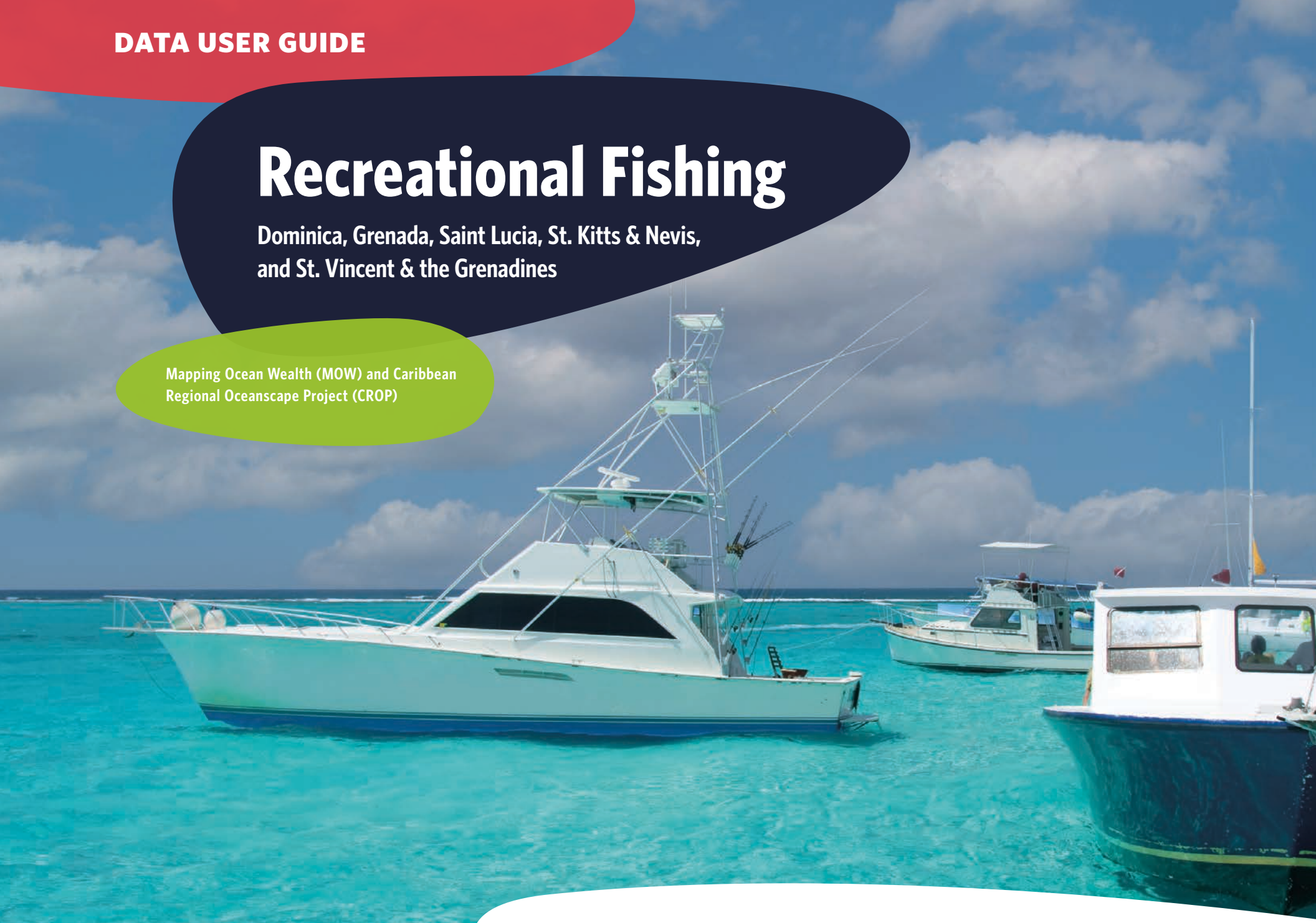
DATA USER GUIDE

Recreational Fishing

Dominica, Grenada, Saint Lucia, St. Kitts & Nevis, and St. Vincent & the Grenadines

Mapping Ocean Wealth (MOW) and Caribbean Regional Oceanscape Project (CROP)



ECS Organisation of Eastern Caribbean States

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The Nature Conservancy

MAPPING OCEAN WEALTH

CROP Project Overview:
https:/oecs.org/en/crop

Map Viewer:
maps.oceanwealth.org/oecs

ABOUT THIS PROJECT

The Global Environment Facility (GEF) and 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. The project timeline was October 2017 - December 2021. Under this project, The Nature Conservancy used the Mapping Ocean Wealth approach to develop ecosystem service models and maps for the five CROP countries in the Eastern Caribbean.

Introduction and Summary of Methodology

Overview

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 fishing. There has been intentional development of the recreational fisheries sector as an activity for tourists visiting the region and today, much of the recreational fishing in the region takes place from private or chartered vessels or during fishing tournaments. Despite its importance, historical attempts to collect standardized data on this sector at a regional level have been limited, and spatial characterization of this activity has been especially lacking.

This project addressed this gap using a combination of image analysis applied to crowd-sourced data from Flickr and TripAdvisor, complemented by participatory mapping and survey data from charter vessel operators, as well as other stakeholder-provided information and guidance. The result is a map of recreational fishing intensity for CROP countries, as well as several complementary summary statistics intended to further emphasize the importance of this sector to the region's economy.

This is the first time that recreational fishing has been so extensively mapped at the regional scale. We believe that the results are of considerable use for better understanding the value of nature-based tourism, applicable to management, that they will enable a broad range of users from the public to industry to government to better plan and manage both the tourism industry and any other active sectors within the blue economy.

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Purpose of the Guide

We have developed this guide for individuals who are interested in downloading, analyzing, and applying the data for projects within the five countries covered by this project (Dominica, Grenada, Saint Lucia, St. Kitts and Nevis, and St. Vincent and the Grenadines). While these datasets were originally developed to complement the marine spatial planning processes undertaken under the Caribbean Regional Oceanscape Project (CROP), we describe a range of possible applications across multiple sectors, along with practical advice on the methodology, interpretation and caveats surrounding these datasets. More details about the model including links to technical reports can be found at Oceanwealth.org/project-areas/Caribbean/crop/recreational-fishing.

This work furnishes stakeholders with detailed data and maps for two of the most important social and economic sectors in these countries.

Regional Policy Relevance

In 2013, the OECS Heads of Government endorsed the Eastern Caribbean Regional Ocean Policy (ECROP). In 2019, the ECROP was revised to align with the UN Agenda 2030 for Sustainable Development – SDG 2030. The CROP is designed in alignment with ECROP (2013) and has an overall objective to develop and implement integrated ocean governance policies to leverage sustainable public and private investment in the waters of OECS member states and other participating Caribbean countries. The first component of the CROP project is to strengthen ocean governance through the development of National Ocean Policies (NOPs) and Coastal and Marine Spatial Planning (MSP). The work described in this project falls under the subcomponent 2.1 of the CROP: Strengthening knowledge and capacity building.

The ecosystem service modelling work was undertaken in parallel with the development of the coastal and marine spatial plans under CROP, meaning that the ecosystem service model results were not available during their planning process. Nevertheless, this work furnishes stakeholders with detailed data and maps for two of the most important social and economic sectors in these countries – tourism and coastal fishing. Such data can now be incorporated into the MSP process and this should be a priority as part of the finalization of these, or indeed any future, plans.

At the simplest level these models and maps enable the discernment of critical areas of current use of natural resources and form a core background for stakeholder discussion and debate. The same information can also be used in the projection of future use options, including the potential costs and benefits of different uses and activities in coastal and marine waters. A key element of MSP is that such planning needs to be cyclical and ongoing, rather than a static, one-off, process. This means that information can be continually added or updated to future planning cycles, along with knowledge of new opportunities or risks.

Methodology and Definitions

The multi-step approach to mapping the spatial footprint and intensity of recreational fishing involved two key steps. The first was the development of a map showing the overall spatial footprint of the activity. A key component of this work was an information gathering exercise in each country where some 23 sport-fishing operators provided information on their business, including mapped locations of fishing areas and information on the size of their operations and costs of trips.

Locational information for fishing was further enhanced to include on fish aggregation devices (FADs), geolocated photographs, and key depth zones which are preferred by many fishing operators. At all times stakeholder guidance was critical to inform and guide the process.

The intensity of activities within this footprint was then developed by weighting the onshore locations of charter operators by the number of reviews from TripAdvisor, and buffering these locations to 20k and 40km to account for maximum distances travelled for half and full-day trips.

AI/ML Methods

Microsoft's Azure Custom Vision (https://azure.microsoft.com/) service was used to identify recreational fishing photos from Flickr and TripAdvisor. The data used to train the model featured people holding trophy fish on boats and docks, as well as images on vessels featuring fishing rods and reels. The images returned were then standardized such that only one image per TripAdvisor user per attraction was counted (photo per attraction per member, or "PAM"). Very few images were returned from Flickr so there was no need to standardized based on unique users. The photos were then mapped as points based on the attraction to which they were linked, or, in the case of Flickr photos, to the location at which the photo was taken, with the latter typically being close to the point of capture.

For TripAdvisor reviews, we used the web-based tool LightTag to label over 2,000 TripAdvisor reviews according to activities and elements described in each review. For this model, we trained the model on reviews that mentioned phrases associated with recreational fishing trips (e.g., "sportfishing", "marlin", "fishing charter"). An expert team from Microsoft then applied a random-forest regression model to automatically classify the remainder of the reviews and return a list of reviews that matched each set of criteria. These were then mapped as points based on the attraction to which they were linked.

Developing intensity maps

To develop the offshore fishing intensity footprint, we applied buffers to the following layers:

- Participatory mapping points (10km)
- Flickr photos (10km)
- FADs (2km)

Depths of 1000m to 2000m were highlighted as optimal fishing locations for some sport-fishing, so we used bathymetric maps, and buffered around these to cover depths ranging from 800m to 2200m.

The intensity maps assumes that each departure location of fishing tours (i.e., shore-based locations of tourism operators) can be used to map a wider offshore area of fishing, weighted by offshore factors influencing fishing activity. A point-based map of onshore operators was generated using data from TripAdvisor, supplemented by information from TNC staff based in the region, resulting in **a total of 104 operators**. Each was weighted using a score based on the number of PAMs and reviews from TripAdvisor (see above).

The model also assumes diminishing fishing effort with distance from shore, and while the participatory mapping points and Flickr images represent known fishing locations, activities around FADs and preferred deep sea fishing grounds will depend on accessibility. We therefore used the onshore operators to develop a simple model of likely fishing extent. For this, we spread their associated fishing intensity weightings between an immediately adjacent

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Data gathered during the participatory mapping exercise also enabled us to generate approximate data on tourism spending.

fishing area (up to 10km), and further distributed these values to the deep-sea fishing layer in an effort to spread the density of activities from the operator locations to the offshore locations where fishing is occurring. For FADs we likewise developed a distance weighting for likely fishing intensity, using the assumption that FADs located further offshore are likely to attract less recreational fishing effort.

Each of the resulting layers was combined and their fishing weightings summed to develop a merged layer of fishing intensity. These final maps were then smoothed across a zone of 2.5km, using a focal statistics tool to better represent the likely blurred boundaries expected in open water fishing.

Economic value

Data gathered during the participatory mapping exercise also enabled us to generate approximate data on tourism spending. From the survey results, we calculated for each country the average number 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 in order to estimate the annual charter sportfishing tourism expenditure, in $USD.

Input Datasets

A summary of datasets used in the analysis is provided below. Users are encouraged to reference the technical report for additional details on sources and geoprocessing steps.

Data Layer	Source
Onshore operators	TripAdvisor & local directory listings provided by TNC Caribbean Division
Participatory mapping points and tracks	Survey and in-person mapping conducted by TNC staff in February 2020
Photos	Flickr & TripAdvisor
Fishing aggregating devices (FAD)	Departments of Fisheries and/or Natural Resources in Dominica, Saint Lucia, and Saint Vincent and the Grenadines
Deep-sea fishing derived from bathymetric contours	Bathymetric contours were derived from bathymetric sounding points digitized from British Admiralty nautical charts by TNC for the ECMMAN project in 2013.

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

Definitions

Recreational Fishing – This model focuses on the activities associated with for-hire charter vessels offering recreational sportfishing trips to tourists. Other terms occasionally used for this fishing, or elements of it, including sportfishing and game fishing. It also accounts for the activities of fishing tournaments in the region.

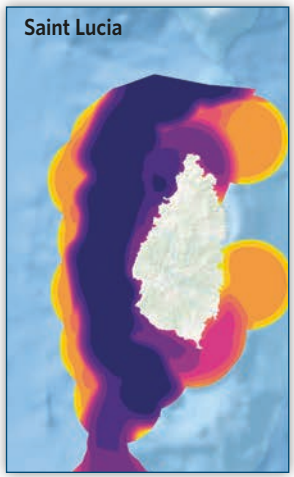
Onshore Operator Locations – This term refers to the departure point of the recreational fishing trips. These locations were defined through attraction location data from TripAdvisor, supplemented through additional desktop research.

Fish Aggregating Devices (FADs) – Artificial structures that float on or just below the surface of the water in order to attract pelagic fish.

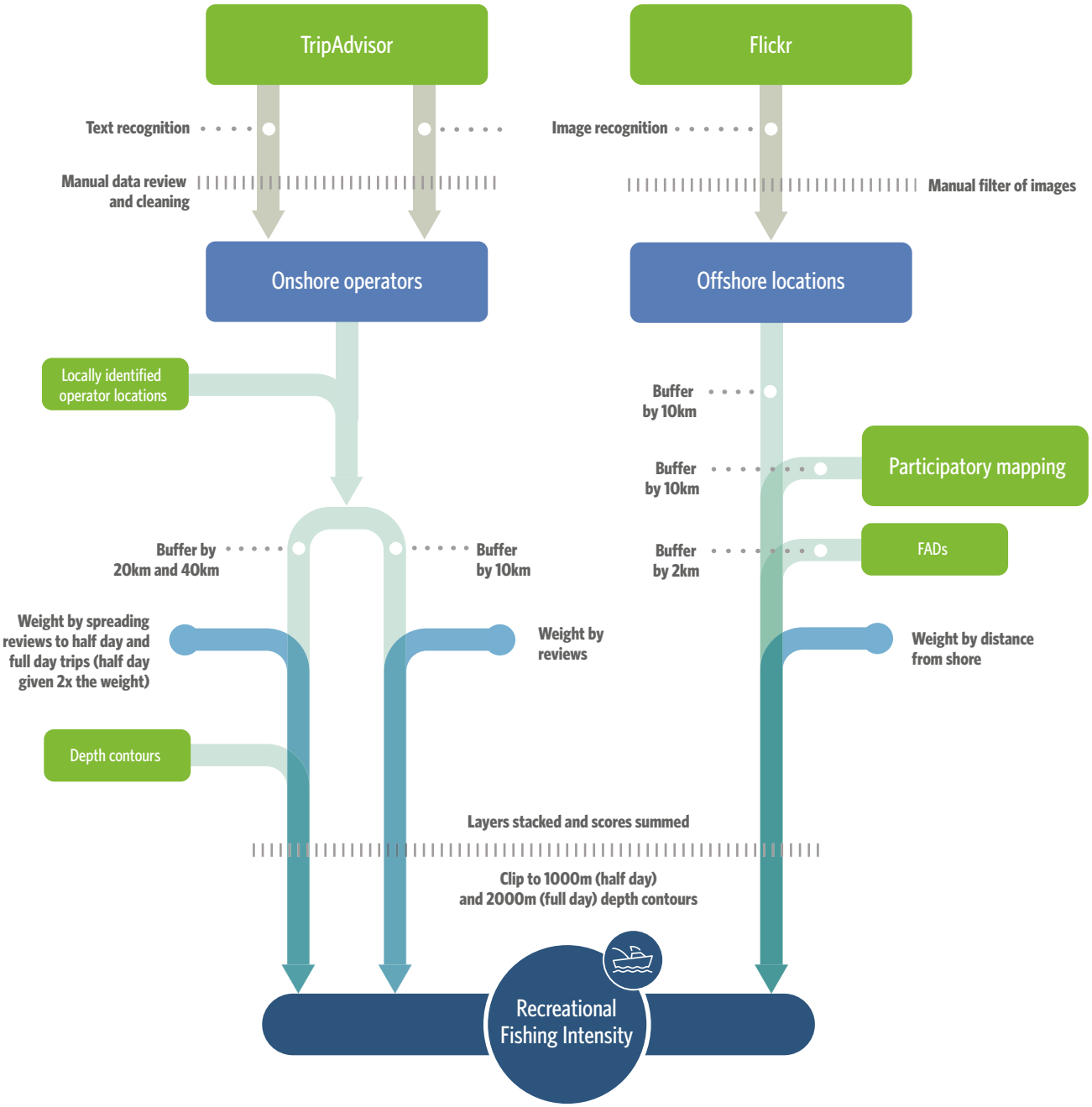
Participatory Mapping – A data gathering approach that invites experts in a particular subject matter, or participants in a specific activity to provide spatial data directly to researchers, based on their knowledge, through structured interviews and/or mapping exercises.

Expenditure – In this project, expenditure refers to the direct payments made from tourists to tourism operators for the cost of the trip. It does not include indirect spending such as travel, accommodation costs, or other any other spending related to the activity (e.g., food purchased in the area or equipment purchased for the trip).

Recreational Fishing Modelling and Mapping Process



Mapped recreational fishing intensity in Saint Lucia



Data

- Input data source
- Intermediate data product
- Map product

Data Processing

- Geoprocessing Step
- Statistical Analysis
- AI/ML

Findings

Three countries dominate our list of recreational fishing operators, with over 40 in Saint Lucia and over 20 each in St Kitts and Nevis and in Grenada. The maps of recreational fishing capture this variance in this activity but also show the very broad spread of recreational fishing across each of the CROP countries, with both nearshore fishing and quite heavy offshore fishing in deep waters in the more southerly countries. The more exposed windward shores are the only areas where fishing is often absent.

Exploring the data

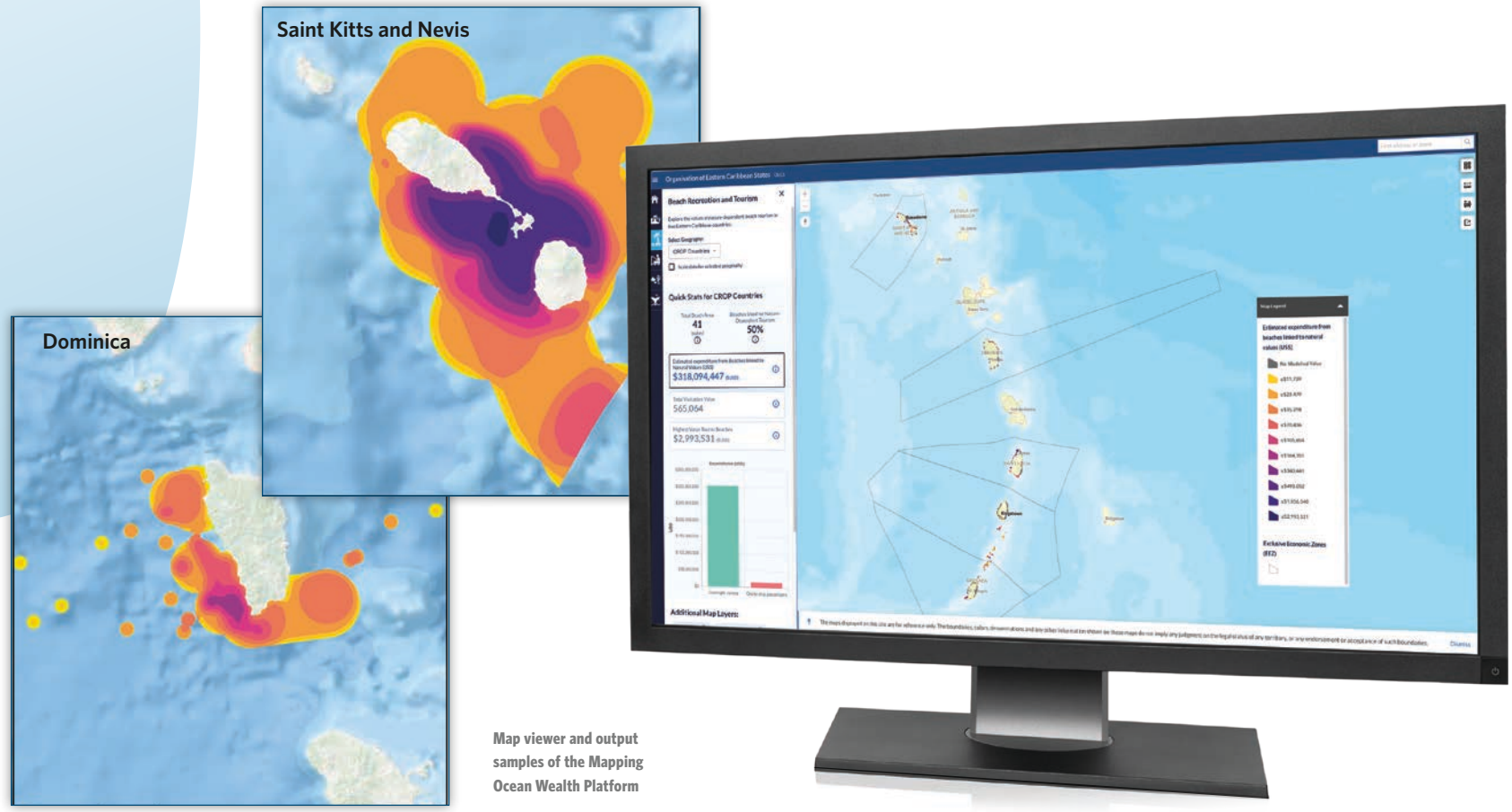
While the financial assessment is drawn from a relatively small sample size, the results indicate **a direct expenditure of over $US 6.8 million per year**. Operators often undertake a variety of activities, but typically run between 120 and 230 recreational fishing trips per year. On a per country basis, the estimated expenditures are as follows:

- Dominica $360,000
- Grenada $1,060,800
- Saint Lucia $2,777,600
- St. Kitts & Nevis $2,407,200
- St. Vincent & the Grenadines $230,400

There are over 40 recreational fishing operators in Saint Lucia, and 20 each in St. Kitts and Nevis and Grenada.

Data Access and Specifications

Outputs of this project included spatial datasets (File Geodatabase Raster Datasets) that can be imported, viewed, and analysed within Geographic Information Systems (GIS) such as Esri ArcMap, ArcPro, or QGIS. Data can be downloaded from the map viewer at maps.oceanwealth.org/oecs or at Oceanwealth.org/project-areas/Caribbean/crop/recreational-fishing. The downloaded file contains a geodatabase and a metadata document. Data are broken out so that users can view data for all CROP countries or by individual countries.



Map viewer and output samples of the Mapping Ocean Wealth Platform

Applications

Maps and data such as these have an immediate and important role in drawing attention to a value that was perhaps already known by some, but which had never been clearly elucidated. Understanding the high value of nature-dependent tourism activities such as recreational fishing highlights an opportunity to further develop this sector sustainably, and also points to the need for effective fisheries management so that this sector can continue to thrive. Raising public awareness of such value can help to foster support for fish habitat conservation and management. Such knowledge needs to be factored in to planning and scenario-building.

By having a common currency, it is possible to place these values alongside others. In particular, high value areas can be seen as key economic drivers at the national scale, to be protected against risks that might arise from overfishing, water pollution, and climate change. These values may become "opportunity costs" or the lost earnings that might be associated with otherwise apparently high value activities. They can also be viewed as indicative values that may be achieved from other locations through a combination of improved management and sustainable development.

Public interest

Compared to other aspects of tourism, public perceptions of recreational fishing value can be quite high – there is some recreational fishing by local people, and many more will see recreational fishing within the framework of fishing more generally. For this reason, the ability to use this information to better describe the extent and the value of recreational fishing may be highly valuable, and while it is not to be expected that individual public users will want or need direct access to the results of our work, the work itself can be used to generate information of high public interest.

Community groups and NGOs should feel empowered to use this work, in support of their own campaigns or outreach. They may, for example, wish to make the case for sustainable tourism development, expanding MPAs, or habitat restoration. Armed with maps and statistics their arguments will be both stronger and more balanced. Concerns about sustainability are often widespread in the fisheries sector and yet, in comparison the commercial fisheries, recreational fisheries can generate high value with relatively low impact, and that impact can be further reduced with catch-and-release fisheries or other catch limits.

Business sector

The maps and statistics from this report are likely to be of interest to anyone working in the charter sportfishing sector, and indeed any business operating charter vessels that may wish to add sportfishing to the types of activities they offer. Many charter tour operators offer sportfishing tours as part of a suite of possible activities (sightseeing, whale and dolphin tours, water taxis), and may be interested in expanding that side of their business offerings based on this information. Adjacent industries such as hotels may also be interested in better understanding these patterns in order to better coordinate trips for their guests.

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Building data into planning

The CROP countries have made a commitment to develop their Blue Economy. Within this framework they are proposing to develop their coastal resources in a manner that is sustainable and that enhances natural value and human benefits.

Marine Spatial Planning is a key component of developing the Blue Economy. Central to MSP is the integration of all relevant sectors; inclusivity, with the engagement of all stakeholders, including minority groups; and the utilisation of all available information to inform planning processes.

In many settings, data on natural resource values for MSP is weak or lacking, however the current work provides a remarkable tool, available in only a very few countries. These data can be used alongside other data sources, ecosystem service values, and stakeholder opinions to guide decision-making and to inform equitable resolutions where there are differing interests. For example, these could be used during participatory mapping exercises, especially when used as a backdrop alongside other tourism activity values to structure conversations with stakeholders who bring their own knowledge regarding the values and impacts of recreational sportfishing to the table.

Management actions

These data can be used in conjunction with information on either current or planned protected areas. For the former, understanding how existing MPAs can add value to tourism activities may be additional justification for siting these locations in manners that can benefit existing nature-dependent tourism locations. Similarly, these maps may also show areas that are risk from overexploitation and may be helpful when used in conjunction with other datasets to identify needed management activities that could ensure sustainability of the sector.

Scale and use considerations

Unlike other Mapping Ocean Wealth data products, our recreational fishing intensity maps are not linked to specific habitats as the activity takes places across a variety of benthic and pelagic habitats. The values presented in the maps are unitless intensity values, that have not been linked to any monetary values. Although we were able to generate national level monetary values these were not considered sufficiently robust to link to the use intensity maps, while the fluidity of the fishing areas themselves might make such inferences a little misleading.

The values and boundaries across our maps have also been smoothed to account for the natural and fluid nature of these fisheries (which focus almost entirely on wide-ranging pelagic species that are not closely tied to particular fixed benthic features). Thus, although the resulting raster is at a 50m resolution,

we recommend that the maps be used at an assumed scale of no less than 1:25,000, and that any statistical reporting is limited to noting the extent of the activity within a specified area of larger than 5x5km.

Time-frames

All of the data used and presented represent tourism up to end 2019. The influence of Covid-19 on tourism has been enormous and we cannot assume that eventual recovery will include a return to the pre-pandemic patterns. We recommend that users who are aware of such influences bear these in mind when examining our maps and make allowances for such change.

Other caveats and limitations

These are modelled data products based on a series of assumptions, including the motivations and activity patterns of tourists. Model assumptions have been vetted by experts, stakeholders, and data where possible. Bias or inaccuracy may have been introduced both through inaccuracies arising from the stakeholder mapping input and the locational inaccuracy sometimes inherent in the TripAdvisor locations that, in turn, drove the weighting of offshore activity. As such, interpretation of statistics, especially for very small areas, should be treated with caution. Estimates will be more robust when based on larger areas. Pixels with no values don't necessarily lack tourism values, as not all values will be captured in the modelling approach used.

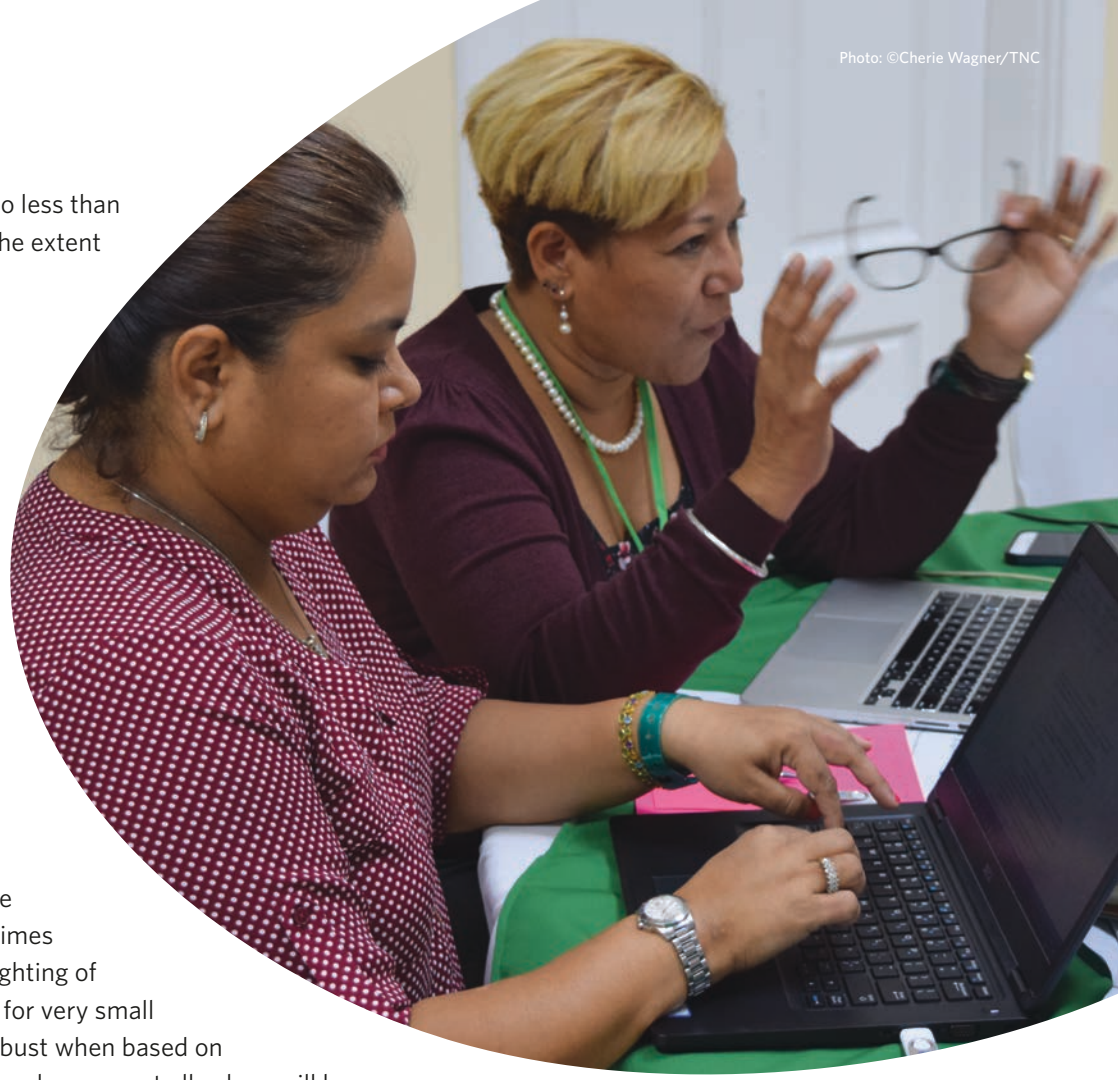

Photo: ©Cherie Wagner/TNC

Stakeholders explore Mapping Ocean Wealth data at a 2019 workshop in Saint Lucia.

Update and revise

A key advantage of our approach has been to build transparent models that are relatively simple to understand. Technical users are encouraged to explore the approaches we used – this may raise awareness of weakness or inspire questions which, at the simplest level, may enable those users to objectively comment on findings and suggest likely biases or even potential scenarios.

It is, of course, possible to re-run the models with different input layers or weightings. Detailed geoprocessing steps can be found in the technical report, and the project team can be contacted to share additional datasets and advise on how this might be done; however, it would of course require key technical and mapping skills to do this.

Post-Covid

The final outcome of the Covid pandemic remains hard to foresee. The grave social and economic impacts from the decline of tourism receipts will have had other consequences which remain poorly understood, but could include positive and negative environmental impacts (for example changes in commercial and artisanal fishing efforts, or coastal development or pollution). The return of tourism may not follow pre-pandemic models. It seems likely that open-air, nature-centric tourism may recover faster than travel which places tourists in more crowded settings such as large-volume hotels and cruise ships.

There may be opportunities to use the pre-Covid models presented here to better understand the different components of tourism across the CROP countries and to begin to inform possible recovery scenarios.

Closing Words

These maps give detail to an already well-understood dimension to tourism in the Eastern Caribbean. Recreational fishing is a core component of tourism, and therefore of considerable importance to the economy of Eastern Caribbean. But these maps and numbers go way beyond simply re-iterating this. By providing hard numbers, and mapping these activities at a resolution that has never previously been achieved they give critical information for management and planning. Such knowledge is critical, enabling demands on coastal space to be properly assessed and enabling informed consideration of both conflicts and synergies with other demands.

We encourage users to explore the data online, but also to consider its validity and utility in different contexts. Deeper engagement with the data will enable wider uses, including in some cases the opportunity to project and predict outcomes beyond the maps themselves. We hope that future users may also be able update and improve the maps, using similar approaches, and informed by the details we have provided underpinning our methods and our findings.

FIND OUT MORE

For access to the high-quality maps and the full technical report, please visit the Mapping Ocean Wealth platform https://oceanwealth.org/project-areas/caribbean/crop/recreational-fishing/

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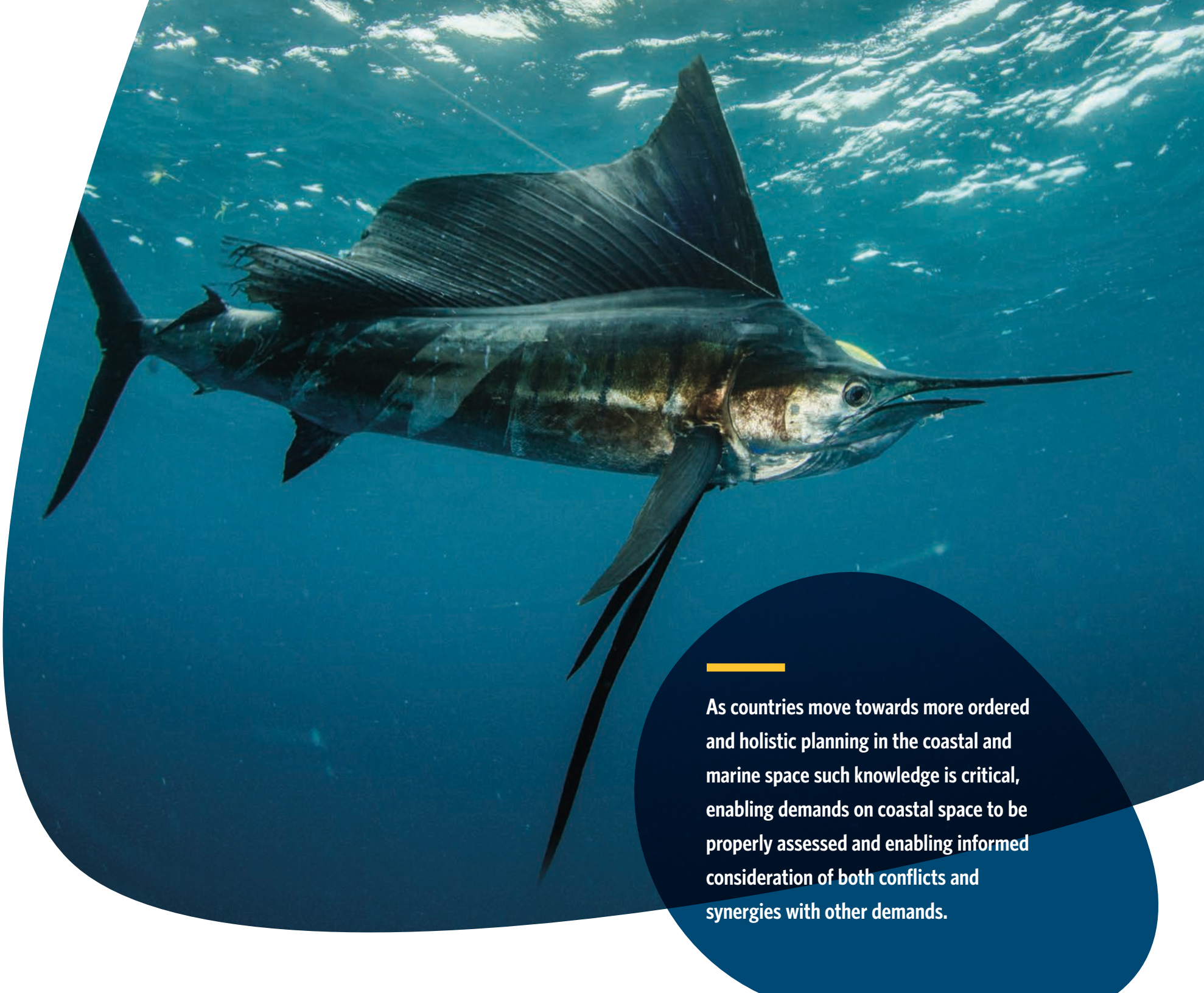

As countries move towards more ordered and holistic planning in the coastal and marine space such knowledge is critical, enabling demands on coastal space to be properly assessed and enabling informed consideration of both conflicts and synergies with other demands.

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