Port Zante Reggae Beach	5	4 hrs (1/2 day) 6-8 hrs (full day)
19	2	Oualie Beach Four Seasons Charlestown Port Zante Reggae Beach	2hrs - 1/2 mile (bottom fishing for kids); 4 hrs - 1.5 - 2 miles; 6 hrs - 15	2, 4, 6 and 8 hrs

		Park Hyatt Christophe Harbour	miles; 8 hrs - 20 miles	
20	2			
21	2	Port Zante Marina	10 - 12	4 hrs
22	2	Oualie Beach Four Seasons Park Hyatt Reggae Beach	2.5 - 3	2 hrs 4 hrs - half day 6-8 hrs - full day
23	2	Port Zante Four Seasons Frigate Bay Turtle Bay	4 - 6	half day - 4 hrs full day - 8 hrs
24	3	Oualie Beach Reggae Beach Crystal Habour	2 -4	4 hrs - half day 6-8 - full day
25	2	Canouan Petit St. Vincent (PSV)	5 - 40	4 hrs 8 hrs
26	3	Admiralty Bay Harbour, Port Elizabeth, Bequia	5 - 10	half day - 4 hrs full day - 7-8 hrs
27	4	Blue Lagoon Marina	6 - 12	5 hrs - half day 8 hrs - full day
28	6			
29	2	Villa	5	4 hrs - half day 6-8 hrs - full day

Participant ID	**10. What is the average cost per tour? ($USD)**	**11. Please select your peak month(s) where you have the most customers.**	**12. What are your average number of tours per week for your (i) peak season (ii) low season [Peak season]**	**12. What are your average number of tours per week for your (i) peak season (ii) low season [Low season]**
1				
2				
3				
4	4 hrs - 1/2 day - 600 8 hrs - full day - 1200	January, February, March, April, November, December	<5	<5
5	4 hrs (1/2 day) - 600 6 hrs (3/4 day)	January, February, March,	<5	<5

	- 800 8 hrs (full day) - 1100	November, December		
6				
7				
8	$500- $1000 with a max of 10 persons. $500 for max of 2 person	January, February, March, April, May, December	<5	<5
9	$400 (half day tour). $100 per hour for longer trips	January, February, March, April, November, December	<5	<5
10	half day - 600 full day - 1000	January, February, March, December	<5	<5
11	1/2 day - 550 3/4 day - 725 full day - 900	January, February, March, April, November, December, Peak months during peak season are February and March	5-7	<5
12	half day - 600 full day - 1500 100 per persons from cruise ships	January, February, March, April, November, December	>12	7-9
13	100 per person 600-900 to charter the boat	January, February, March, November, December	5-7	<5
14		March	5-7	<5
15	4 hrs - 550/660 6 hrs - 660/880 8 hrs - 880/1100 **dependent on boat 31ft/38ft	January, November, December	7-9	<5
16	half day - 350-500 full day - 400 - 800	January, February, December	<5	<5

	**dependent on number of guests **270-370 local rate			
17	half day - 550 full day - 1200	January	<5	
18	4 hrs (1/2 day) - 600 6-8 hrs (full day) - 1200	January, February, December	5-7	<5
19	2 hrs - 300 4 hrs - 650 6 hrs - 950 8 hrs - 1400	January, February, March, November, December, March is peak for kids	5-7	<5
20				
21	600 (foreigners rate) 550 (local rate)	January, February, March, April, December	5-7	<5
22	2 hrs - 300 4 hrs - 600 6-8 hrs - 1200	January, February, March, April, May, November, December	5-7	<5
23	half day - 600 full day - 1200	January, February, March, April, December, last 2 weeks of December is the peak	5-7	<5
24	4 hrs - 600 6-8 hrs - 1200	January, December	10-12	<5
25	4 hrs - 200 8 hrs - 400	December	5-7	<5
26	half day - 600 full day - 1000	January, February, March, April, November, December	<5	<5
27	half day - 500 full day - 800	January, February, December	<5	<5
28				
29	half day - 400 full day - 700	January, February, March, April,	<5	<5

		November, December		

Participant ID	13. What are the species of fish caught?	14. Which are the most abundant of the species caught?	15. Do you do any catch and release? If yes, what species?	16. What is the estimated percentage of customers who are local vs foreign?
1				
2				
3				
4	Barracuda, Sailfish, Dolphin, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, kingfish, spanish mackerel, sero mackerel	Barracuda, Blue Marlin, Wahoo	No	100 foreign
5	Dolphin, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, snapper, grouper	Yellowfin Tuna	Yes, sailfish, marlin	90% foreign
6				
7				
8	Barracuda, Dolphinfish, Cavalli, spanish mackerel, kingfish	Barracuda, Cavalli	No	80% Foreign : 20% Local
9	Barracuda, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, cavalli	Yellowfin Tuna, Skipjack Tuna	No	100%
10	Barracuda, Sailfish, Dolphin, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna,	Barracuda, Sailfish, Wahoo, Yellowfin Tuna	Yes, billfish	90% foreign and 10% local

	Skipjack Tuna, Rainbow Runners, snapper, grouper			
11	Barracuda, Sailfish, Dolphin, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners	Barracuda, Sailfish, Dolphin, Wahoo	Yes, All billfish	5% local, 95% foreign
12	Barracuda, Sailfish, Dolphin, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, kingfish, snapper, grouper, cavalli, amber jack	Barracuda, Sailfish, Dolphin, Blue Marlin, Wahoo, Yellowfin Tuna	Yes, billfish	95% foreign and 5% local
13	Barracuda, Sailfish, Dolphin, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, mackerel, red snapper, jacks, cavali, grouper	Barracuda, Sailfish, Dolphin, Wahoo, Yellowfin Tuna	Yes, Billfish	80% foreign and 20% local
14	Barracuda	Barracuda	Yes	10
15	Barracuda, Sailfish, Dolphinfish, Blue Marlin, Wahoo, Yellowfin Tuna, snapper, spanish mackerel, cavalli	Barracuda	Yes, billfish	95% foreign and 5% local
16	Barracuda, Dolphinfish, Blue Marlin, Wahoo,	horse-eye jack	No	55% local and 45% foreign

	Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, cavalli, horse-eye jack, snapper, grouper			
17			Yes, billfish	
18	Barracuda, Dolphin, Blue Marlin, Wahoo, Rainbow Runners, blackfin	Barracuda, Dolphin, Yellowfin Tuna	Yes, billfish	95% foreign
19	Barracuda, Sailfish, Dolphin, Blue Marlin, Wahoo, Skipjack Tuna, blackfin, spanish mackerel, bonito	Barracuda, Dolphin, Wahoo	Yes, billfish	100% foreign
20				
21	Barracuda, Sailfish, Dolphin, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners	Barracuda, Dolphin, Wahoo	Yes, Billfish	80% foreign
22	Barracuda, Dolphinfish, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, Bonito, spanish mackerel	Barracuda, Wahoo	Yes, billfish	95% foreign and 5% local
23	Barracuda, Dolphinfish, Wahoo, Skipjack Tuna, blackfin tuna. king fish, spanish mackerel	Dolphinfish, Wahoo	Yes, billfish and juvenile dolphinfish	95% foreign and 5% local

24	Barracuda, Dolphinfish, Wahoo, Yellowfin Tuna, Skipjack Tuna, kingfish, billfish	Barracuda, Wahoo	Yes, billfish	100% foreign
25	Barracuda, Dolphin, Blue Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna	Barracuda, Dolphin, Yellowfin Tuna	Yes, Flyfishing bonefish permit and tarpon	100% foreign
26	Barracuda, Sailfish, Dolphinfish, Blue Marlin, Yellowfin Tuna, Skipjack Tuna, cavalli	Barracuda	No	95% foreign and 5% local
27	Barracuda, Sailfish, Dolphinfish, Blue Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, Rainbow Runners, snapper, amber jack, grouper	Barracuda, Wahoo	Yes, billfish	70% foreign and 30% local
28				
29	Barracuda, Dolphinfish, Blue Marlin, White Marlin, Wahoo, Yellowfin Tuna, Skipjack Tuna, spanish mackerel, cavalli	Barracuda, Yellowfin Tuna, Skipjack Tuna, cavalli	No	100% foreign
Participant ID	**17. Where do you depart from?**	**18. What is the length of your whale watching tour? (You may select more than if you offer different packages)**	**19. What is the average distance (miles) you travel on a tour?**	**20. What is the average cost per tour? ($USD)**
1	Barrouallie	2-4 hrs	2	100

2	Portsmouth Beach Hotel Dock Longhouse Roseau Ferry Terminal	4-6 hrs, swim with the whales - 8 hrs	3 miles out and traverse 30-40 miles	100
3	Kingstown but can depart from Bequia or other Grenadines islands if required	2-4 hrs	7	1000 to charter boat; 120 per person for cruise ship passengers
4	Newtown Fishery Roseau Ferry Terminal	2-4 hrs, 3 hrs	1/2 - 10 miles	70
5	Fort Young Castle Comfort/ Dive Dominica Jetty Anchorage, Roseau	2-4 hrs, 2.5 - 3 hrs	5 - 8 miles	89
6	Roseau Ferry Terminal, Castle Comfort/Dive Dominica Jetty	2-4 hrs, 3.5hrs	1/4 - 15 miles	69
7	Villa Beach Kingstown Cruise Birth	2-4 hrs	15-20	60
8				
9				
10				
11				
12	Vigie Marina Castries Port	2-4 hrs, 3 - 3.5 hrs	3-5 miles	55
13	Ganters bay	2-4 hrs	2.5 - 3	60
14				
15	Soufriere Castries (for cruise ship passengers)	2-4 hrs	1 - 5	66 - adult, 44- children (local rates 30 and 15 for adult and children respectively)
16				
17	Vieux Fort Soufriere Castries	2-4 hrs		550
18				
19				
20	Barrouallie	2-4 hrs	12	40
21				

22				
23				
24				
25				
26				
27	Blue Lagoon Marina	4-6 hrs, usually whale watching is coupled with other activities such as snorkeling, beach visits and coastal tours	3	500 to charter boat (max of 8 guests)
28	Roseau Ferry Terminal, Roseau Woodbridge	2-4 hrs	3 - 12 miles	60 b
29	Villa Kingstown Cruise Birth Young Island Dock	4-6 hrs, whale watching is coupled with other activities such as snorkeling and beach tours	5 - 10 miles	400 to charter the boat; 50 person person (if over 8 persons)

Participant ID	**21. Please select your peak month(s) where you have the most customers.**	**22. What are your average number of tours per week for your (i) peak season (ii) low season [Peak season]**	**22. What are your average number of tours per week for your (i) peak season (ii) low season [Low season]**	**23. What is the average number of guests per tour during your peak and low season? [Peak season]**
1	January, February, March, April, May, June, July, August, October, November, provide tours to schools and partners/affiliates of the St. Vincent and the Grenadines Environmental Fund (SVGEF) year round	<5	<5	>10

2	January, February, March, April, December	5-7	<5	>10
3	January, February, March, April, November, December	5-7	<5	>10
4	January, February, March, April, November, December	5-7	<5	>10
5	January, February, March, November, December	5-7	<5	7-9
6	January, February, March, November, December	>12	7-9	>10
7	January, February, March, November, December	<5	<5	>10
8				
9				
10				
11				
12	January, February, March, April, November, December	>12	5-7	>10
13	January, February, March, November, December	<5	<5	>10
14				
15	January, December	<5	<5	7-9
16				
17				
18				
19				

20	January, February, March, April	<5	<5	5-7
21				
22				
23				
24				
25				
26				
27	March, April, August	<5	<5	3-5
28	January, February, March, November, December	7-9	<5	>10
29	January, February, March, April, November, December	<5	<5	7-9

Participant ID	**23. What is the average number of guests per tour during your peak and low season? [Low season]**	**24. What are the species of whales and dolphins seen?**	**25. What are the most common species of whales and dolphins seen?**	**26. What is the estimated percentage of customers who are local vs foreign**	**27. Please feel free to share any other comments or information about your whale watching and/or recreational/sport fishing activities that you deem relevant to this exercise.**
1	3-5	Sperm whale, Short-fin pilot whale, Killer whale, Humpback whale, Bottle-nose dolphin,	Short-fin pilot whale, Bottle-nose dolphin	85% foreign and 15% local	

		risco/grampus dolphin			
2	5-7	Sperm whale, Short-fin pilot whale, Pygmy killer whale, Cuvier beaked whale, Humpback whale, Dwarf sperm whale, Fraser's dolphin, Bottle-nose dolphin, Rough tooth dolphin	Sperm whale, Pan tropical spotted dolphin	90% foreign	Runs a 5 days ocean programme which includes watching and swimming with whales.
3	>10	Sperm whale, Short-fin pilot whale, Humpback whale, Pan tropical spotted dolphin, Bottle-nose dolphin	Sperm whale, Short-fin pilot whale, Pan tropical spotted dolphin, Bottle-nose dolphin	100% foreign	
4	5-7	Sperm whale, Short-fin pilot whale, Killer whale, False killer whale, Pygmy killer whale, Humpback whale, Dwarf sperm whale, Pygmy sperm whale, Pan tropical spotted dolphin, Fraser's dolphin,	Sperm whale, Short-fin pilot whale, Pan tropical spotted dolphin, Bottle-nose dolphin	100 foreign	

		Bottle-nose dolphin, Rough tooth dolphin, Long-snouted spinner dolphin			
5	3-5	Sperm whale, Humpback whale, Bottle-nose dolphin, Long-snouted spinner dolphin	Sperm whale, Bottle-nose dolphin, Long-snouted spinner dolphin	90% foreign	
6	>10	Sperm whale, Short-fin pilot whale, Killer whale, False killer whale, Melon-headed whale, Pygmy killer whale, Cuvier beaked whale, Humpback whale, Bryde's whale, Dwarf sperm whale, Pygmy sperm whale, Pan tropical spotted dolphin, Fraser's dolphin, Bottle-nose dolphin, Rough tooth dolphin, Long-snouted	Sperm whale, Short-fin pilot whale, Pan tropical spotted dolphin, Fraser's dolphin, Bottle-nose dolphin	90% foreign	During peak season, 3 vessels are in operation. At full capacity (cruise ship season particularly the months Nov-Feb), each tour can be as much as 270 guests. Tours are run on Sundays specifically for locals.

		spinner dolphin			
7	7-9	Sperm whale, Short-fin pilot whale, Humpback whale, Bottle-nose dolphin, spinners	Short-fin pilot whale, Bottle-nose dolphin	95% foreign and 5% local	
8					
9					
10					guest preference is the major influence as to where I would go for fishing. Eg. Tours with young passengers will be focused closer to shore within the inner bay, whereas more experienced passengers would prefer longer tours further out at sea. Bottom fishing for snapper and grouper will normally take place around rein deer shallows which would range from 40 to 100/150ft in depth. 5 miles off rein

					deer shallows one can find an under water mountain where most of trolling would take place for yellow fin tuna.
11					- Usually fish in areas with a depth of between 1000-2000m but can travel to areas with 8000m depths. - The western side of the island with its calmer water is best for fishing particularly when winds are coming in from the East. Worst conditions are usually when winds are coming in from the North. Very rarely do wind come from South (would not go out in these cases)
12	>10	Sperm whale, Short-fin pilot whale, Melon-headed whale, Humpback	Sperm whale, Short-fin pilot whale, Pan tropical spotted dolphin, Fraser's	90% foreign and 10% local	

		whale, Pan tropical spotted dolphin, Fraser's dolphin, Bottle-nose dolphin, milke, grampus, spinner dolphin	dolphin, Bottle-nose dolphin		
13	>10	Sperm whale, Short-fin pilot whale, Killer whale, False killer whale, Humpback whale, Pan tropical spotted dolphin, Fraser's dolphin, Bottle-nose dolphin, spinners, grampus	Sperm whale, Short-fin pilot whale, Pan tropical spotted dolphin, Bottle-nose dolphin	80% foreign and 20% local	
14					
15	3-5	Sperm whale, Short-fin pilot whale, Humpback whale, Pan tropical spotted dolphin, Fraser's dolphin, Bottle-nose dolphin, spinner dolphin	Short-fin pilot whale, Pan tropical spotted dolphin, Bottle-nose dolphin	65% foreign and 35% local	
16					
17					UB Tours is a new provider operating for 2 months
18					

19					
20	<3	Sperm whale, Short-fin pilot whale, Humpback whale, Bottle-nose dolphin	Short-fin pilot whale, Bottle-nose dolphin	80% local and 20% foreign	
21					
22					
23					
24					
25					Wish people could fish a little more sustainable and stop the swine nets on beaches which are completely ruined the country...if you remove the bait you kill the rest of the food chain
26					
27	<3	Sperm whale, Short-fin pilot whale, Killer whale, False killer whale, Humpback whale, Pan tropical spotted dolphin, spinner dolphin	Short-fin pilot whale, Pan tropical spotted dolphin, spinner dolphin	100% foreign	
28	>10	Sperm whale, Short-fin pilot whale, Humpback whale, Bottle-nose dolphin,	Sperm whale, Bottle-nose dolphin	98% foreign	

		Rough tooth dolphin			
29	3-5	Sperm whale, Short-fin pilot whale, Killer whale, False killer whale, Humpback whale, Dwarf sperm whale, Pygmy sperm whale, Pan tropical spotted dolphin, Fraser's dolphin, Rough tooth dolphin, spinner dolphin	Short-fin pilot whale, Pan tropical spotted dolphin, Fraser's dolphin, spinner dolphin	90% foreign and 10% local	

Appendix B. Artificial Intelligence and Machine Learning Technical Overview

Image Classification

For the image classification component of this research we used Lobe, a free, desktop application that can be used to classify and train image recognition models. Lobe allows users to rapidly train and deploy these models, and use a set of customized tools to export model outputs as either photos or tabular data for further analysis and validation.

Image Sources

Flickr

The image sharing platform, Flickr, provides an API that can be used to query image metadata for publicly shared images. This metadata includes many attributes including the images publicly available URL (used to view and analyze images), coordinates, title, tags (text keywords assigned by the photo's owner), the image date, among many others.

TripAdvisor

TripAdvisor provided a table that included records with URLs for 212,709 images. Some of these images were no longer available, and some were too large to send to the Cognitive Services API, so they were removed from the pool. 190,509 images fit the criteria for analysis.

Methods

Downloading Flickr Images

We used the flickrapi Python library (https://pypi.org/project/flickrapi, version 2.4.0) to query the Flickr API to identify all images in the Eastern Caribbean from 2005 through August 2019. Any of the fields in the Flickr data schema can be queried, which allowed us to easily construct spatiotemporal queries. We noticed some inconsistencies when querying large numbers of images at once (for example the entire island of Saint Lucia), so to ensure a complete dataset was returned, we used ¼ degree bounding box spatial queries combined with monthly date range temporal queries (looping through each ¼ degree cell for each month) and then compiled the results into a table. The bounding boxes were limited to covering an area of 30 meters from coral reefs for the area of interest (Figure 1). This data was saved into a CSV table, yielding a total of 174,288 images. Of these, 40,568 were

within the Exclusive Economic Zone (EEZ) of the five countries studied for this project.

Developing Training Data

To support this project, Microsoft built a custom set of tools that allowed us to quickly import photos from the Flickr API using either a geographic bounding box or a set of keywords (Figure B1). We used keywords such as "whale" "dolphin" and "whale watch" and used bounding geographies for tropical, non-CROP countries to obtain photos that had a similar visual signature to those we were trying to find in the subset of Flickr photos that we had previously obtained for the CROP countries (see below). We also used Google Image Search to supplement our training data using the same set of keywords. These images were loaded into Lobe where they were manually labelled as "Whale" if there was a whale or dolphin clearly visible in the photograph.

Some of the images that came up in the image search did not contain a whale or dolphin, but were often photos of boats, people on boats, photos of the water, or other marine life. These were also used as negative classification images and helped to refine the accuracy of the model (Figure B1).

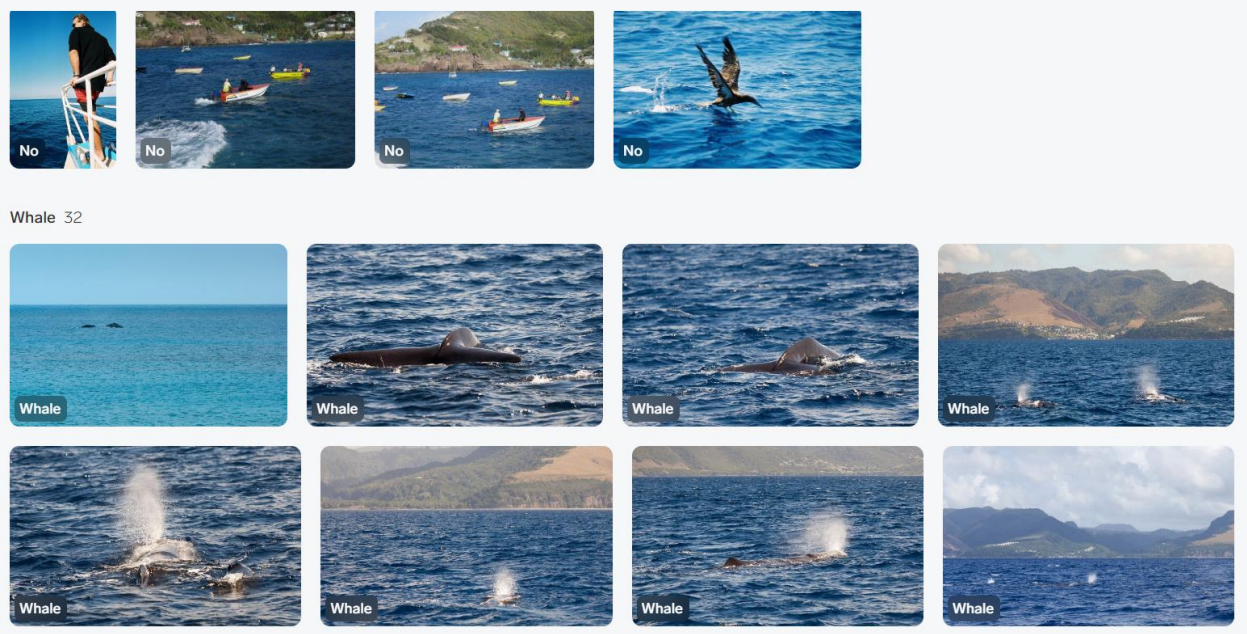

Figure B1. Examples of negative and positive classification images used to train the model in the Lobe interface.

Once sufficient images were obtained for both positive and negative training categories (~300 images in each category), the model was exported, and run on

the csv of Flickr images obtained for the CROP countries. Lobe works iteratively, in that it will classify input images as being either positive or negative (i.e. containing whales or not), and users can correct the classifications manually, thereby increasing the accuracy of the model. Lobe gives an estimate of overall model quality based on this input. We ran several iterations of the model on subsets of Flickr data in an attempt to improve overall model quality. However, even when the tool was reporting >95% of images predicted correctly, upon visual inspection of the results, we found a number of false positives which we removed manually, resulting in a total of 62 images.

Despite the low number of positive photographs, we believe that accessible desktop tools like Lobe show promise in quickly sorting through large volumes of photographic data. We believe that the highly specific, but also somewhat variable nature of types of photographs used as positive images in the classifier made using AI tools for this purpose somewhat challenging, especially as there were not many images that met the criteria in the target dataset. However, this tool did provide us with an advantage because, even though it returned false positives, it significantly narrowed down the number of photos that we needed visually inspect. Visually inspecting the complete dataset would have been so time consuming as to be prohibitive for the scope of this project.

Text Classification

The team defined and developed criteria for nine different categories related to nature-dependent tourism by which to classify TripAdvisor attraction reviews. For the purpose of the models described in this report, the categories and criteria were as follows, although we used this tool to identify other categories of tourism not described in this report.

When looking to classify attraction reviews as positive for the whale and dolphin category, we looked for any indication that the reviewer was enjoying a vessel-based tour and was seeing whales and/or dolphins either as the main focus of the tour, or even opportunistically (i.e. on a general sightseeing or snorkelling/diving tour). These reviews were inclusive of situations where a reviewer went on a whale/dolphin tour but did not end up seeing any animals. Similarly, for birding, we looked for any indication that the reviewer was noticing birds in the wild.

We used the free, web-based tool LightTag to classify reviews that met the criteria described above, as well 7 other aspects of nature-dependent tourism, to be used in other models. The team would read reviews one at a time, and select from a drop-down menu any of the activities that the review described (Figure B2).

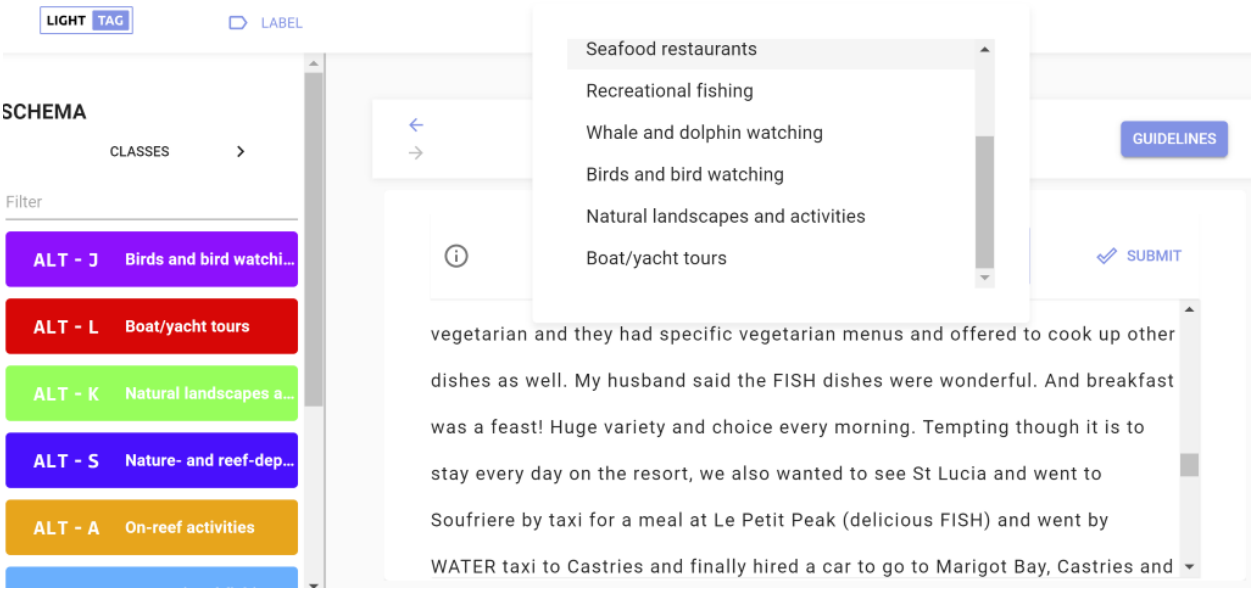

Figure B2. *Screen shot of LightTag API interface*

Based on the training data, the remainder of the reviews fed into a random forest machine learning algorithm, which analyzes patterns of language to identify reviews with a high likelihood of meeting each category's criteria. The algorithm also calculates a score for model quality according to several metrics:

- **Precision**: of the reviews that the model predicted are positive for the category, what proportion actually are positive (low scores mean lots of false positives)
- **Recall**: of the reviews that actually are positive for the category, what proportion did the model correctly predict (low scores mean lots of false negatives)
- **F1 score**: The harmonic mean of precision and recall = 2*(precision * recall)/(precision + recall) -- (essentially, in order to have high F1, you not both high precision and recall – having either one of those be poor will push the F1 score toward 0, because of the multiplication of the two proportions in the numerator)

As seen in Table B1, whale and dolphin watching had very high recall and moderately high precision, making it a good contender for inclusion in the models.

Table B1. Descriptive statistics for text analysis models

	f1-score_rf	precision_rf	recall_rf	s
On-reef activities	0.932692	0.910798	0.955665	
Seafood restaurants	0.833333	0.863636	0.805085	
Nature- and reef-dependent beaches	0.455446	0.638889	0.353846	
Reef-adjacent activities	0.893617	0.933333	0.857143	
Whale and dolphin watching	0.891304	0.836735	0.953488	
Birds and bird watching	0.852459	0.812500	0.896552	
Boat/yacht tours	0.697917	0.807229	0.614679	
Natural landscapes and activities	0.824281	0.796296	0.854305	
Recreational fishing	0.727273	0.909091	0.606061	

Appendix C. Detailed data source and processing notes

Birdwatching

Birder Footfall and Species Importance

These two models were generated from eBird data. To clean this dataset, points were removed that had non-specific locality names (e.g. 'Dominica', 'Saint Lucia') if these points fell near the centroid of the island or constituted a large number of overlapping points in one location. A grid of 500x500m cells was generated spanning the entire region, from Saint Kitts and Nevis to Grenada, using the 'Create Fishnet' tool. Cell IDs were then assigned to the original eBird points via a spatial join. Observer Observation Day (OOD) points were derived by applying the 'Dissolve' tool to the eBird points layer using observers (field: 'recordedBy'), dates (field: 'DateClean'), and grid cell IDs (field: 'CELL_ID') as Dissolve Fields (no specified Statistics Fields). The sum of OODs per cell was calculated using a spatial join from the grid cell layer to the OOD points, where the count was the total number of OODs.

For the species importance layer, species-specific data from BirdsCaribbean's Birds of the West Indies Checklist (common name, endemic region, abundance, and IUCN status) were linked to the original eBird data by the scientific species name field using a 'table join'. "Charismatic species" boolean scores were assigned using 'Select by Attribute' and 'Field Calculator'. 'Field Calculator' was used again to sum these boolean scores. Species Observer Observation Day (SOOD) points were derived by applying the 'Dissolve' tool to the eBird points layer using species (field: 'species'), observers (field: 'recordedBy'), dates (field: 'DateClean'), and grid cell IDs (field: 'CELL_ID') as Dissolve Fields with the Statistics Field of 'Score' set to 'MAX' Statistic Type. The sum of the scores of the SOODs per cell was calculated using a spatial join from the grid cell layer to the SOOD points with the attributes summarized by 'Sum'. The sum of the 'score' field ('score_SUM') gives the total species importance score of each grid cell (i.e. the total of number of SOODs per cell multiplied by the score of each SOOD).

Areas of Conservation Importance

Summary statistics were generated within each IBA and PA by applying a spatial join from the IBA and PA layers to the dissolved eBird data (OOD and SOOD layers) with the 'OOD' and 'SOOD' fields summarized by 'sum'. This gives total number of OODs and SOODs per PA/IBA. Then, an 'Intersect' was run between the PA/IBA layers and the original eBird data points. A 'Dissolve' was applied on the intersected file with species ('species') and the area name ('AREANAME' for PAs, 'NatName' for IBAs) as 'Dissolve Fields' and the charismatic species boolean field ('TouristSpecies') as the 'Statistics Field' with 'Statistic Type' set to 'MAX'. Finally,

applying 'Summarize' to the PA/IBA area name field was used to give the number of species and charismatic species per PA/IBA, with the charismatic species field ('MAX_TouristSpecies') summarized by 'Sum' ('COUNT' is the number of species, 'MAX_TouristSpecies_SUM' is the number of charismatic species). The resulting tables were linked back to the original PA/IBA files by the area name field using 'join table'.

Birding hotspots

Some birdwatching areas were compiled from workshops and consultations with stakeholders and partners in the region either verbally or via written notes. These areas were manually digitized using Google Maps and Open Street Map as references. Point data provided by Caribbean Birding Trail was incorporated into this layer. Natural areas were extracted from TripAdvisor data for inclusion in this layer, using keywords for inclusion ('bay', 'beach', 'boat', 'botanical', 'cays', 'cliffs', 'falls', 'ferry', 'forest', 'garden', 'gorge', 'island', 'jungle', 'lagoon', 'mangroves', 'MPA', 'mudflat', 'nature', 'NP', 'N.P.', 'park', 'pasture', 'pitons', 'pond', 'preserve', 'protected', 'rainforest', 'reserve', 'river', 'rock', 'sail', 'sanctuary', 'sea', 'seashore', 'springs', 'trail', 'volcano', 'waterfall') and keywords for exclusion ('airport', 'bar', 'campus', 'club', 'estate', 'golf', 'guest house', 'guesthouse', 'inn', 'highway', 'hotel', 'Hyatt', 'lodge', 'manor', 'port', 'resort', 'restaurant', 'shop', 'tour', 'villa') to eliminate locations such as 'xx Beach Hotel' from inclusion in the natural area layer. The keywords were applied using 'Select Layer by Attribute' and 'Field Calculator' to assign boolean scores based on keyword searches (expression in ArcGIS Pro: Where PRIMARYNAM contains the text 'garden'). Points were also considered natural if they were found within protected areas or offshore. This was similarly done using 'Select by Location' and 'Field Calculator', using The Nature Conservancy in the Caribbean's regional protected areas layer and 4m-resolution shoreline file.

Whale and dolphin watching

Two types of data were compiled: (1) onshore operators and (2) offshore locations of tours. Since the intent of this model is to show highlight the habitats that support whale and dolphin watching, the model only has an offshore footprint. Onshore operators were compiled from TripAdvisor data, as previously described. Offshore data included participatory mapping points, Flickr PUDs, and iNaturalist citizen science and Diveboard trip log points accessed through the Global Biodiversity Information Facility (GBIF).

Participatory mapping points were converted to lines where applicable through manual digitization, buffering of the coastline, or extraction of bathymetric contours:

- If a participant's note for a point described that the tour takes place along the 3000m bathymetric contour, that contour was included in the offshore data layer. The bathymetric contours were derived as needed from a TNC layer of bathymetric sounding points that was previously digitized by TNC

from British Admiralty nautical charts (see Output 6 Recreational Fishing Report for details).

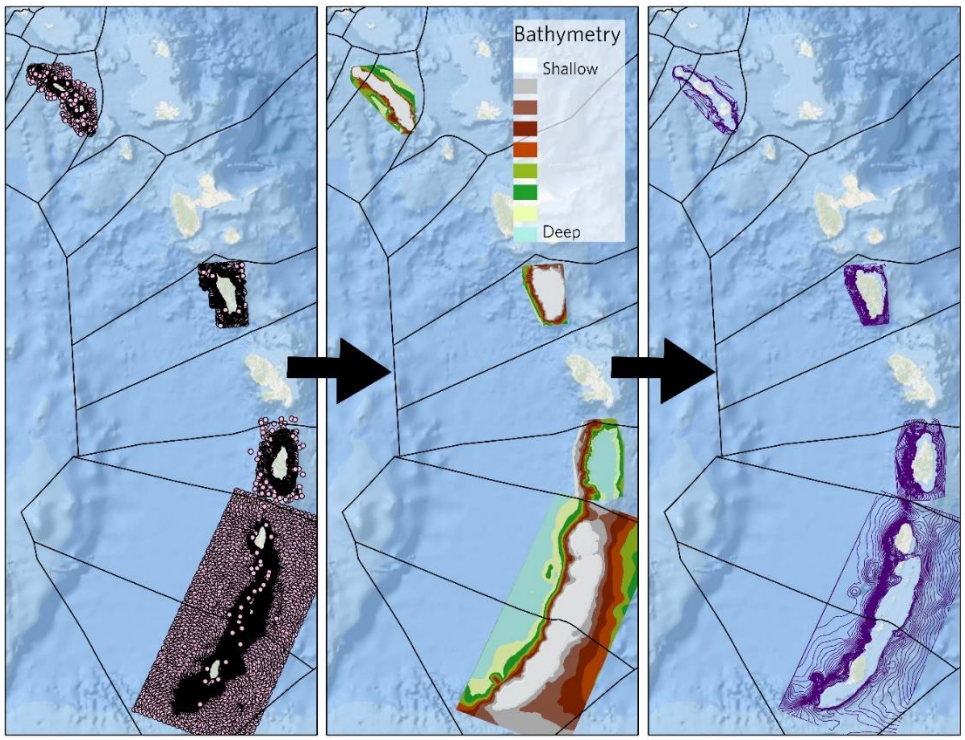

Figure C1. *Derivation of bathymetric contours from sounding points.*

- If a participant's note for a point described that the tour takes place along the west coast around 3 miles from shore, the shoreline was buffered 3 miles to generate that pathline. A 4m-resolution Caribbean shoreline file was used, previously derived by TNC from PlanetScope Dove satellite imagery.
- If a participant placed two points on the map as a start and end point of a tour, a line was manually digitized between those points, following the coastline as a guide.

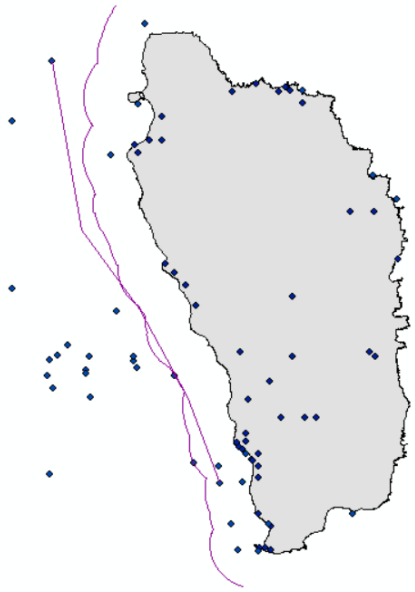

Figure C2. *All offshore and onshore input data for the model in Dominica (participatory mapping, TripAdvisor, Flickr, iNaturalist & Diveboard via GBIF).*

All offshore data points and lines were buffered by 5km.

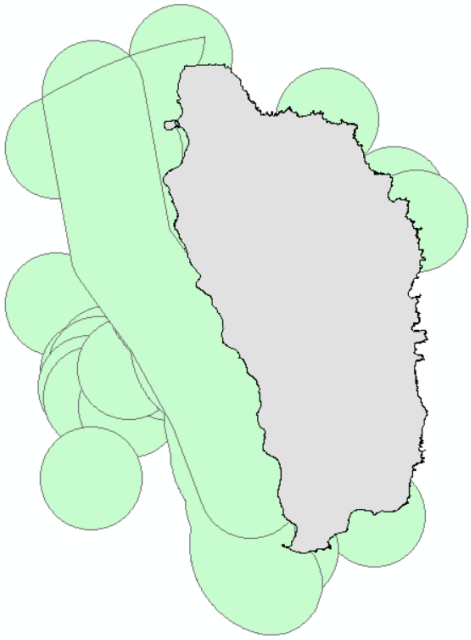

Figure C3. *All offshore data buffered by 5km in Dominica.*

All of these areas were given an equal weight of 1. They were combined into one layer using the 'Merge' tool. Weights were assigned by counting overlaps using the 'Count Overlapping Features' tool in ArcGIS Pro.

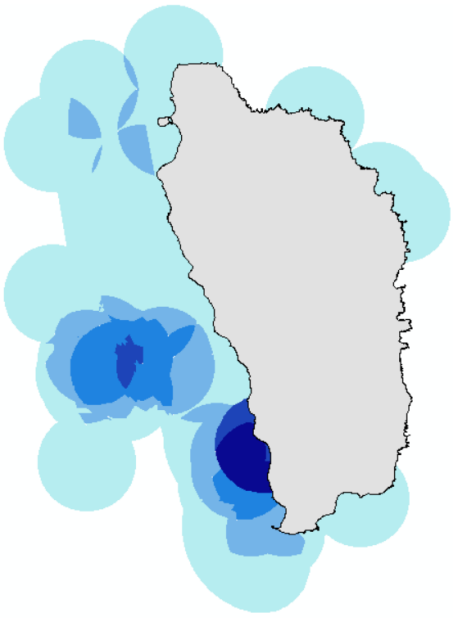

Figure C4. *All offshore data buffers with overlapping features counted in Dominica (light blue: fewer overlaps, dark blue: up to 20 overlaps).*

A 'Dissolve' was applied to the merged file of 5km buffers to create an offshore footprint layer where the weight of the onshore data points could be spread.

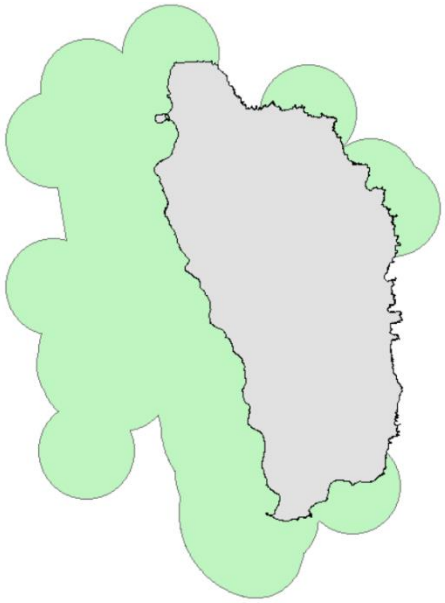

Figure C5. *Offshore footprint in Dominica.*

The onshore operator points were given a score between 1-4 based on the number of reviews. The seven operators with no TA data were given a score of 2. These weights were spread to the offshore footprint using 20km and 40km buffers. This

was done using a ModelBuilder model that buffered each onshore operator point individually at 20km and 40km, then erased the 20km buffer from the 40km, creating donut hole 40km buffers so that the buffers of each individual point did not overlap.

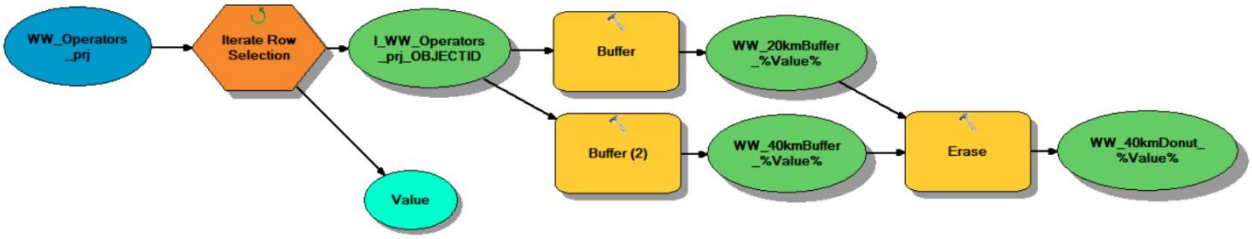

Figure C6. *ModelBuilder model for buffering onshore operator points.*

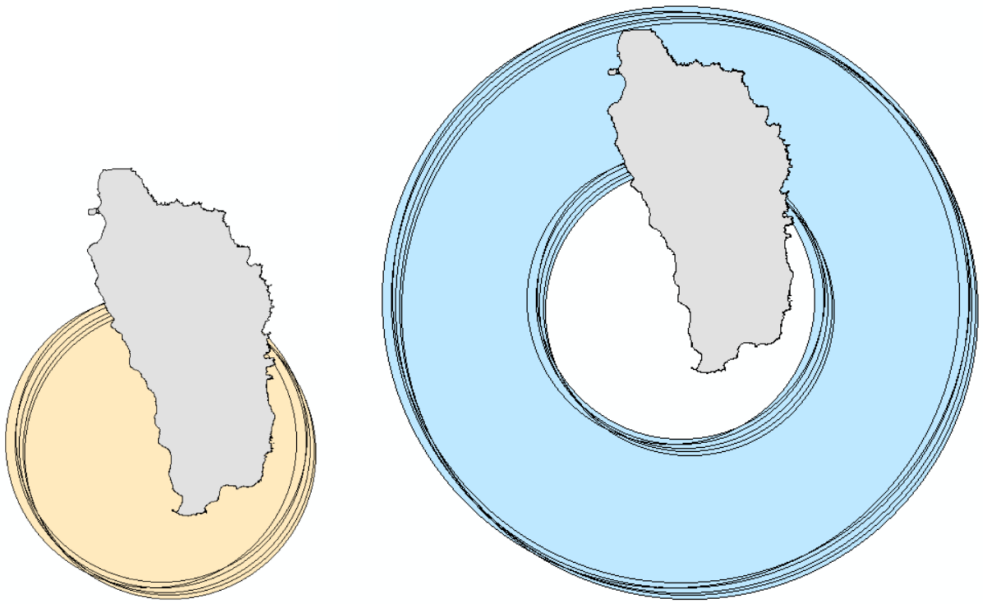

Figure C7. *Donut hole buffers spreading the weights from the onshore operators to the offshore whale and dolphin watching areas in Dominica. Orange buffers are 0-20km around each operator and blue 20-40km.*

Scores from the operators were split between the 20km and 40km buffers: 20km buffers received the full weight; 40km buffers received half of the weight. This is because we expect that half day tours, closer to shore, are much more common than full day tours that venture farther offshore. Weights were assigned using 'Field Calculator'.

A 'Merge' was used to combine all of the buffers shown in Figure C7, and then 'Clip' was used to clip those buffers to the offshore footprint. Overlaps between individual buffers and data layers were summed so that if two layers with a score of 2 and 3 overlapped, the overlapping section would be given a score of 5. This was done by

applying a ‘Union’, creating a unique ID for each location using the X and Y centroid values (‘Calculate Geometry’) concatenated (‘Field Calculator’), and applying a ‘Dissolve’ by XY ID field while summing the score field.

Figure C8. *Offshore footprint weighted by onshore operator reviews by distance from shore (buffers) in Dominica.*

The two resulting maps (Figures C4 and C8), developed from offshore data and onshore data respectively, were then combined into one layer of offshore use intensity. This was done by converted both layers to raster datasets (‘feature to raster’) with cell sizes of 50x50m. A constant raster of zero value was created around all 5 countries using ‘Create Constant Raster’. The four raster layers were summed using ‘Cell Statistics’.

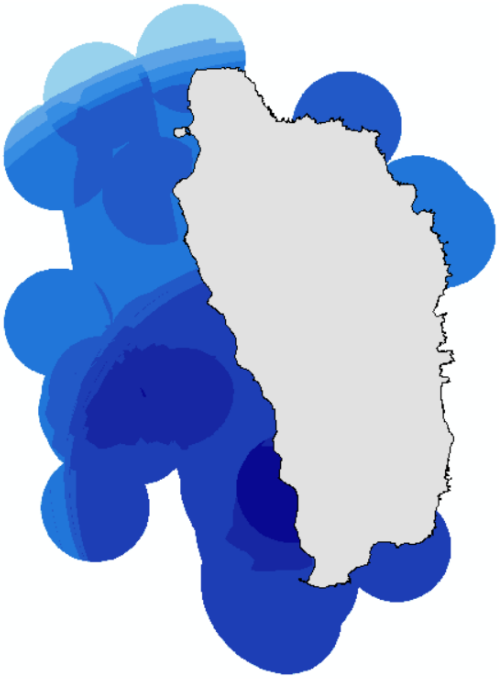

Figure C9. *Whale and dolphin watching intensity raster layer in Dominica.*

In order to smooth the dataset, the focal statistics tool was run on it for a circular neighborhood with a radius of 50 cells (2.5km) using mean statistics. The final raster was then clipped so that it was only offshore (not on land) using TNC's shoreline vector file as well as only within the exclusive economic zone (EEZ) boundary (vector data: Flanders 2021) for each country using 'Clip Raster'.

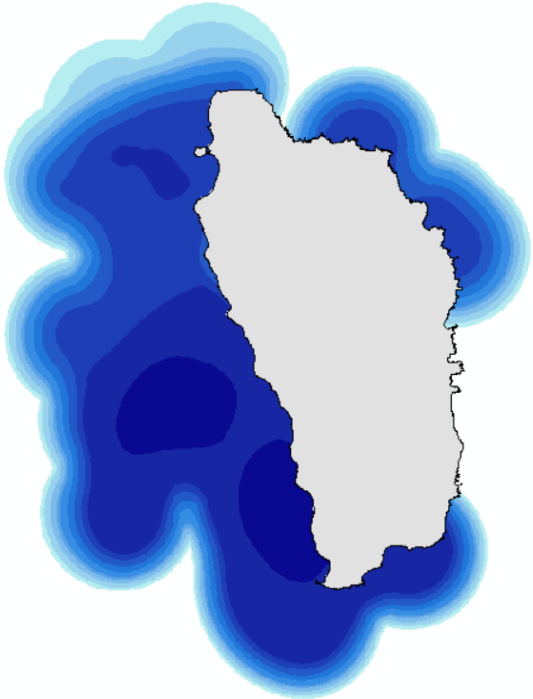

Figure C10. *Whale and dolphin watching intensity final layer in Dominica.*

The final raster was clipped to the footprint of the original output vector data and the exclusive economic zone (EEZ) boundary for each country.

Appendix D Maps by country

Figures D1 – D20 depict total birder footfall intensity, species importance, areas of conservation importance, and birding hotspots in each of the 5 OECS countries. Values are mapped at a 500m resolution.

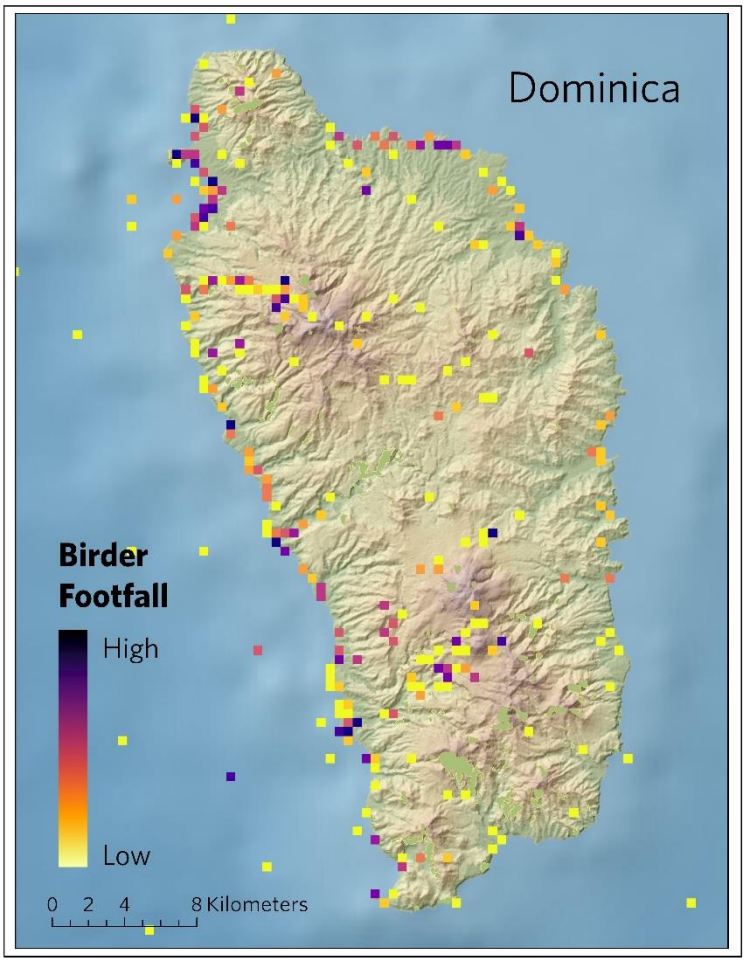

***Figure D1**. Birder Footfall – Dominica*

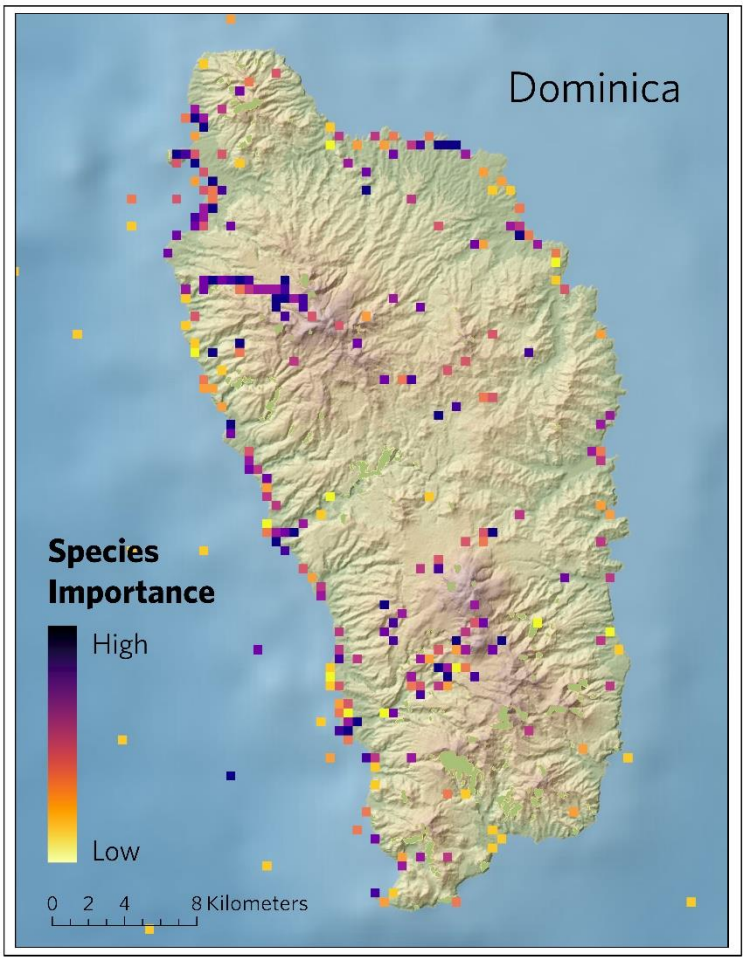

***Figure D2**. Species Importance – Dominica*

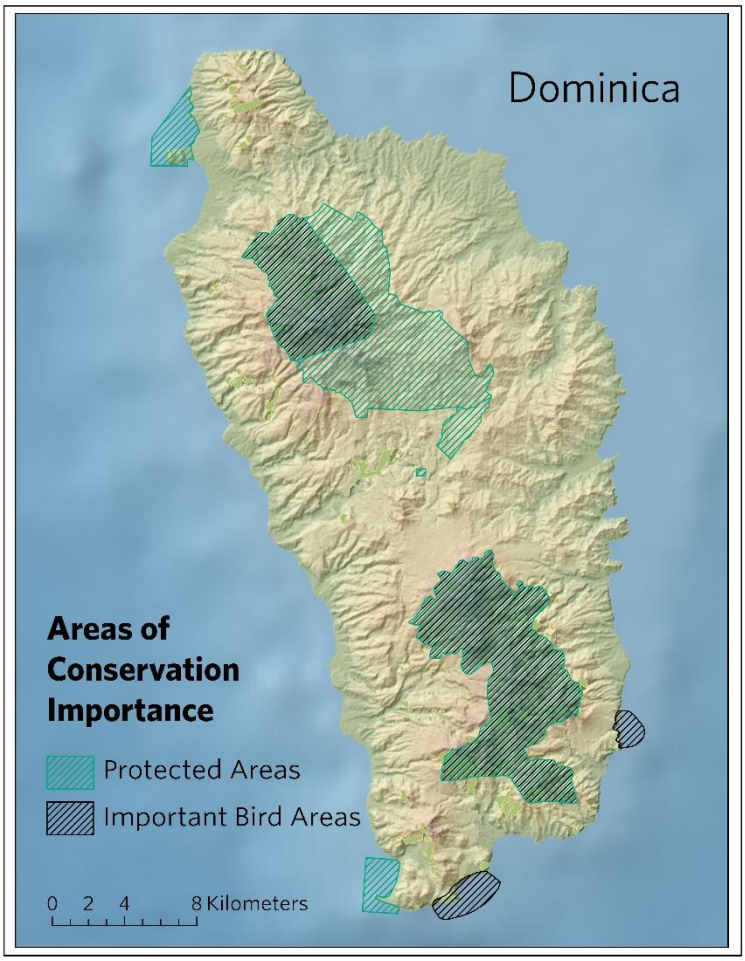

***Figure D3**. Areas of conservation importance – Dominica*

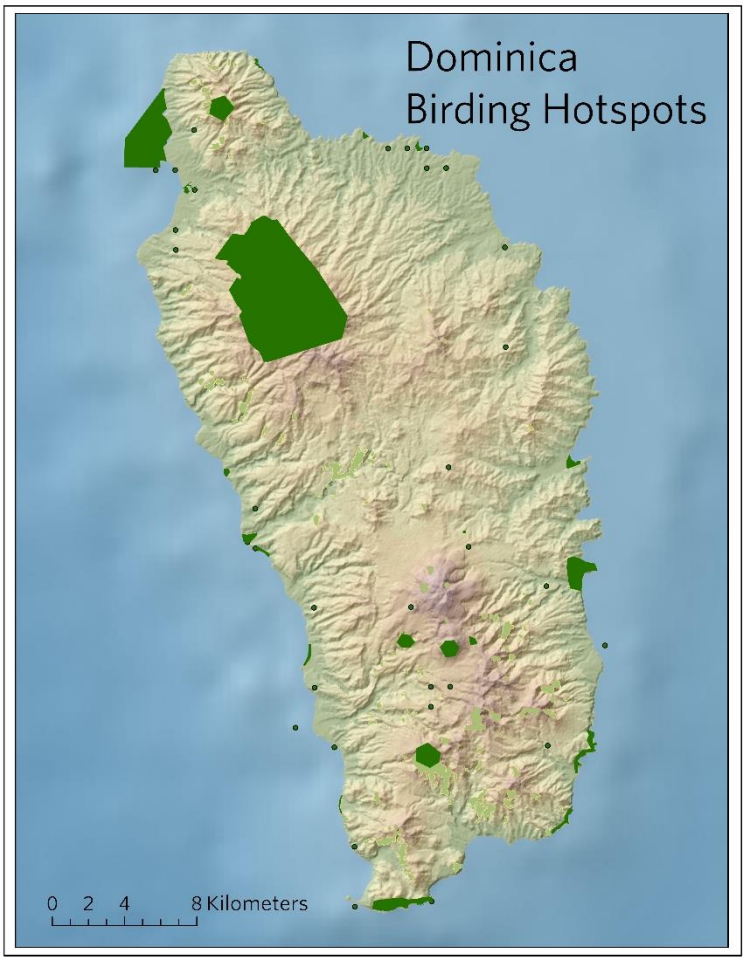

***Figure D4**. Birding hotspots – Dominica*

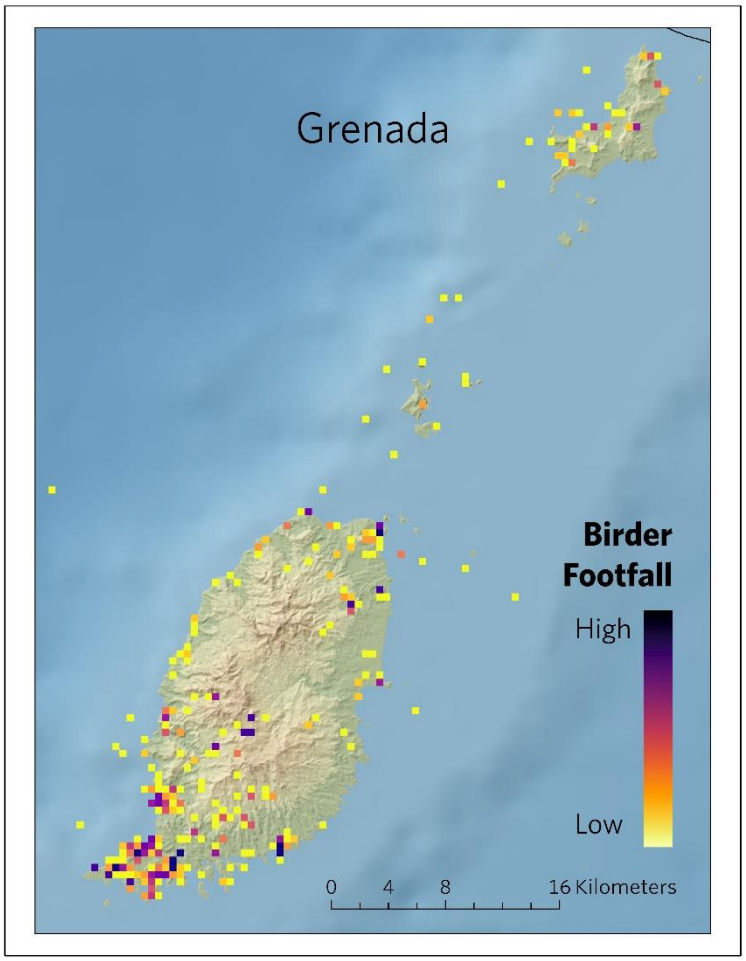

***Figure D5**. Birder Footfall – Grenada*

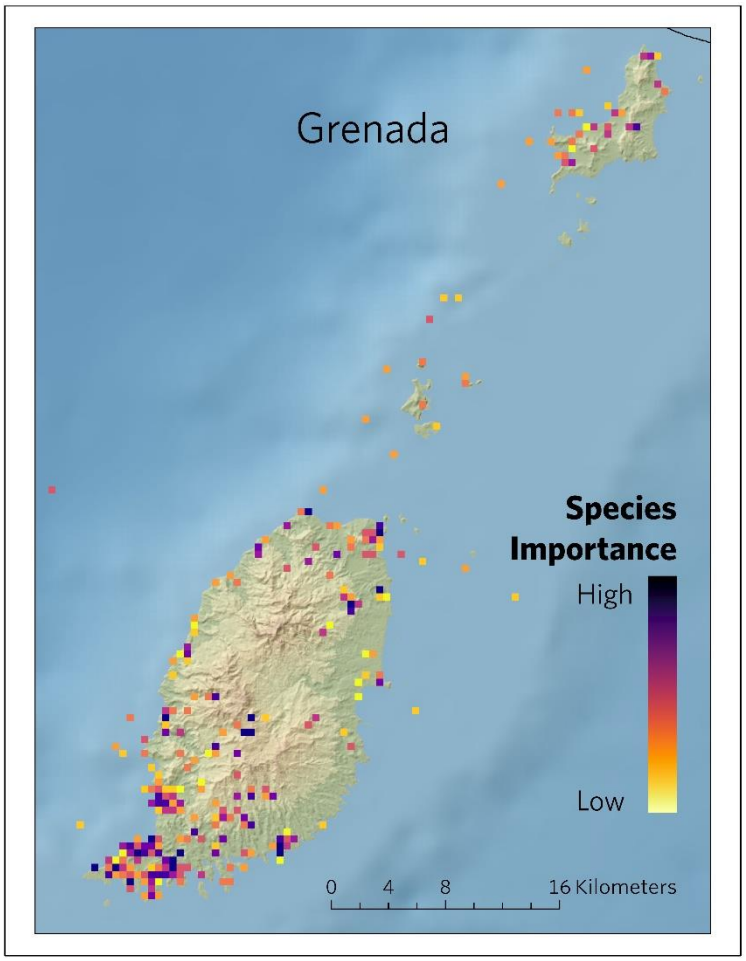

***Figure D6**. Species Importance – Grenada*

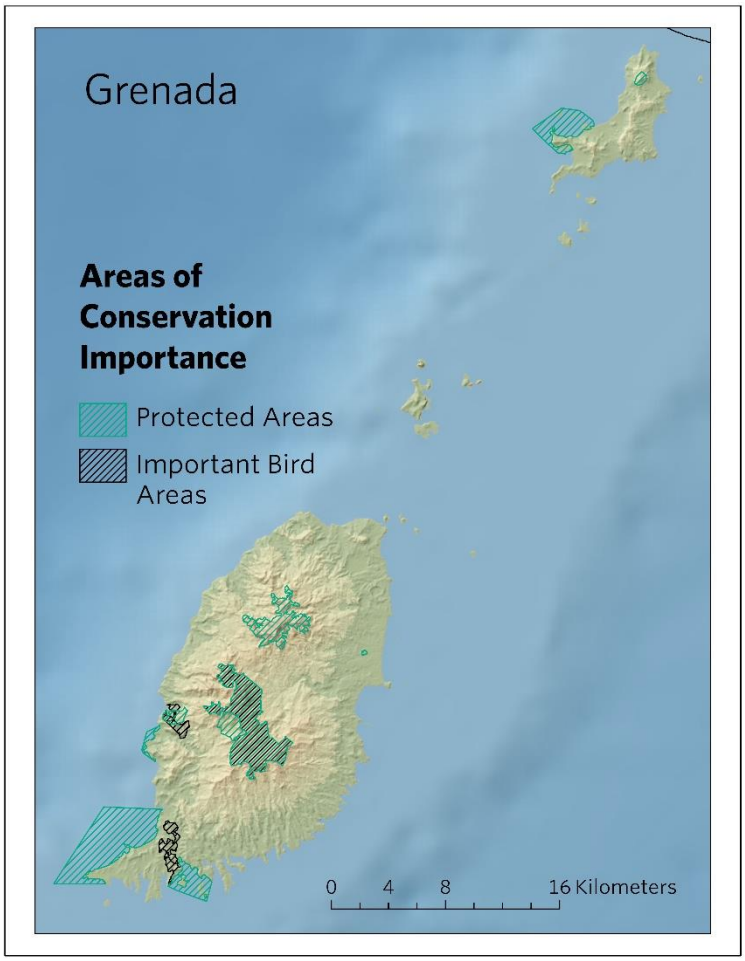

***Figure D7**. Areas of conservation importance – Grenada*

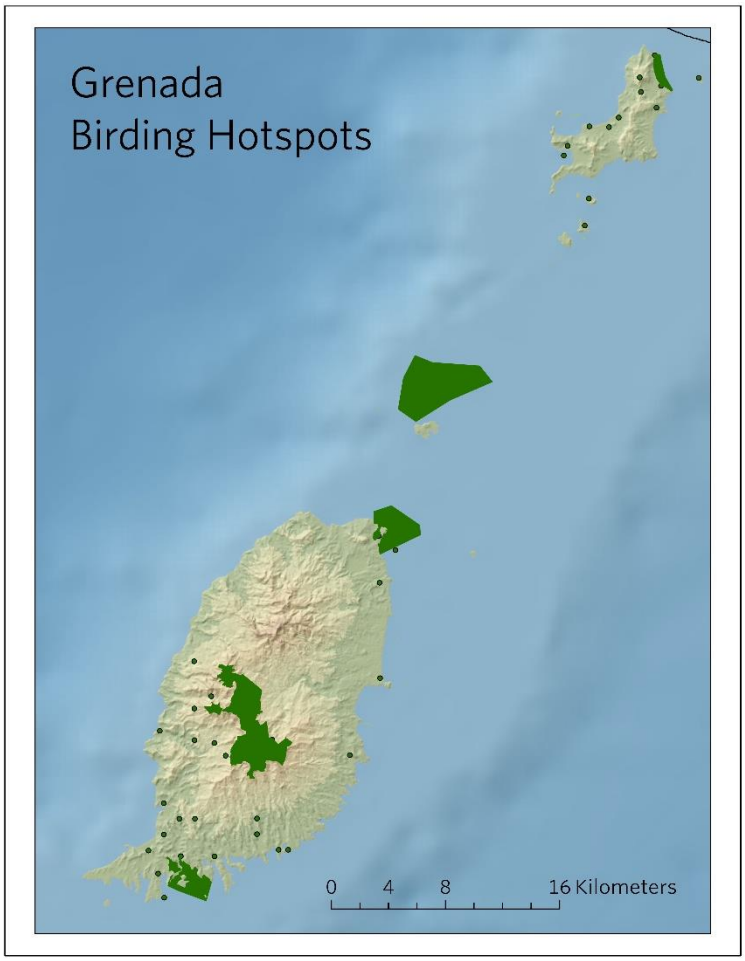

***Figure D8**. Birding hotspots – Grenada*

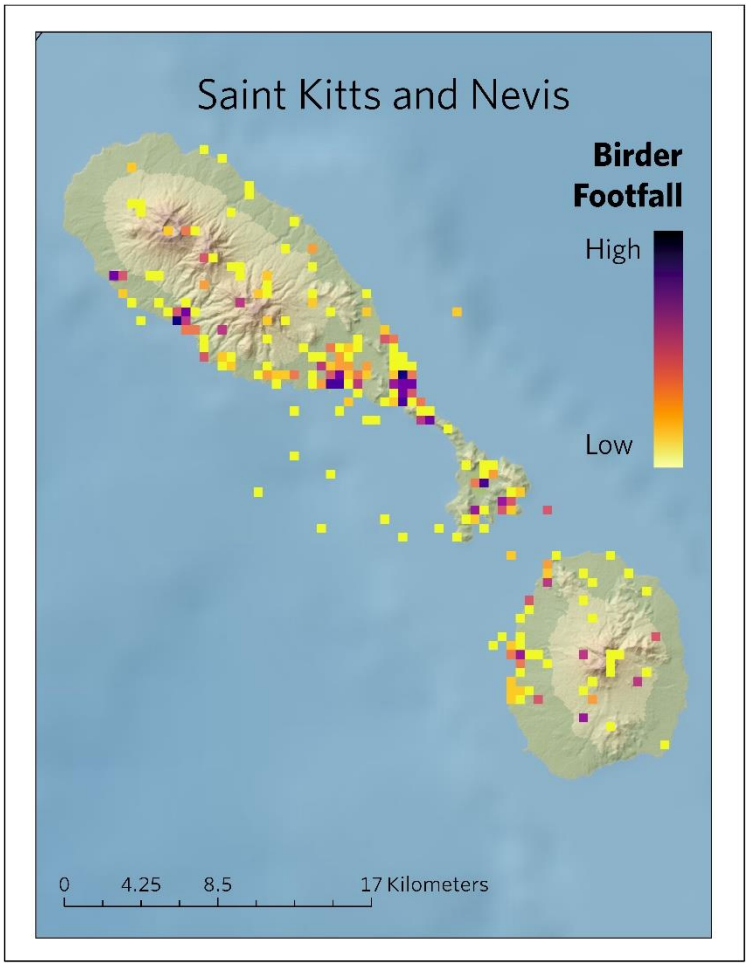

***Figure D9**. Birder Footfall – Saint Kitts and Nevis*

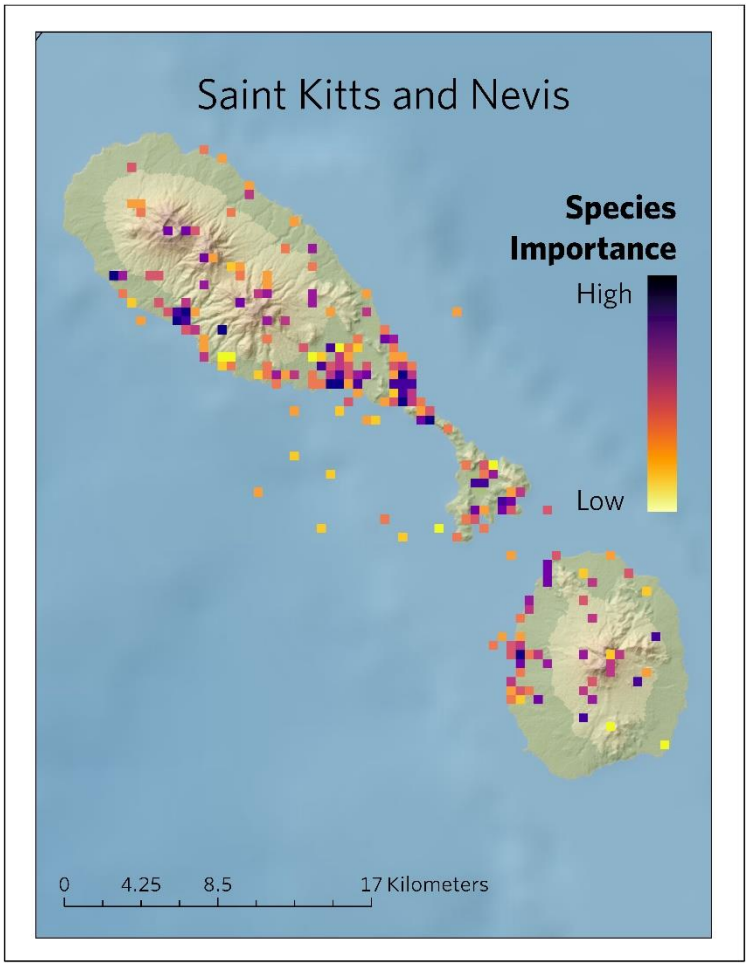

***Figure D10**. Species Importance – Saint Kitts and Nevis*

***Figure D11**. Areas of conservation importance – Saint Kitts and Nevis*

***Figure D12**. Birding hotspots – Saint Kitts and Nevis*

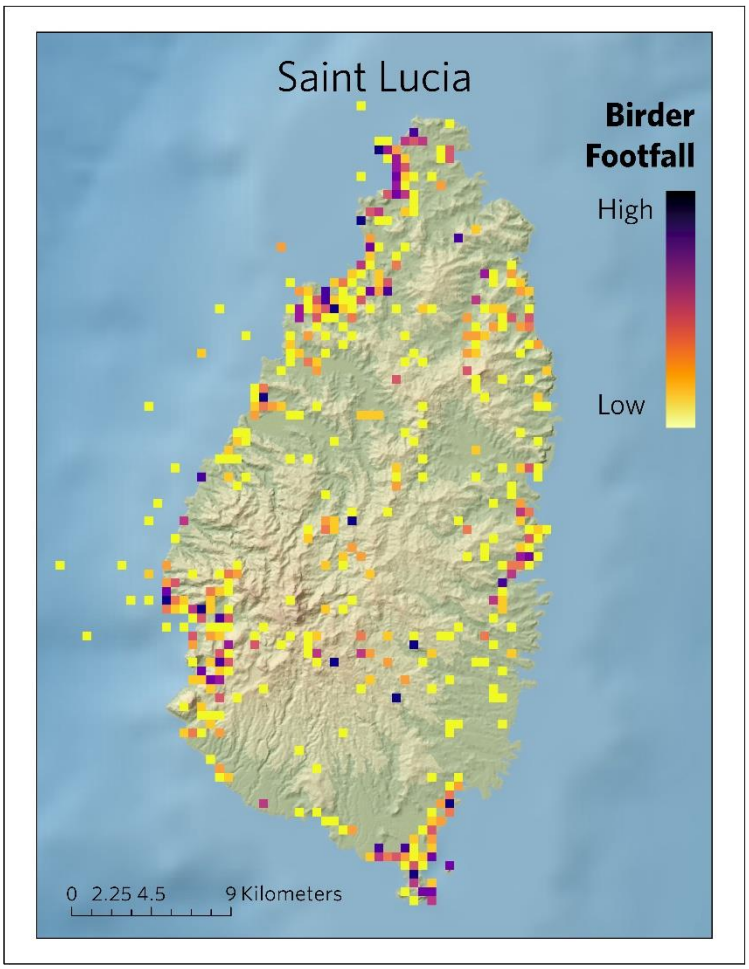

***Figure D13**. Birder Footfall – Saint Lucia*

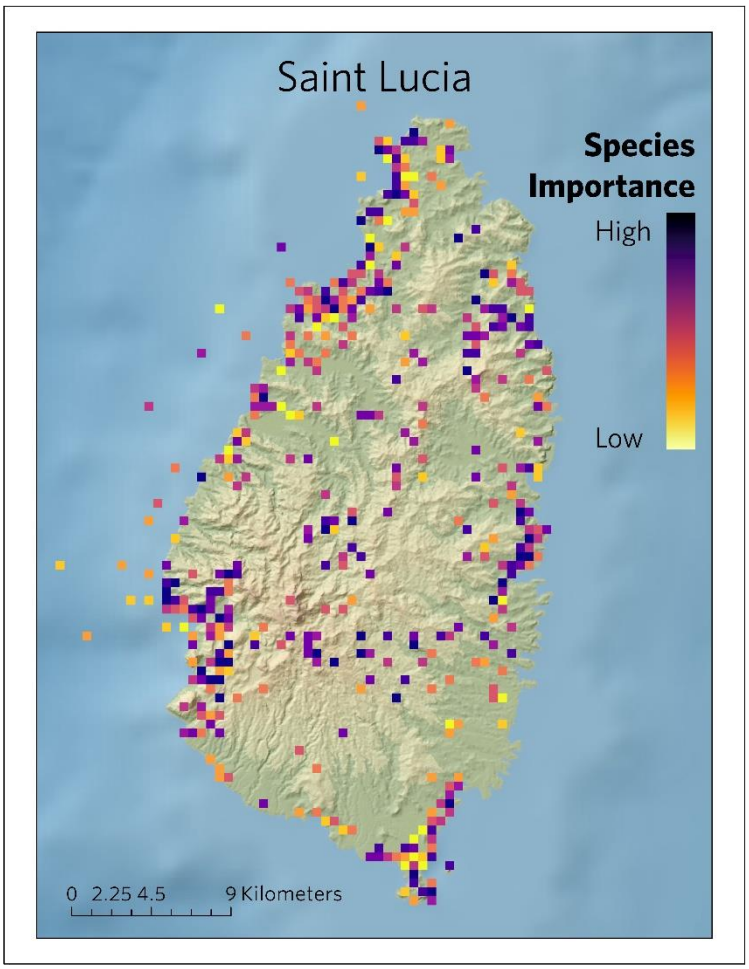

***Figure D14**. Species Importance – Saint Lucia*

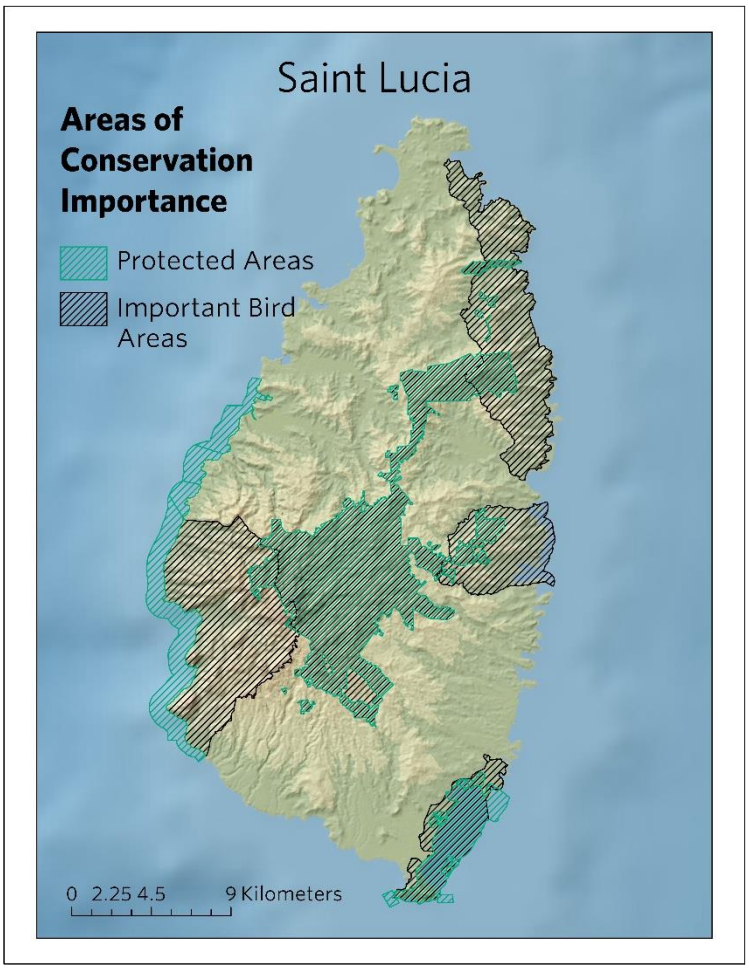

***Figure D15**. Areas of conservation importance – Saint Lucia*

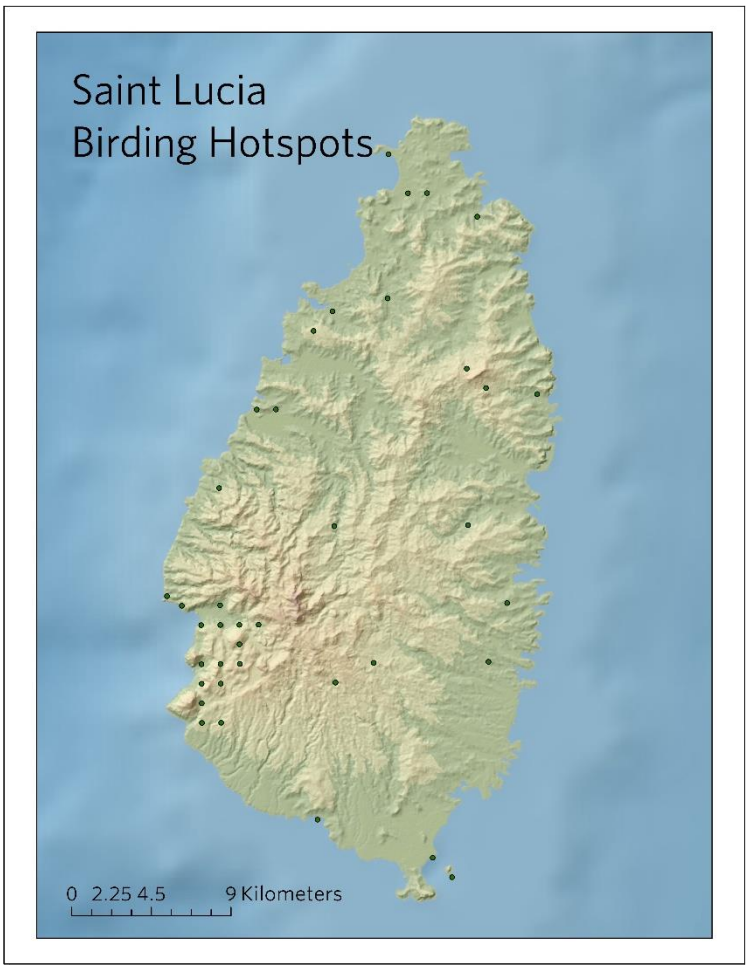

***Figure D16**. Birding hotspots – Saint Lucia*

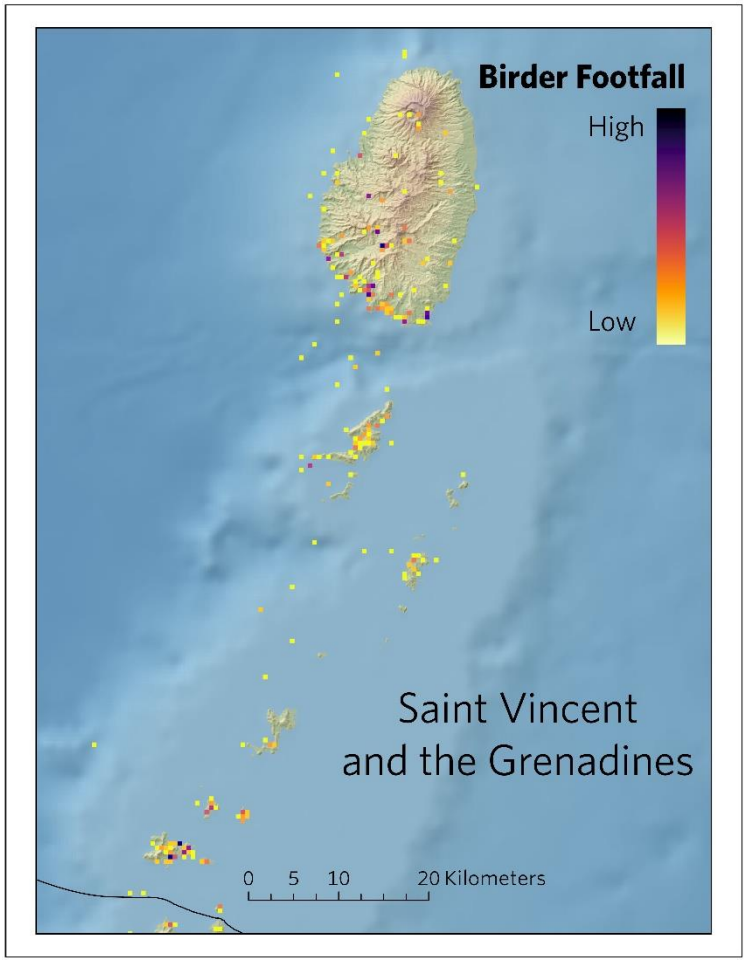

***Figure D17**. Birder Footfall – Saint Vincent and the Grenadines*

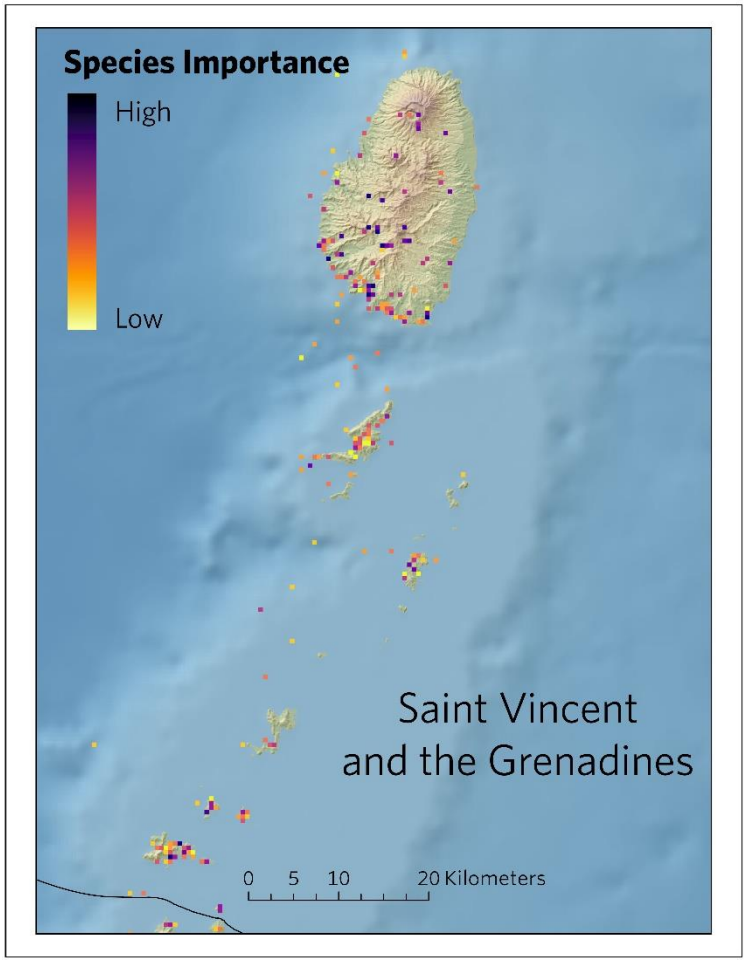

***Figure D18**. Species Importance – Saint Vincent and the Grenadines*

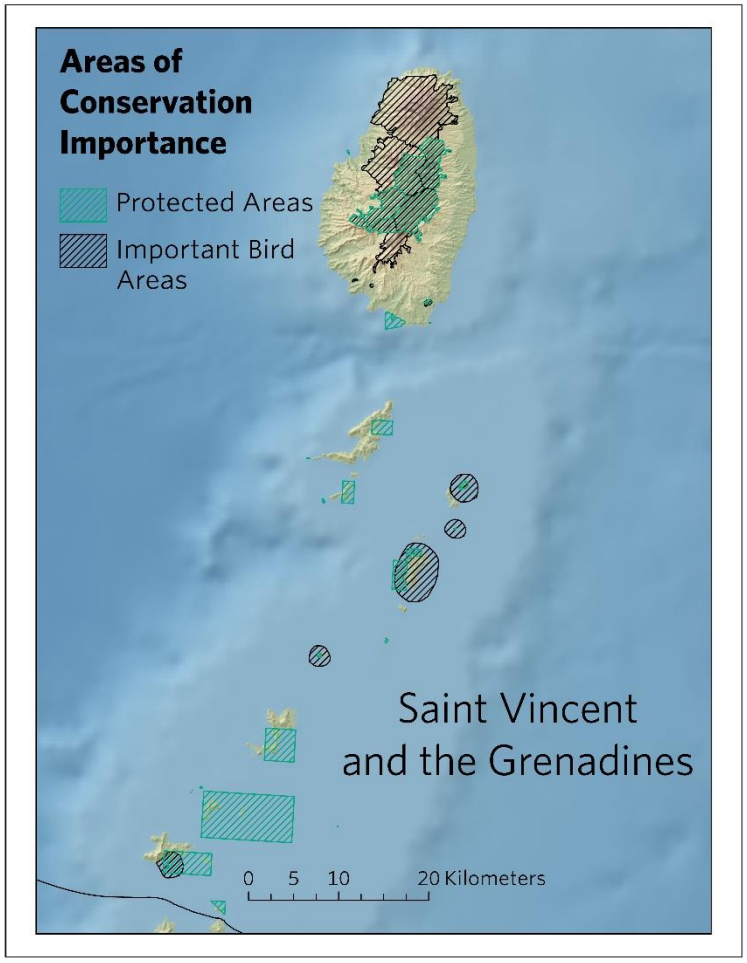

***Figure D19**. Areas of conservation importance – Saint Vincent and the Grenadines*

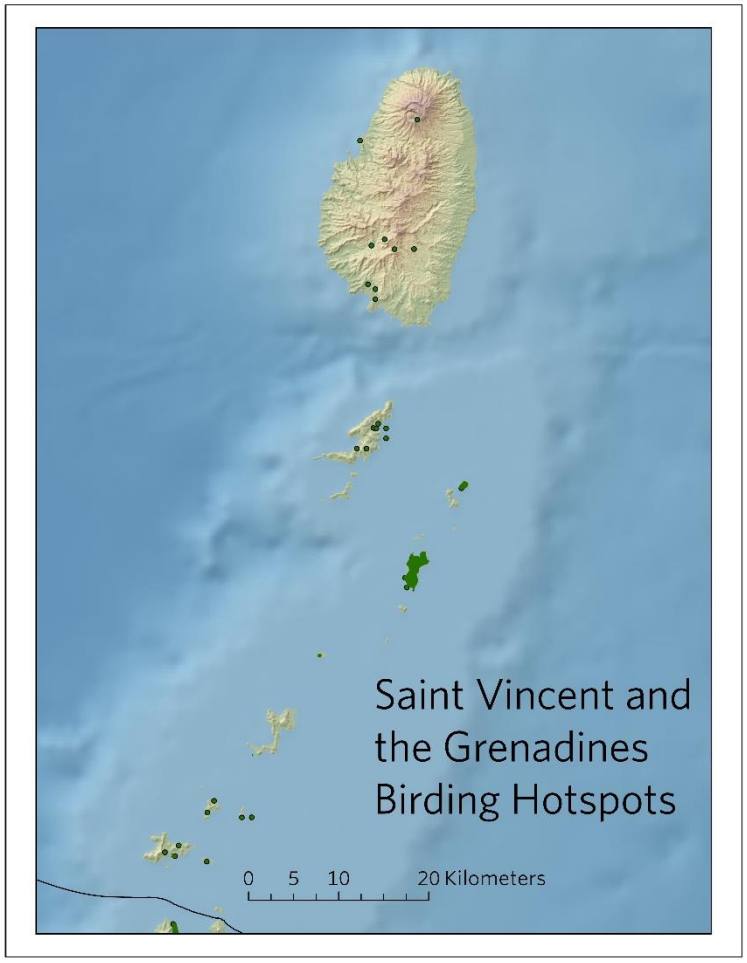

***Figure D20**. Birding hotspots – Saint Vincent and the Grenadines*

Figures D21 – D24 depict whale and dolphin watching intensity in 4 of the 5 OECS countries. Values are mapped at a 50m resolution. Note that St. Kitts and Nevis is omitted due to a lack of data.

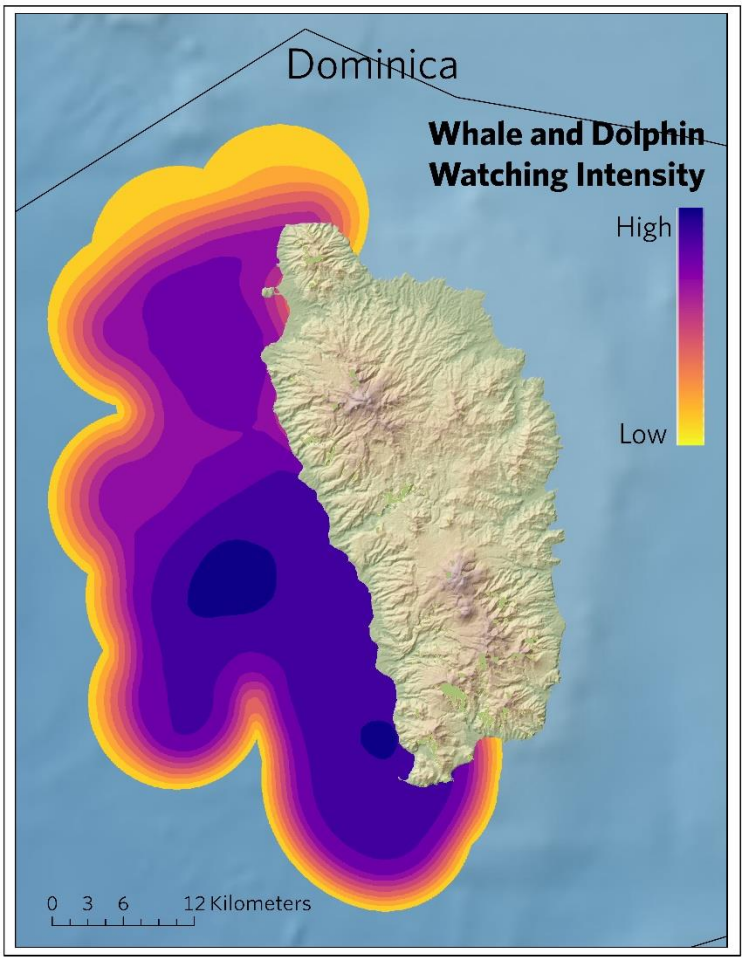

***Figure D21**. Whale and dolphin watching – Dominica*

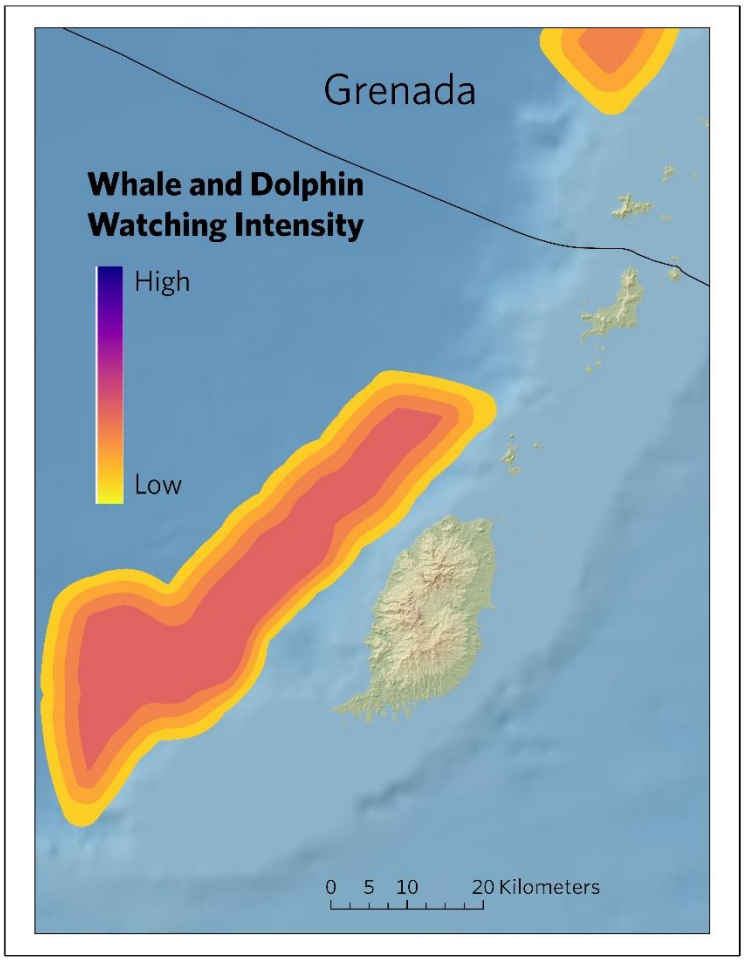

***Figure D22**. Whale and dolphin watching – Grenada*

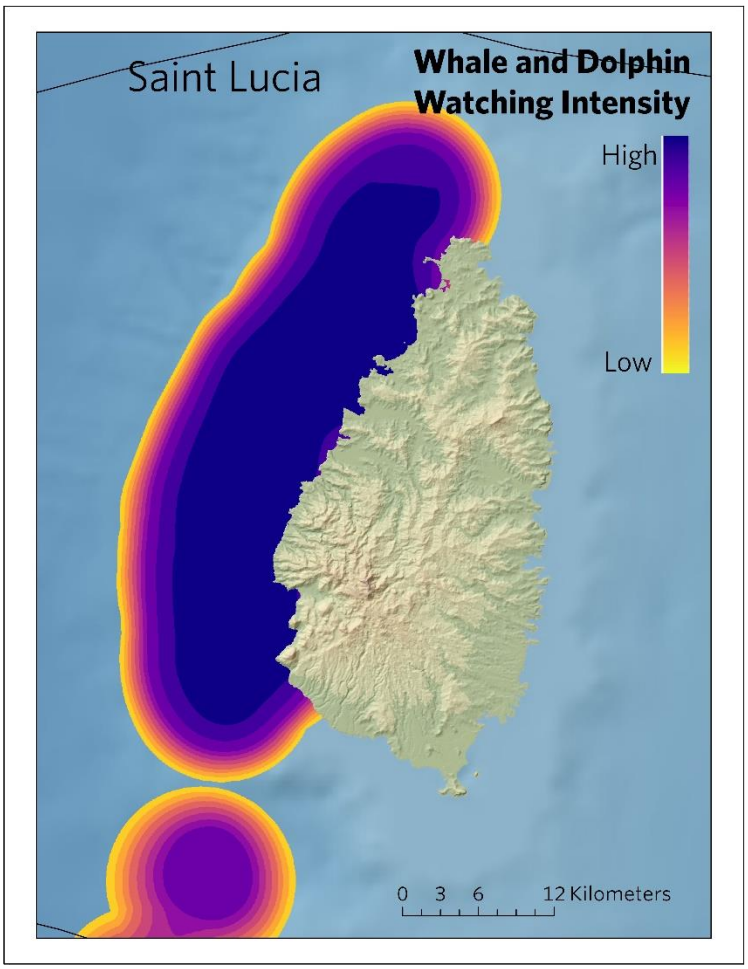

***Figure D23**. Whale and dolphin watching – Saint Lucia*

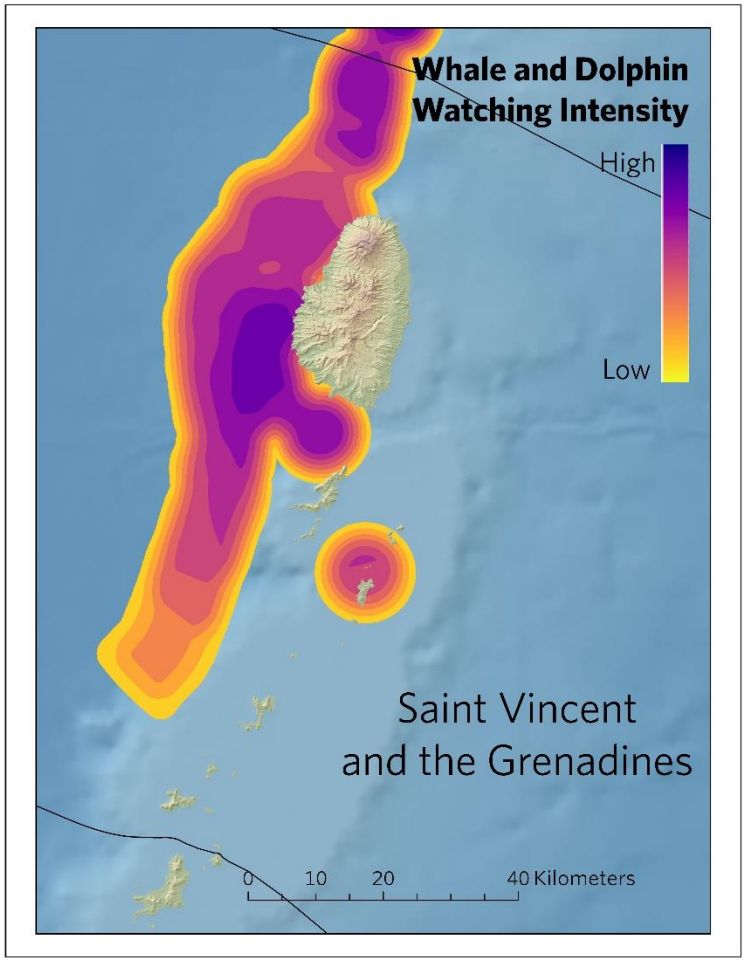

***Figure D24**. Whale and dolphin watching – Saint Vincent and the Grenadines*