DATA USER GUIDE

Coral Reef Fish and Fisheries

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

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

Page 5 – No green line below depth variable in table

ECS Organisation of Eastern Caribbean States

gef

WORLD BANK GROUP

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. Under this work, a team at Florida International University led the development of the Coral Reef Fisheries model.

Photo: © Tim Calver

Introduction and Summary of Methodology

Overview

The reefs of the Eastern Caribbean are a vital resource for island residents, supporting subsistence, artisanal, and small-scale commercial fishing. Reef fisheries contribute to social well-being by supporting island economies, contributing to food security, and playing a role in the region's cultural identity. These are multi-species and multi-gear fisheries, targeting several major fish groups: snappers, groupers, parrotfish, grunts, jacks, squirrelfish, surgeonfish and triggerfish are the most common. Traps and hook-and-line (predominately handlines) are widely used, along with some use of spears, nets, and vertical and bottom longlines. Though fishing pressure on reef species is variable across the region, in general coral reefs have been heavily fished, and populations of snappers and groupers have been severely depleted. Despite depletions, many people rely on reef fisheries for food and income. Reef fisheries in the region are also vulnerable to climate change, and other threats to reef health, underscoring the need for prudent management. To support this management need, this project modelled and mapped fishing impact and fish biomass throughout the region and assessed the potential of conservation and management measures for reef fisheries.

The maps and information developed through this work are the first spatially explicit, continuous maps of reef fishing impact, current biomass and the potential biomass gains that may accrue if certain management actions are implemented and effectively enforced in the region. We believe that the results are of considerable use for understanding the value of coral reefs and coastal ecosystems at local scales, applicable to management, and that they will enable a broad range of users from the public to industry to government to better plan and manage artisanal fisheries and coral reef habitats in the region.

The maps and information developed through this work are the first spatially explicit, continuous maps of reef fishing impact, current biomass and the potential biomass gains from management actions.

Purpose of the Guide

We have developed this guide so that individuals who are interested in downloading, analyzing, and applying the data for projects within the 16 Eastern Caribbean countries covered by this project can better understand the origins, potential uses, and limitations of the data. 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/coral-reef-fish-and-fisheries.

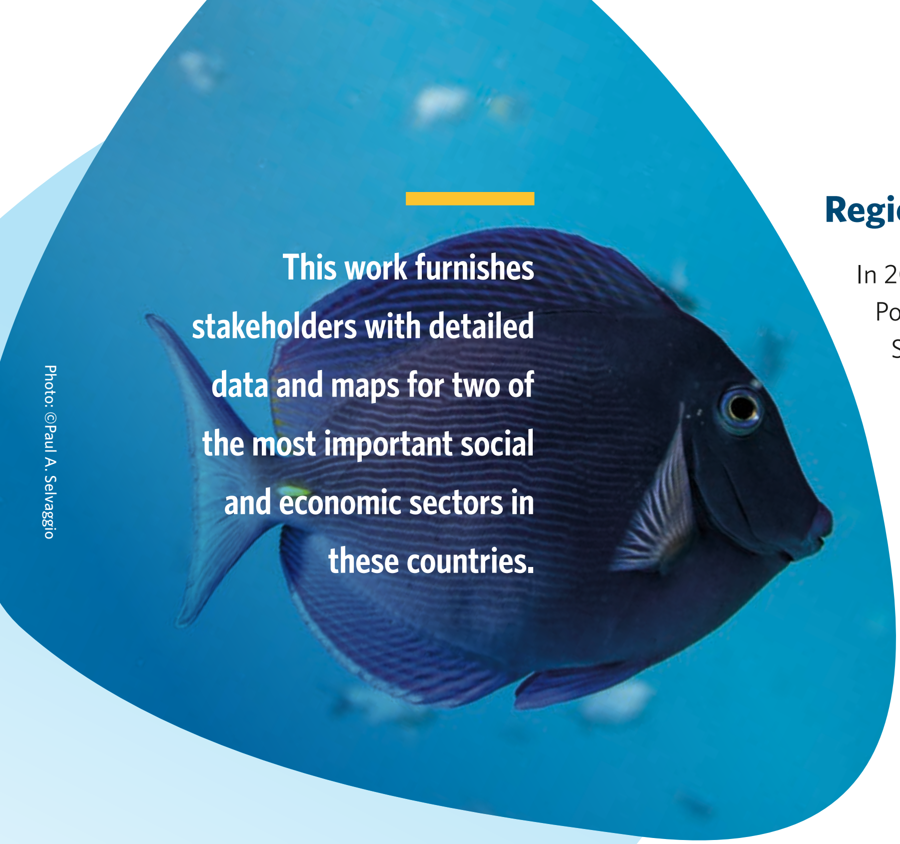


Photo: ©Paul A. Selvaggio

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 Plans. 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

To model fishing impact, data were compiled from expert fish surveys done on SCUBA across common reef habitats in the focal countries and nearby islands (which were added to the analysis to increase the size of the available dataset for the study).

The survey methods used for datasets in the analysis of this project varied by the organization that collected the data and are as follows.

- **AGRRA (Atlantic and Gulf Rapid Reef Assessment) :** The AGRRA data (Lang et al. 2010) are collected to assess reef health across the region and focus on a subset of fish species that are ecologically important.
- **Steneck et al. 2018:** Used a slightly modified AGRRA methodology to collect data, which was originally intended to examine reef resilience in the area.
- **Waitt Institute:** Methods followed the monitoring guidelines used by Global Coral Reef Monitoring Network (GCRMN)-Caribbean1 and were dependent on the skill level of the surveyors
- **Institute for Tropical Marine Ecology (ITME):** Surveys were done with an early (now outdated) AGRRA protocol that recorded only a subset of the species currently included in AGRRA datasets.
- **Observatoire du Milieu Marin Martiniquais (OMMM):** Fish and benthic surveys were conducted at five permanent monitoring sites.
- **Future of Reefs in a Changing Environment (FORCE):** Fishes (all species > 10 cm and all groupers and snappers irrespective of size) were identified to species, counted, and total length estimated to the nearest centimeter in eight 30 by 4 m belt transects to address a range of reef management questions.

Country/Jurisdiction	Year(s)	Number of Sites	Source
Anguilla	2013	3	Steneck et al. 2018
Sint Maarten (Dutch)	2013	3	Steneck et al. 2018
St. Kitts and Nevis	2011	25	Lang et al. 2010
Antigua and Barbuda	2013, 2017	33	Waitt Reports, Steneck et al. 2018
Montserrat	2015	48	Waitt Reports, Steneck et al. 2018
Dominica	2005	16	ITME
Martinique	2019	5	OMMM
Saint Lucia	2013, 2014	9	Steneck et al. 2018
St. Vincent and the Grenadines	2014 - 2018	40	Lang et al. 2010, Steneck et al. 2018, Newman et al. 2015
Grenada	2014 - 2018	20	Lang et al. 2010, Steneck et al. 2018
Total		**202**	

More detailed descriptions of each survey can be found in the technical report.


Photo: ©Paul Selvaggio

From the fish survey data, we calculated the mean length of parrotfishes (excluding those <10 cm) at each site. Because parrotfish populations are sensitive to fishing pressure, this metric provided a powerful indicator of fishing levels on a reef. As reef fishing pressure increases, the mean size of parrotfishes tends to decrease. Using mean parrotfish length as a response variable in the models, we calculated mathematical relationships between the mean length of parrotfishes and a wide range of biophysical factors such as depth, temperature, coral cover (see 'Input datasets'), and fishing-related factors, such as market gravity, at each site.

Once this model was built and highlighted all key variables, we could use it to extrapolate to all other reefs (1 ha resolution cells) where no survey data were available. However, we were only interested in the fishing-related factors in the model because we wanted to model the impact of fishing, not predict mean length of parrotfish at all sites (which is caused by a combination of natural and fishing factors). Therefore biophysical variables were held constant for this extrapolation so as exclude variation in parrotfish length due to environmental gradients and conditions (only the important fishing-related factors changed in each 1 ha cell). The estimated mean length of parrotfish due only to fishing impacts for each pixel of coral reef was then converted into a scale of fishing impact (0-1), where high values of mean length translated to low values of fishing impact. These fishing impact estimates were then used to create a map of fishing impact across Eastern Caribbean countries.

The fishing impact spatial data layer was then used as a key input alongside other environmental data (see 'Input datasets') into models of current fish biomass for three groups: key carnivores (snappers and groupers); herbivores (parrotfishes), and all reef fish species combined (i.e., all fish species sampled using Atlantic Gulf Rapid Reef Assessment protocols). Again, data from fish surveys (those sites not used for the fishing model) conducted on SCUBA was fundamental in building these models. As for fishing, the statistical model allowed extrapolation to reef cells where no survey data were available and the production of a continuous map of fish biomass for the CROP countries.

Finally, the models of current biomass were then used to estimate the potential biomass under different management initiatives. In one set of models, fishing impact was adjusted to zero, simulating a no-take zone being implemented. In another set of models, an increase in coral cover was simulated. The scenarios tested were limited by the predictor variables found to be significant predictors of fish biomass – only significant predictors could be manipulated to predict future biomass. If future model outputs identify additional management-related covariates as significant (e.g., mangrove availability for snapper-grouper biomass or sea surface temperature for parrotfish biomass), these could be used to simulate other management approaches, such as restoring mangrove forests, or to estimate potential effects of climate change. However, the scenarios that were calculated give new insights into the potential benefits of two management initiatives.

Input Datasets

Examples of some of the datasets used in the analyses is provided below. Users are encouraged to reference the technical report for additional details on sources and geoprocessing steps and for the full list of variables.

Data input	Source(s)
Biophysical Variables	
Depth	GEBCO
Diadema density	Siegel et al. 2019
Geomorphology	Google Earth imagery
Coral reef habitat	TNC (benthic habitat maps created under the ECMMAN Project) and TNC Reef Report Cards
Oceanic net primary productivity	Oregon State University (mean net primary productivity from monthly data 2012 - 2016)
Protected status	TNC protected areas layer
Sea surface temperature	NOAA CoRTAD satellite-based ocean temperature dataset
Wave exposure	Chollett et al. 2012
Fishing-related variables	
Demography	Various governmental and non-governmental sources
Fish landing sites	Stakeholder input and various reports and articles (e.g. Staskiewicz et al. 2008, Guyader et al. 2 13, Ramdeen et al. 2014a, de Graaf et al. 2017, Gumbs et al. 2015, Lindop et al. 2015
Fisheries economy	Siegel et al. 2019
Fish survey datasets	Atlantic and Gulf Rapid Reef Assessment (AGRRA); Steneck et al. 2018, Waitt Institute, Institute for Tropical Marine Ecology (ITME), Observatoire du Milieu Marin Martiniquais (OMMM), and the FORCE project.
Governance	Worldwide Governance Indicators Kaufman et al. 2010; compiled by Siegel et al. 2019
Market gravity	Cinner et al. 2018
Population	LandScan human population data
Ports	Various governmental sources and non-governmental sources

Definitions

Fishing Impact: Modelled, unitless metric of fishing pressure on coral reefs based on mean parrotfish lengths recorded in SCUBA surveys. Values are scaled from 0 (lowest fishing) to 1 (highest fishing). Impact values are relative to the fishing impact across the entire study region (Anguilla to Grenada).

Current Biomass – Modelled metric of reef fish availability (expressed in g/m^2) based on existing environmental conditions and fishing impact.

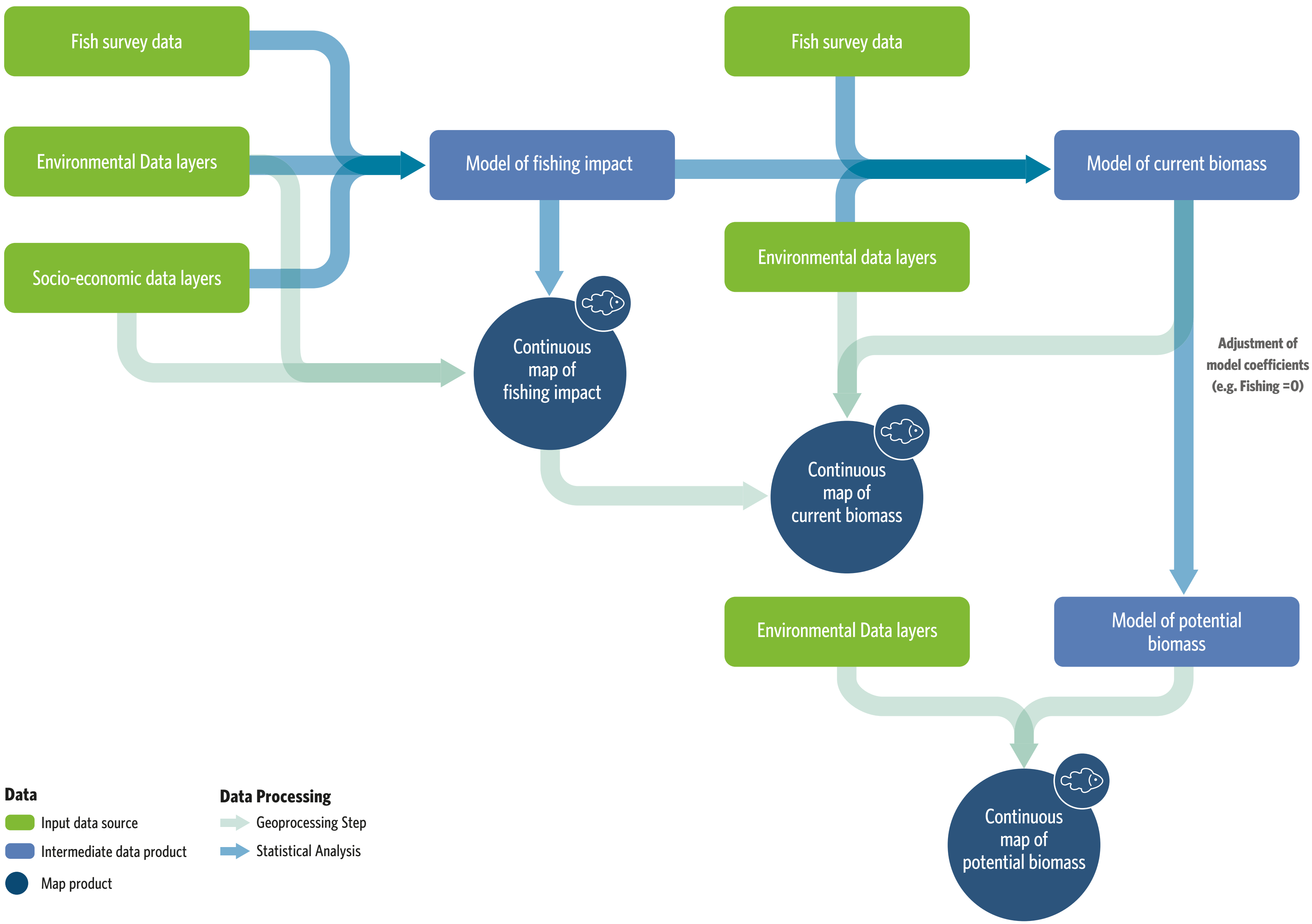
Potential Biomass – Modelled metric of reef fish availability (expressed in g/m^2) following a simulated management initiative and sufficient time for populations to recover. For snapper-grouper, the management initiative tested was a no-take reserve, which was simulated by reducing all values of fishing impact in the model to zero. For parrotfish, a 25% increase in hard coral cover was tested to simulate the effects of coral restoration on parrotfish species.

Time to Recovery – Estimate of the number of years it would take for the reef population to increase from current biomass to 90% of the total carrying capacity (estimated using the predicated biomass from the no-take scenario).

Market Gravity – A concept describing the size and proximity of the nearest fish market. The gravity concept infers that potential interactions increase with population size, but decay exponentially with the effective distance between two points. This project uses the total market gravity (sum of the market gravity of every population center) and calculated gravity as the number of people in the population center divided by the square of the distance between that center and the reef cell.

Photo: ©Tim Calver

Coral Reef Fisheries Conceptual Overview



Findings

Only snappers and grouper species were significantly negatively affected by fishing impact, reflecting the preference fishers for these species and the potential importance of additional marine reserves.

The fishing impact model had sufficient explanatory power to successfully predict values of fishing impact across the reef tracts of focal countries. The model showed that mean parrotfish length increased with increasing distance from fish landing sites and was lower where there was greater market gravity (i.e. higher concentrations of people and proximity to fish markets). These results reflect the importance of reefs isolated from human populations for maintaining fish stocks and the utility of market gravity as a proxy for fishing impacts. Furthermore, countries that reported a higher number of small-scale fishers showed lower mean parrotfish length (and thus higher fishing impact) on nearshore reefs.

Integrating the fishing impact data with biophysical variables allowed the team to model the total fish biomass for the region and for each country. Total fish biomass and the biomass of important fishery species decreased in warmer water, potentially reinforcing concerns about the impact of climate change on fisheries. Across all surveyed species, the biomass values ranged from 21 – 85 g/m^2 . Biomass values were higher in deeper water, potentially reflecting increased productivity close to areas of upwellings and the use of reef walls by large transient predators. The increase in biomass of snappers, groupers and parrotfishes in deeper water may be reflecting the challenges of living in shallower reef habitats with high water movement. Only snappers and grouper species were significantly negatively affected by fishing impact, reflecting stronger impacts of fishing on these species and the potential importance of additional marine reserves. The increasing biomass of parrotfishes with the availability of nursery habitats is consistent with many of these species using seagrass and mangroves as juveniles before moving to offshore reefs.

Exploring the data

To explore differences among countries, we summarized the proportion of reef areas in each country that had low (0 - .33), medium (.34 - .67) or high (.68 – 1) values for fishing impact. None of the CROP countries had reefs that fell into the low impact category which was restricted to offshore areas more remote from human populations. While Dominica and St. Lucia have ~40% of their reefs categorized as having high fishing impact, fewer areas in Grenada, Saint Kitts and Nevis and St. Vincent and the Grenadines fall into this category. While this analysis is useful for understanding relative fishing impact within the study region, the 'high' fishing impact reported here may not be as high as other heavily fished locations in the wider Caribbean, and similarly, low fishing impact in the Eastern Caribbean may be significantly higher than in older, well-enforced protected areas elsewhere.

The resulting maps of biomass allowed us to quantify variation across the focal islands by summarizing the proportion of reef areas in each country that has low (<1st quantile), medium, and high (>3rd quantile) values.

For example, St. Kitts and Nevis has the largest proportion of reef cells with high current biomass of snapper and grouper, perhaps reflecting the relatively low fishing impact for these species in this country. Meanwhile, St. Vincent has the highest proportion of low current biomass reef cells (~60%). However, these comparisons also reflect variations in biophysical context (e.g. reef depth profiles) as some reefs naturally support more fishes.

The models were used to simulate two management scenarios: a no-take fishing closure for snappers and groupers, and a 25% increase in live coral cover for parrotfishes. The first simulation demonstrated that marine reserves have the potential to increase the biomass of snappers and groupers by up to 113%. However, this substantial increase would likely occur only in a well-enforced reserve. When exploring the relationship between parrotfish biomass and coral cover, the models showed that increasing coral cover by 25% could increase parrotfish biomass significantly compared to current levels. This result suggests that a successful, long term coral restoration initiative could have positive impacts on parrotfishes, a group important for healthy reef communities.

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

The impacts of a no-take marine reserve or a habitat-based management intervention (e.g. reef restoration to increase coral cover) on fish biomass are not instantaneous and will lag behind the management intervention. Models estimated that it would take on average 20-40 years for most reefs to reach carrying capacity (estimated as 90% of the predicted biomass in the no-take fishing scenario) for the snapper-grouper species group, although more fish will be seen inside the reserves well before this time. And while it is likely that full recovery of snapper and grouper populations would take this long, these results should be interpreted with caution, given their complex life histories (e.g. forming spawning aggregations) and the many other factors that affect reef fish assemblages. Despite the caveats, the results highlight the importance of long-term fishery management initiatives.

Data Access and Specifications

Map viewer and output samples of the Mapping Ocean Wealth Platform

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 https://oceanwealth.org/project-areas/caribbean/crop/coral-reef-fish-and-fisheries/. The downloaded file contains a geodatabase and a metadata document.

Data are organized to allow users to view data for the entire region (Anguilla to Grenada, denoted in the file name as "EC"), for just the CROP countries (denoted in the file name as "CROP"), or by individual countries (denoted in the file name by their country code). For reach region or country, the following datasets are available:

- Current Biomass of Snapper Grouper
- Current Biomass of Parrotfish
- Current Biomass of All AGRRA Species
- Potential Biomass of Snapper Grouper (No Fishing Scenario)
- Percent Change in Biomass for Snapper Grouper (Under No Fishing Scenario)
- Time to Recovery for Snapper Grouper (Under No Fishing Scenario)
- Potential Biomass of Parrotfish (Increase in Coral Cover Scenario)

Selected environmental variables used as model inputs are also available upon request as layer packages. These datasets include: Nursery mangrove, distance to deepwater, nursery seagrass, distance to fish landing, area of reef within 20km or 200km, sea surface temperature (sst), net primary productivity (npp), fish landing sites within 5km or 20km, and coral reefs. See project contact information for access.

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 translated to a simple map visual. These maps are a useful tool in illuminating the relationship between coral reef habitat and their values to local communities. Raising public awareness of the current and potential values of coral reefs can help to foster support for their conservation and rehabilitation. Such knowledge needs to be factored in to planning and scenario-building during the marine spatial planning process, or when considering other management interventions.

Public interest

While coastal residents of the Eastern Caribbean are well aware of the importance of reef fish for income and food, more broadly, public perception of the value of reefs can be low or vague. 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 to restore degraded reefs, to join the fight against climate change or to steer their communities to more sustainable fishing methods. For example, using these maps to demonstrate the linkages between higher sea surface temperature and lower biomass, and pointing to the geographical locations where this impact is most prevalent could be a powerful force in highlighting the specific impacts of climate change on local livelihoods. Armed with maps and statistics their arguments will be both stronger and more balanced.

Management actions

These data can be used alongside other data sources to identify priority sites for new marine reserves or other reef and fishery management measures. For example, decision-makers might use the map of fishing impact and estimates of current and potential biomass to highlight reefs where there is a high potential for fishery benefits with spatial protection or other strengthened management. Potential protected areas could be designated on reefs with low levels of fishing impact (relatively unfished reefs that could be protected from increases in anthropogenic impact) or on more heavily fished reefs with a large potential for fish biomass increases if fishing was limited.

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 (MSP) 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 habitat and fisheries data to structure conversations with stakeholders who bring their own knowledge regarding the values and impacts of coral reef fisheries to the table.

Reefs in particular are well suited for these discussions as they generate ecosystem services values across many sectors. In addition to their value in providing food and income for fishers and island communities, reefs also drive tourism and protect coastlines. The management scenarios presented in this work could potentially benefit other sectors. On-reef activities, notably diving, are often enhanced and show very high visitation values in marine reserves, and reef restoration efforts may enhance opportunities for on-reef tourism. Likewise, other activities in coastal waters, may be better planned with an understanding of key areas of fishing.

Scale limitations

The values here have been linked to individual reef cells of 1 hectare (100m x 100m). While the coral reef habitat data inputs to this model were mapped at a very fine scale (4m), experimentation indicated that 1 hectare cells represented an appropriate grid size that retains habitat detail, but is computationally tractable (~6800 cells) and at a reasonable scale to estimate using biophysical datasets (e.g., sea surface temperature) which are often available only at a much coarser resolution. Although the reefs are mapped at a 1 hectare resolution, we recommend that the maps be used at an assumed resolution of no less than 1:25,000 and in generating statistics we advise not attempting to summarise information for any areas smaller than 5km x 5km.

Time-frames

The large dataset assembled for this project was not collected simultaneously; we use data from fish surveys undertaken from 2011 to 2019 (with the exception of Dominica surveys completed in 2005 and used only for estimates of parrotfish mean length). Year of collection was included in the models of both fishing impact and fish biomass to account for any temporal variation in fish assemblages. Where year was a significant variable, values of fishing impact or fish biomass across the region were predicted across the continuous maps using 2018 to provide currently expected values that are most useful for ongoing management planning. It is possible that Covid-19 may have disrupted some of these patterns; however, the direction (i.e. increasing or decreasing fishing impact) and intensity is not yet known. We recommend that users who are aware of such influences bear these in mind when examining our maps and make allowances for such change. Future monitoring data could be used to further refine the models and maps.

Other caveats and limitations

These are modelled data products, with overall accuracy dependent on the quality of input datasets. Due to low sample sizes, a full range of management scenarios, other species/species groups, and relationships between fish biomass and other variables have not been evaluated under this project. These products can be most useful in a management context when used together with other forms of data and knowledge regarding the distribution of fishing and fishing impacts and fish biomass on these reefs.

Please note, the maps only represent coral reef fisheries, they do not cover the extensive offshore fisheries for pelagic species (such as mahi mahi, wahoo, tuna) or fishing in seagrass meadows and associated patch reefs (where invertebrates such as lobster and conch are found).

Update and revise

Technical users are encouraged to explore the approaches and input datasets used and the products generated by this project. 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. Future iterations of this type of modelling could incorporate new findings or data which could strengthen outcomes and reduce biases. Given new or improved datasets, it is possible to re-run these models with the new or different input layers, and incorporating additional fish survey data would be useful assuming sufficient spatial statistics background and other technical qualifications. Detailed geoprocessing steps can be found in the technical report; all spatial data processing was done using ArcGIS Pro and models were coded and run in R. The project team can be contacted to access data and for further information.

Post-Covid

The final outcome and impacts of the Covid pandemic remain hard to foresee. In some locations around the world, decreases in tourism revenue during Covid-19 have driven increases in coastal fishing pressure as communities turn back to traditional fishing as a source of food and revenue. In other cases, a drop in demand for local seafood from tourism attractions has temporarily decreased pressure. At present, there is no data suggesting what the impact will be on coral reef fisheries in CROP countries; however, the pandemic presents an opportunity to evaluate future scenarios and promote active management to ensure long-term stability of these.

Closing Words

These maps give detail to an already well-understood dimension of the economy in the Eastern Caribbean. The reefs of the Eastern Caribbean are a vital resource for island residents, supporting subsistence, artisanal, and small-scale commercial fishing. 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/coral-reef-fish-and-fisheries/

PROJECT CONTACT:

Kate Longley-Wood,
Project Manager,
The Nature Conservancy

Kate.longley-wood@tnc.org

Organisation of Eastern Caribbean States

The Nature Conservancy
oceanwealth@tnc.org
https://oceanwealth.org/project-areas/caribbean/crop/

Cover photo: ©Tim Calver
This page photo: ©Shane Gross