



BE-CLME+ Project: Promoting National Blue Economy Priorities  
Through Marine Spatial Planning in the  
Caribbean Large Marine Ecosystem Plus  
(GEF Project ID 10211).

National Consultancy to Conduct  
Data Gap and Needs Assessments  
for the Fisheries Sector to Inform  
Marine Spatial Planning in Barbados.

## Report

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## List of Acronyms and Abbreviations

BE	Blue Economy
BFD	Barbados Fisheries Division
CAF	Development Bank of Latin America and the Caribbean
CERMES	Centre for Resource Management and Environmental Studies
ESRI	Environmental Systems Research Institute, Inc.
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environmental Facility
GIS	Geographic Information Systems
GOB	Government of Barbados
CLME	Caribbean Large Marine Ecosystem
CZMU	Coastal Zone Management Unit
CRFM	Caribbean Region Fisheries Mechanism
ESS	Environmental and Social Safeguards
FADs	Fish Aggregating Devices
MSP	Marine Spatial Planning
NGO	Non-Governmental Organization
PMU	Project Management Unit
POC	Point of Contact
TNC	The Nature Conservancy
TOR	Terms of Reference



## Executive Summary

Since 2018, with the creation of the Ministry of Maritime Affairs and the Blue Economy (BE) the government of Barbados has been promoting the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems (on the entire exclusive economic zone —EEZ). These efforts are supported by a financial initiative called “Blue Bond for Ocean Conservation” and made possible with the support from TNC and the Inter-American Development Bank. This initiative allows the country to reduce its international debt and will direct an estimated \$50 million into a comprehensive marine protection effort.

In 2021, with funding from the Inter-American Bank, the government adopted the Blue Economy Policy Framework and Strategic Action Plan (IADB, 2021) to guide development of that country’s blue economy. While the BE focuses on leveraging ocean resources sustainably, Marine Spatial Planning (MSP) provides the tools and processes to manage marine environments effectively through the optimization of the use of marine space, user conflict remediation and enhancing the health of the marine ecosystem.

Because of the integration between the BE and the MSP process, the government is currently developing the “Barbados Marine Spatial Planning Design Guide”. This document will be used as an internal document to guide the process of developing the MSP, providing information on elements related to strategic direction, project management processes, and communications for use by the MSP planning team (GOB, 2023). A MSP Project Unit (within the Barbados Coastal Zone Management Unit) is undertaking the tasks and activities for the MSP process with the support of other government agencies (including the Barbados Fisheries Division), non-governmental organization (such as The Nature Conservancy), and academic institutions (such as Centre for Resource Management and Environmental Studies), among others.

Regional initiatives are also aiding this process, including key partners such as TNC. Furthermore, this consultancy to conduct a data gap and needs assessment is being supported by the BE-CLME+ Project: Promoting National Blue Economy Priorities Through Marine Spatial Planning in the Caribbean Large Marine Ecosystem Plus (GEF Project ID 10211).

The objective of this consultancy is to develop a comprehensive assessment of data gaps and needs (focused on the fisheries sector) to inform MSP in Barbados. To this end, three interconnected activities were implemented:

1. a systematic literature and web review which included scholarly works and gray literature developed by governments, international agencies, and NGO’s. At least 240 documents were reviewed.
2. a participatory mapping exercise involving fisherfolks. The objectives of this activity were to map important areas related to the fisheries sector, and to facilitate the engagement of fisherfolks in the marine spatial planning process. Two mapping sessions were conducted with the support of the Barbados Fisheries Division (BFD). This activity jump-started data collection on desired fishing themes and the participation of fisherfolk in the MSP

process. The BFD will organize and implement further mapping sessions to increase sample size and the representativeness of this information.

3. structured interviews with key stakeholders representing the fisheries sector. Interviews were conducted via email, face to face, and via phone (WhatsApp). Solicited information included awareness of spatial layers related to the fisheries sector, data sharing protocols, and perception of needed spatial data to inform MSP.

The overarching goal of the BE Roadmap is *“to create and implement governance that enables inclusive and distributive economic growth within the limits of healthy and resilient marine ecosystems”* (IADB, 2021; Singh-Renton, 2024). Similarly, the MSP incorporates a holistic approach by considering ecological, economic, and social factors and integrating multiple uses for an inclusive decision-making that considers the needs and inputs of multiple parties. The BE Policy Framework and Strategic Action Plan proposed pivotal sectors are fisheries, tourism, marine transportation, energy, marine technology, marine services, and maritime non-living resources (e.g., sand, minerals, etc.) (IADB, 2021).

This assessment focused on the fisheries sector that might operate on the entire EEZ of Barbados. The BE Roadmap proposed goal for the fisheries sector is *“a sustainable fisheries sector, that enables inclusive and distributive economic growth within the limits of healthy and resilient marine ecosystems, through enabling policies for equitable participation, environmental and social protection, industry growth and diversification, clean technologies, circular material flows, and outcome-based management”* (Singh-Renton, 2024).

The MSP process in Barbados is still in the early stages of development (step 3 and 5) and zones have yet to be determined. The MSP process is typically divided into the following steps:

- |  |  |
|--|--|
| 1) Identifying need and establishing authority | 6) Defining and analyzing future conditions                      |
| 2) Obtaining financial support                 | 7) Preparing and approving the spatial management plan           |
| 3) Organizing the process through pre-planning | 8) Implementing & enforcing the spatial management plan measures |
| 4) Organizing stakeholder participation        | 9) Monitoring and evaluating performance                         |
| 5) Defining and analyzing existing conditions  | 10) Adapting the spatial management process                      |

In terms of available data to inform MSP, this assessment found that although some data, related to the fisheries sector, is available (e.g., distribution of seine, longline, fishery, sea urchin, queen conch fishing grounds, etc.), its use for MSP may be limited because it requires effort and time to bring all the current data into one geospatial platform. For instance, when describing the distribution of the fishery sector, some layers show the distribution of fishing areas by gear while others describe the distribution by target species. Furthermore, in some cases the distribution of the fishery in question is symbolized using dots, while in other cases it is displayed using polygons or grid cells. Additionally, much of the current data is outdated and it represents a single or limited snapshot of the distribution of the feature of interest. During the

MSP step 5 (defining and analyzing existing conditions) the use of the current data types from the existing literature is going to be challenging. Further analysis (e.g., scenario modeling) and systems to collect and analyze longitudinal data will be required to better support the MSP process in Barbados.

Like data pertaining to the fisheries sector, other associated data (e.g., marine habitats, species distribution, risk assessments, etc.) present some challenges. The limitations identified for data currently available is that most of it is in a non-spatial format (e.g., contained in reports as images); some of the data is more than 10 years old which limits its relevance in dynamic environments; some data were created with specific objectives and outputs that might not align with MSP processes and goals; most of the current data does not cover the entire of Barbados' Exclusive Economic Zone (EEZ); the target species and themes characterizing features potentially relevant to MSP are limited and data collection protocols will have to be developed and implemented to fill data gaps in spatial and temporal resolution. Addressing these limitations requires collaborative efforts among stakeholders, investment in data collection and management, and the development of standardized practices to enhance the quality and accessibility of marine data.

In terms of technological resources, both the CZMU and the BFD meet the minimum hardware requirements for installing and working with GIS software. They also have backup systems and antivirus software. However, the current internet connectivity (speed and reliability) could be improved. Furthermore, the government of Barbados has not negotiated a multiagency ESRI<sup>1</sup> license. Therefore, each agency must secure funding and negotiate their individual license with an authorized distributor or use alternative software. At the time of the assessment, CZMU was utilizing ESRI products, but the BFD was in the process of getting its license. It is recommended that all relevant sectors (and agencies) use the same software for data collection, management and sharing. This will facilitate integrating data from multiple sources into a unified MSP platform or system.

An essential factor in the success of MSP is human capacity. It encompasses the skills, knowledge, and resources that individuals and organizations possess to effectively engage in the MSP process. There are discrepancies regarding human resources between the CZMU and the BFD. The CZMU MSP team is integrated by a multidisciplinary team with GIS knowledge ranging from intermediate to advanced. While the BFD has limited personnel with only basic knowledge in GIS. However, due to lengthy hiring processes and salary funding sources, in both cases, several people interviewed from BFD and the CZMU are yearly contracted personnel, which could create an unstable environment and a greater personnel turnover. Capacity development should also be promoted through the different agencies. Including training and outreach opportunities for key stakeholders and the public in general should also be provided. This will help to implement more effective, equitable, and sustainable marine management strategies that balance ecological health with human needs and values.

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<sup>1</sup> The Environmental Systems Research Institute, Inc. (ESRI) is one of the world's leading supplier of GIS software, web GIS and geodatabase management applications. Esri's GIS technology enhances the effectiveness and efficiency of MSP initiatives by providing several interconnected products useful for data collection and integration, visualization, collaboration, analysis tools and real-time or near-real-time data.

Finally, MSP presents an opportunity to promote collaboration and synergy among government agencies, non-profit organizations, and academic institutions to collectively assist in capacity development and the refinement of processes for data collection, meta-data, storage, and analysis to underpin MSP policy, stakeholder engagement and buy-in, and enforcement.

## Introduction

Marine Spatial Planning (MSP) is an adaptive process to analyze the spatial and temporal distribution of bio-physical features and human activities in marine and coastal areas. These data underpin policy and management that strive to balance the protection of human needs and the integrity of marine resources to achieve ecological, economic, and social objectives (Douvere & Ehler, 2009).

The Barbados Blue Economy Policy Framework and Strategic Action Plan is intended to guide the development of the country's blue economy (IADB, 2021). In support of this plan, the government of Barbados (GOB) has signed onto the "blue bond" agreement which is currently supporting the development of the country's MSP. The planning area will include Barbados' maritime areas (Territorial Sea and Exclusive Economic Zone) (Figure 1).

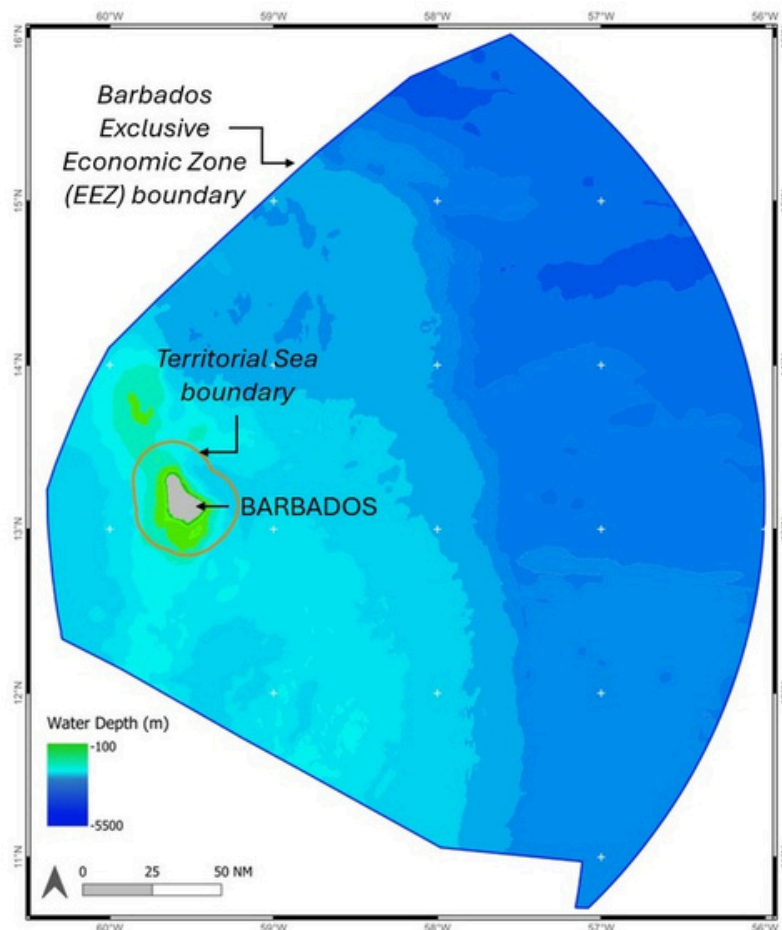


Figure 1. Barbados territorial sea (12nm) and exclusive economic zone (200nm) boundaries.

The MSP encompasses a holistic approach by considering ecological, economic, and social factors and integrating multiple uses and stakeholders (each with unique interests and responsibilities) for an inclusive decision-making that considers the needs and inputs of multiple parties. Effective MSP requires collaboration among these stakeholders to balance competing interests, promote sustainable use, protect marine ecosystems, and enhance livelihoods. Engaging all relevant parties early in the planning process ensure diverse perspectives are considered and actions to implement a marine spatial plan have greater support from the different ocean users. Table 1 describes Barbados proposed pivotal sectors (IADB, 2021).

*Table 1. Barbados BE Action Plan/Roadmap essential sectors (IDB, 2021).*

Sector	Description
Fisheries	Involves the harvesting, processing, and distribution of fish and other aquatic organisms for human consumption and other uses.
Tourism	All activities and services related to travel and hospitality.
Marine transportation	Involves the movement of goods and people over water using various types of vessels.
Energy	All activities related to production, distribution, and consumption of energy.
Marine technology	Relies on bioprospecting, market demand, R&D, as well as the availability of sustainable supplies of the resource that are confirmed by surveys and inventories. It is also supported by the feasibility of harvesting biomaterials given the logistical considerations, environmental impacts, and profitability.
Marine services	These services include mapping and data collection, engineering, data management systems, maritime surveillance, compliance and safety inspections through monitoring and enforcement, risk management, insurance, financial services, production of metocean data, and support services for offshore industries such as offshore oil and gas exploration and mining.
Maritime non-living resources	Includes marine aggregates, sands, and deep-sea minerals.

The Coastal Zone Management Unit (CZMU) is the leading agency responsible for the execution of the MSP. Its mission is to develop and implement a national risk resilient Integrated Coastal Zone Management policy and planning framework and, through acting as key advisors to government, support the provision and coordination of quality, timely and relevant information to those who require it. A Marine Spatial Plan Project Unit (within the CZMU) is undertaking the tasks and activities for the MSP process with the support of specialists and consultants. This unit will coordinate with the different BE pivotal sectors (Table 1).

This data gaps and needs assessment is being supported by the BE-CLME+ Project, which is a regional initiative aimed at promoting blue economy development in the Caribbean region

through MSP and marine protected areas, ecosystem approaches to fisheries, development of climate-smart sustainable fisheries value chains, and knowledge management in six Caribbean countries—including Barbados.

This consultancy focuses on the Barbados fisheries sector. The BE action plan/roadmap specific objectives for the fisheries sector include building climate resilience, improving sustainability, and improving community access to high value capture fisheries (HVCF), as well as developing the value chains associated with HVCFs, extending the range of HVCFs, and exploring mariculture options (IADB, 2021). These objectives will require supporting data not only related to the fisheries (spatial and temporal distribution of the different fisheries) but also more and better data of commercially important fish species and the potential for the development of mariculture opportunities. Therefore, this consultancy worked with Barbados' Fisheries Division on an assessment of needs, data availability and data gaps, specifically related to the fisheries sector, to contribute to the work currently being undertaken by the CZMU to inform the MSP process in Barbados.

The government of Barbados has developed the Barbados Fisheries Policy 2023—2033 as part of the ongoing BE agenda. *“The policy provides for a set of principles and guidelines that will serve as an overall framework for guiding public action and related investments in the sector and support the forthcoming Sustainable Fisheries Management and Development Suite of Laws and an updated Fisheries Management Plan”* (Fisheries Division, 2023). The integration of MSP into this policy is fundamental for achieving holistic management of the country's marine environments. Some synergies between this policy and MSP are:

- Sustainability goals: Both the fisheries policy and MSP aim to promote sustainable use of marine resources, ensuring that fishing practices do not deplete stocks or harm marine ecosystems.
- Ecosystem-based management: Both frameworks advocate ecosystem-based approaches, considering the interconnections between species, habitats, and human activities in marine environments.
- Data-driven decisions: Effective MSP relies on comprehensive data collection and analysis. Barbados' fisheries policy encourages the improvement of existing data collection system to support scientific research, economic analysis, and local knowledge to inform management decisions.
- Zoning: MSP provides a framework for spatially managing different marine activities, such as fishing, tourism, and conservation. Zoning can help reduce conflicts between sectors and protect critical habitats.
- Stakeholder engagement: The fisheries policy emphasizes the importance of involving fishers, local communities, and other stakeholders in decision-making processes. MSP facilitates this engagement by bringing various interests together.
- Capacity building: Both initiatives stress the importance of capacity building for fishers and communities, enhancing their ability to participate effectively in fisheries management and MSP processes.

- Monitoring and evaluation: Regular monitoring and evaluation of marine activities are essential components of both frameworks, helping to assess the effectiveness of management measures and adjust them as needed.

This holistic approach promotes collaboration, stakeholder engagement, and informed decision-making, ultimately benefiting both people and the environment.

The MSP process is typically divided into steps (Fig. 2), each critical for creating and implementing an effective marine spatial plan. An initial analysis can be performed with existing data to establish a baseline and to initiate stakeholder dialogue and participation (steps 1 to 4). However, as the process evolves, more reliable data should be secured (step 5 & 6) and/or use to improve results and adapt the spatial management process (steps 9 & 10). Stakeholders' input is central throughout the different steps to ensure that results (and their implications) reflect true and acceptable conditions. The MSP process in Barbados is still in the early stages of development (step 3 and 5) and zones have yet to be determined.

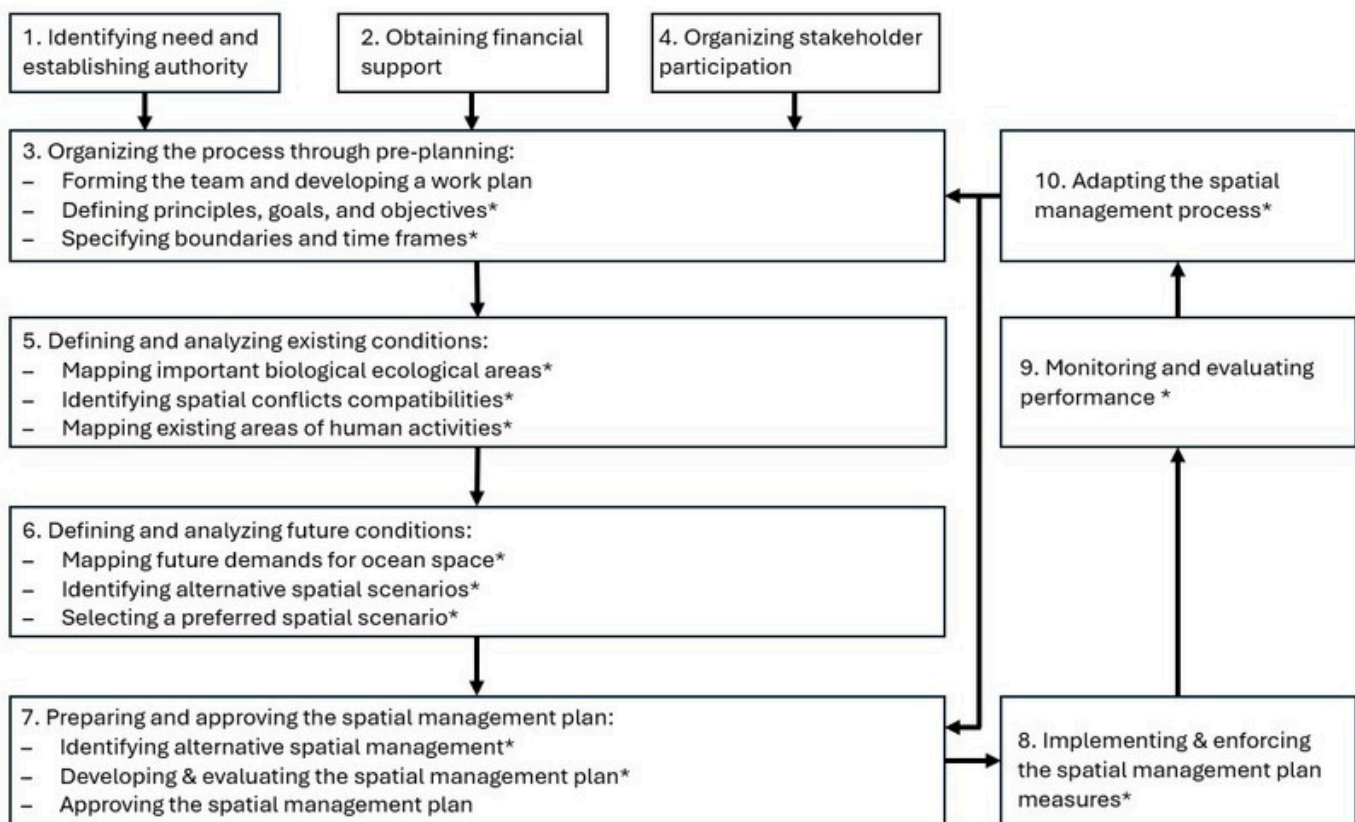


Figure 2. MSP steps (Ehler & Douvère, 2009). Asterisk (\*) indicates stakeholder participation in step.

The MSP process should be guided by clear objectives. However, in terms of data needs, four broad categories have been identified in the literature (World Bank, 2022):

- Administrative boundaries: A limit or border of a geographic area under study or area of interest. Example of these layers are national, territorial, EEZ, protected areas, etc.

- Physical, chemical, and biological features and processes: This information provides details about the physical and chemical conditions and processes in the ocean (e.g., sea surface temperature, bathymetry, etc.). It also includes biological features and processes which include data on the distribution and/or condition/status of marine-related species (e.g., fish, birds, sea turtles, coral reefs, pollution, invasive species, etc.).
- Human activities and uses: these layers are used to identify temporal and spatial geographic areas where human activities of interest are taking place, for example, shipping channels or lanes, fishing effort, location of fish aggregating devices (FADs), underwater heritage sites, etc.
- Socio-economic: the inclusion of this information in MSP varies. This information is usually obtained through trade-offs and economic valuation studies.

The MSP process requires the collection of spatial data and information underpinning planning processes and collaborative decision-making. Data for MSP is intended to help characterize the spatial distribution of human activities within marine ecosystems, allowing for the prioritization of zones compatible for various human uses, zones that should be afforded some measure of environmental protection, and zones that are suitable for shared space opportunities. Data collected for MSP may also be relevant in evaluating future economic and climate scenarios.

## Objective

The objective of this consultancy is to comprehensively assess data availability, data gaps and data needs - specifically related to the fisheries sector - to inform MSP in Barbados. Several countries in the Caribbean, including Barbados, have initiated MSP and Blue Economy development processes, and as such, the assessment is intended to complement ongoing BE processes in Barbados (Appendix 1).

## Approach and Methodology

Our approach consisted of 3 interconnected activities: (1) a systematic literature review and on-line exploration for relevant spatial data (2) a participatory mapping exercise involving small-scale fishers to identify and map zones that are important to their fishing activities; and (3) an assessment of organizational capacity and needs through interviews with key stakeholders in the fisheries management sector.

### Systematic literature review and spatial data exploration

An online literature review (activity 1) was conducted to identify publicly available information and spatially represented data (print or digital) relevant to the objective and activities of this consultancy. This review included scholarly works and gray literature developed by governments, international agencies, and NGO's. The review included information pertinent to recommending data sources, acquisition costs (where applicable), and collection methods.

The main databases queried were Google Scholar (97 results 04/20/2024), CERMES technical reports (109 results 05/010/2024), and AquaDocs (35 results 05/08/2024). Terms used during online searches included “Barbados”, “fisheries.” Each result was scanned for spatial data (e.g., GPS information, maps, or geospatial file information). Furthermore, during the interviews (activity 3), participants were asked to provide any lead to known research or projects with spatial or geo-referenced data.

Spatial atlases and databases were also explored using the same search terms and through a snowball method (if a layer was found, other information shared by the author of that layer and his/her organization was investigated). Below is a description of the atlases and databases identified.

- [ArcGIS Online](#) is a cloud-based mapping and analysis platform. It is used to create maps and analyze spatial data which can be easily shared with other users. It requires the creation of an account.
- [Mapping Ocean Wealth](#) provides spatial information about the economic, social, and cultural values of coastal and marine habitats worldwide. Several topics are available in the mapping tool including the value of healthy ecosystems to the tourism industry, coastal protection benefits of coral reefs, and status of coral reef fisheries, among others.
- [Resource Watch](#) (World Resource Institute —WRI) features several data sets such as coral bleaching monitoring, water temperature and salinity, commercial shipping lanes, among others. Data can be visualized through their mapping platform, and it is also easily downloaded.
- [Caribbean Science Atlas](#) (The Nature Conservancy —TNC) provides a compilation of the TNC scientific resources. Data can be visualized and downloaded for further analysis. It also provides tools such as the Blue Carbon Explorer, Climate Mitigation, Coral Restoration, Climate Adaptation, and Marine Protection. Layers available through these tools can be requested by providing a brief description of how the layer will be used.

A complete inventory and description of spatial data references identified is provided in tables 2-7.

## Participatory mapping exercise

The objectives of the mapping exercise were to: (1) map important areas related to the fisheries sector, drawing from participants’ local knowledge, and (2) facilitate the engagement of fisherfolks in the marine spatial planning process.

### 2.1. Pre-mapping exercise activities:

In coordination with the Fisheries Division, a SeaSketch project was created (Appendix 3) to facilitate two participatory mapping workshops with fishers (activity 2). SeaSketch is an online mapping platform that can be used to engage stakeholders and collect spatial information. The SeaSketch project developed for this activity consisted of an online map in which different spatial layers can be accessed by the data collector to guide discussions with fisherfolk (e.g.,

country boundaries, administrative divisions, location of fish landing sites, bathymetry, benthic habitats, vessel distribution, etc.). Layers used for the SeaSketch project were obtained through searches in mapping atlases (e.g., ArcGIS online, Caribbean Science Atlas, etc.). The SeaSketch application was used to guide discussions with fisherfolk to identify current fishing grounds, fish nursing areas, fish aggregation sites, localities of observed user conflict, and the location of any known FADs. Mapped information was connected to a set of questions to gather information about the participants being interviewed (e.g., age, fishing experience, gear used, etc.).

## 2.2. Participatory Mapping Sessions:

Two participatory mapping sessions organized by the BFD were held with fishers on May 6, 2024 (first session) and May 7, 2024 (second session). The first session, held at the Barbados Fisheries Division, was attended by 16 fishers (Fig. 3). The second session, attended by 12 fishers, took place at the Oistins Fisherfolk Cooperative. Small-scale, recreational, and commercial fishers participated in this mapping exercise (Appendix 4: list of participants). Participants were also asked to complete a voluntary participant profile survey (e.g., what sector do you represent, what is your gender, etc.) (Appendix 5).

The consultants provided an overview of the mapping exercise and instructions to the participants to guide their discussions and demarcation of six key data layers, where their input was needed (Appendix 6). Break out



Figure 3. Mapping exercise. A) Fisheries Division May 6, 2024. B) Oistins fisher cooperative May 7, 2024.

groups were organized into six stations allowing groups of fishers, discuss and map features characterizing:

1. Current fishing grounds
2. Historical fishing grounds
3. Fish nursing grounds
4. Fish spawning aggregation areas
5. Locations of known conflict
6. Locations of fish aggregation devices

Discussion taking place at each station was facilitated by the consulting team, members from the BFD, CRFM, and CZMU, who were trained to complete

specialized data forms corresponding to mapped features for each of the six topical areas. Two paper maps (24x36in) displaying the country's administrative divisions and bathymetry were available per station (Fig. 4).

## 2.3 Mapping Exercise Follow-Up:

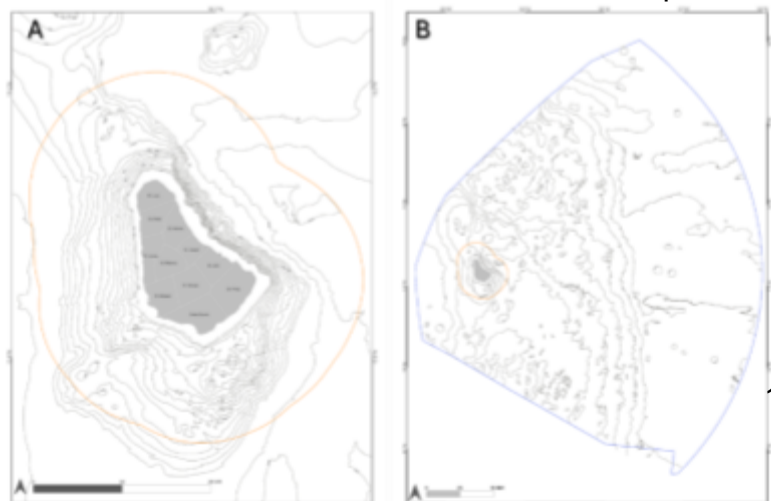


Figure 4. Poster maps (24x36 in) used during the exercise

The Fisheries Division is currently in the process of acquiring the ArcGIS software and was interested in continuing their engagement with fisherfolk the MSP process using a digital data collection application that mimicked the mapping exercise sessions. A live demonstration of the form developed to continue data collection was conducted during a virtual meeting on May 23, 2024. The digital form was shared with the BFD data collectors to facilitate ongoing data collection. Step-by-step instructions on how to install the application and examples of how to use the application for data collection, online and offline, were presented to the fisheries division (Appendix 7).

Data obtained in the participatory mapping exercise was analyzed and summarized maps (when applicable) were created. The information provided by the fisherfolk was digitized as shapefiles (WGS84). A sampling grid (cells=0.5 x 0.5 km) was created to summarize polygon layers and to create density maps. Qualitative and quantitative methods were used to analyze the information obtained by the interviews and the mapping exercise.

### Interviews with key stakeholders in the fisheries sector.

The target group was comprised of people that work/use fisheries spatial and temporal data. People invited to participate in the interviews were identified by the BFD (Appendix 8). Interviews were conducted via email, face to face, and via phone (WhatsApp). Solicited information included awareness of spatial layers related to the fisheries sector, data sharing protocols, and perception of needed spatial data to inform MSP, which was supported by a digital questionnaire designed and used to guide the interviews and ensure that relevant topics were discussed during the meetings (Appendix 9). The main topics discussed during the interviews were (1) the types of existing data and uses of that data, (2) data that is of interest but not being collected or represented spatially, (3) the technical capabilities and training needs/interests among staff to engage in marine spatial planning, and (4) the kinds of software and hardware that are now being utilized to fulfill data acquisition, storage, and analysis. The BFD and the CRFM reviewed the questionnaire and provided feedback.

A national validation workshop was conducted on August 20, 2024. During this activity participants had the opportunity to validate and provide feedback (Appendix 10). A list of participants was created in coordination with the BFD and the CZMU (Appendix 11). Invitations were distributed by the Fisheries Division (Appendix 12). Furthermore, to highlight the findings of this assessment, a brochure was designed in coordination with CRFM and BFD (Appendix 13).

## Results and Discussion

### Assessment of the status of MSP processes in Barbados

Barbados has been actively engaging in MSP to enhance its marine resource management and support sustainable development. The MSP efforts are closely aligned with Barbados's Blue Economy strategy through planning and guiding documents such as:

- The Barbados Blue Economy Scoping Study (Stocktake, 2020): within the thematic area 1: enabling environments through the Area 1.1. integrated approaches to ocean governance, the document highlights the need for establishing a national marine spatial planning and zoning programme through MSP. And under Area 1.6. Research and marine information, the reports document the lack of information to inform MSP (especially at a national EEZ-scale).
- Implementation of an Integrated Blue Economy Policy Framework and Strategic Action Plan for Barbados (IADB, 2021): through its section on enabling strong blue growth, it emphasizes the need for integrated multisectoral data inventories (including the fisheries sector) and the importance of transitioning to an information governance framework (digital ocean).

The data gap and needs assessment conducted will complement the current MSP process being undertaken by the Government of Barbados (GOB). The development of this MSP is overseen by a cabinet-appointed MSP Project Steering Committee (PSC). This committee is comprised of representatives from the Ministry of Environment and National Beautification; the CZMU, the Blue Economy and Fisheries Divisions; the Policy Research Planning and Information Unit, the Planning and Development Department; the Ministry of Energy and Business; the Ministry of Tourism and International Transport (Tourism, Shipping Registry, and Barbados Coast Guard), the University of the West Indies (UWI) – Centre for Resource Management and Environmental Studies (CERMES), the Barbados Chamber of Commerce and Industry (BCCI), and the Nature Conservancy (TNC).

The MSP Project Steering Committee is currently developing the “MSP Design Guide” which will provide information on elements related to strategic direction, project management processes, and communications for use by the MSP planning team. The guide’s workplan includes actions to generate sector-specific analysis (including the fisheries sector) of existing and future conditions (as needed). It also includes actions to create and maintain a geospatial database with a web-based data viewer and planning tools.

The MSP Plan is currently under development under the leadership of the CZMU. Several milestones have been identified, including: 1) determine goals and objectives, 2) identify issues and collect appropriate information/forecast, 3) analyze information and generate options, 4) evaluate options, 5) prepare spatial plan, 6) examination of plan, 7) adopt plan, 8) implement and monitor and review. The MSP process in Barbados is currently working on milestone 2.

## Data currently available that could be used to inform MSP

The following section characterizes the status of fisheries-related data deemed relevant to the MSP process based on existing literature and examples of MSP worldwide. MSP relies on various types of data (e.g., fisheries data, species distribution, habitat data, oceanographic data, etc.) to make informed decisions about the sustainable use of marine resources.

### Fisheries Distribution

This category refers to spatial arrangement or movements of fishing activities. Incorporating fisheries data into MSP ultimately supports balanced and effective marine resource use,

benefiting both ecosystems and human communities. In general, available spatial information related to the fisheries sector is limited. The available data was presented with different thematic approaches (e.g., distribution of fishing activities by gear or by target species), spatial data types (points, polygon, line data or raster format), with little to no details of how the data was collected, how the analysis was conducted, or how the resulting map was created (e.g., coordinate system, spatial tools used, etc.). Existing data are presented at different spatial resolutions and scales (study site, countrywide, etc.), and represent a static view (snapshot) of observed distributions. Below is a summary of these observations, with references provided in Table 2.

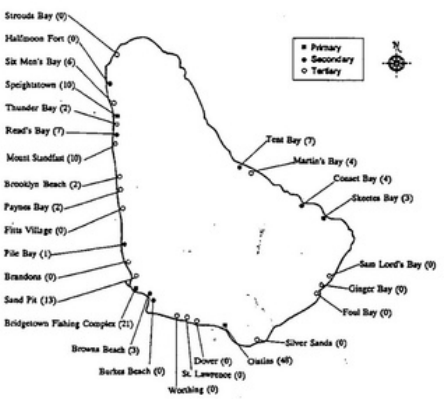
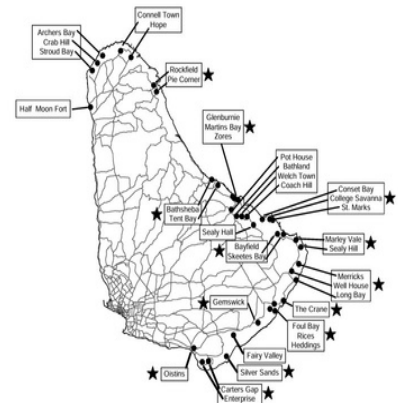

- **Thematic approach:** Ideally a map should have only one purpose or message so that the information it presents is clear and concise. Existing spatial information can be broken down into four thematic categories.
  - Location of fish landing sites: This includes estimates of the number of fishers per site. Data are represented as point features on land (Cecil, 1943; Bair, 1996; Prescod et al., 1996; Salas et al. 2011). This provides a general overview of where fisherfolk are launched from (as well as historical references), but it does not provide information about the location of different fishing activities on the water (e.g., how far from shore they are fishing, where their fishing grounds are located, fishing effort, etc.), limiting its use for MSP.
  - Distribution of fishing activities by gear: Some of the studies found are documenting the spatial distribution of longline fishing, seine fishing, or spear fishing, etc. (Rawlins et al. 2007; Walcott et al., 2009; Maraj et al., 2011; Blades et al., 2019; Gill et al., 2019).
  - Fishing grounds of specific target species: Other studies documented the distribution of fishing grounds or fishing activities based on target species such as flying fish, queen conch, sea urchin, lobster, etc. (Sobers 2010; Sheibling & Mladenov, 1987; McConney et al., 2003; Vermeer et al., 2005; Cox and McConney, 2012).
  - Vessel tracking data: this is the most spatially precise and provides the greatest amount of information, but it is also resource and capacity demanding. It involves the use of vessel tracking devices. This technology allows for the creation of maps showing fishing distribution by gear or by target species over time. It also requires higher levels of fisherfolk participation as they must agree to install the device on their vessel and provide information related to their catch. This data was collected through the project Digi-Fish a 1-year project funded by the Barbados Environmental Conservation Trust. Current data was collected in 2022 through a pilot test with 30 small-scale vessels (devices were installed in 12 landing sites, most of them in the west coast of Barbados).
- **Data types:** There are two data models used in GIS for mapping data: vector or raster. A vector model can be represented as points, polygons or lines features. A raster model (grid data) consists of a matrix of equally sized cells. Each cell represents a location and contains a numeric value with continuous or discrete data. Characterization suggests that existing data characterizing fisheries distribution is presented in different data types. Some of the studies conducted used point features (Mitchell, 1999; Rawlins et al. 2007; Oxenford et al., 2007; Walcott et al., 2008; Mahon et al., 2003), others used polygon features (Maraj et al.,

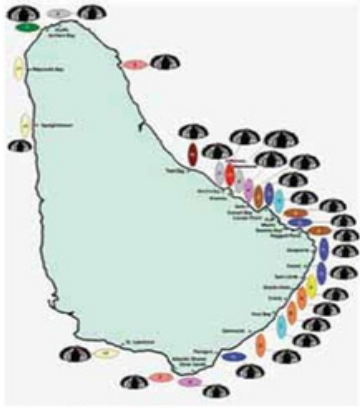
2011; McConney et al., 2003 Blades et al., 2019), while others represent the data using a grid (raster) format (Gill et al., 2019; Zuecher et al., 2021; DigiFish, 2023). The multitude of different data types/formats for characterizing similar features suggests that comparison might require standardization and/or will be challenging. MSP involves combining multiple data layers. When all layers are in the same type, it facilitates easier integration and analysis, allowing planners to see relationships and patterns clearly. Furthermore, different software and tools used in MSP may require specific data formats. Having all layers in the same type increases compatibility across various platforms.

Furthermore, most current data is available in a PDF format which is not compatible with GIS software. Spatial layers will have to be requested to the authors. If the spatial data used to create the map of interest is no longer available, the PDF map(s) can be digitized and georeferenced. However, this will require extra effort and give rise to potential errors to the spatial layer diminishing the accuracy of the data being presented.

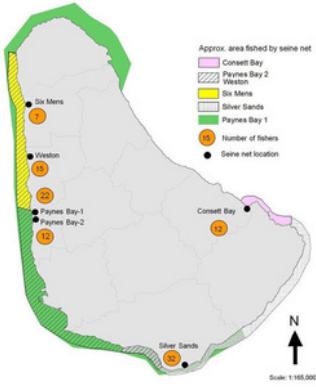
- **Metadata:** In GIS metadata describes how the data were created or obtained, what parameters were used, at what scale, etc. Because the metadata provides essential context and information about the data being used, it is important to have access to such data. Some of the data found did not have metadata (especially information found in PDF format) limiting and cautioning about its use.
- **Data accuracy and spatial resolution:** Data accuracy is a statement of how closely a spatially referenced feature reflects reality. Spatial resolution refers to the detail/precision with which a map depicts the location of geographic features. The data review indicated that there is a different level of accuracy based on how data was collected and analyzed. Basic studies (Sobers, 2010; Sheibling & Mladenow, 1987; Vermeer et.al., 2005) used simple methods (e.g., circles and/or marks) indicative of low accuracy and spatial resolution. Other studies used data generated through interviews to show the distribution of interest with simple unprocessed polygons (Maraj & Cox, 2011) or point features (Rawlins et al. 2007; Walcott et al., 2008; Blades et al., 2019). In other studies, more sophisticated methods (e.g., results were generated from modelling observed data and explanatory variables) were used (Gill et.al., 2019; Zuecher et.al., 2021). The latest approach includes the use of tracking technology (DigiFish, 2023), which increases data resolution and reduce errors and uncertainty commonly associated with other data collection methods. These sorts of applications will allow for the capture and generation of higher-resolution data for mapping and characterizing the spatial distribution of specific fisheries in Barbados.
- **Spatial scale:** Spatial scale involves grain, the size of pixels, and extent, the size of the study area. Most of the spatial information currently available and analyzed is described for land (Mitchell et al., 1999; Salas, et al., 2011;), and nearshore (Sheibling & Mladenov, 1987; McConney et al., 2003; Vermeer et al., 2005; Oxenford et al., 2007; Maraj et al., 2011; Cox and McConney, 2012; Gill et al., 2017; Zuecher et al., 2021). There are limited examples of fishing distribution outside Barbados territorial waters (Sobers, 2010; Rawlins et al., 2007; Walcott et al., 2009; Blades et al., 2019; DigFish, 2023).
- **Explanatory and predictive capacity:** Spatial information referenced in reports and scientific literature, in most cases, represented a single or limited snapshot of the distribution of the

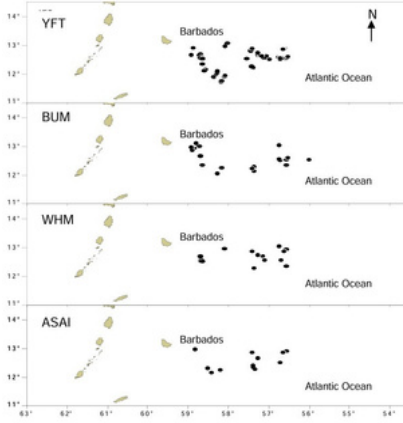
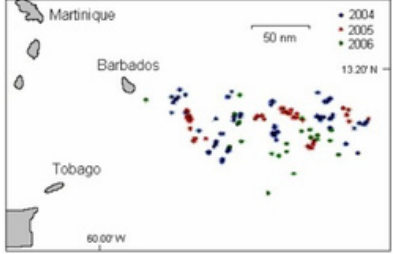
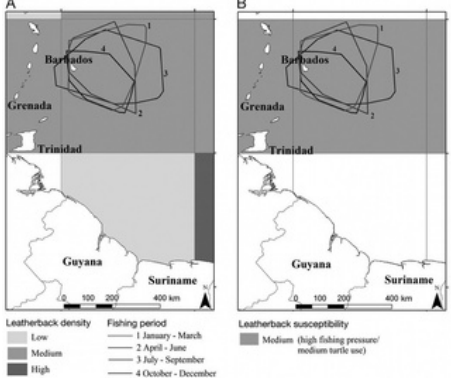


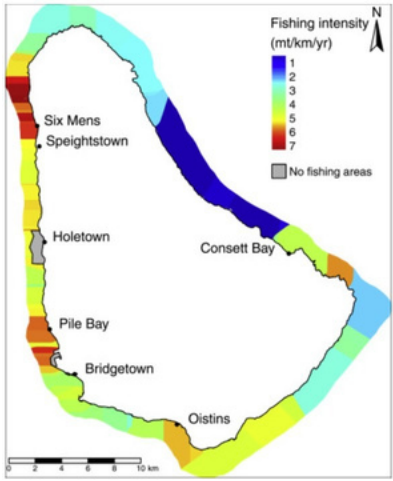
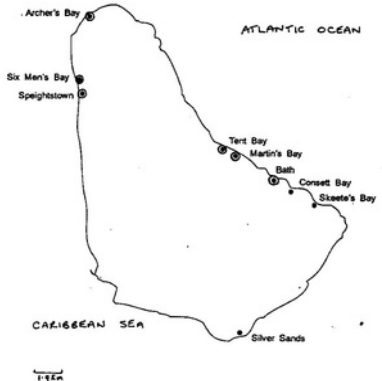

Reference	Name	Documented spatial data:	Spatial data
Prescod et al. 1996	<a href="#">The snapper fishery of Barbados: present status and a preliminary assessment of the potential for expansion</a>	<p>Fig. 1. Fish landing sites around Barbados showing the location and number of boats involved in the snapper fishery. Pag. 161</p> <p>Other information: Table 1 shows snapper fishing fleet by gear used based on Fig. 1. Pag. 163</p>	
Mahon et al. 2003	<a href="#">Participatory methodology used for sea urchin co-management in Barbados</a>	<p>Fig. 1. The main sea egg fishing communities as identified by fishers and by the initial contact survey.</p> <p>Communities enclosed in boxes are perceived by fisherfolk to be one community. Stars indicate communities where meetings were held.</p>	
Salas et al. 2011	<a href="#">Coastal fisheries of Latin America and the Caribbean</a>	<p>Fig. 5. Distribution of sea urchin harvesters. Pag. 66.</p>	 <p>Source: Fisheries Division.</p>

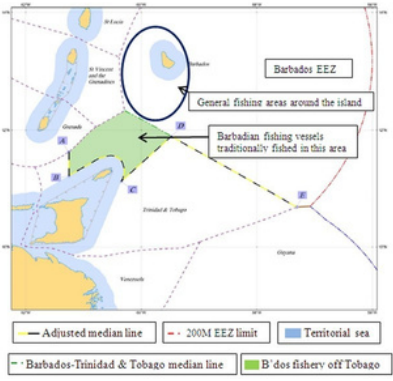
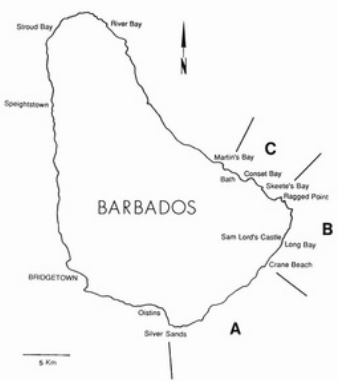

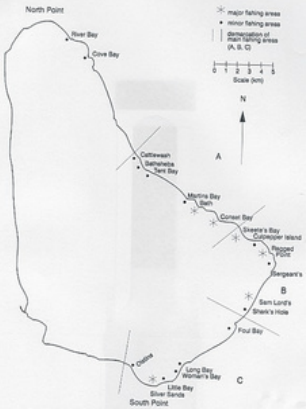
Reference	Name	Documented spatial data:	Spatial data
Salas et al. 2011	<a href="#">Coastal fisheries of Latin America and the Caribbean</a>	Fig. 6. Distribution of sea urchin resources. Pag. 66.	 <p>Source: Fisheries Division.</p>


Distribution of fishing activities based on fishing gear

Maraj et al. 2011	<a href="#">The small-scale seine fishery of Barbados: Description and current contribution to the fishing industry</a>	Fig. 1. Map of Barbados showing the location of the six seine nets, numbers of seine fishers and approximate areas fished by each net around the coastline. Pag. 3	
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Reference	Name	Documented spatial data:	Spatial data
Rawlins et al. 2007	<a href="#">Preliminary Investigation of the Diets of Large Oceanic Pelagic Species of Importance to the Longline Fishery in Barbados</a>	Fig. 2. Location of capture for each sampled fish (black dots) shown separately for each species. FYT – yellowfin tuna, BUM – Blue marlin, WHM – white marlin, ASAI – Atlantic sailfish. Pag. 245	
Walcott et al. 2008	<a href="#">Current Status of the Longline fishery in Barbados</a>	Figure 4. GPS coordinates of fishing sets made by five Barbadian longline vessels between 2004 and 2006. Pag. 26	
Blades et al. 2019	<a href="#">Leatherback bycatch in an eastern Caribbean artisanal longline fishery</a>	Fig. 1. Areas fished by 5 Barbados longline vessels during different quarters of the year between April 2014 and December 2016, superimposed on (A) leatherback sea turtle density pixels estimated from satellite tracks (adapted from Fig. 1b in Fossette et al. 2014) and (B) areas of susceptibility to bycatch where high fishing pressure overlapped with leatherback habitat use (adapted from Fig. 2 in Fossette et al. 2014)	

Reference	Name	Documented spatial data:	Spatial data
Gill et al. 2017	<a href="#">Making the most of data-poor fisheries: Low-cost mapping of small island fisheries to inform policy</a>	<p>Fig. 2. Variability in annual commercial fishing intensity (mt km<sup>-2</sup> yr<sup>-1</sup>) for reef-associated species on the nearshore shallow shelf in Barbados.</p> <p>Other information:            Fig. 4. Spatial variation in fishing intensity (mt km<sup>-2</sup> yr<sup>-1</sup>) from (A) spear fishing, (B) trap fishing, (C) line fishing, and (D) seine fishing.</p>	
<b>Fishing grounds by target species</b>			
Mitchell 1999	<a href="#">Notes on the local fishery and import trade for spiny lobsters in Barbados</a>	<p>Fig. 1. Fishing areas and landing sites for lobster in Barbados. Pag. 123</p> <p>Note: handmade map</p>	
Oxenford et al. 2007	<a href="#">Fishing and marketing of queen conch in Barbados</a>	<p>Fig. 3.1 Map of Barbados showing conch fishing grounds, landing sites and number of conch divers active on each coast. Deep fishing grounds are &gt; 15 m, requiring SCUBA gear to access them. Pag. 14</p>	

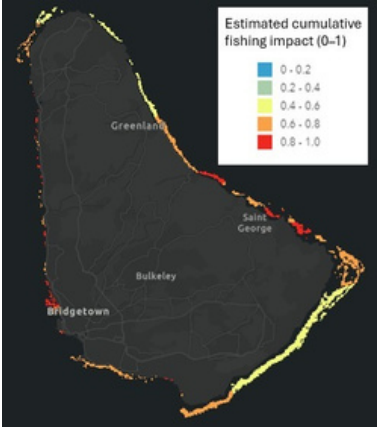
Reference	Name	Documented spatial data:	Spatial data
Sobers 2010	<a href="#">Bioeconomic analysis of the flying fish fishery in Barbados</a>	Fig 2. Barbadian fishing vessels traditional flying fish area. Pag. 7	 <p>The map displays the Barbados Exclusive Economic Zone (EEZ) with various fishing areas. A legend at the bottom identifies: Adjusted median line (dashed line), 200M EEZ limit (dotted line), Territorial sea (blue shaded area), Barbados-Tinidad &amp; Tobago median line (dashed line), and B's fishery off Tobago (green shaded area). A callout box highlights the 'Barbadian fishing vessels traditionally fished in this area'.</p>
Sheibling & Mladenov 1987	<a href="#">The Decline of the Sea Urchin, <i>Tripneustes ventricosus</i>, Fishery of Barbados: A Survey of Fishermen and Consumers</a>	Fig. 1. Places and subareas (A, B, C, D) of sea urchin fishing grounds. Pag.63	 <p>The map shows the island of Barbados with four subareas labeled A, B, C, and D. Subarea A is located on the southern coast near Silver Sands and Clarks. Subarea B is on the eastern coast near Sam Lord's Castle and Long Bay. Subarea C is on the northern coast near Martin's Bay. Subarea D is on the western coast near Speightstown. A scale bar indicates 5 km.</p>
McConnelly et al. 2003	<a href="#">Barbados case study: the sea egg fishery</a>	Figure 5.3 The main sea egg fishing grounds of Barbados (gray shading). Pag. 11	 <p>The map shows the island of Barbados with a gray shaded area representing the main sea egg fishing grounds. Key locations labeled include North Point, Speightstown, Belleplaine, Conset Bay, Ragged Point, Bridgetown, and Oistins.</p>
Vermeer et al. 2005	<a href="#">An assessment of the potential for community-level management of the sea urchin fishery in Barbados</a>	Fig. 1. Sea urchin fishing areas on the southeast and east coasts of Barbados. Pag. 81	 <p>The map shows the island of Barbados with fishing areas on the southeast and east coasts. A legend identifies: major fishing areas (dashed line), minor fishing areas (dotted line), and the delineation of the fishing area (A, B, C). A scale bar indicates 5 km. Subareas A, B, and C are labeled on the map.</p>

Reference	Name	Documented spatial data:	Spatial data
Cox and McConnell 2012	<a href="#">The Role of Livelihood Outcomes and Strategies Play in the Adaptive Co-management of the Sea Urchin Fisheries in Barbados and St. Lucia</a>	Location of the five communities under study in Barbados (2 communities). Pag. 337	

Distribution of fishing activities based on vessel tracking device

DigFish 2023	<a href="#">DigiFish: Data Driven Solutions to Inform Decision Making</a>	Fishing activity overview – by community	
Digifish 2023	<a href="#">DigiFish: Data Driven Solutions to Inform Decision Making</a>	Fishing effort	

Distribution of fisheries activities based on a modeling approach

Reference	Name	Documented spatial data:	Spatial data
MOW Zuecher et al. 2021	<a href="#">Mapping Ocean Wealth</a>	<p>Estimate cumulative fishing impact (0–1).</p> <p>Estimated cumulative fishing impact calculated based on parrotfish mean size. Values scaled from 0 (no fishing) to 1 (highest fishing). Impact values are relative to the fishing impact across the entire study region (Anguilla to Grenada).</p>	

The Barbados fisheries division is also collecting fisheries related data including vessel and fisher registration, and estimated fish catches at landing sites. Data collected at landing sites is recorded using paper forms that are later digitized. However, the BFD has recently developed digital forms for documenting vessel and fisher registration. These forms provide details about Barbados fishing vessel fleet (e.g., size, types, abundance, etc.) as well as general characteristics of fisherfolk (e.g., parish of residence, age, etc.).

#### *Participatory Mapping*

One of the first steps in marine spatial planning is the identification or mapping of human activities (e.g., fishing grounds, shipping, tourism, suitable areas for economic activities, areas prone to conflict between users, vulnerable areas to climate change impacts, etc.), and ecologically significant areas (e.g., marine habitats, species distributions, spawning and nursery grounds, etc.). These activities benefit from stakeholder participation at different levels. To date, there are no similar mapping exercises documented for Barbados.

Fourteen participants completed the voluntary profile survey. Most of the respondents were male (86%); highly experienced (93% with more than 10 years fishing in Barbados), and 50 years old or older (79%). Almost 40% of respondents stated that more than 51% of their previous year's income came from fishing activities (catching and selling the fish), and 57% are members of a fishing association and/or cooperative. The majority (57%) participate in commercial fishing while 21% participate in small-scale fishing and recreational fishing. Most respondents are using a day boat (36%) and longliner (22%). The preferred fishing gear is hand line or rod and reel (40%) followed by long line and gill nets (20%). Most of them are also using a GPS unit (60%) to locate their fishing areas/spots (Fig. 5).

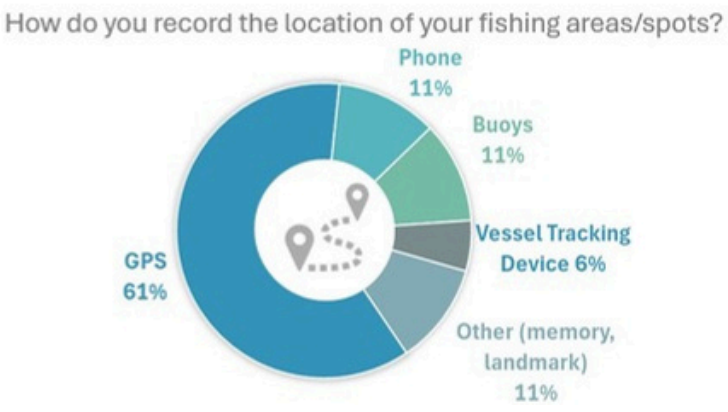
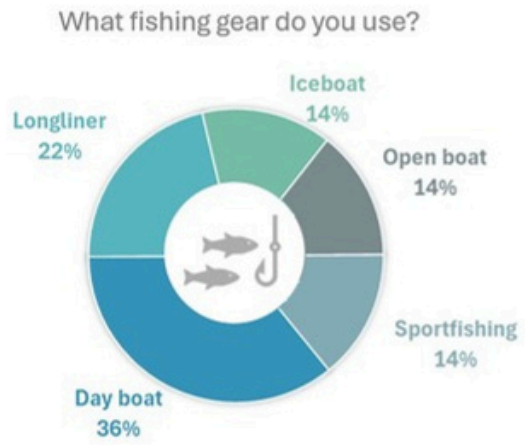
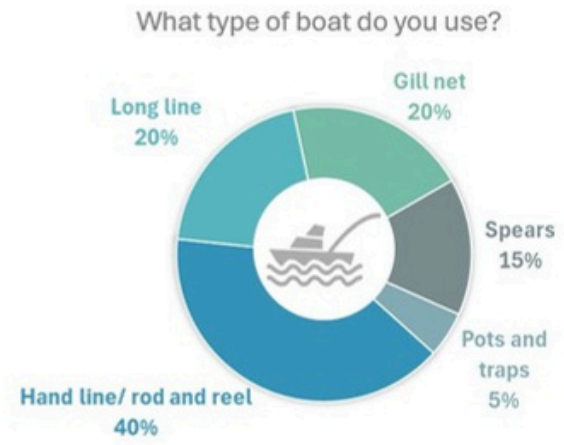


Figure 5. Participants boat, gear, and positioning system characteristics (n=14).

Mapping exercise participants were asked to provide information related to 6 themes:

1. Current fishing grounds: this topic generated the greatest amount of feedback, with 41 polygons. Figure 6 shows participants' feedback as a surface density layer (each grid summarizes the number of overlaying features). A greater number of reports occurred in the nearshore areas (within the territorial sea) in the south (depths 600m or less), and east of Barbados (depths between 450 – 1,000m). Some areas in the north also show a high number of reported fishing (depths up to 150m). Another bank with depths between 350m and 1000m was also reported as a current fishing ground. Areas with only one report were located farther from land. In the EEZ, participants reported fishing grounds between depths of 2,500 – 4,500m along the middle portion of the EEZ. They also reported fishing ground areas east of the Barbados mainland that cover most of the eastern section of the EEZ. The most reported species in the areas mapped include snappers, amberfish, barracuda, and tuna (Table 3).

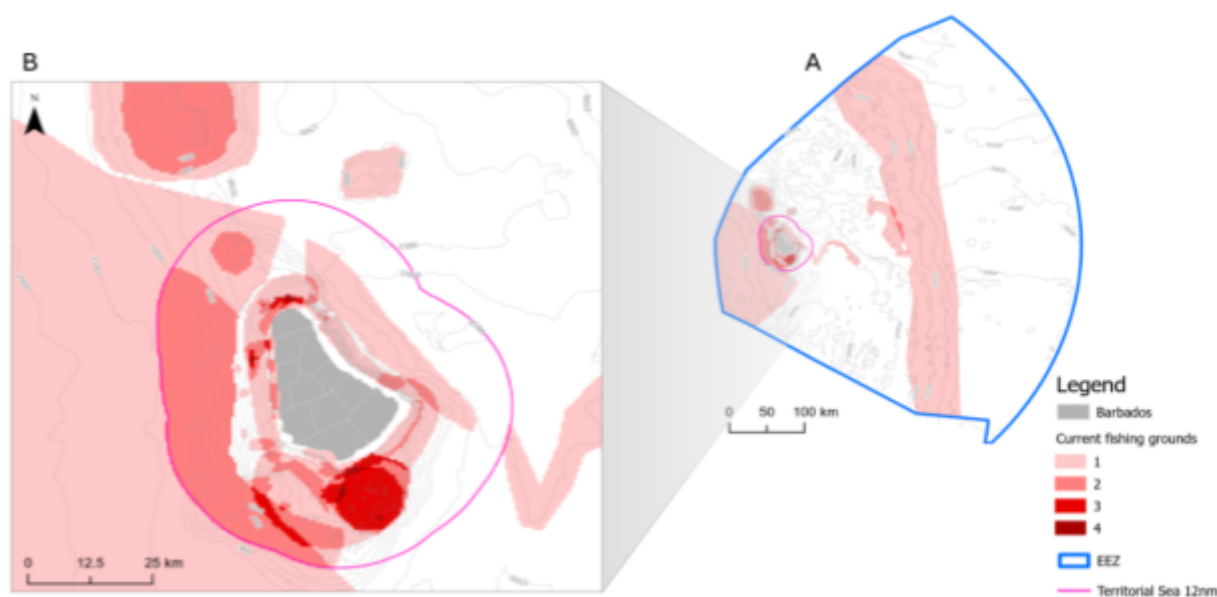


Figure 6. Current fishing grounds identified during the mapping exercise (n=41). A) Barbados Exclusive Economic Zone; B) Territorial Sea.

Table 3. Species identified for the current and historical fishing grounds and fish nursing grounds. \*Species identified in all 3 fishing grounds.

Species	Current fishinggrounds		Historical fishinggrounds		Nursing grounds	
	# of times reported	Percentage	# of times reported	Percentage	# of times reported	Percentage
Amberfish	0	8%	1	3%	0	0%
Bait fish	11	0%	4	3%	2	3%
Barracuda	2	8%	1	12%	0	0%
Billfish	6	1%	0	3%	0	0%
Blowgoat		4%		0%	1	1%

Species	Current fishing grounds		Historical fishing grounds		Nursing grounds	
	# of times reported	Percentage	# of times reported	Percentage	# of times reported	Percentage
Blue marlin	2	1%	0	0%	0	0%
Bonita	5	1%	3	0%	0	0%
Cavally*	5	4%	1	9%	6	9%
Conch*	8	4%	1	3%	6	9%
Dolphin fish	0	6%	0	3%	0	0%
Flying fish	0	0%	1	0%	0	0%
Grouper	0	0%	1	3%	0	0%
Gunnit	5	0%	3	3%	0	0%
Jacks*	9	4%	1	9%	5	7%
Kingfish	8	6%	1	3%	0	0%
Lionfish*	5	6%	1	3%	5	7%
Lobster*	5	4%	2	3%	7	10%
Mackerels*	7	4%	2	6%	5	7%
Pot fish*	2	5%	0	6%	3	4%
Sailfish	5	1%	2	0%	4	6%
Sea Cat*	0	4%	2	6%	3	4%
Sea eggs	4	0%	2	6%	5	7%
Shark*	0	3%	1	6%	6	9%
Silversides	15	0%	2	3%	0	0%
Snapper*	5	11%	0	6%	6	9%
Swordfish	10	4%	1	0%	0	0%
Tuna*	0	7%	0	3%	2	3%
Trumpet	9	0%	0	0%	1	1%
Wahoo	140	6%	34	0%	0	0%
Total					67	

2. Historical fishing grounds: There were only 6 reports of areas where participants or their communities used to fish but no longer do. Figure 7 shows the unprocessed shapes (features are presented as collected and no analysis or summation was done). Most of the reports of historical fishing grounds were located nearshore (depths less than 100m) by the St. Philip parish and in the northern section of the Christ Church parish. The most reported species in those areas include barracuda, cavally, and jacks, followed by mackerel, pot fish, sea cat, sea eggs, and sharks (Table 3).

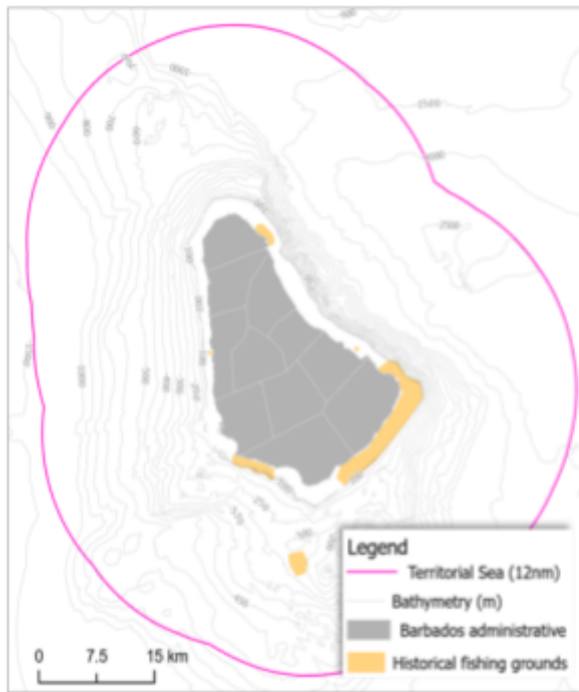


Figure 7. Historical fishing grounds identified during the mapping exercise (n=6).

3. Fish nursing grounds: Seven polygons were created to identify areas where juvenile fish and other organisms grow. Figure 8 shows the unprocessed shapes. Several small areas were located nearshore (depths less than 100m) by the Christ Church parish. Some of these areas were linked to pipe structures. The northern bank with depths between 350m and 1000m was also reported as a fish nursing ground. The most reported species in those areas include cavally conch, lobsters, sharks, and snappers (Table 3).

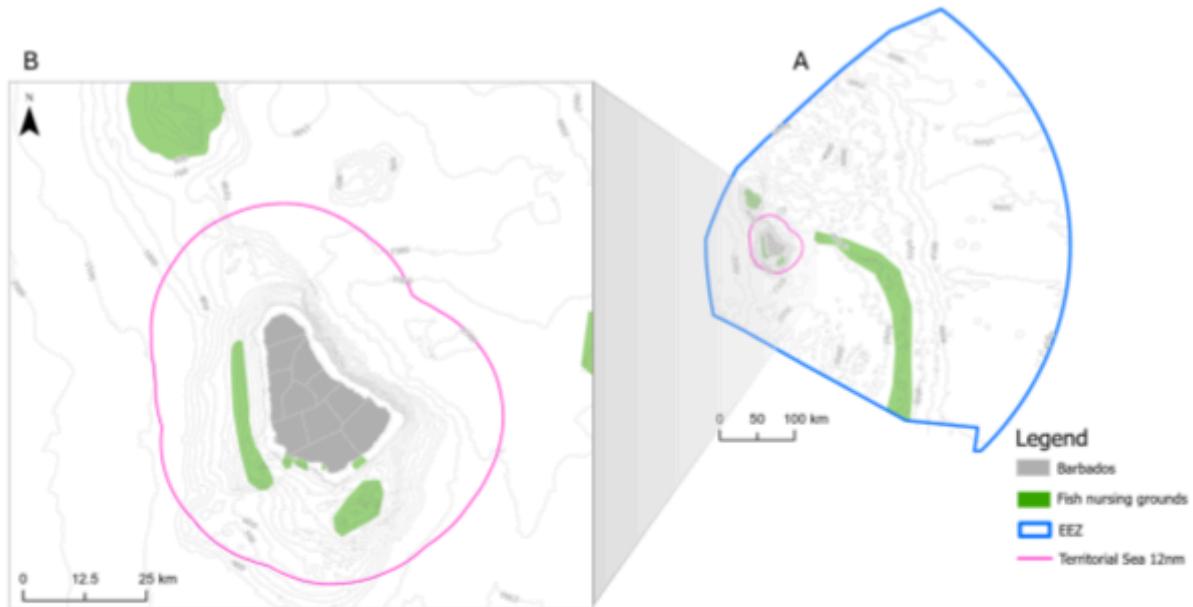


Figure 8. Fish nursing grounds identified during the mapping exercise (n=11). A) Barbados Exclusive Economic Zone; B) Territorial Sea.

4. Fish spawning and aggregation areas: none of the participants were able to identify areas where fish gather to breed and rear their young. It should be noted that, generally, the participating fisherfolk were less knowledgeable about locating nursing grounds and fish spawning and aggregation areas than spatially delineating and characterizing the other fishery layers in question.
5. Fish aggregating device's (FADs) locations: Participants identified the location of 14 FADs. Most of them are located within the territorial sea in the eastern side of Barbados (Fig. 9). Two of the FADs were located beyond a depth of 1,500m very close to the EEZ east border. All the identified FADs were described as anchored structures with 79% of them identified as owned by the government.

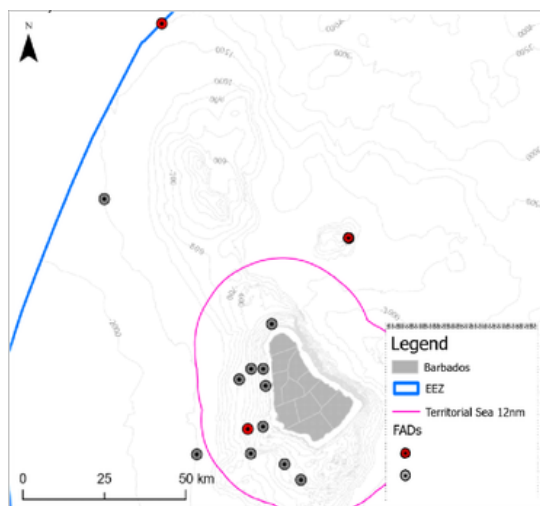


Figure 9. FADs locations identified during the mapping exercise (n=14).

6. Observed user conflict locations: There were 7 locations in which participants observed issues or conflict among users (Fig. 10). Most reported incidents involve issues between spear fisher and transiting vessels (e.g., recreational, commercial, and transportation vessels).

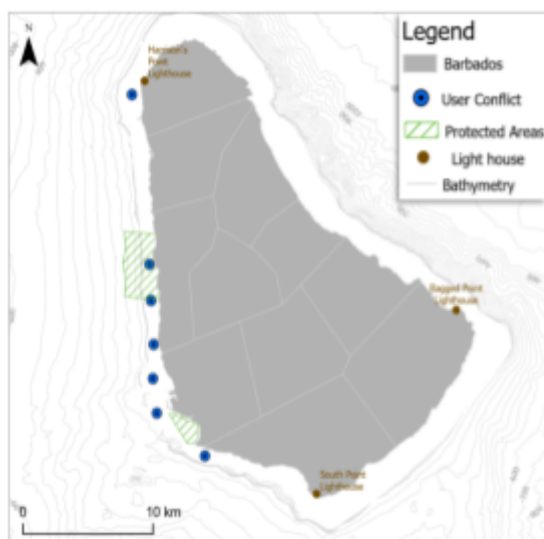


Figure 10. Observed user conflict locations identified during the mapping exercise (n=7).



The results of the mapping exercise described above have **limitations**.

Currently, there are over one-thousand licensed fisherfolks in Barbados, therefore, these results are not representative of the target population because of the low number of participants.

The BFD will organize and implement further mapping sessions to increase sample size and representativeness of this information.


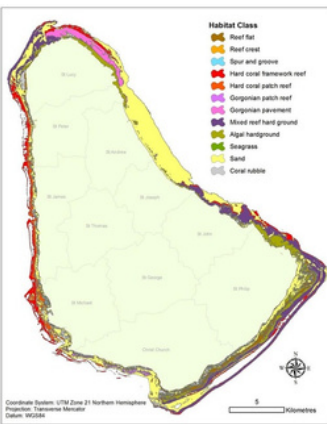

Although some authors (Brown & Pullar, 2012) have suggested an acceptable sample size of 25 participants (to obtain 100 – 125 polygons or features per mapped attribute), we suggest following Carrie and others (2022) recommendation by using a data spatial agreement (measure by polygon overlap) instead to determine an acceptable sample size.




## Marine Habitats

Two main sources of information for nearshore benthic habitats in Barbados were identified: Baldwin and others (2019) and Schill and others (2021). The datasets provided from both sources are available in geospatial format. There is no information about marine habitats in the Barbados EEZ area. However, the CZMU has spatial information about the deep-sea geomorphic features (e.g., sills, canyons, etc.) that could also be used as surrogates (an alternative) for some species until efforts to collect this information become available. Additionally, there are examples of small-scale studies related to specific habitats such as coral and seagrass (Horrocks, 1991; Rakitin & Kramer, 1996; Cowen et al., 2003; Maclean & Oxenford, 2016; Oxenford et al., 2020). Only one example was found that describes the location of a coral bleaching event (Oxenford et al., 2008).

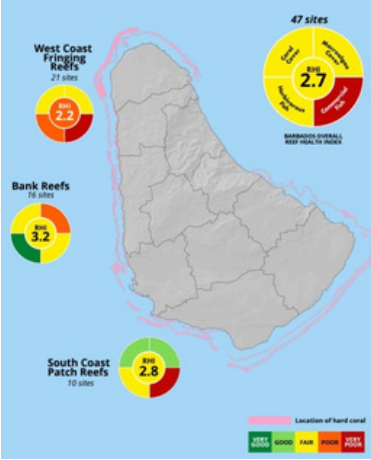

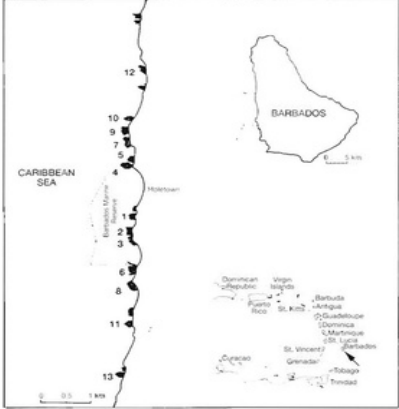
Table 4. Current spatial information related to marine habitats.

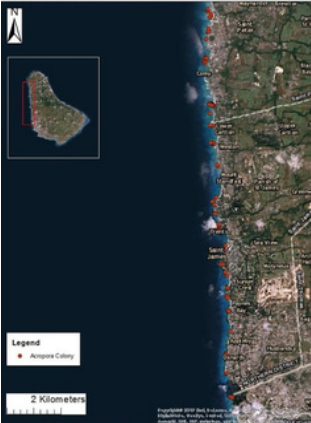

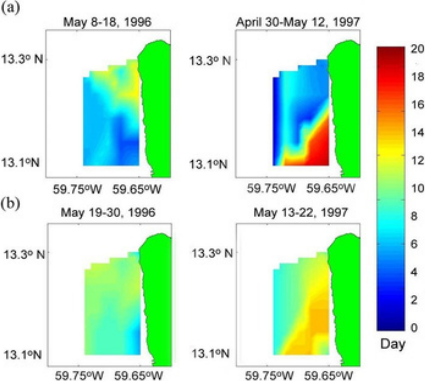
Reference	Name	Documented spatial data:	Spatial data
Nearshore Benthic Habitat			
Peterson et al. 2014	<a href="#">Future of Reefs in a Changing Environment: an ecosystem approach to managing Caribbean coral reefs in the face of climate change Barbados Country Profile</a>	Multiple layers. CZMU has the spatial layers produced by this project.	

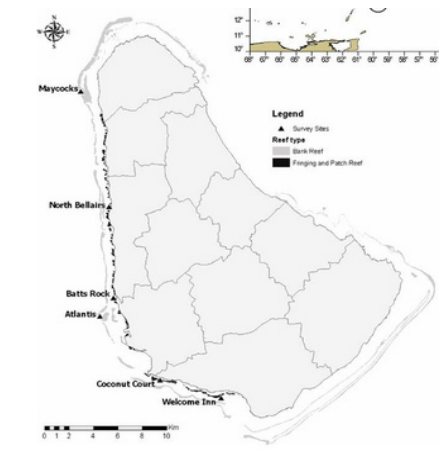
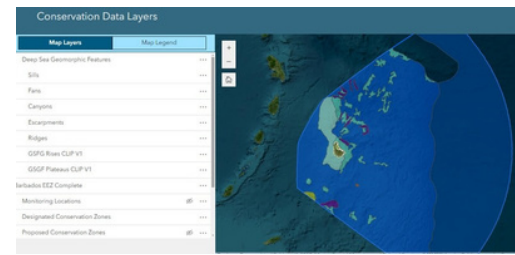
Reference	Name	Documented spatial data:	Spatial data
Baldwin et al. 2019	<a href="#">Developing a benthic habitat classification scheme and island-wide map for Barbados based on remote sensing and comprehensive ground-truthing</a>	Figure 14. Map of the class (deep water) showing areas around the coastline where habitats were beyond the resolution of remote sensing technology. Pag. 28	 <p>The map shows the island of Barbados with a light green interior. A dark blue line follows the coastline, representing deep water. A legend in the top right corner identifies this area as 'Deep water'. The map includes a north arrow and a scale bar for 5 kilometers. At the bottom, it specifies the coordinate system: UTM Zone 21 Northern Hemisphere, Projection: Transverse Mercator, Datum: WGS84.</p>
Baldwin et al. 2019	<a href="#">Developing a benthic habitat classification scheme and island-wide map for Barbados based on remote sensing and comprehensive ground-truthing</a>	Fig.15. Final 12-class benthic habitat map of the coastal marine environment of Barbados. Pag. 29	 <p>The map shows the island of Barbados with various colored zones along the coastline representing different benthic habitats. A legend in the top right corner lists the following habitat classes: Reef flat (orange), Reef crest (yellow), Spur and groove (light blue), Hard coral framework reef (red), Hard coral patch reef (pink), Gorgonian patch reef (purple), Gorgonian pavement (dark purple), Mixed reef hard ground (grey), Algal hardground (green), Seagrass (light green), Sand (yellow), and Coral rubble (white). The map includes a north arrow and a scale bar for 5 kilometers. At the bottom, it specifies the coordinate system: UTM Zone 21 Northern Hemisphere, Projection: Transverse Mercator, Datum: WGS84.</p>
Baldwin et al. 2019	<a href="#">Developing a benthic habitat classification scheme and island-wide map for Barbados based on remote sensing and comprehensive ground-truthing</a>	Fig. 16. Map of the shallow reefs (fringing reefs comprising reef flat, reef crest and spur and groove zones and other reef flats) around Barbados. Pag. 30	 <p>The map shows the island of Barbados with colored zones along the coastline representing shallow reefs. A legend in the top right corner identifies the following habitat classes: Reef flat (orange), Reef crest (yellow), and Spur and groove (light blue). The map includes a north arrow and a scale bar for 5 kilometers. At the bottom, it specifies the coordinate system: UTM Zone 21 Northern Hemisphere, Projection: Transverse Mercator, Datum: WGS84.</p>

Reference	Name	Documented spatial data:	Spatial data
Baldwin et al. 2019	<u>Developing a benthic habitat classification scheme and island-wide map for Barbados based on remote sensing and comprehensive ground-truthing</u>	Fig. 17. Map of the hard coral framework reefs (bank reefs and other reef slopes) around Barbados. Pag. 31	
Baldwin et al. 2019	<u>Developing a benthic habitat classification scheme and island-wide map for Barbados based on remote sensing and comprehensive ground-truthing</u>	Fig.18. Map of the mixed reef hard ground and gorgonian pavements typical of the high wave energy coastal waters of Barbados. Pag. 32	
Baldwin et al. 2019	<u>Developing a benthic habitat classification scheme and island-wide map for Barbados based on remote sensing and comprehensive ground-truthing</u>	Fig. 19. Map of the hard coral and gorgonian patch reefs found along the more sheltered coastlines of Barbados. Pag. 33	

Reference	Name	Documented spatial data:	Spatial data
Caribbean Science Atlas	<a href="#">Caribbean Reef Explorer</a> (Caribbean Science Atlas) This site compiles TNC scientific resources for use by partners and stakeholders.	Benthic Habitats (4m resolution). Source: Schill, et.al. 2021 Data is available upon request.	
MOW	Ocean Wealth: <a href="#">Mapping Ocean Wealth Explorer</a>	Several data layers. For example: modeled coral reef fisheries catch	
MOW	Ocean Wealth: <a href="#">Mapping Ocean Wealth Explorer</a>	Coastal protection:	
CSA	<a href="#">Caribbean Reef Explorer</a> (Caribbean Science Atlas)	Coral refugia ranking	

Reference	Name	Documented spatial data:	Spatial data
CZMU	<a href="#">Coastal Zone Management Unit</a>	Status of Barbado's coral reefs 2017. The CZMU has available online form to report available to the public to stony coral tissue loss disease and coral bleaching.	
Small-scale habitat distribution studies			
Horrocks 1991	<a href="#">Sea Turtle Recovery Action Plan for Barbados</a>	Map 2. Locations of sea grass and offshore bank coral reefs around Barbados, West Indies. Pag. 48.	
Rakitin & Kramer 1996	<a href="#">Effect of a marine reserve on the distribution of coral reef fishes in Barbados</a>	Fig. 2. Map of the study area...Left: the study area on the west coast of Barbados showing the location of the Barbados Marine Reserve (dashed lines) and the fringing reef (shaded). Reefs are numbered according to increasing distance from the center of the Reserve.	

Reference	Name	Documented spatial data:	Spatial data
Maclean & Oxenford 2016	<a href="#">Mapping the return of acroporid corals on fringing reefs along the west coast of Barbados</a>	Figure 12. The overall spatial distribution of Acropora colonies found along the west coast of Barbados from June to August 2015. Pag. 19 Other figures showing the distribution of Acropora and benthic habitats, cluster and demarcation. Appendix 2 shows Lat/Lon of the 46 reefs surveyed. Pag. 55	
Oxenford et al. 2020	<a href="#">Assisted recovery of elkhorn coral (Acropora palmata) on a fringing reef in Barbados: A pilot study 2016-2019</a>	Appendix 3. Report of elkhorn spawning at Mullins Field report of Acropora palmata (elkhorn coral) spawning observations at Mullins fringing reef, Barbados. Pag. 41. Other information: Appendix 4. Genetic samples database with GPS data. Pag. 45	
Cowen et al. 2003	<a href="#">Impact of North Brazil Current rings on local circulation and coral reef fish recruitment to Barbados, West Indies</a>	Fig. 3. Maximum residence time (RT) on the western shore of Barbados during the 1996 and 1997 experiments at the mean depth of center of mass for Thalassoma bifasciatum (40-60 m) (a) before and (b) after low salinity intrusions.	

Reference	Name	Documented spatial data:	Spatial data
Oxenford et al. 2007	<a href="#">Quantitative observations of a major coral bleaching event in Barbados, Southeastern Caribbean</a>	Fig. 1. Map of Barbados showing extent of coral reefs and location of survey sites. Pag. 437.	
<b>Geomorphic features</b>			
CZMU 2024	Conservation Data Layers CZMU	<a href="#">Deep sea geomorphic features.</a> Sills Fans Canyons Escarpments Ridge Rises Plateaus	

## Species distribution

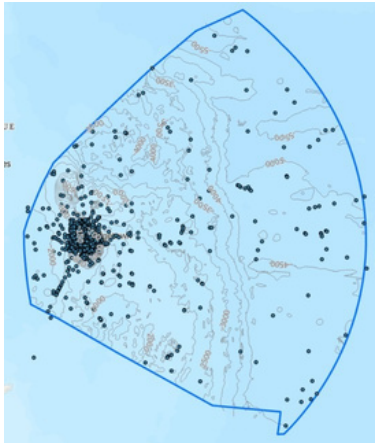
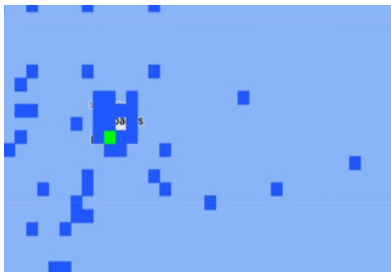
This section refers to information about the arrangement and location of different species. For Barbados, in general, information about relevant marine species is limited temporally and spatially. The Global Biodiversity Information Facility (GBIF) provides sightings information for different groups of species (e.g., birds, turtles, fishes) but the information is obtained through opportunistic encounter events and is not systematically collected. Only one study was found that documents the movement of fishes off the west coast of Barbados (Chapman & Kramer, 2000). The Mapping Ocean Wealth online platform has layers showing the estimated biomass for snappers/groupers and parrotfish which are located mainly in nearshore waters. Additionally, two studies documented the movements and home ranges of queen conch; however, these are small scale studies, which are limited (Bissada-Gooding & Oxenford 2010; Phillips et al. 2011).

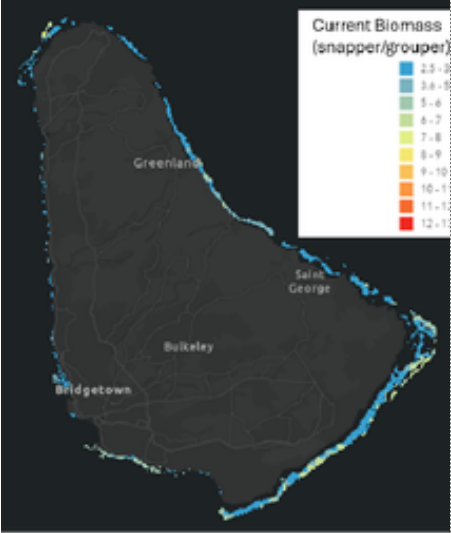
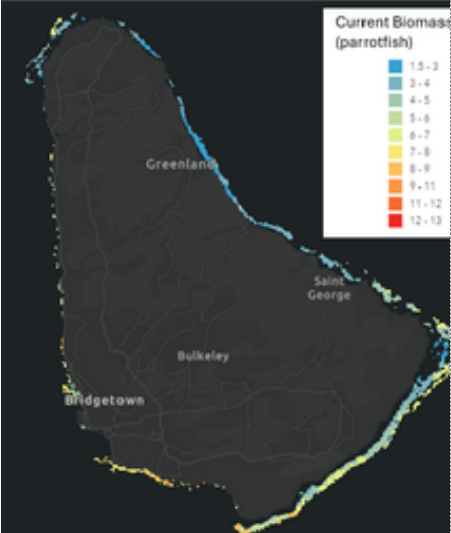
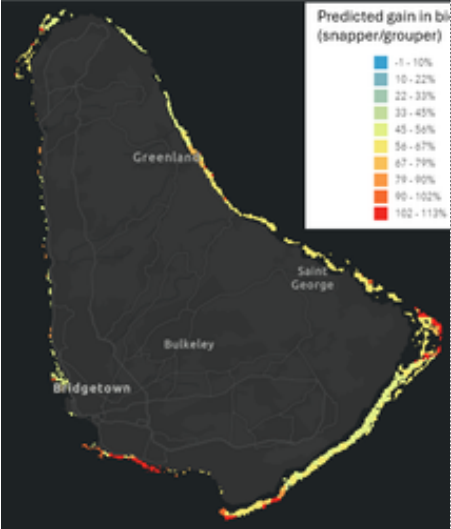
Several studies that map the distribution of sea turtle nesting beaches were identified (Horrocks & Scott, 1991; Horrocks & Willoughby, 1991; Horrocks, 1992; Horrocks & Walcott, 2016; Dow et al., 2007), nearshore movements (Walcott et al., 2009; Walcott et al., 2012; Walcott et al., 2014), and international distribution tracking (Horrocks et al. 2001; Luke et al., 2004; Krueger et al., 2011; Browne et al., 2010). Some of these studies may provide useful baseline information for MSP. An option to consider is tapping the expertise of these researchers and scientists by

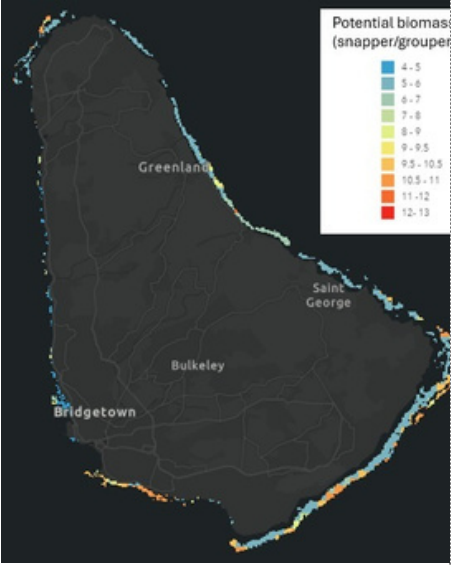
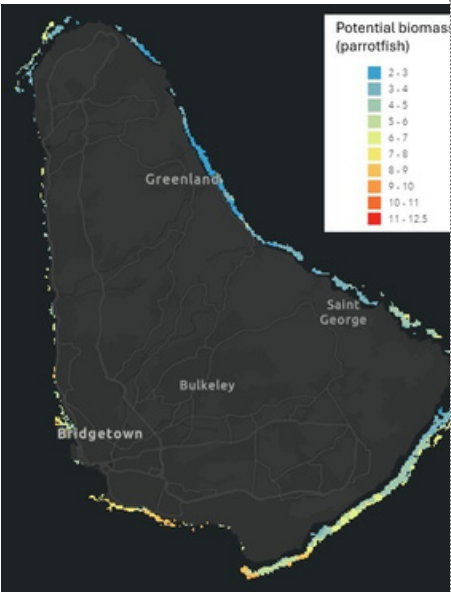
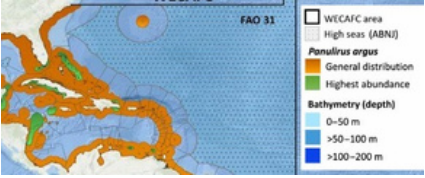

developing a methodology that includes feedback from them (participatory mapping with experts) and encouraging their participation throughout the MSP process.

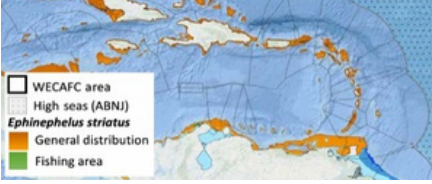
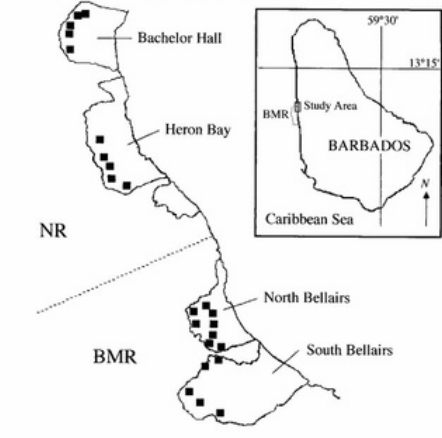
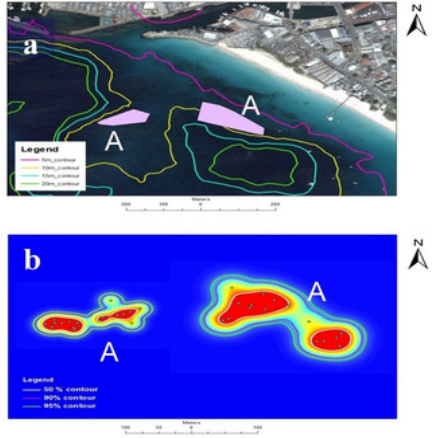
One reference mapped the distribution of marine mammals in Barbados (Basran et al., 2023), documenting that sighting of a humpback whale and her calf. Additionally, one reference provides the general location and estimates of lionfish and other marine invasive species in Barbados (Valles et al., 2023). Sargassum (an invasive floating seaweed) is monitored using satellite derived data through a seasonal bulletin managed by CERMES. There was also a report documenting a fish kill event (Willoughby et al., 2002). The limited number of studies and spatial information related to fish kills and invasive species is concerning because these occurrences constitute significant threats to marine biodiversity, ecosystems, and human activities. Mapping and risk assessment of these topics would be a valuable contribution to the MSP because it involves evaluating potential threats and uncertainties associated with human activities and natural processes in marine environments.



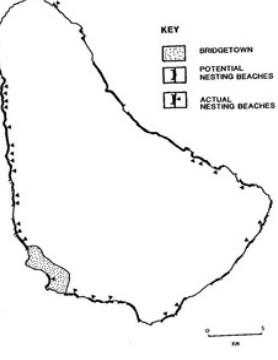
Table 5. Current spatial information related to species distribution.



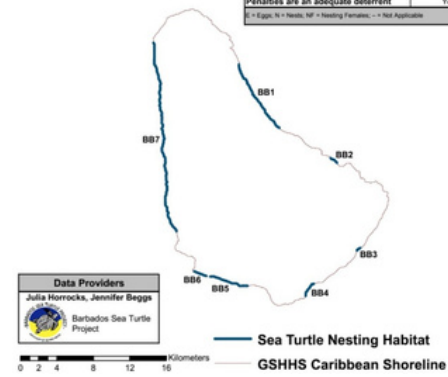
Reference	Name	Documented spatial data:	Spatial data
Biodiversity			
GBIF	<a href="#">The Global Biodiversity Information Facility (GBIF)</a>	<p>GBIF is an international network and research infrastructure funded by the world's governments and aimed at providing anyone, anywhere, open access to data about all types of life on Earth.</p> <p>There were 154,672 records found for the Barbados area.</p>	
	<a href="#">OBIS-SEAMAP</a>	<p>It is a spatially, temporally interactive online database for marine mammal, sea turtle, seabird and ray &amp; shark data. Only 104 records found for Barbados area.</p>	
Fish distribution			

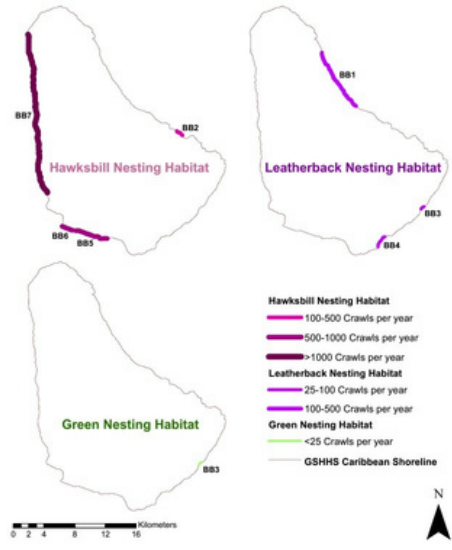
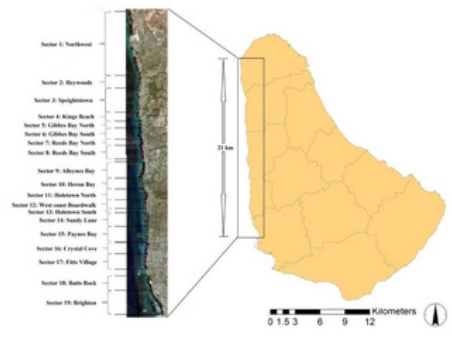
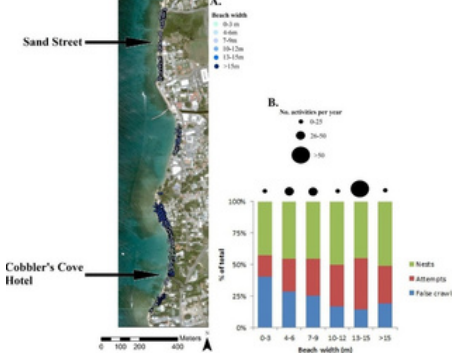
Reference	Name	Documented spatial data:	Spatial data
MOW	<a href="#">Mapping Ocean Wealth</a>	Coral reef fisheries: current biomass (snapper/grouper). Predicted current total biomass of snapper-grouper complex, derived from models and originally informed by and documented by fisheries independent visual surveys.	
MOW	<a href="#">Mapping Ocean Wealth</a>	Coral reef fisheries: current biomass (parrotfish). Predicted current total biomass of parrotfish, derived from models and originally informed by and documented by fisheries independent visual surveys.	
MOW	<a href="#">Mapping Ocean Wealth</a>	Coral Reef Fisheries: Predicted Gain in Biomass (snapper/grouper). The expected percent increase in snapper-grouper fish stocks if fishing were reduced to 0 in each 1 ha cell. This could be through a marine reserve or some other fisheries management measure.	



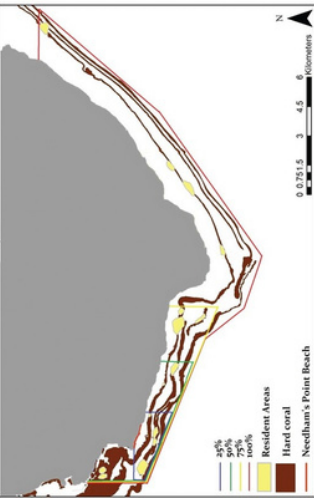
Reference	Name	Documented spatial data:	Spatial data
MOW	<a href="#">Mapping Ocean Wealth</a>	Coral Reef Fisheries: Potential Biomass (snapper/grouper) Predicted future biomass for snapper-grouper complex if fishing were to be reduced to zero.	
MOW	<a href="#">Mapping Ocean Wealth</a>	Coral Reef Fisheries: Potential Biomass (parrotfish). Predicted future biomass of parrotfish with a 25% increase in reef cover.	
Arocha et al. 2024	Review of biological data, spatial distribution of the stocks and ecological connectivity between areas beyond national jurisdiction and exclusive economic zones	The report contains regional distribution maps for several commercially important fishes for example distribution of Caribbean spiny lobster, red grouper, Nassau grouper, red hind, grey snapper, among others.	<p>Spiny lobster</p>  <p>Red grouper</p> 

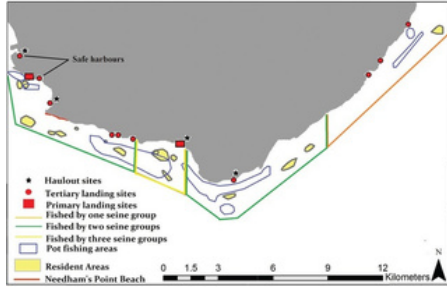
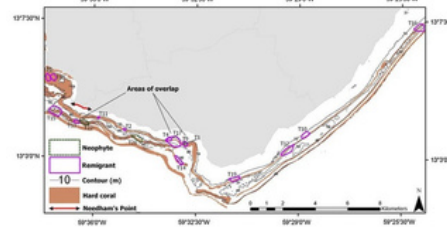
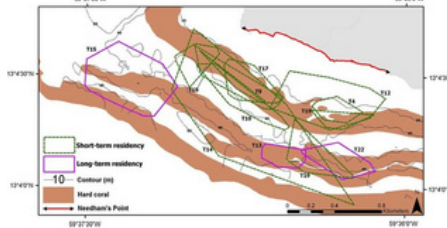
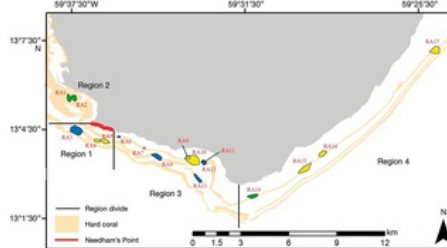
Reference	Name	Documented spatial data:	Spatial data
	in the Western Central Atlantic Fishery Commission Region		<p>Nassau grouper</p> 
Chapman & Kramer 2000	<p><a href="#">Movements of Fishes Within and Among Fringing Coral Reefs in Barbados</a></p>	<p>Fig. 1. Map of the west coast of Barbados showing the location of study reefs (stippled) and the 23 sites (squares) where fish were tagged and recaptured. The dashed line indicates the boundary between the Barbados Marine Reserve (BMR) and the non-reserve (NR). They tagged 1443 individuals of 35 reef fish species. Most species were strongly site attached, with most recaptures and re-sightings occurring at the site of tagging.</p>	
Queen Conch			
Phillips et al. 2011	<p><a href="#">Preliminary Investigation of the Movements, Density, and Growth of Juvenile Queen Conch in a Nursery Area in Barbados</a></p>	<p>Fig. 5. Maps showing (a) minimum convex polygon home ranges and (b) kernel density estimation of home ranges for key informant juvenile conch (AC6 and AC7) in Carlisle Bay, Barbados over the summer (July 14 – Sept 23, 2010. Pag. 432. Other information. Fig. 1. Study sites. Pag. 428.</p>	

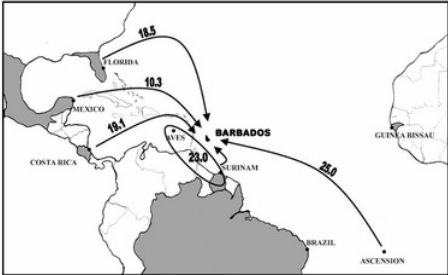
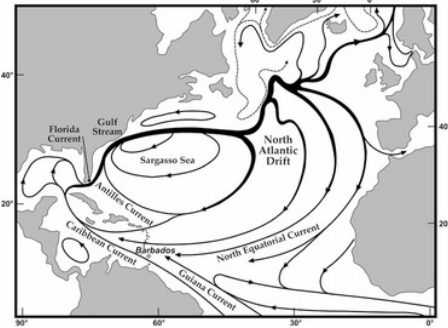
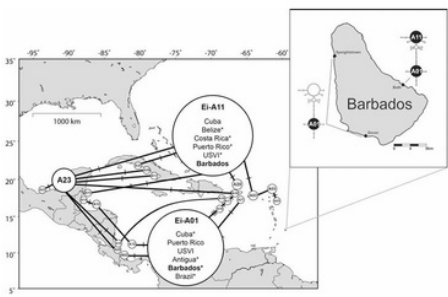
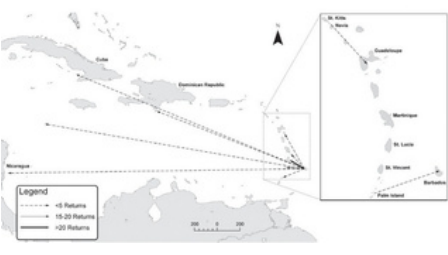
Reference	Name	Documented spatial data:	Spatial data
Bissada-Gooding & Oxenford 2010	<a href="#">Estimating home range and density of a Queen Conch aggregation using acoustic telemetry and conventional tagging</a>	<p>Fig. 1 Map of Barbados showing the study site located on the west coast. Pag. 384.</p> <p>Note: The study site is described as close to Bridgetown Port. They mapped the position of all conch but no info is provided in the document. They have home range estimates based on 3 tagged conchs.</p>	
Sea turtle nesting			
Horrocks & Scott 1991	<a href="#">Nest site location and nest success in the hawksbill turtle <i>Eretmochelys imbricata</i> in Barbados, West Indies</a>	<p>Barbados, showing locations of hawksbill nests in 1987, 1988 and 1989. Pag. 2.</p>	
Horrocks & Willoughby 1991	<a href="#">Reproduction, mortality and conservation of the hawksbill turtle (<i>Eretmochelys imbricata</i>) in Barbados</a>	<p>Fig. 1. Ma of Barbados showing potential nesting beaches and beaches where hawksbills nest. Pag. 248</p> <p>Note: poor quality image and hard to read the line features.</p>	

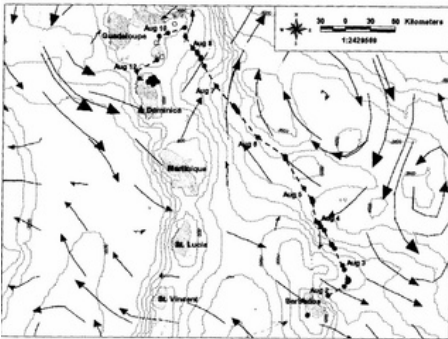
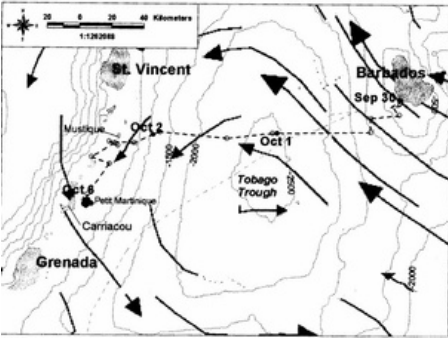
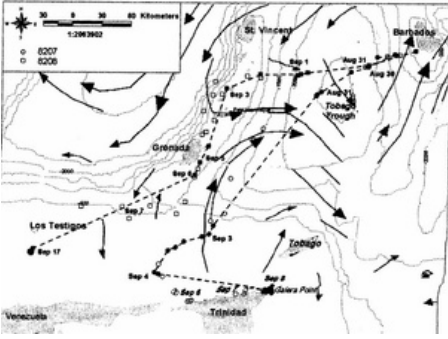
Reference	Name	Documented spatial data:	Spatial data
Horrocks 1992	<a href="#">Sea Turtle Recovery Action Plan for Barbados</a>	Map 3. Locations of potential nesting beaches and actual nests for the leatherback sea turtle ( <i>Dermochelys coriacea</i> ) in Barbados, West Indies, 1984-1991. Pag. 49.	
Horrocks 1992	<a href="#">Sea Turtle Recovery Action Plan for Barbados</a>	Map 4. Locations of hawksbill sea turtle ( <i>Eretmochelys imbricata</i> ) nests reported by the public in 1990 (stars) and 1991 (dots) in Barbados. Pag. 50.	
Dow et al. 2007	<a href="#">An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region</a>	Sea turtle nesting habitat. Pag. 83.	

Reference	Name	Documented spatial data:	Spatial data																				
Dow et al. 2007	<p><a href="#">An Atlas of Sea Turtle Nesting Habitat for the Wider Caribbean Region</a></p>	<p>Nesting habitat. Pag. 84</p> <p>Other information: Tables with identified threats to sea turtles nesting areas and foraging/migrating</p> <table border="1" data-bbox="565 470 915 558"> <thead> <tr> <th colspan="4">Beach Identification Codes with Beach Names</th> </tr> </thead> <tbody> <tr> <td>BB1</td> <td>East Coast Beaches</td> <td>BB5</td> <td>South Coast Beaches</td> </tr> <tr> <td>BB2</td> <td>Bath Beach</td> <td>BB6</td> <td>Hilton Beach</td> </tr> <tr> <td>BB3</td> <td>Foul Bay</td> <td>BB7</td> <td>West Coast Beaches</td> </tr> <tr> <td>BB4</td> <td>Long Beach</td> <td></td> <td></td> </tr> </tbody> </table>	Beach Identification Codes with Beach Names				BB1	East Coast Beaches	BB5	South Coast Beaches	BB2	Bath Beach	BB6	Hilton Beach	BB3	Foul Bay	BB7	West Coast Beaches	BB4	Long Beach			
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BB4	Long Beach																						
Horrocks & Walcott 2016	<p>Nesting by hawksbill sea turtles on the west coast of Barbados in relation to beach wide: with recommendations for conservation of critical nesting habitat.</p>	<p>Fig. 1. The Nineteen Sectors of West Coast Beaches in Barbados monitored by the Barbados Sea Turtle Project.</p>																					
Horrocks & Walcott 2016	<p>Nesting by hawksbill sea turtles on the west coast of Barbados in relation to beach wide: with recommendations for conservation of critical nesting habitat.</p>	<p>Figure 5. Sector 3 Speightstown. A. Aerial photo showing the positions of Nesting Activities, color coded to show the average width of the Location where the Activities occurred; B. showing the % Nests, Attempts and False Crawls on stretches of different widths within the Sector. Place names are shown for orientation only. Other areas are also shown in the report.</p>																					

Reference	Name	Documented spatial data:	Spatial data
Fish et al. 2008	<p><a href="#">Construction setback regulations and sea-level rise: mitigating sea turtle nesting beach loss.</a></p>	<p>Fig. Location of the study beaches around the island of Barbados.</p>	
Sea turtle nearshore movement			
Walcott et al 2009	<p><a href="#">Telemetric monitoring of inter-nesting behaviour and habitat use by hawksbill turtles (Eretmochelys imbricata) nesting at Needham's Point, Barbados</a></p>	<p>Fig. 6. Movement patterns of three tracked females. Poster</p>	
Walcott et al. 2014	<p><a href="#">Design of a protected area for inter-nesting hawksbills in Barbados: an evidence-based approach</a></p>	<p>TOP: Fig. 3. Portions of the coast and the marine environment that would need to be protected, according to the percentage of all Resident Areas (n = 17) afforded protection (25%–100%). The respective boundaries are indicated by colored lines). Pag. 975</p> <p>Fig. 4. Tourism and local recreational use of (A) the waters adjacent to the south coast of Barbados and (B) the beachfront. Pag. 976.</p> <p>BOTTOM: Fig. 5. Fishing related use of the south coast of</p>	

Reference	Name	Documented spatial data:	Spatial data
		<p>Barbados and the waters adjacent to it. Primary landing sites represent sites where there is physical infrastructure present in the form of a market, while tertiary landing sites are those with no physical infrastructure present and simply represent beaches. Pag. 978</p>	
<p>Walcott et al. 2012</p>	<p><a href="#">Tracking hawksbill sea turtles (<i>Eretmochelys imbricata</i>) during inter-nesting intervals around Barbados</a></p>	<p>Fig.3 Inter-nesting resident areas (polygons) utilized by study animals. Pag. 933</p>	
<p>Walcott et al. 2012</p>	<p><a href="#">Tracking hawksbill sea turtles (<i>Eretmochelys imbricata</i>) during inter-nesting intervals around Barbados</a></p>	<p>Fig. 5 Area of the Needham's Point nesting beach utilized by females for both long-term (as inter-nesting resident areas, N=3) and short-term (23–65 h prior to a nesting emergence, N=8) residency. Pag. 935</p>	
<p>Walcott et al. 2014</p>	<p><a href="#">Use of a towed camera system to investigate benthic habitat use by inter-nesting female hawksbill sea turtles</a></p>	<p>Fig. 1. Southern portion of Barbados, showing the nesting beach of hawksbill sea turtles <i>Eretmochelys imbricata</i> (Needham's Point), the resident areas (RAs, colored polygons) utilized by study animals (n = 17) and the hard coral reef system. Yellow, blue and green polygons represent high-, medium- and low-quality RAs, respectively. The 4 regions indicating different distances from the nesting beach are also shown. Pag. 161.</p>	
<p>Sea turtle international movements</p>			

Reference	Name	Documented spatial data:	Spatial data
Luke et al. 2004	<a href="#">Origins of green turtle (<i>Chelonia mydas</i>) feeding aggregations around Barbados, West Indies</a>	Fig. 1. Map of the Atlantic region showing green turtle ( <i>Chelonia mydas</i> ) rookeries (excluding Cyprus) relative to Barbados foraging population. Mean percentage contributions by the different nesting populations, as estimated by Markov chain Monte Carlo estimation, are indicated. Note: the pathways shown are not indicative of migratory corridors. Pag. 803	
Luke et al. 2004	<a href="#">Origins of green turtle (<i>Chelonia mydas</i>) feeding aggregations around Barbados, West Indies</a>	Fig. 2. The major Atlantic currents affecting the Caribbean region. Pag. 804.	
Browne et al. 2010	<a href="#">Population subdivision in hawksbill turtles nesting on Barbados, West Indies, determined from mitochondrial DNA control region sequences</a>	Fig. 1 Sampling locations from the leeward (Speightstown to Dover) and windward coast (Bath) nesting sites in Barbados, within the Caribbean region. The TCS parsimony network for the regional haplotypes is overlaid on the In the Barbados map inset, the haplotype diversities for the two coasts are indicated by black haplotypes within scaled down representations of the complete regional haplotype network.	
Krueger et al. 2011	<a href="#">International Movements of Adult Female Hawksbill Turtles (<i>Eretmochelys imbricata</i>): First Results from the Caribbean's Marine Turtle Tagging Centre</a>	Figure 2. International tag returns for adult female hawksbill sea turtles ( <i>Eretmochelys imbricata</i> ) tagged in Barbados, as well as in Palm Island and Nevis (insert), using MTTC tags during the reporting period (January 2002 to June 2009). Arrows point to the location of recapture. Pag. 23. Table 2. shows where turtles were tagged and then recaptured. Pag. 21	

Reference	Name	Documented spatial data:	Spatial data
Horrocks et al. 2001	<a href="#">Migration Routes and Destination Characteristics of Post-Nesting Hawksbill Turtles Satellite-Tracked from Barbados, West Indies</a>	<p>Fig. 1. Post-nesting migration route (•---•) of hawksbill turtle 8179 between her nesting beach in Barbados and her foraging ground destination off Dominica (• location fixes of LC1-3; o location fixes LC &lt; 1). Dates are provided for location fixes occurring at the same time of day on the date indicated. Geostrophic current directions are indicated by arrows, and strength of currents by the length of the arrow. Isobaths at 500 m intervals are indicated.</p>	
Horrocks et al. 2001	<a href="#">Migration Routes and Destination Characteristics of Post-Nesting Hawksbill Turtles Satellite-Tracked from Barbados, West Indies</a>	<p>Fig. 2. Post-nesting migration route (•---•) of hawksbill turtle 8180 between her nesting beach in Barbados and her foraging ground destination off Petite Martinique (Grenada) (• location fixes of LC1-3; o location fixes LC &lt; 1). Dates are provided for location fixes by the length of the arrow.</p>	
Horrocks et al. 2001	<a href="#">Migration Routes and Destination Characteristics of Post-Nesting Hawksbill Turtles Satellite-Tracked from Barbados, West Indies</a>	<p>Fig. 3. Post-nesting migration route of hawksbill turtle 8207 (•---•) between her nesting beach in Barbados and her foraging ground destination off Trinidad, and of hawksbill turtle 8208 (▪---▪) between her nesting beach in Barbados and her foraging ground destination off Los Testigos (Venezuela) (• and ▪ indicate location of fixed LC1-3; o and ◻ location fixes LC &lt; 1). For each female, dates are provided for location fixes by the length of the arrow.</p>	

Marine mammal distribution

Reference	Name	Documented spatial data:	Spatial data
Basran et al. 2023	<a href="#"><u>Short Communication: First documented migration of an Icelandic humpback whale mother and calf pair from the West Indies breeding grounds</u></a>	Fig. 1. Map and photographs showing the sighting locations, dates and photographic evidence of ISMN0028 and her calf. Dates in red text, denoted with *, indicate the within-year migration of the mother-calf pair between Barbados and Iceland. Pag. 207.	

### Invasive species distribution

Valles et al. 2023	<a href="#"><u>Assessment and Management of Lionfish and Status of Other Marine Invasive Species of Threat to High Biodiversity-value Reef Ecosystems</u></a>	Figure 2.2. Location of the ten coral reef sites on the west and south coast of Barbados used for the repeat surveys of native coral reef fish and lionfish. Black stars indicate the main reef fish landing sites where fisher surveys were conducted (see Section 2.2.2). Appendix 2. GPS coordinates for fish survey sites.	
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### Fish kill



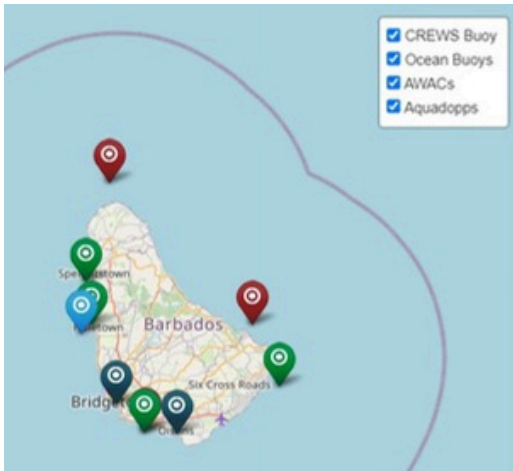
Willoughby et al. 2002	<a href="#"><u>Factors contributing to the 1999 mass mortality of reef-associated fish in Barbados</u></a>	Fig. 2. Areas of Barbados where fish were beached during the 1999 fish kill. Pag. 28  Note: legend and symbology difficult to read.	
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Reference	Name	Documented spatial data:	Spatial data
Sargassum			
CERMES	<a href="#">Sargassum Sub-regional Outlook Bulletin</a>	<p>This bulletin is brought to you by the Sargassum Team at The Centre for Resource Management and Environmental Studies (CERMES).</p> <p>The processed satellite image shows sargassum abundance over the 7-day period 26 May - 1 June 2024.</p> <p>Source: <u>USF Oceanography Laboratory</u>      Optical</p>	
Reports of spiny coral tissue loss/disease			
AGRRA 2024	<a href="#">Atlantic and Gulf Rapid Reef Assessment Data Explorer</a>	There are 34 reports for Barbados in the AGRRA database.	

## Oceanographic Data

The most available resources of oceanographic data are the CZMU and NOAA. The CZMU has several spatial layers related to oceanographic variables (e.g., bathymetry, water quality, etc.). Furthermore, international platforms such as NOAA, also provide satellite derived information (e.g., sea surface temperature, salinity, currents, etc.). The table below describes the sources and provides examples of the most oceanographic data identified.

Table 6. Current spatial information related to oceanographic variables.

Reference	Name	Documented spatial data:	Spatial data
GEBCO	General Bathymetric Chart of the Oceans <a href="#">GEBCO</a>	GEBCO Bathymetry Contours (500m) 2021.  It doesn't cover nearshore areas.	
CZMU	Coastal Zone Management Unit.  Nearshore Bathymetry Contours (m).	The nearshore bathymetry layer was provided by the CZMU.	
CZMU	Coastal Zone Management Unit. <a href="#">Oceanographic Monitoring Stations and Historical Data</a>	<p>CREWS – Coral Reef Early Warning System Buoy. Measures a range of hydrometeorological parameters</p> <p>3 Metre Discus Buoy – Measures directional wave and current parameters (height, speed, period) as well as meteorological parameters (wind speed and direction, air temperature, barometric pressure)</p> <p>Triaxys Wave Buoy – Measures directional wave and current data and water temperature</p> <p>AWAC – Acoustic Wave and Current Profiler. Measure directional wave and current data and water temperature</p> <p>AQUADOPP – Acoustic Doppler Current Profiler. Measure directional wave and current data.</p>	

Reference	Name	Documented spatial data:	Spatial data
NOAA	National Oceanic and Atmospheric Administration (NOAA).  <a href="#">Global near-surface currents (annual mean)</a>	A drifter-derived annual climatology of global near-surface currents. Satellite-tracked SVP drifting buoys provide observations of near-surface circulation at unprecedented resolution. Description <a href="http://www.aoml.noaa.gov/phod/dac/dac_meanvel.php">http://www.aoml.noaa.gov/phod/dac/dac_meanvel.php</a>	
NOAA	National Oceanic and Atmospheric Administration (NOAA).  <a href="#">Sea Surface Temperature.</a>	Ocean temperature measured at the surface by satellites. The SST scale ranges from -2 to 35 °C. Data are produced globally at 5km-resolution and are updated daily.	
Salas et al. 2011	<a href="#">Coastal fisheries of Latin America and the Caribbean</a>	Fig. 1. Barbados oceanographic features. Pag. 50.	

### Other relevant layers for the fisheries sector


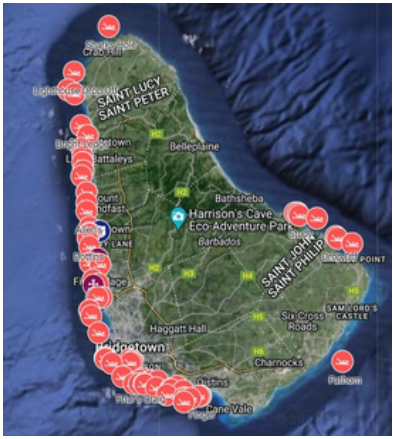
This grouping includes data on administrative boundaries, location of relevant features such as wetlands, scuba diving sites, land cover/use layers, distribution of shipping/cargo vessels and marine traffic, hazard risk assessments and hurricanes, and layers related to spatial distribution of tourism activities.

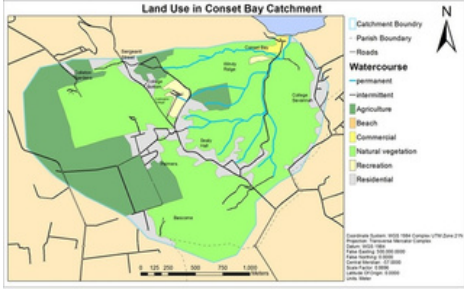
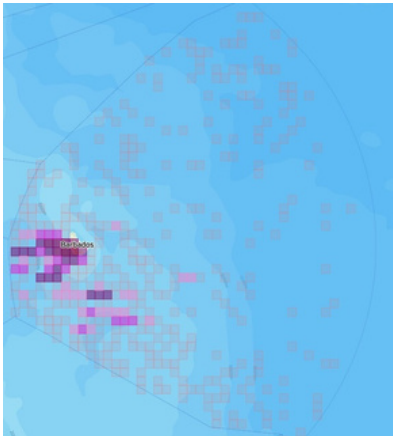
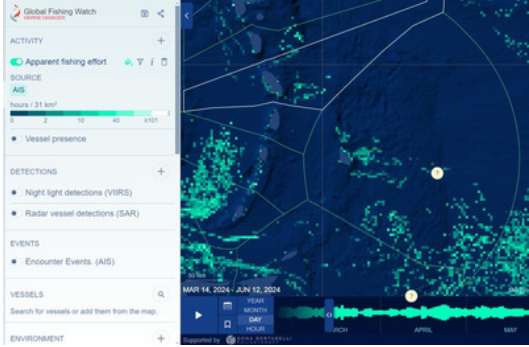
Country jurisdictional and administrative boundary layers (e.g., county boundaries, administrative divisions, roads, etc.) are available through online sources. Furthermore, the CZMU has access to these administrative layers including boundary layers for the territorial sea and the economic exclusive zone (EEZ).

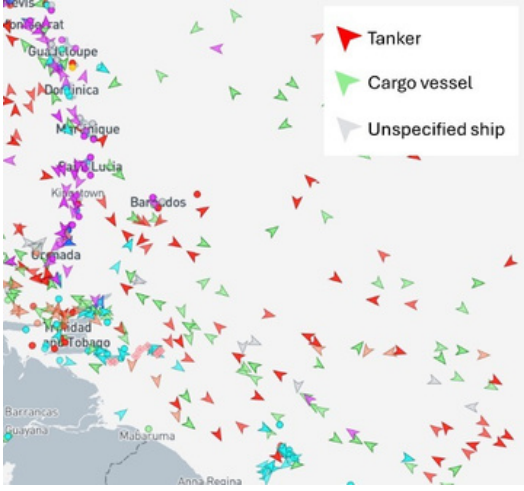
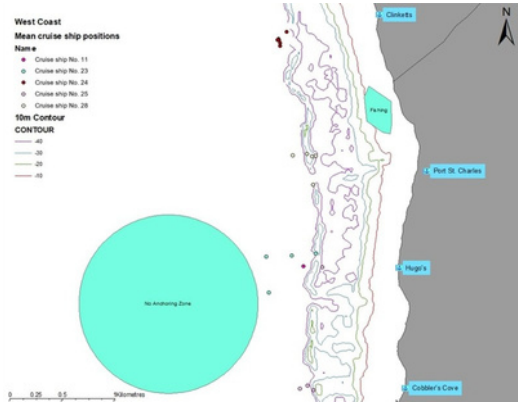
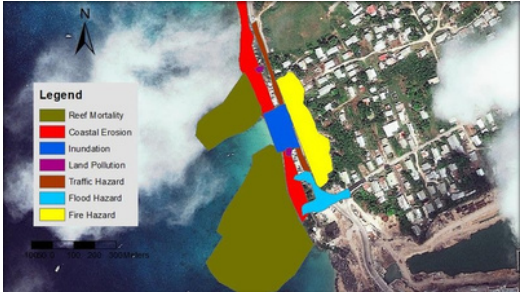
There is a relatively new wetland inventory depicting the location of nationally important wetlands (Mahon & Mascia, 2023). In addition, the Barbados SCUBA Dive Site Association has made GPS locations of diving sites available through their website (Table 7).

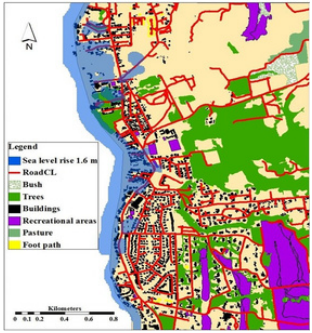

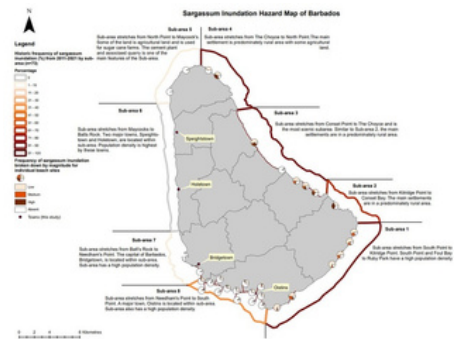
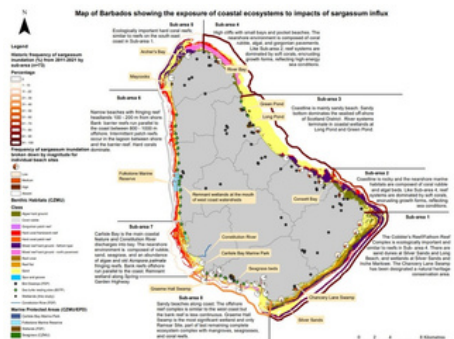
Commercial vessels (shipping and cruise industries) represent main actors in the marine spatial environment. Due to their size these vessels are required to have an automatic identification system (AIS) that documents their location, speed, direction, among other attributes. There are several websites and tools that can be used to access real-time and historical data such as the Global Fish Watch and the Marine traffic tool (Table 7).

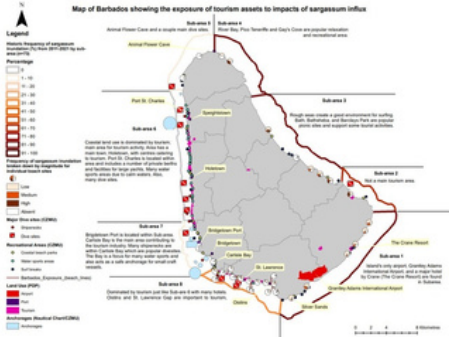
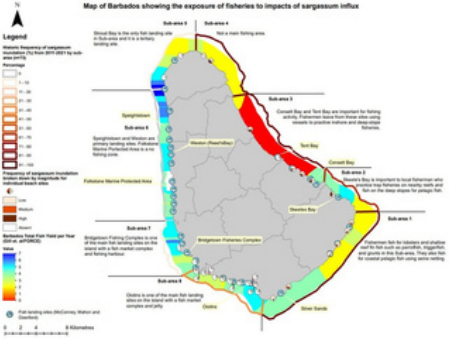

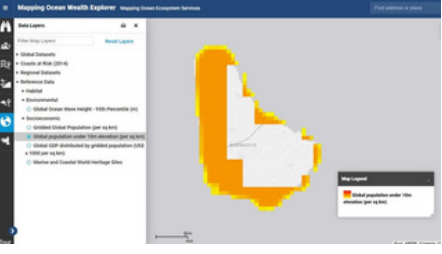
Table 7. Current spatial information related to other relevant layers.

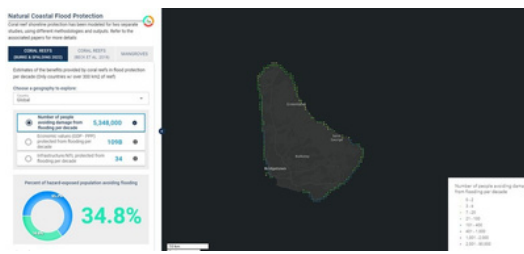
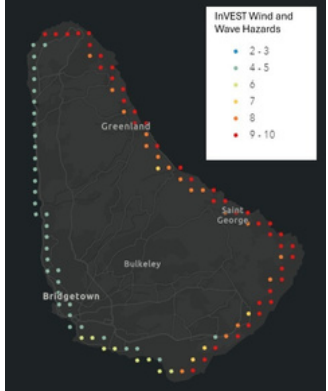
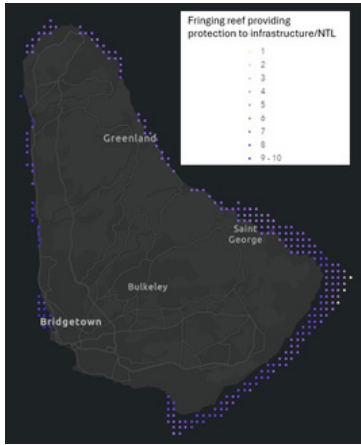
Reference	Name	Documented spatial data:	Spatial data
Other relevant layers			
Mahon & Mascia, 2023	<a href="#">Barbados National Wetland Inventory</a>	Figure 1. the location of nationally important wetlands. Pag. 11.  Detail spatial information of primary wetlands.	
BSDS	<a href="#">Barbados SCUBA Dive Sites</a>	Waypoints are available to download as KML. Map was published on Oct 13, 2023.	
LULC			

Reference	Name	Documented spatial data:	Spatial data
Gosine and Mahone 2015	<a href="#">Mapping land-use, human activities and vegetation in the Conset Bay watershed, Barbados, to determine potential sources of coastal pollution</a>	Several layers. For example, Fig. 8 Land-use map of Conset Bay Catchment area. Pag. 22	
Shipping and transportation layers			
GFW	<a href="#">Global Fish Watch</a>	<p>GFW is an open-access online platform for visualization and analysis of human activity at sea.</p> <p>Vessel abundance</p>	
GFW	<a href="#">Global Fish Watch</a>	<p>Apparent fishing effort: GFW uses data about a vessel's identity, type, location, speed, direction and more that is broadcast using the Automatic Identification System (AIS) and collected via satellites and terrestrial receivers. GFW analyzes AIS data collected from vessels that their research has identified as known or possible commercial fishing vessels and applies a fishing presence algorithm to determine "apparent fishing activity" based on changes in vessel speed and direction.</p>	

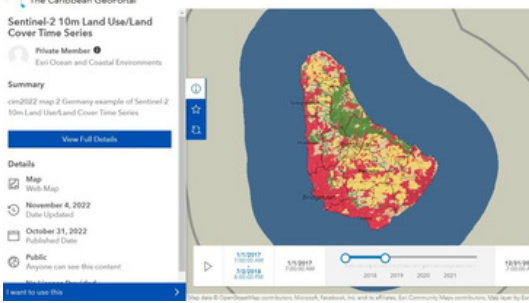
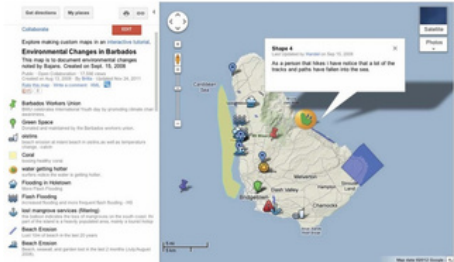
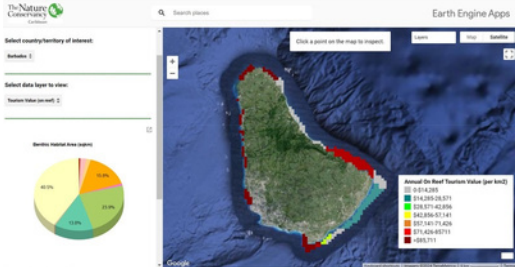

Reference	Name	Documented spatial data:	Spatial data
MT	<a href="#">Marine traffic</a>	<p>Smart ship tracking and maritime analytics.</p> <p>This is a paid licensing tool that starts off with a 7-day free trial, subsequently, the cost is \$19 USD per month for the standard plan or \$69 USD per month for the professional plan.</p>	
Small & Oxenford 2021	<a href="#">Assessing anchoring impacts of cruise ships in Barbados during the COVID-19 pandemic of 2020</a>	<p>Figure 3.7 Map showing the locations of 20 cruise ship anchoring events on the west coast of Barbados between 1 March and 1 September 2020. Pag. 21</p> <p>Other information: Appendix 1 Time, date and position when cruise ships' AIS status changed from to 'At anchor' for all 132 recorded anchor drops in Barbados between 1 March and 1 September 2020</p>	
Hazard risk assessment			
Alleyne-Greene 2016	<a href="#">Assessing vulnerability to climate change and variability at Six Men's Bay fishing community</a>	<p>Figure 15: Community-based hazard map of Six Men's Bay. Pag. 33</p> <p>Other information: Figure 21: 1 in 100-year storm surge flood hazard map of Six Men's Bay. Pag. 38</p>	

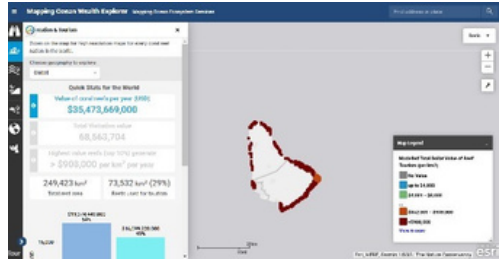
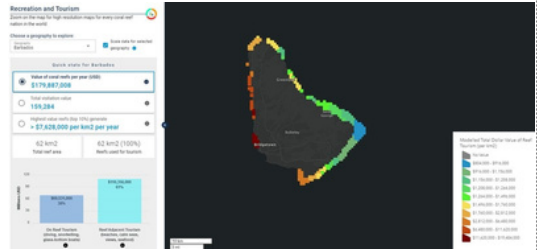
Reference	Name	Documented spatial data:	Spatial data
Alleyne 2019	<a href="#">Assessing the vulnerability of Holetown, Barbados, to relative sea level rise and storm surge</a>	Figure 16: Hazard map: relative sea level rise impact zone: 1.6 m; Critical infrastructure, land use and economic areas affected. Pag. 30	
Mycoo et al. 2021	<a href="#">Human Adaptation to Coastal Hazards in Greater Bridgetown, Barbados</a>	Fig. 4. Flood hazard map of Bridgetown showing some of the key coastal assets (Coastal Zone Management Unit, Government of Barbados). Pag. 7.	
Degia et al. 2022	<a href="#">Applying hazard risk assessment and spatial planning tools to sargassum inundations in the Eastern Caribbean Small Island Developing States as a basis for improving response</a>	Fig. 10. Map of Barbados showing the level of sargassum inundations by the eight coastal sub-areas and at 31 exposed beaches. Pag. 21.	
Degia et al. 2022	<a href="#">Applying hazard risk assessment and spatial planning tools to sargassum inundations in the Eastern Caribbean Small Island Developing States</a>	Fig. 11. Map of Barbados showing the exposure of coastal ecosystems to sargassum inundations. Pag. 23.	

Reference	Name	Documented spatial data:	Spatial data
	<p><a href="#">as a basis for improving response</a></p>		
<p>Degia et al. 2022</p>	<p><a href="#">Applying hazard risk assessment and spatial planning tools to sargassum inundations in the Eastern Caribbean Small Island Developing States as a basis for improving response</a></p>	<p>Fig. 12. Map of Barbados showing the exposure of tourism to sargassum inundation. Pag. 25.</p>	
<p>Degia et al. 2022</p>	<p><a href="#">Applying hazard risk assessment and spatial planning tools to sargassum inundations in the Eastern Caribbean Small Island Developing States as a basis for improving response</a></p>	<p>Figure 13 Map of Barbados showing the exposure of fisheries assets to sargassum inundations. Pag. 27.</p>	
<p>OW</p>	<p>Ocean Wealth: <a href="#">Mapping Ocean Wealth Explorer</a></p>	<p>Flood protection Coral reefs: People Protected (No.)</p>	
<p>OW</p>	<p>Ocean Wealth: <a href="#">Mapping Ocean Wealth Explorer</a></p>	<p>Population under 10m elevation (per sq km)</p>	

Reference	Name	Documented spatial data:	Spatial data
MOW	<a href="#">Mapping Ocean Wealth</a>	Natural Coastal Flood Protection: Number of people avoiding damage from flooding per decade.	
MOW	<a href="#">Mapping Ocean Wealth</a>	<p>InVEST Wind and Wave Hazards.</p> <p>A model of wind and wave hazards was built using the wind and wave indicators from InVEST [1,2]. These data are derived from peak (top 10 %) historic wind and wave records over the period 1997–2007.</p>	
MOW	<a href="#">Mapping Ocean Wealth</a>	<p>Fringing reef providing protection to infrastructure/NTL</p> <p>The relative importance of fringing reefs in defending adjacent coastal infrastructure from flooding.</p>	

Hurricanes

Reference	Name	Documented spatial data:	Spatial data
CGP	<a href="#">The Caribbean GeoPortal</a>	Contains several spatial layers and tools for hurricanes and cyclones, land use/land cover from 2017-2021, and sargassum worldwide or regional distribution. No specific layers for Barbados (5/29/2024).	
Tourism			
Ricker et al. 2013	<a href="#">Tourism and environmental change in Barbados: gathering citizen perspectives with volunteered geographic information (VGI)</a>	They used map-based online tools (google maps, Geoweb) to facilitate citizen participation in discussing the impacts of tourism. Figure 3. Google My Map interface and results. (A color version of this figure can be found in the online version at <a href="http://www.tandfonline.com/JOST">www.tandfonline.com/JOST</a> .) The map is no longer available 06/8/2024	
CSA	<a href="#">Caribbean Reef Explorer</a> (Caribbean Science Atlas)	Tourism value (on reef)	
CSA	<a href="#">Caribbean Reef Explorer</a> (Caribbean Science Atlas)	Tourism value (reef adjacent)	

Reference	Name	Documented spatial data:	Spatial data
OW	Ocean Wealth: <a href="#">Mapping Ocean Wealth Explorer</a>	Modelled total dollar value of reef tourism (per km <sup>2</sup> )	
MOW	Mapping Ocean Wealth	Recreation and tourism	

## Fisheries related data gaps

Effective MSP often faces challenges due to missing or incomplete data about a particular topic. Because the MSP embraces a holistic approach, in which several sectors should be included, addressing data gaps is essential for an effective planning process. Some of the strategies to mitigate data gaps often require enhanced monitoring programs, improved data sharing practices, and collaboration between different stakeholders (e.g., governmental, NGO's, private sector, academic, etc.). In terms of data gaps related to the fisheries sector, the assessment identified the following data gaps:

Human activities — fisheries sector:

- There is incomplete and/or outdated information on the distribution of fisheries activities (e.g., longline, seine, etc.). Except for the information provided by the DigiFish project, other existing information related to the distribution of fishing activities and fishing grounds is incomplete in terms of its spatial and temporal coverage. Furthermore, fisheries statistics data should also be reviewed and improved to better serve the needs of the MSP process based on clear objectives that have not yet been defined for Barbados.
- There is a lack of information related to conflict between the different fishing activities and between other sectors (e.g. spearfishing and cruising vessels).
- There is no information related to the use and impact of FADs.
- Limited information on the fishing community vulnerability and risk assessment to climate change and sea level rise.
- Through the BE, there is a great interest in promoting and developing the aquaculture/mariculture industry. However, there is no information regarding potential areas, species, and cost for aquaculture/mariculture endeavors.

#### Biological data:

- Although there is data on the distribution and status of benthic habitats, this data requires periodical reports and updates usually through the establishment of monitoring systems. For example, although there is information about the status of coral reefs in Barbados in 2017, the information is now 7 years old. Furthermore, there is no information about the status of other habitats such as seagrass and mangrove habitats. There is no information about deep-sea habitats.
- There is a gap in information related to the distribution of most of the commercially important fish species. Including information about their nursing, spawning and mating grounds. Although, in some cases it is possible to use surrogate data (such as habitat type, seafloor morphology, etc.) specific information about their seasonal distribution throughout the whole EEZ should be a priority.
- The assessment identified several reports on the distribution of other species such as sea turtles. This information combined with expert advice could be used during initial assessments. Although the Global Biodiversity Information Facility (GBIF) provides location information of opportunistic sightings of different species through Barbado's EEZ, there is not a study that documents/describes/analyses this data for Barbados.
- Information about invasive species and their effect on the marine environment is unknown.
- There is missing information related to the distribution of marine mammals and sea birds especially for migratory species.

#### Environmental Data:

- There is inadequate/missing information on sources and levels of pollution, including plastic debris, chemical contaminants, and nutrient runoff and their effects on marine ecosystems, species and the economy.
- Further research on sargassum is needed to inform on its impact on Barbados environmental and socio-economic aspects.
- There is a data gap related to the effects of artificial light on sea turtles and nearshore fishes' populations.

#### Socioeconomic Data:

- Insufficient data on the distribution and economic value of the fisheries industry.
- Data to support profitability and production analysis to determine how profitable and productive different fishing gears operating in different locations are, including new fisheries sub- sectors areas such as mariculture and aquaculture.
- Lack of detailed information on how marine activities impact (e.g., overfishing, pollution, habitat degradation, etc.) coastal communities and their livelihoods.
- There is a lack of data that help to define and measure the standard of living of Barbados small-scale fishing Communities.

## Fisheries related data needs to inform MSP

The MSP process is typically divided into steps, each critical for creating and implementing an effective marine spatial plan. An initial analysis can be performed with existing data to establish a baseline and to initiate stakeholder dialogue and participation. However, as the process evolves, more reliable data should be secured and/or used to improve the results. Stakeholders' input is central throughout the different steps to ensure that results (and their implications) reflect true and acceptable conditions.

The MSP process should be guided by clear objectives, which in turn, will also help determine the data needed during the different phases of the MSP process. Typical, data categories used for MSP process include administrative boundary layers (e.g., country boundaries, EEZ, protected areas, etc.), physical, chemical and biological layers that includes oceanographic data (e.g., bathymetry, sea surface temperature, ocean acidification, nutrients, etc.), species distribution and/or biological layers (e.g., benthic habitats, fishes, birds, sea turtles distribution, nursing, spawning and/or mating habitats, etc.), human spatial and temporal distribution (e.g., fisheries, transportation, energy, tourism and recreation), and socio-economic information which can be use as indicator variables and or combined but specific analysis to be included in the spatial analysis (e.g., fishing value, tourism value, livelihood information, etc.). Other categories include specific objectives, such as the inclusion of mariculture activities into current or already developed zoning, pollution layers, impact of climate change and sea level rise, among others.

At the very least, data should be objective, reliable, spatially and temporally relevant. Any data limitations should be clearly disclaimed, so they are considered by stakeholders.

Table 8 shows a list of data related to the fisheries sector considered useful to guide an initial MSP assessment. The table also includes suggested methodologies that could improve existing data for further phases of the MSP process. Integrating these types of data into a comprehensive spatial planning/analytical framework will allow managers and stakeholders to collaboratively assess options for balancing the use and conservation of Barbados' marine habitats and resources.

It should be noted that the effort to document existing data needs and capacity gaps for the fisheries sector to inform MSP is being complemented by similar efforts led by the CZMU to obtain information for other relevant sectors including maritime transportation, tourism, energy production (renewable & non-renewable), and mining (sand and gravel), among others. It is fundamental that MSP focuses on managing marine environments in a way that considers the complex interactions between ecological systems and human activities (holistic approach).

Table 8. Suggested data inputs for the early stages<sup>1</sup> of the Barbados MSP related to the fisheries sector. Additionally, descriptions of methods for data collection during the implementation phase<sup>2</sup> (improve current data) are included in the methods column.

Spatial data	Priorityfor	Current availability	Method for obtaining/collecting data	Partners for improving data catalog
<b>HUMAN ACTIVITIES — FISHERY SECTOR</b>				
Small-scale fishing distribution	High	Some data; mainly nearshore	Participatory mapping (low resolution, medium cost, EEZ coverage)	BFD CZMU Fishers/Fisheries organizations CERMES
Recreational and charter-for-hire distribution	High	Some data; mainly nearshore	Vessel tracking system (through the DigiFish project or similar) (high resolution, high cost, EEZ coverage)	
Commercial fishing distribution	High	Data poor	<sup>2</sup> Human activity distribution models (medium resolution, medium cost, EEZ coverage)	
Areas where users' conflicts have been reported	High	Some data; mainly nearshore		
<del>Distribution of fisheries activities by gear</del> (e.g., longline, seine, spearfishing, etc.)	High	Some data; mainly nearshore		
Fishing grounds (historical & current)		Data poor		
—subsistence/commercial FAD locations	High			
Landing sites	High	Data poor		
Anchorage/mooring areas	High	Some data	<sup>1</sup> Use satellite data to estimate location of features (low resolution, low cost, land and nearshore coverage)	BFD CZMU Fishers/Fisheries organizations Barbados divers' association (BADASS'n)
Diving sites	Low	Some data	<sup>2</sup> Ground truthing locations estimated with satellite data (high resolution, medium cost, land and nearshore coverage)	
	High	Good BADASS'n		
Other fisheries related land base facilities (e.g., boat yards, marinas, lighthouses, etc.)	Low	Some data		
Offshore aquaculture/mariculture (potential)	High	Data poor	<sup>1</sup> Implement suitability study (high resolution, high cost, mix coverage)	BFD CERMES

Spatial data	Priority for collecting data	Current availability	Method for obtaining/collecting data	Partners for improving data catalog
Fisheries socio-economic data (e.g. fish caught by landing site, number of vessels and fisherfolk register, etc.)	High	Some data	<sup>1</sup> Continue using current fisheries socio-economic data. <sup>1,2</sup> Evaluate and improve current data collection of fisheries socio-economic data.	BFD Fishers/Fisheries organizations Barbados Statistical Service
<b>BIOLOGICAL — Habitats</b>				
Coral reefs distribution	Medium	Baldwin et al., 2019 & Schill et al., 2021	<sup>1</sup> Continue using information from current sources (mix resolution, low cost, nearshore coverage) <sup>2</sup> Enhance current monitoring system to update current habitat information (medium resolution, high cost, nearshore coverage)	CZMU TNC MENB Barbados diving association
Seagrass distribution	Medium	Baldwin et al., 2019 & Schill et al., 2021		
Benthic habitats distribution	Medium	Baldwin et al., 2019 & Schill et al., 2021		
Mangrove distribution	Medium	Some data		
Degraded habitats distribution due to climate events (e.g., coral bleach, seagrass loss, etc.)	High	Data poor	<sup>1</sup> Implement specific studies (mix resolution, high cost, nearshore coverage) <sup>2</sup> Implement a reporting and monitoring system (citizen science — mechanism for people to report events)	CZMU BFD MENB TNC Fishers/Fisheries organizations CERMES Barbados diving association
Population and demographic data	Low	National statistical data	<sup>2</sup> Analyze ecosystem services provided by marine habitats based on population and demographic data	CZMU BFD CERMES

				TNC
BIOLOGICAL — Species Distribution				
Nursing areas	High	Data	poor	<sup>1</sup> Participatory mapping (low resolution, medium cost, mix coverage)  <sup>1,2</sup> Distribution models (low-medium resolution, medium cost, mix coverage)  <sup>1,2</sup> Tracking studies (high resolution, high cost, mix coverage)
Spawning aggregation sites	High	Data	poor	
Fish distribution	High	Data	poor	
Lobster distribution	High	Data	poor	
Conch distribution	High	Data	poor	
Sea urchin distribution (sea egg)	High	Data	poor	
Sea turtle distribution	High	Data	poor	
Marine mammal distribution	Low	Some	data	
Algae distribution	Medium	Data	poor	
Sargassum distribution	Low	Data	poor	
Invasive species (Lionfish) distribution	Low	Satellite	data	
OCEANOGRAPHIC CONDITIONS				
Bathymetry (contourlines or satellite imagery)	Low	Nearshore (CZMU, 2015) EEZ (GEBCO, 2023)		<sup>1</sup> Continue using global digital elevation models (DEM) (e.g., GEBCO, Seabed 2030) (medium resolution, low cost, EEZ coverage)  <sup>2</sup> Update lidar data (high resolution, very high cost, nearshore coverage)
Chlorophyll a concentration	Low	Satellite	data	
Nutrients (e.g., nitrates, phosphates, etc.)	Low	Satellite	data	<sup>1</sup> Continue using satellite data (medium resolution, low cost)  <sup>2</sup> Deploy oceanographic buoys

Ocean currents (direction and speed)	Low	Satellite data	(high resolution, high cost, usually nearshore coverage)	
Prevailing winds (direction and speed)	Low	Satellite data		
Salinity	Low	Satellite data		
Sea surface temperature	Low	Satellite data		
Hydrometeorological parameters	Medium	CZMU Buoy	<sup>1</sup> Continue using information provided by current deployed oceanographic buoys (nearshore) (high resolution, high cost, usually nearshore coverage)  <sup>1,2</sup> Deploy oceanographic buoys in other areas (farther offshore). (high resolution, high cost, usually nearshore coverage)	CZMU BFD
Directional wave	Medium	CZMU Buoy		
Water temperature	Medium	CZMU Buoy		
Meteorological parameters such as wind speed and direction, air temperature, barometric pressure	Medium	CZMU Buoy		
Current wave parameters (height, speed, period)	Medium	CZMU Buoy		
OTHER RELATED DATA				
Land cover/land use	Low	Some data	<sup>1</sup> Continue using available data (mix resolution, low cost, land nearshore coverage)  <sup>1,2</sup> Implement specific studies (mix resolution, high cost, land and nearshore coverage)	MENB CERMES
Wetlands	Low	MENB, 2023		
Watersheds	Medium	Some data		
Pollution (e.g., trash, sewage, etc.)	Medium	Data poor		
Hazard risk coastal areas	Medium	Data poor		
Flooding	Medium	Data poor		
Hurricanes	Low	Some data	<sup>1,2</sup> Implement specific studies (mix resolution, high cost, nearshore coverage)	CZMU MENB CERMES
Sea level rise	Low	Data poor		

Ocean acidification	Low	Some regional data		
Changes in sea surface temperature	Low	Satellite data		
Changes in tides and waves	Low	Satellite data		

Early phases of the MSP; MSP Implementation phase

## Data access

Data accessibility refers to the ease with which users can find, retrieve, understand, and use the data. During this assessment of data access in Barbados several limitations for accessing data were found and are described below. These limitations can significantly impact the effectiveness of MSP planning and management efforts.

- Data integration: Existing data must be integrated into a project to allow for its incorporation and usage in analytical tools. This could be a challenge because existing data from different sources have varying formats (e.g., shapefile, geotiff, geoJSON, KML, jpg, png, PDF, etc.), temporal and spatial scales (e.g., collected locally, nationwide, nearshore, regionally, etc.), and quality (which is highly dependent on data collection methodologies and equipment). Most of the current available data in Barbados is in PDF format. Thus, the information will have to be requested from the source. If the map/layer is not in a usable format (usually a spatial format) then further procedures will have to be completed (e.g., digitalization, georeferencing, etc.) so the data can be combined into a cohesive and usable format.
- Data quality: This can be measured based on several characteristics such as completeness (presence or absence of features and/or their attribute information), spatial (related to the position of features in relation to Earth), and thematic (related with the attributes within features) accuracy. Existing data for Barbados was collected with specific objectives and methodologies which can affect its quality and accuracy. For instance, the spatial accuracy of a layer created using a GPS unit (higher accuracy) is different than a layer created using aerial imagery (lower accuracy). The layer's metadata is usually used to evaluate its quality. GIS metadata refers to essential information about a layer or dataset, including its source, quality, content, and other characteristics. Exploring and understanding the quality of a layer is an important step in any GIS/spatial dependent project.
- Locating data: Finding relevant data can be challenging due to the plethora of platforms to publish data (e.g., reports, scientific publications, organization servers and/or websites, atlas and portals, etc.). To mitigate this limitation a national data access and sharing platform will have to develop and coordinate, so data from all the pivotal sectors can be included there. The CZMU could lead the development of this MSP platform or mechanism (index) in which authors can share a description of their research and/or project with a section for describing and sharing their spatial data.
- Unwillingness to share information: There are several reasons for people or an organization's indisposition to share information. Data may be sensitive (e.g., precise location of endemic species) or proprietary (e.g., fishing spots). There could be legal or regulatory constraints, or in some cases it could be because there is a lack of trust. Several strategies can be used to mitigate this limitation. For instance, trust can be enhanced by fostering open communication and building relationships with stakeholders and data holders, by establishing clear procedures and protocols that provide details regarding how data will be used, shared, and protected, by creating different data sharing

privileges so sensitive data might only be shared with relevant stakeholders, among others.

Clear guidance documents and procedures should mitigate the effect of these limitations during the implementation phase of the MSP process. At the very least, this should include:

**Data sharing agreements:** They are formal contracts that outline the terms and conditions for sharing data. Their purpose is to ensure that all parties understand their rights and responsibilities concerning data use, access, and protection. In most cases, data related to the fisheries sector is shared through informal agreements. Usually, a request is made to the source of information (e.g., Fisheries Division Chief officer, professor or principal investigator, etc.) and data sharing is decided on a case-by-case basis. Usually involving the acknowledgment of the source of the requested information. The development of a MSP sharing platform or mechanism should include a data sharing agreement. The Caribbean Science Atlas sharing agreement is a good example of such practices, in which users are required to complete and sign the agreement before they can download information available through this atlas.

**Data sharing protocols:** they contain practical guidelines for technical and operational aspects of data exchange (who should share, what to share, what format, etc.). For instance, once the MSP data sharing platform is operational it should allow stakeholders to upload and share their data. The data sharing protocols will then provide the necessary information to ensure that new data meets established data quality standards, and it is provided in a format that allows for seamless integration with current data (as possible).

## Technological and human resources

Effective Marine Spatial Planning (MSP) relies on both technological and human resources to ensure that data is accurately and effectively collected, analyzed, and utilized for decision-making.

### Technological resources

For this assessment technology resources consist of hardware and software required for developing and implementing a MSP process.

#### Hardware

Running GIS analysis, models and simulations, as well as managing large datasets can be computationally demanding. Typical computer needs include multi-core processors, minimum 8GB of memory/RAM (recommended  $\geq 32$ GB), a dedicated graphic card, and preferable solid-state drivers for faster data access. Furthermore, other important resources include stable internet connectivity (for accessing online GIS data sources, cloud-based GIS services, and software updates), backup systems and protocols (hardware and cloud-based), and up-to-date antivirus software.

Both the CZMU and the BFD meet the minimum hardware requirements for installing and working with GIS software. They also have backup systems and antivirus software. However, the current internet connectivity (speed and reliability) could be improved. During the interview

process with stakeholders, it was rated by staff that were interviewed as intermediate —3 out of 5).

As the MSP leading agency, the CZMU will have to increase their technological resources (e.g., servers, data storage, clearinghouse data, etc.) to accommodate the national data sharing mechanism able to manage complex and large datasets expected from combining information from multiple agencies and organizations (e.g., shipping sector, tourism, environmental, fisheries, etc.).

## Software

Geographic Information System (GIS) software is essential in MSP because it provides tools for collecting, managing, analyzing, visualizing, and sharing marine and coastal data and results. There are several software options currently available for developing, curating and analyzing spatial data. This assessment focused on the most popular software for MSP, which can be divided into three main categories based on their capacity: a) acquiring, exploring and preparing data; b) analyzing data; and c) sharing and interacting with data results.

### Software for acquiring, exploring, and preparing data

Once the objectives of the MSP are determined, the focus can turn to acquiring the information needed. In the case of Barbados, some of the information is readily available (e.g., country boundary, fisheries statistics, etc.). Some information might require further processing or manipulation (e.g., clipping to study areas, coordinate system, etc.) to standardize all the spatial layers (usually from different sources) for further analysis. In some instances, spatial information must be collected and therefore, ideally, the software should provide tools or extensions to aid in data collection (paper and digital forms).

ArcGIS Pro and QGIS are leading software packages used to create, manage, analyze and visualize spatial data (Table 9). In general, ArcGIS software is very reliable, user-friendly, with advanced spatial analysis tools and easy integration with other features for data visualization (e.g., interactive maps, story maps, dashboard, etc.). However, it is also expensive and requires a yearly license per user. QGIS is also a powerful software, with several standard GIS functionalities but customization depends on its community for more specialized tools. Although the license for QGIS is open source (no cost), other features, training, and customization might require a fee. Furthermore, although features for publishing and visualizing data can be accessed, they might be available through other companies (e.g., [Mapbox](#)) which can increase effort and cost.

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Table 9. Comparison between ArcGIS and QGIS software.

Characteristic	ArcGIS (ESRI products)	QGIS
Cost	Paid license (3 levels). The cost of the <a href="#">GIS professional advance licensing</a> in the US is USD \$4,150/year for 1 computer/user. Additionally, the cost of the software extensions bundle is USD \$1,950/year*.	Open-source and free to use. There might be costs associated with training, support, and customization.
User interface	User-friendly with comprehensive documentation and support tools (e.g., websites, forums, blogs, tutorials, and training –some at no extra cost).	Steeper learning curve for beginners. It offers extensive customization options. Community-driven support (e.g., forums, video tutorials, and developers).
Functionality	Wide array of advanced spatial analysis tools and integration with other services (R software, satellite data)	Broad range of GIS functionalities, including spatial analysis, map design, geoprocessing, and plugins for additional capabilities. It depends on its community for more specialized tools.
Customization	Through scripting and coding (mainly Python language).	Through plugins and scripts (Python language and others). Community-driven plugin repository that allows users to access and contribute plugins.
Features for data visualization	It offers cloud-based solutions such as ArcGIS Online, interactive maps, dashboards, story maps, among others. Because the different solutions are integrated, a map created in ArcGIS Pro is easily shared among the different apps.	Interactive maps are shared through plugins but require other platforms (e.g., OpenLayer, Leaflet, MapBox) to make it available online.
System compatibility	ArcGIS is a Windows-only application. It can be run on Mac systems using a natively on a Windows partition. Support and troubleshooting are limited.	It runs on Windows, macOS, Linux, and BSD.

\* Pricing was estimated for the United States (2024) and it might differ based on the country, organization, number of users, software credits, etc. Please contact your local ESRI provider for accurate cost estimates.

R software is another option, not requiring a license, for working with GIS data. However, R is mainly used as statistical software with capabilities for performing GIS analysis. It is not as user-friendly, with a steep learning curve (requiring dedicated time and effort) that includes R syntax (programming), data structure, and the use of multiple packages (collections of functions, documentation, and data that expand R).

The CZMU is currently utilizing the ArcGIS software. Their personnel skills level with the software ranges from intermediate to advanced. The CZMU [marine spatial planning website](#) provides a glance of some of the spatial data (interactive maps created using ESRI products). Furthermore, the CZMU has developed a data collection form to gather fisherfolk input related to fishing areas (Fig. 11) using [Survey123](#).

The BFD is currently securing funds to obtain one ArcGIS license. They have one technician designated to support MSP, but the level of GIS expertise is basic. Furthermore, the BFD recently developed a digital form in Kobo Toolbox for registering fishing licenses and vessel inspections. Kobo Toolbox provides data collection tools starting with a community license for free. However, some of the comments related to the use of this software expressed issues mainly while collecting data offline.

Both the BFD and CZMU agencies have basic expertise in working with QGIS. They know about the software and have used it sporadically for simple mapping applications.

ArcGIS and QGIS are continually developing and providing access to new associated products and tools. Therefore, there are opportunities for further capacity and technical training on the use of both software for MSP.

### Analyzing MSP process data

There are several software packages with specific tools, extensions and plugins designed to help decision makers to interpret results and find solutions for complex issues during the MSP process. Table 10 shows a comparison of the main software packages currently available. Marxan and SeaSketch are platforms specifically created to support planning processes, requiring basic knowledge in GIS, while ArcGIS and QGIS are software packages developed to work with spatial data (not specific for planning) but with the capacity to perform spatial and scenario modeling analysis. However, ArcGIS and QGIS require technicians with intermediate to advanced knowledge in GIS, spatial analysis, and in operating the software itself.

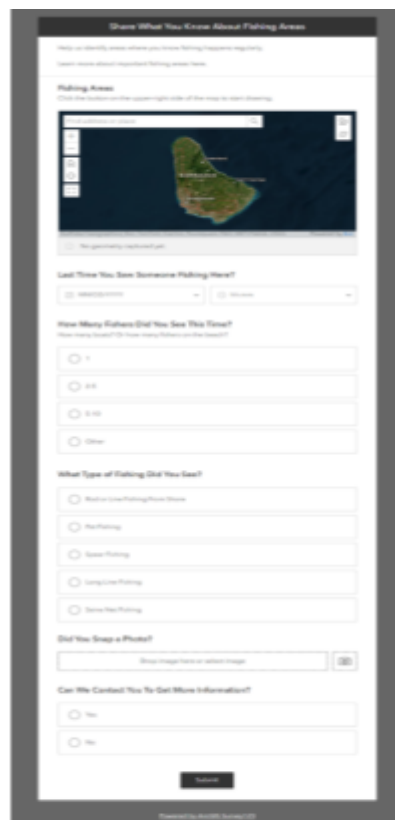


Figure 11. CZMU Fishing areas survey (Survey123).

A comprehensive list and description of other specialist MSP software was published in 2022 by the World Bank through its MSP [Blue Economy Data and Tools report](#). The list includes:

Software and application tools:

1. Adaptation Design Tool: Corals and Climate Adaptation Planning
2. ARIES
3. Capturing Coral Reef & Related Ecosystem Services (CCRES) project tools
4. Changing tides. Climate Adaptation Methodology for Protected Areas (CAMPAs): coastal and marine
5. Climate Adaptation Toolkit for Marine and Coastal Protected Areas
6. Coastal Climate Adaptation Decision Support
7. Decision Support Tool for Blue Economy in Marine Protected Areas
8. DEVOTES
9. Earth Blox
10. Ecolmpact Mapper
11. Ecopath with Ecosim (EwE)
12. EO4SD Marine and Coastal Resources Portfolio
13. ExtendSIM
14. Guide for Planners and Managers to Design Resilient Marine Protected Area Networks in Changing Climate
15. iMarine
16. Living Standards Measurement Study (LSMS)
17. Marxan
18. Natural Capital Project
19. ODEMM
20. Reef Resilience Toolkit
21. The Marine Spatial Planning Challenge
22. Tools4MSP

Online GIS mapping tools and portals:

1. ArcGIS Online
2. ARIES for SEEA Explorer
3. Caribbean Marine Atlas
4. Climate Engine
5. Coastal Resilience
6. Earth Map
7. European Atlas of the Sea
8. Google Earth Engine
9. IPCC WGI Interactive Atlas
10. Marine Protection Atlas
11. MESH Seabed Habitat Maps (EMODnet)
12. Ocean+ Habitats
13. Ocean Wealth Explorer
14. PEDDR Opportunity Mapping Tool
15. SeaSketch
16. Spatial Agent
17. Tools4MSP Geoplatform
18. The World Bank Maps
19. AI Tools for Rapid Natural Capital Accounting
20. Ocean Accounts Diagnostic Tool
21. System of Environmental Economic Accounting
22. Symphony
23. Wealth Accounting and the Valuation of Ecosystem Services (WAVES)
24. Bayesian Belief Networks
25. Leaflet
26. TerraGo Toolbar

Table 10. Comparison among selected MSP software.

Software	Marxan	SeaSketch	ArcGIS	QGIS
Description	It applies an algorithm (procedure) to find one or more solutions to a well-defined problem.	Participatory mapping software.	GIS software for creating, modifying, analyzing, and reporting spatial information.	GIS software for creating, modifying, analyzing, and reporting spatial information.
Basic software cost	Free	Free	\$\$	Free
Advance software cost (customization)	Free	Baseline \$3K. Group project \$15-\$20K. Large projects \$30-80K	Basic \$2K. Advanced \$5K per user/year	\$
Project setup	Moderate	Easy	Moderate	Moderate
Support	Though its community is free Specialized training \$\$	Though its community is free Specialized training \$\$	Basic is included Specialized training \$\$	Though its community is free Specialized training \$\$
Level of GIS expertise	Moderate	Basic	High	High
Guided workflows	Yes	Yes	No	No
MSP tools	Reserve design, with zones, with connectivity y With probability	Zoning but it can be customized	Several such as suitability modeler	Several plugins
Scenarios capacity	Yes	Yes	Yes	Yes
Data collection forms setup	No	Easy	Moderate	Moderate

Online data collection	No	Projects & surveys	FieldMaps, Survey123	QField
Offline data collection	No	\$\$	Included	\$\$
Layer preparation	No	No	Yes	Yes
Sharing results, stakeholder collaboration	Marxan web	SeaSketch Projects	Interactive maps, story maps, dashboards	Plugins to other companies

Cost/Effort



## Sharing and interacting with data and results

MSP should be a participatory and collaborative process that benefits from software and tools with integrated data sharing capabilities. From the selected software in Table 11, ArcGIS has the greatest level GIS. ESRI has a series of other completely integrated products such as ArcGIS Hub, dashboards, story maps, interactive maps, digital data collection (Field Maps and Survey123), among others. QGIS is also a powerful GIS software able to complete all the steps of the GIS. However, some of its products are not fully integrated and require access to extra software (offered by different companies). MSP requires that personnel using ArcGIS and QGIS to also have intermediate to advanced GIS skills.

Marxan and SeaSketch provide web-based sharing platforms of data and results. However, data acquisition, exploration and manipulation cannot be performed using either of these packages. These applications are, however, relatively easy to use, require personnel with basic GIS skills, and are well adapted as MSP digital data collection platforms.

## Human resources

For this assessment, human resources refer to core team personnel in charge of overseeing the day-to-day activities involved in developing and implementing a MSP process.

Several people interviewed from BFD and the CZMU are yearly contracted personnel, which could create an unstable environment and a greater personnel turnover. One of the reasons to justify this arrangement is that official permanent positions within the government are difficult to create and might require a lengthy process. Furthermore, some of these personnel are hired with budget from projects that require a determined budget time execution.

The composition of an MSP team typically includes a multi-disciplinary range of experts, including a project manager, GIS professionals, communication and outreach specialist, policy and legal expert, an ecologist or marine biologist, an economist, an information technology specialist, and technicians to support data collection effort. Currently, the [CZMU team](#) is comprised of 11 people with a wide range of expertise and capable of handling the development and implementation of a national MSP process.

In terms of the fisheries sector, the BFD has some personnel limitations. Currently, there is only 1 data analyst with basic knowledge in GIS, and whose duties and effort are divided among multiple projects and activities. The BFD has several data collectors and/or field observers; however, it is anticipated that a great amount of effort is necessary to support fisheries data collection, analysis, and reporting, which may require more than 1 dedicated data analyst — at least at the early stages of the MSP process.

## Capacity building

MSP requires a combination of technical capacities and skills. At the very least, technicians should have a basic to intermediate knowledge and skills in GIS including acquiring reliable and relevant data, managing and processing individual layers as well as integrating the diverse layers and datasets, usually from multiple sources (including non-spatial data) and with different formats, into one project for further analysis.

Several software products and tools used for MSP consist of underlying models (e.g., reserve design in Marxan, suitability model in ArcGIS, etc.) to provide insight into the question of interest. MSP technicians should have at least basic knowledge of mathematical and statistical modeling techniques to maximize the use and interpretation of “canned” (standard or already developed) models (e.g., reserve design with zones, suitability analysis, etc.). As the MSP progresses, technical capacities should also grow expanding on standard tool applications and developing customized models to support the long-term goals of the MSP (complex simulations to help predict the impacts of different planning scenarios).

It is anticipated that the MSP team (within the CZMU) will oversee the implementation of core MSP analysis. The MSP team has capacity for working with spatial (e.g., shapefile, raster, etc.) and non-spatial data (e.g., socio-economic data, surveys, etc.). They also have access to the ESRI products and support. However, they might benefit from training related to advanced spatial analysis and modeling techniques. GIS technology is usually improving, and it is important to participate in conferences and specialized training to make use of the most advanced techniques and tools.

In contrast, the BFD does not have a technician exclusively working on supporting MSP activities, personnel level of expertise in GIS is basic, and they are currently securing funding for the ESRI license. However, once this software is acquired the expectation is that it will aid in/contribute to fisheries related data collection efforts by the BFD, while the MSP team from CZMU will handle the robust analysis and data sharing efforts. Nevertheless, it is important to build capacity among the different governmental agencies, and therefore it is suggested that the BFD technicians and personnel focus their training on digital data collection —designing surveys and stakeholder engagement.

The area of stakeholder engagement is an opportunity for BFD and CZMU collaboration. Therefore, training in communication, outreach, writing, design of presentation, and facilitation skills should also be considered.

Capacity building programs should consider multiple training strategies to account for potential personnel turnover. For example, in-person training could be complemented with online, at learners’ pace, training modules. Table 11 presents several recommended trainings to improve current technical capacity to support the MSP process, which are applicable not only to the fisheries sector but also to other relevant agencies for developing and improving MSP in Barbados.

Table 11. Suggested trainings for technicians supporting Barbados MSP process.

Trainings	Main topics
Introductory training in GIS	Acquiring data Managing spatial data Basic analysis based on already established tools (e.g., analyst tools)
Digital data collection	Participatory mapping surveys Direct data collection through tracking data. Monitoring systems (e.g., acoustic monitoring, drones and remotely operated vehicles)
Facilitation skills	Methods for participatory planning and stakeholder engagement
Remote sensing	Acquiring satellite data Creating and working with derived data (data created as a product of previous analysis)
Introduction to modeling and simulations	Basic knowledge MSP software and tools (in deep exploration of current leading platforms to understand their strengths and limitations)
Models and simulations (intermediate training)	Understanding of ecological and environmental modeling concepts Creating and modifying models Modeling software (e.g., MATLAB, Python, R software, etc.) Spatial statistics (e.g., cluster analysis, hot spot analysis, etc.) Advance simulations
Economic analysis	Cost-benefit analysis of different scenarios Trade-off evaluation among competitive uses Assessment of economic development opportunities
Legal and policy	Introduction to national and international laws, regulations, and policy framework related to MSP National and international data sharing protocols
Cloud-based platforms for sharing data	Exploration of current platforms (strength and weakness based on national need) Design and implementation of online platforms and tools (e.g., website, interactive maps, dashboards, mapping surveys, discussion forums, etc.) for sharing data and results to support stakeholder engagement Mobile apps (design and implementation for data and results sharing)

Incorporating fishermen (e.g., small-scale, commercial, and recreational fisheries) into the MSP process not only supports sustainable resource management but also promotes social equity and resilience in coastal communities. Their involvement is essential for creating

comprehensive and effective marine management strategies. Therefore, it is important to provide training opportunities and outreach activities for this group that include:

- Marine Spatial Planning training that describes:
  - o what it is,
  - o how it is done,
  - o how they can actively participate in this process,
  - o how the information they provide is used and shared and
  - o the importance of accurate, up-to-date information for an effective MSP process.
  
- Training in the use of technology to collect, share, analyze and visualize data that might be useful for MSP and their fishing operations (e.g., GPS to locate fishing spots, cargo ships distribution, sea surface temperature, interactive maps, etc.).

## Recommendations

Barbados government is committed to promote and develop its Blue Economy, in part by developing and implementing a MSP process. Based on this assessment the following recommendations are proposed:

### Data collection

Although the DigiFish dataset (vessel tracking project) has its limitations (e.g., there is a need to increase its sample size), it provides the best information related to the temporal and spatial movements of fishing vessels. It also allows for further analysis based on time spent in the water (effort), vessel and fisherfolk characteristics, etc. It is recommended that efforts should be allocated to secure funding to extend this project and increase its sample size, so the data is more representative of the fishing community.

There is some basic data that can be used during the early stages of the MSP process (e.g., scientific reports, governmental data, etc.). However, it is recommended that the results of the analysis performed using this available data should be interpreted carefully due to the limitations inherited by this data (e.g., data was collected using different methodologies, timeframes, purposes, etc.).

Because there are temporal and spatial gaps in information related to the distribution of fishing activities and commercially important species, the MSP team should prioritize data collection on these topics. A timely and effective option is the use of surveys and participatory mapping that can be applied to collect initial data (through consultations with fisherfolk, managers, and researchers). Participatory mapping will not only provide basic information but will also facilitate necessary stakeholder engagement at early stages of the MSP process. These methodologies can be timely,

and they don't require a vast number of resources. Nevertheless, because they rely on recollection of information rather than direct observations, participatory mapping has its limitations which should be recognized during the results interpretation and reporting. Some spatial layers obtained with these methodologies include fishing grounds, nesting, nursing and spawning areas (e.g., commercially important fishes, sea turtles, marine mammal, invasive species, etc.), areas where conflict has been experienced, on-the-water areas used for tourists (e.g., swimming, diving, snorkeling, jet ski, yacht cruising, etc.), livelihood and gender related data, among others.

Although the BFD is still collecting data using paper forms, they are also trying to transition into digital data collection with mixed results. Therefore, there is an opportunity to develop these digital data collection tools using integrated software. As well as sharing related expertise among agencies.

It is also recommended partnering with other relevant institutions such as TNC, academic centers in the Caribbean region, and other NGOs to collect specific data that will improve the baseline assessment performed with current available data. As the MSP process progresses, reliance on current available data should decrease in favor of data collected through established protocols. For instance, efforts and funding should be allocated to collect data through tracking devices such as the Digifish project. This will provide more accurate and higher resolution estimates of fishing grounds (by gear, by target species, fishing effort, etc.) and important species. Furthermore, there are some important topics such as potential areas, species and cost evaluations for the mariculture industry on which there is no current available data. Therefore, specific studies will have to be implemented with support from the different partners.

### MSP Analysis

The government of Barbados has not negotiated a multiagency ESRI license. Therefore, each agency must secure funding and negotiate their individual license with an authorized distributor or use alternative software (such as QGIS and Kobo Toolbox, etc.). It is recommended that all relevant sectors (and agencies) use the same software for data collection, management and sharing. Therefore, a decision must be made and actions to secure access to all relevant actors should be implemented. This will facilitate integrating data from multiple sources into a unified MSP platform or system. Capacity building can also be tailored to the use of the chosen software and tools.

It is also recommended to use other MSP specialized software such as Marxan. It is powerful software capable of handling complex solutions (e.g., connectivity, zoning, etc.) for defined objectives. It provides the ability to evaluate the impact of different scenarios to support the planning process. Its use and capabilities can be

complemented by other relevant spatial analysis performed in GIS software (ArcGIS Pro and QGIS).

#### Required human and technological resources

The CZMU has technological resources such as computer equipment, operating software, antivirus, and backup systems to perform all the necessary analysis and reporting. Internet resources could be improved because some of the tools for data collection, managing information and interactive sharing of data and results rely on a stable internet connection. CZMU will have to increase their technological resources to accommodate the MSP data sharing platform. It is expected that the platform should be able to handle large and complex datasets. As well as providing diverse tools for sharing data and interactive results to promote stakeholder engagement.

In terms of human resources, the MSP process requires a dedicated multidisciplinary team, each contributing critical knowledge and skills to the planning process to ensure that spatial plans are scientifically sound, legally compliant, and socially equitable. The CZMU MSP team consists of and relies on multidisciplinary professionals to provide support related to planning, data collection, stakeholder engagement, marine ecology, fisheries, communication, policy and legal expertise, among others. In addition, the MSP Project Steering Committee (a multi-sectoral technical advisory committee) provides guidance to the CZMU MSP team. It is recommended that Barbados continue embracing a multidisciplinary team to implement and guide its MSP process. However, some of the personnel are on a contractual basis of employment which can generate gaps and instability as people seek other employment opportunities and/or their contract is renewed. Usually, long-term contracts in governmental institutions must have secure funding, and require a lengthy recruitment process. The team leading the MSP in Barbados, should develop strategies and protocols to mitigate any disruptions or gaps generated due to personnel turnover.

The MSP team should seek training opportunities to continue their skills and capacity development as the MSP process progresses. It is also recommended that the MSP team participate in regional and international opportunities to share their experiences and lessons learned during the development of the Barbados MSP process. Furthermore, training and outreach opportunities for key stakeholders (e.g., fisherfolks) and the public in general should also be provided. This will help to implement more effective, equitable, and sustainable marine management strategies that balance ecological health with human needs and values.

#### Information sharing

The MSP process depends on an effective and comprehensive mechanism that allows not only sharing data (spatial and non-spatial) with different access privileges

levels (for sensitive data), but the share of preliminary results for discussion and enrichment through stakeholders' feedback. Such a data sharing mechanism as well as data sharing agreements and protocols should be developed and implemented by the CZMU during the early steps of the MSP process.

## Conclusions

The MSP needs and data gaps assessment conducted is intended to characterize existing data, technology, and human capacities and identify any needs and gaps that may be relevant to the MSP process. Accordingly, this assessment is framed around the desire to develop a collaborative framework for recognizing and integrating fisheries contributions into the entire MSP process for Barbados (Figure 10).

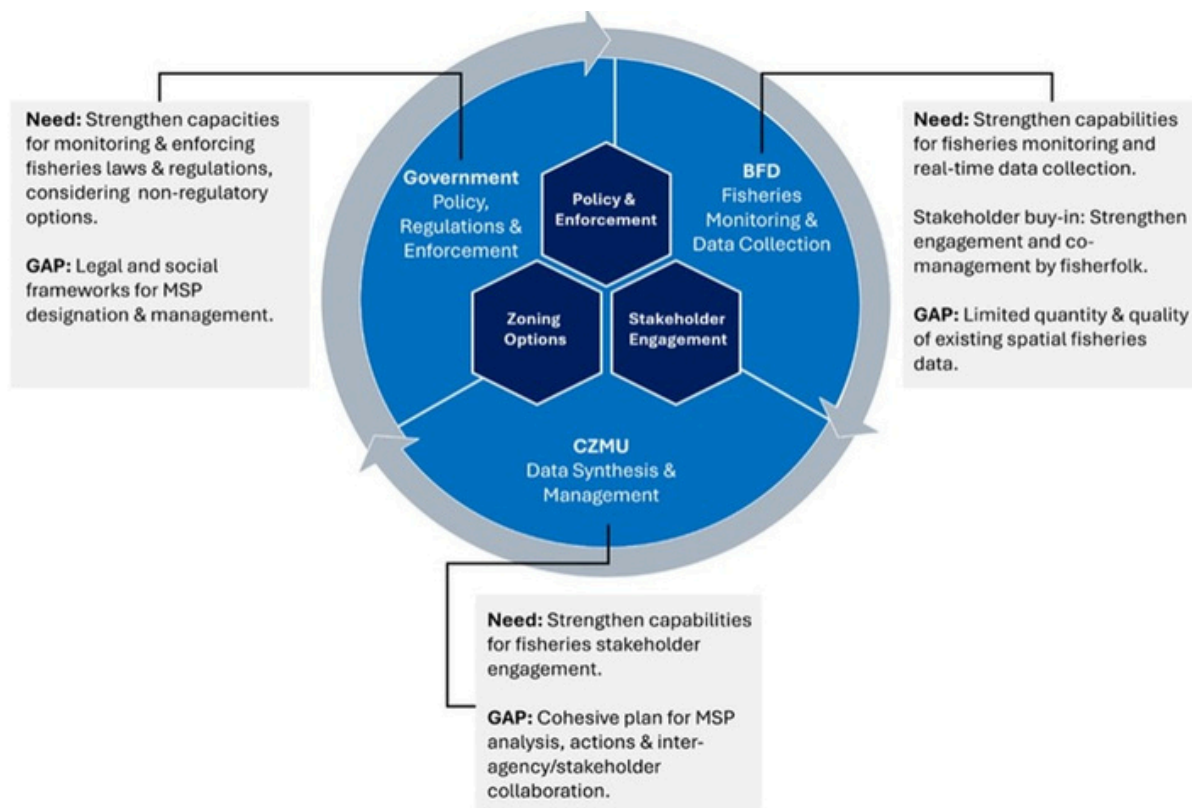


Figure 12. A collaborative framework for integrating fisheries interest into the MSP process

This framework concentrates on the interrelationships between two principal governmental entities that will play an important role in the monitoring and collection of relevant fisheries data (the BFD) and in data synthesis, management, sharing and reporting (the CZMU). Key collaborative activities to be undertaken include stakeholder engagement and the spatial modeling framework that will map zoning options for human uses and marine ecological/habitat conservation. These activities

should synchronize and support government decision-making to establish policies, promulgate regulations and engage in enforcement actions.

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# Appendix

## Appendix 1: Terms of Reference (TOR)



### **BE-CLME+ Project: Promoting National Blue Economy Priorities Through Marine Spatial Planning in the Caribbean Large Marine Ecosystem Plus (GEF Project ID 10211)**

#### Terms of Reference for a National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform MSP in Barbados

##### **1.0 Background & Justification.**

1.1 The BE-CLME+ Project is a regional initiative aimed at promoting blue economy development in the Caribbean region through Marine Spatial Planning (MSP) and Marine Protected Areas (MPAs), Ecosystem Approach to Fisheries (EAF), development of climate-smart sustainable fisheries value chains, and knowledge management in Barbados, Belize, Guyana, Jamaica, Saint Lucia, and Panama. The Caribbean Regional Fisheries Mechanism (CRFM) is the Executing Agency for the project, while the Development Bank of Latin America and the Caribbean (DBL) and the Food and Agriculture Organization (FAO) of the United Nations are the Global Environment Facility (GEF) Co-Implementing Agencies.

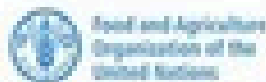
1.2 The 2023-2024 BE-CLME+ Project Workplan & Budget was approved by the Regional Steering Committee on 29<sup>th</sup> September 2023, and calls for a national consultancy to conduct data gap and needs assessments to inform MSP interventions in the country.

1.3 The Government of Barbados signed an agreement in September 2022 with the Inter-American Development Bank and The Nature Conservancy for a "blue bond" debt conversion. This agreement will enable the country to reduce its debt and increase its investment in marine conservation. One important component of this agreement is the preparation, approval and implementation of a marine spatial plan (MSP) for the sustainable management of the marine and coastal ecosystems.

The Coastal Zone Management Unit (CZMU) has been designated as the lead agency responsible for the execution of the MSP with funding from the Barbados Environmental Sustainability Fund. A Marine Spatial Plan Project Unit, a project unit within the CZMU will undertake the tasks and activities for the MSP process with the support of specialists and consultants where required.

The Coastal Zone Management Unit (CZMU) launched the Marine Spatial Planning process on Wednesday January 18<sup>th</sup> 2023 at the Hilton Barbados Resort, Aquatic Gap, St. Michael. This planning process will lay the groundwork for the management of Barbados' ocean space (Territorial Sea and Exclusive Economic Zone (EEZ)), with technical and financial assistance from the Inter-American Development Bank (IDB) and The Nature Conservancy (TNC).

This MSP Process builds upon Barbados' long-time work on marine ecosystems and environmental governance. It is also part of Barbados' commitments under the debt conversion for nature transaction that the Caribbean country signed in September 2022, backed by a US\$150 million guarantee from the IDB and The Nature Conservancy (TNC).



## **2.8 Objective of the Consultancy**

The process of Marine Spatial Planning (MSP) requires the collection of spatial data and information related to a variety of issues and processes and data forms the backbone of any decision-making and planning process. Data for MSP provides an overview of spatial distribution of human activities, marine ecosystems, and hotspots, identifies conflicts and shared space opportunities, and allows spatial exploration of future economic and climate scenarios.

The objective of this consultancy is to comprehensively assess data availability, data gaps specifically related to the fisheries sector, and an assessment of needs to inform MSP in Barbados. Several countries in the Caribbean have ongoing MSP and Blue Economy development processes, and as such, these assessments shall make every effort to build on and complement ongoing BE processes in Barbados.

## **3.0 Key Activities will include, but not be limited to those listed below:**

**3.1 Assess the status of MSP processes in Barbados and the types and sources of data being used to inform MSP.**

3.1.1 Currently underway is assessment of spatial and temporal data needs to include *inter alia*, pollution and habitat degradation linked to economic sectors active in the coastal zone as well as anthropogenic sources, geographic/physical, biologic, economic, social (including a prioritization of gender and other marginalized groups), physical and ecological patterns and processes, relative ecological importance of areas, ecosystem services, vulnerability and resilience, economic activities, benefits and impacts, distribution among current and emerging uses of the blue space, existing management measures, and future needs of existing or proposed uses of the blue space. This consultancy will focus on sessions with fisheries and aquaculture stakeholders to conduct a use survey to map the areas such as aquaculture farms, fishing grounds for different species, nursery areas, spawning aggregations sites, FAD and landing site locations. Shapefiles can be created and overlaid with existing benthic habitat layers and bathymetry.

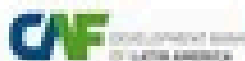
3.1.2 Assess availability and needs of relevant spatial and temporal data not covered in Section 3.1 of importance to inform national BE strategies.

3.1.3 Consult with the MSP authorities in Barbados to confirm data and other needs not addressed in this TORs that may be necessary to inform MSP in the country. Also, understanding the terms to access data from data producers and sources, including an assessment of barriers to access data.

3.1.4 Recommend data sources, acquisition costs (where applicable), and collection methods to address data needs identified. Such recommendations should be feasible and achievable considering the country's context. Also, the Consultant is expected to produce the shape files consistent with CIMU methodology.

3.1.5 Identify capacity needs for data analysis and interpretation to inform MSP.

3.1.6 Consult with the CRFM/PMU and be informed of the Environmental and Social Safeguards (ESS) triggered by the BE: CLME+ Project and identify what data is needed to ensure MSP in Barbados complies with ESS triggered by the project.



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3.8 In coordination with the CREFM/PMU, organize and convene a virtual national workshop to present the results of the Data Gap and Needs Assessments to inform MSP and to discuss synergies with other national and regional activities and projects.

3.9 Develop at least one (1) communication and visibility material on the Data Gap and Needs Assessments to inform MSP conducted for Barbados. These materials will be submitted to the CREFM/PMU for review, vetting of content, and onward communication via the CREFM's Knowledge Management and Information System and broader regional network.

#### 4.0 Expected Outcomes and Deliverables.

4.1 The consultant(s) are expected to deliver the following products:

Product 1: Inception Report detailing activities, milestones, timeline, and a robust methodology to carry out the assignment.

Product 2: Draft Report – Data Gap and Needs Assessments to Inform MSP in Barbados.

Product 3: Final Report - Data Gap and Needs Assessments to Inform MSP in Barbados and virtual national workshop to present the results of the Data Gap and Needs Assessments to inform MSP.

Product 4: Materials consistent with Section 6.0 of these Terms of Reference.

#### 5.0 Project Schedule and Milestones.

Deliverable	Date	Payments
Product 1: Inception Report detailing activities, milestones, timeline, and a robust methodology to carry out the assignment.	7 days after contract signature	30% of contract value
Product 2: Draft Report – Fisheries Data Gap and Needs Assessments to Inform MSP in Barbados.	2.5 months after contract signature	40% of contract value
Product 3: Final Report - Data Gap and Needs Assessments to Inform MSP in Barbados and virtual national workshop to present the results of the Data Gap and Needs Assessments to Inform MSP.	4.0 months after contract signature	50% of contract value
Product 4: Materials consistent with Section 6.0 of Terms of Reference (including Shapefiles)		

#### 6.0 Reporting Requirements.

6.1 The consultant will present the deliverables following the schedule established in section 5 of these terms of reference. The deliverables must include reports in Word, PowerPoint presentations, and other documents used as the basis of the analysis (including other formats such as Excel spreadsheets, etc. as applicable) and a folder with the list of bibliographic references used to develop the analysis. All materials must be delivered in English and in Spanish, in the case of materials used to for assessments in Panama. Products 2 and 3 must be delivered in both English and Spanish. All reports, studies, plans, drawings,



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source code, technical data, specifications, and any other material prepared by or worked upon by the consultant exclusively for the CRFM under this Agreement are the sole and exclusive property of the CRFM and as such the CRFM has exclusive title, rights, and interest in all such material including the right of dissemination, reproduction, and publication. The consultant will also work closely with the Regional Project Coordinator and the Seafood Value Chain Specialist of the BE: CLME+ Project on the assignment.

## **7.0 Acceptance Criteria.**

7.1 Payments will be authorized once the CRFM accepts the products specified by the TOR. The CRFM will have up to three weeks to provide written comments/recommendations to the consultant(s) reports. Unless previously determined, the CRFM will generally accept the deliverables once the consultant or consulting firm confirms the following: (i) receipt and additional inclusion of comments/recommendations in a revised version and (ii) provision of date for presentation of the revised versions of the submitted deliverables. The consultant(s) are expected to include these comments two weeks after receipt.

## **8.0 Consultant's Effort and Required Skills**

8.1 This consultancy has been estimated to require a maximum of 35 Consultant Days.

8.2 Applicants should meet the following requirements:

- Master's Degree in Marine Management, Fisheries Science, Natural Resource Management, Coastal Zone Management, or Marine Science.
- Training in Marine Spatial Planning and/or Blue Economy and Geographic Information Systems will be a distinctive asset.
- Minimum of 7 years' experience working as a technical expert in one of the marine fields listed above.
- Work experience in any or all the project countries.
- Experience in the elaboration of MPA management plans, CZM plans, or MSPs will be extremely valuable.
- Ability to work with senior government officials, non-governmental organizations (NGOs), and local communities.
- Experience working with resource users across multiple sectors, especially in the fisheries, protected areas, tourism, and maritime transport, etc.
- A good understanding of biodiversity, Marine Protected Areas, Climate Change, Marine Spatial Planning.

## **9.0 Application and Selection Procedure.**

9.1 Interested consultants are invited to submit their Curriculum Vitae (CV), a declaration of availability, and a declaration of no conflict of interest.

9.2 CVs will be evaluated against the criteria described in Section 8.2 and contracting will be subject to a successful price negotiation with the selected consultant.

9.3 Interested consultants should submit their Application Cover Letter outlining why they believe they are best suited for this assignment and CV in PDF format by 15<sup>th</sup> December 2023 to [secretariat@crfm.int](mailto:secretariat@crfm.int) and [dcimar.lansall@crfm.int](mailto:dcimar.lansall@crfm.int).

## Appendix 2: Inception Meeting

This meeting took place virtually on April 4, 2024, at 10:00 AM (Barbados time). Below is the meeting agenda:

### Inception Meeting Agenda

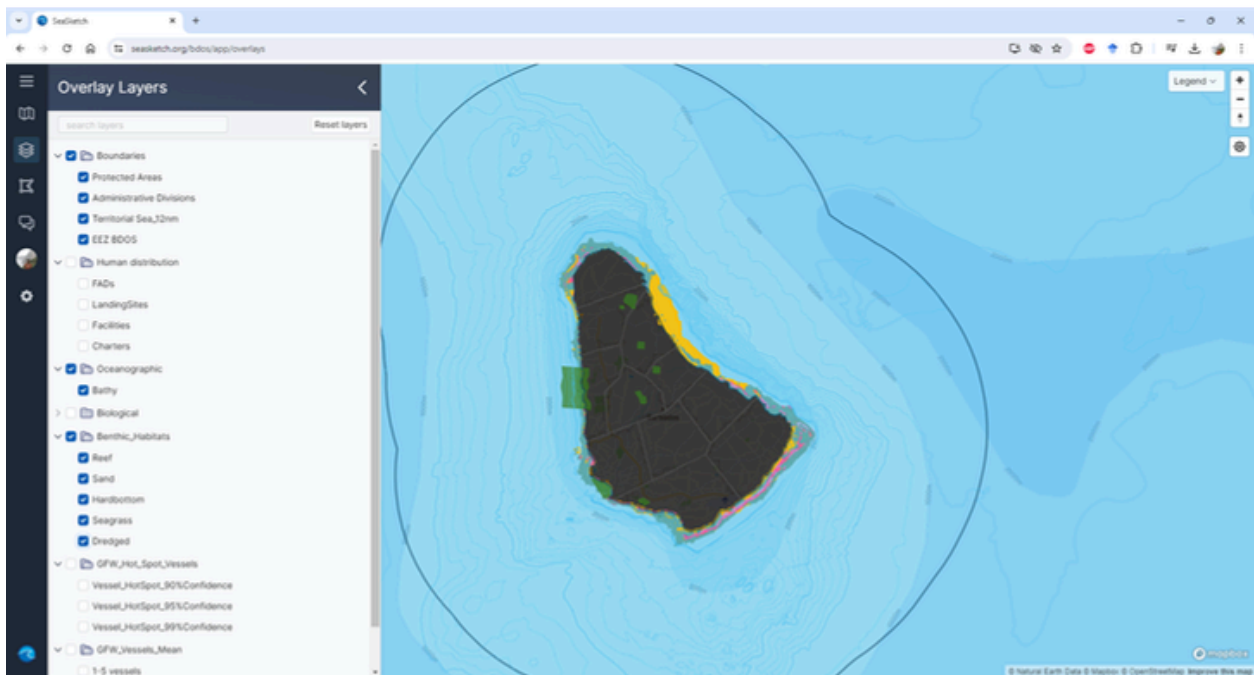
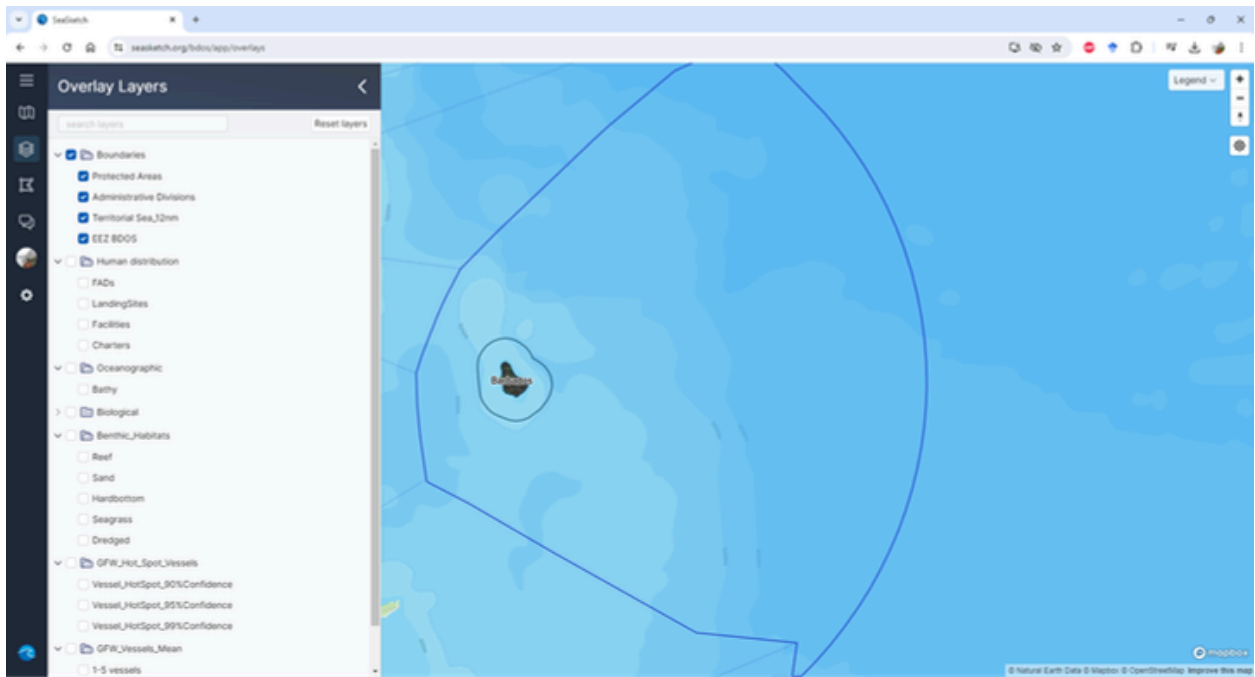
Welcome and introductions.	CRFM-BE: CLME+ Project
Overview of BE: CLME+ Project	CRFM-BE: CLME+ Project
Objective of the assignment	CRFM-BE: CLME+ Project
Understanding of and approach to the assignment (methodology/ workplan)	Consultant
Resource needs and support from national agencies and project partners	Consultant
Roles, responsibilities and reporting requirements.	CRFM-BE: CLME+ Project Team
Next steps	CRFM-BE: CLME+ Project Team

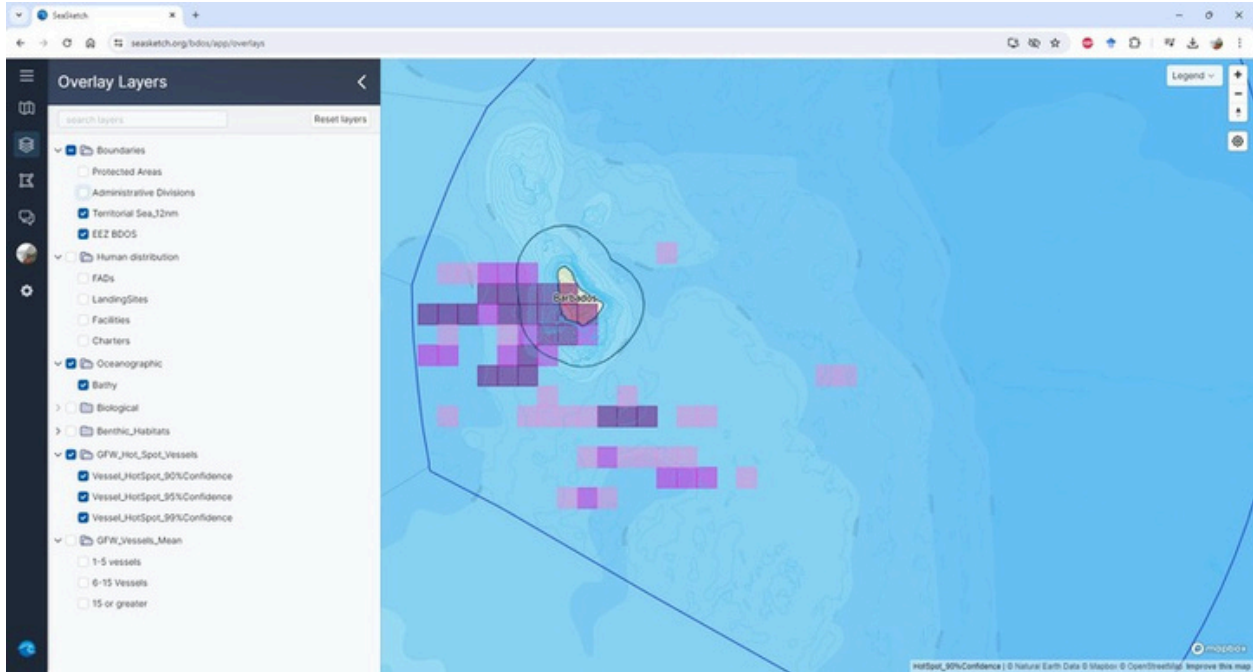
### MEETING PARTICIPANTS:

- Barbados Fisheries Division: Dr. Shelly-Ann Cox and Christopher Parker
- CRFM: Allena Joseph and Keegan Slinger
- Data gap and needs consultants: Dr. Nancy Montes and Dr. Charles Sidman
- BE Roadmap consultant: Dr. Susan Singh-Renton

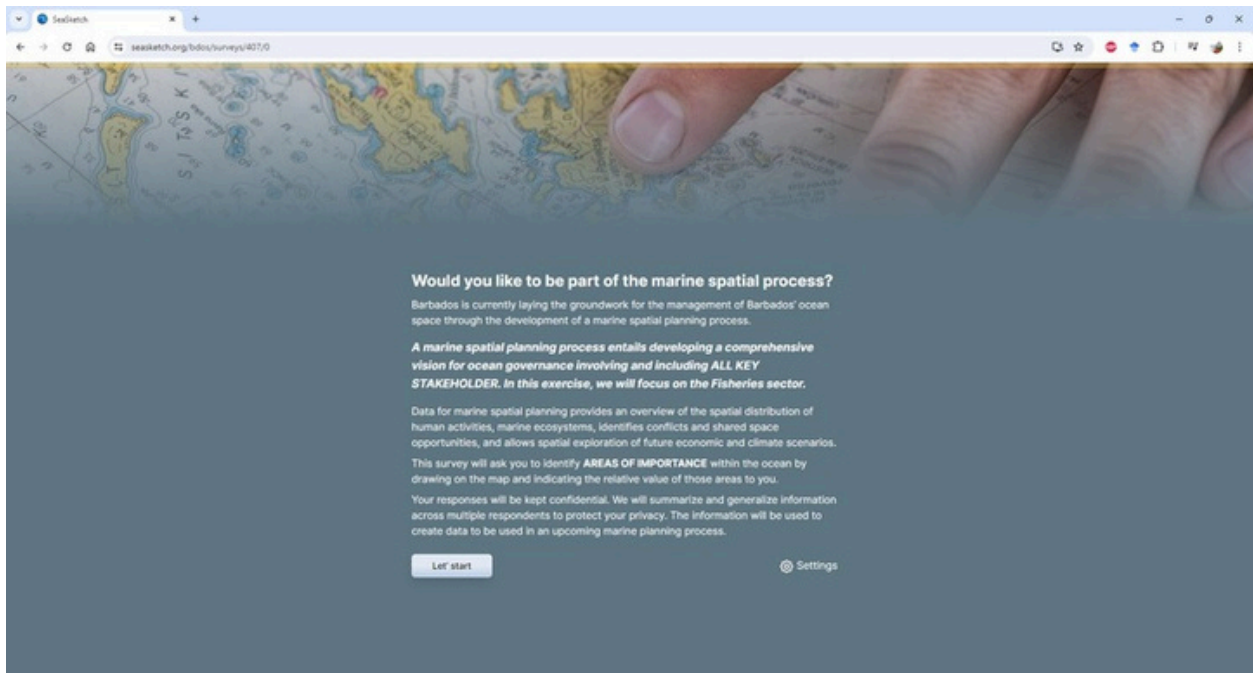
### Appendix 3. SeaSketch project

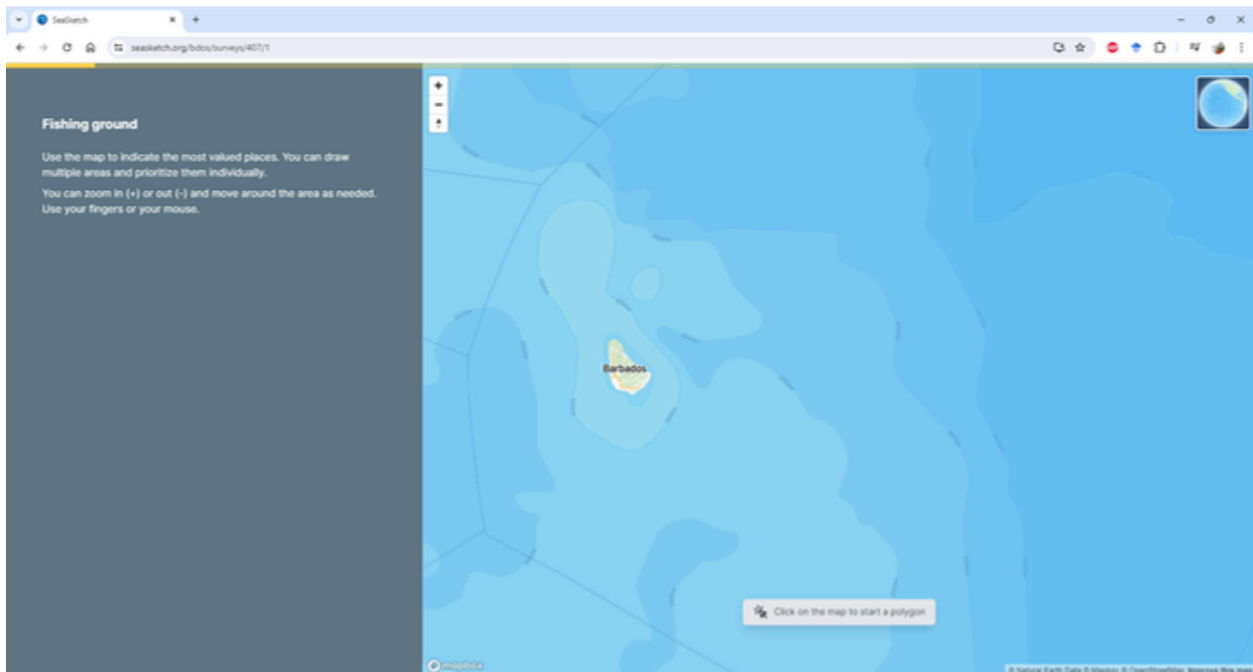
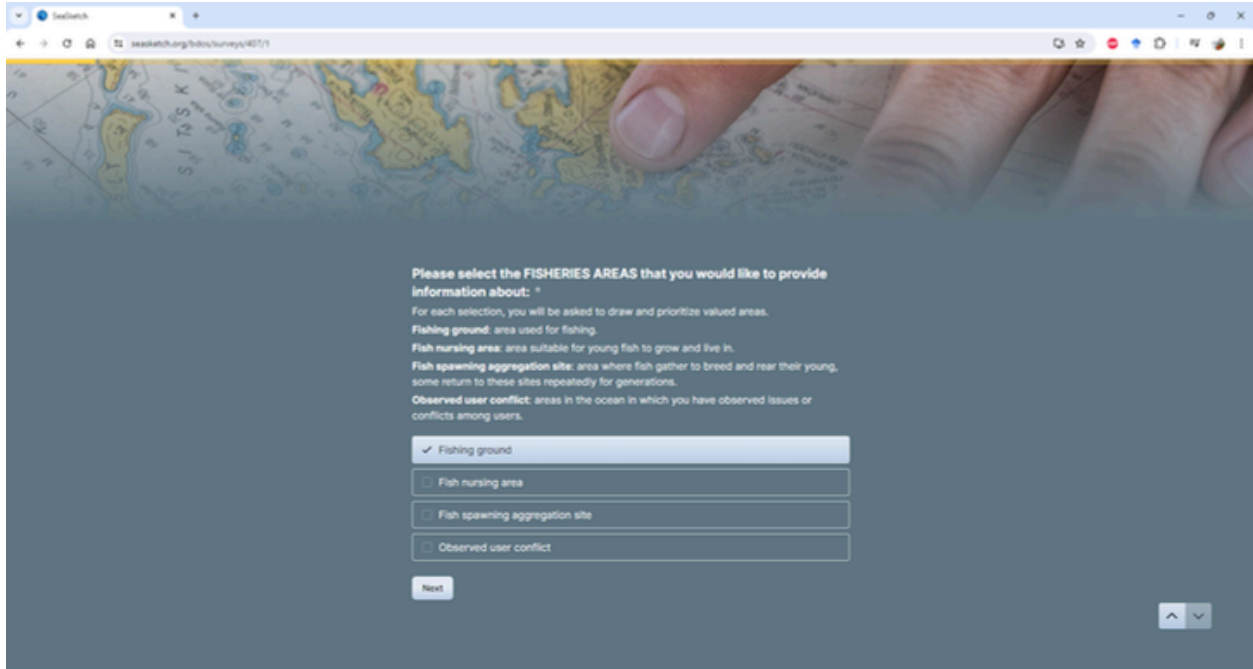
A map with different layers created.

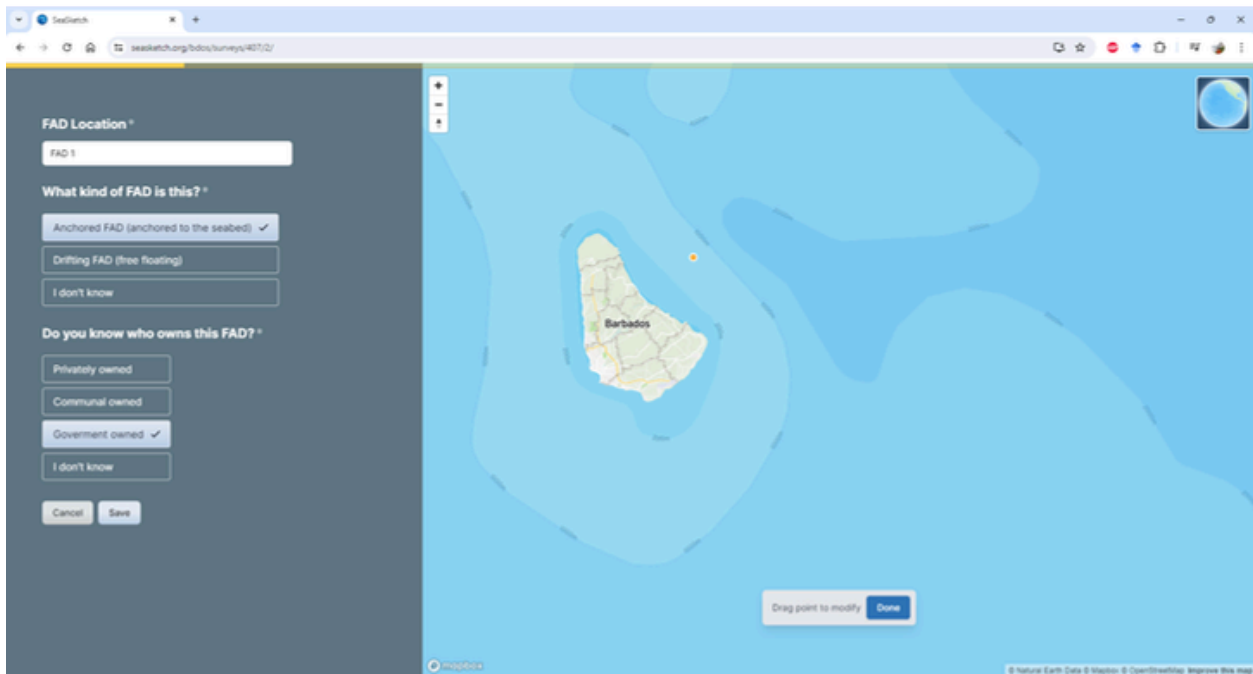
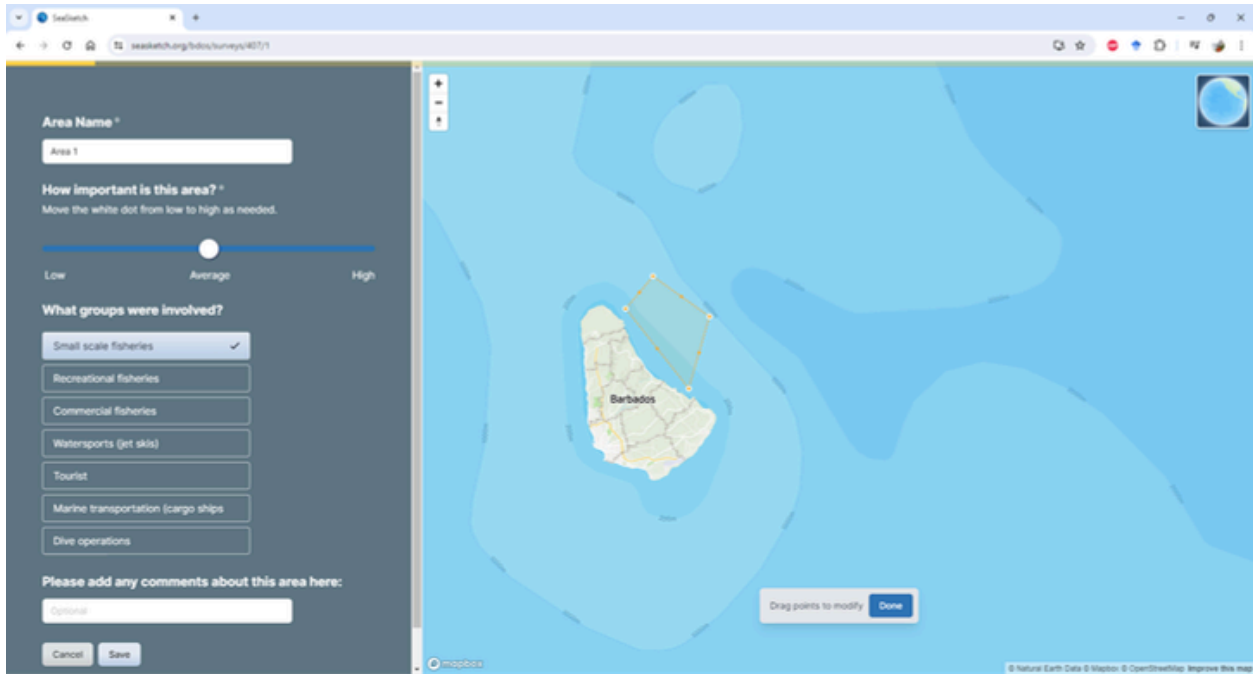


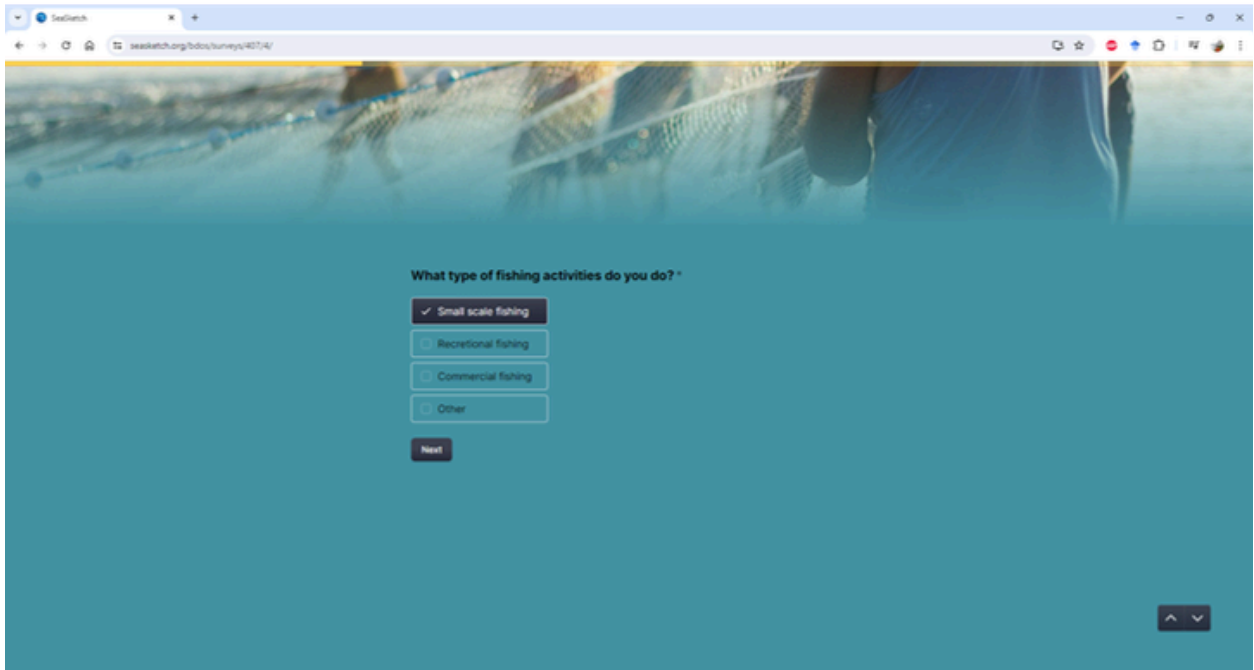
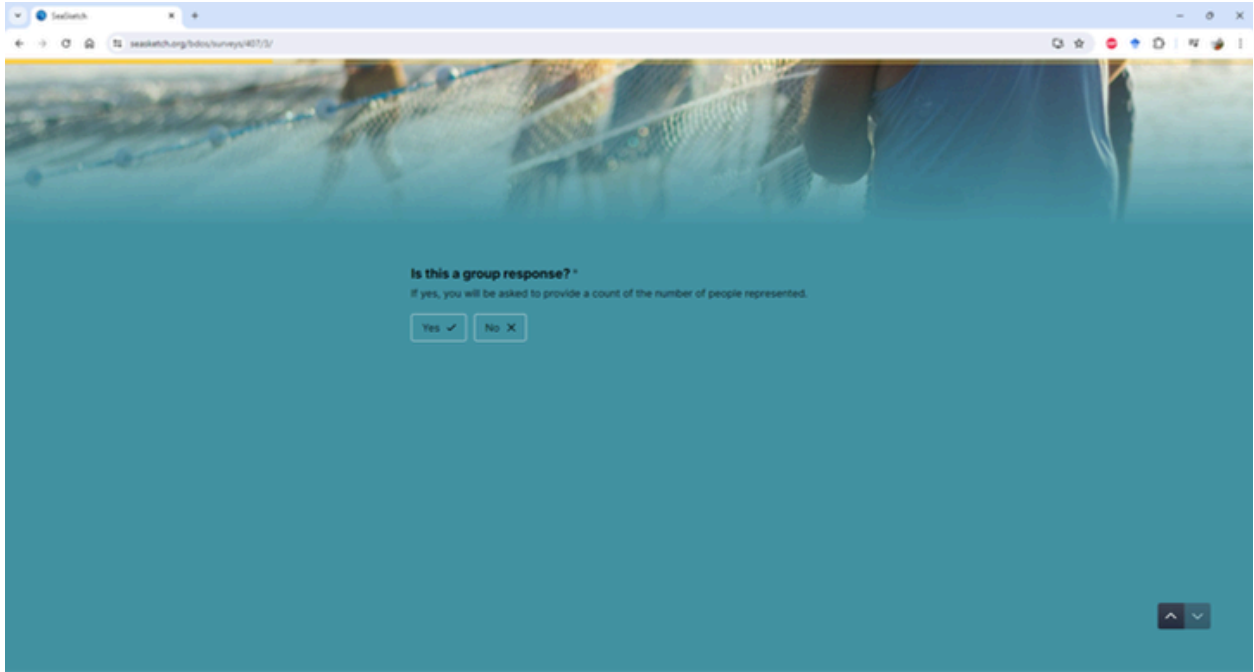


A survey project was also created:










Sealtech

sealtech.org/tdou/surveys/4075/



### What fishing gear do you use? \*


- Long line
- Hand line
- Rod and Reel
- Gill net
- Pots and traps
- Spears
- Other

Next

^ v

Sealtech

sealtech.org/tdou/surveys/4075/



### What are the ages of everyone in the group?

Please make sure your answers total the number of people in the group.

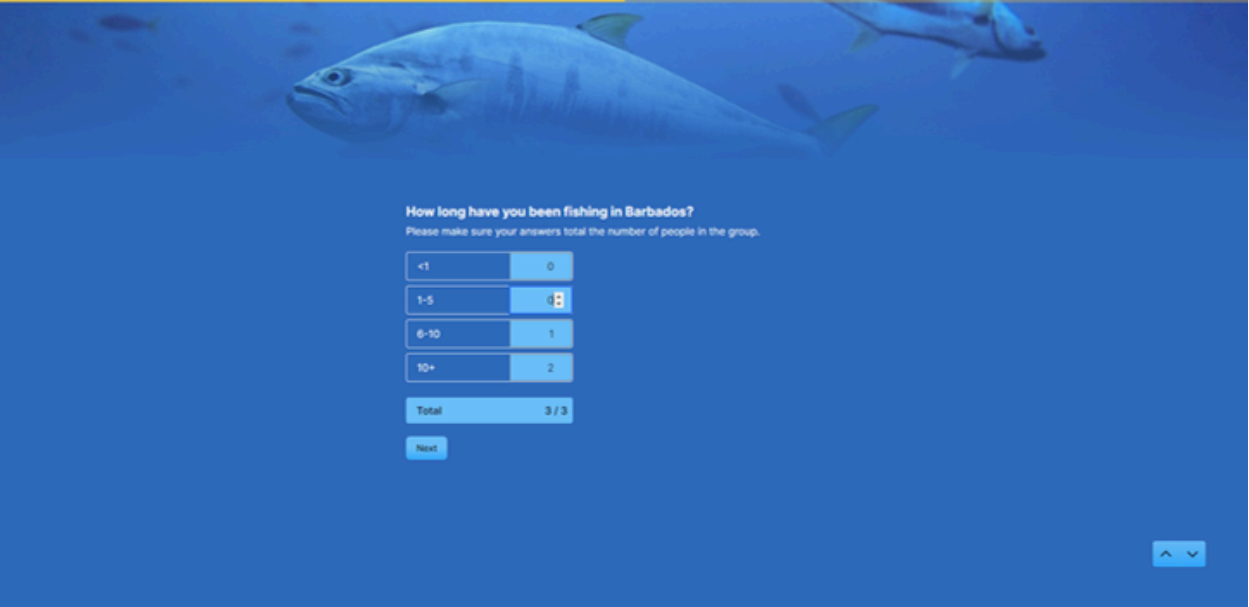
<18	0
18-30	0
30-50	2
50+	1
<b>Total</b>	<b>3 / 3</b>

Next

^ v

Seafetch

seasketch.org/tdou/surveys/407/0/



### How long have you been fishing in Barbados?

Please make sure your answers total the number of people in the group.


<1	0
1-5	0
6-10	1
10+	2
<b>Total</b>	<b>3 / 3</b>

Next

^ v

Seafetch

seasketch.org/tdou/surveys/407/0/



### What percentage of your last year's income came from fishing? (catching and selling fish)

Please make sure your answers total the number of people in the group.

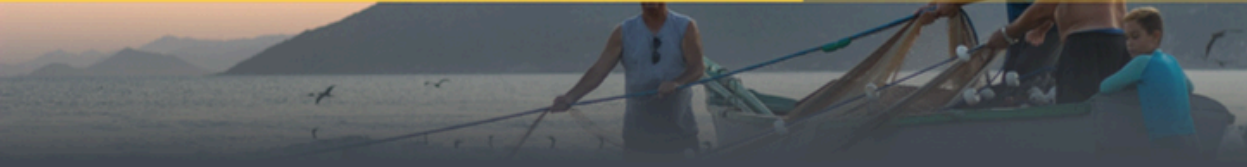
0%	0
1-25%	0
26-50%	0
51-75%	3
76-100%	0
<b>Total</b>	<b>3 / 3</b>

Next

^ v

SeSketch

seasketch.org/tdou/surveys/407/10/



**Are you a member of a fishing association/cooperative?**  
Please make sure your answers total the number of people in the group.


Yes	3
No	0
<b>Total</b>	<b>3 / 3</b>

Next

^ v

SeSketch

seasketch.org/tdou/surveys/407/10/



**How do you record the location of your fishing areas?**  
Please make sure your answers total the number of people in the group.


Phone	1
GPS	1
Buoys	0
Memory	1
Land marks	0
Other	0
<b>Total</b>	<b>3 / 3</b>

Next

^ v

SeSketch

seasketch.org/bdo/surveys/407/13/



**What is the gender of everyone in the group?**  
Please make sure your answers total the number of people in the group.


Male	3
Female	0
Rather not say	0
<b>Total</b>	<b>3 / 3</b>

Complete Submission

^ v

SeSketch

seasketch.org/bdo/surveys/407/13/



**Thank You for Responding**  
Please contact the Fisheries Division if you would like more information about the status of the marine spatial planning process in Barbados.

Submit Another Response

## Appendix 4. List of participants of the mapping exercises

**A**

CAF  
CENTROAMERICANA Y DEL CARIBE  
Food and Agriculture Organization of the United Nations  
ACREM  
AGRICULTURA Y PESQUERÍA  
get  
Geographic Information Science

BE-CLME+ Project: Promoting National Blue Economy Priorities Through Marine Spatial Planning in the Caribbean Large Marine Ecosystem Plus (GEF Project ID 10211).  
National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform MSP in Jamaica

BARBADOS MAPPING EXERCISE FOR THE FISHERIES SECTOR

**Participants List**

#	Print Name	Organization or group you identify with
1	TERENCE WILHE BOACH	
2	THOMAS MICHAEL	Weston Fishfolk & Community Inc
3	ANN HARDING	Weston Fishfolk & Community Inc.
4	Ian Hunt	Spri's fishermen
5	Catherine Sandford-Tull	Weston Fishfolk & Community Inc
6	DONVILLE REATH-HUNT	FISHERMAN
7	Everton Bonalume	FISHERMAN
8	Wigil the	Fisherman
9	Chris Watson	FISH FOLK MAN
10	Karina Chapman	Pike Bay
11	Tia Chapman	Pike Bay
12	Nikola Simpson	Sustainable Caribbean
13	Tonya Ifill	Fisheries Division
14	YENNEL NICHOLLS	BARBADO
15	Chris Parker	Fisheries Division
16	Ismael Dessar	MSP UNIT
17		

**B**

CAF  
CENTROAMERICANA Y DEL CARIBE  
Food and Agriculture Organization of the United Nations  
ACREM  
AGRICULTURA Y PESQUERÍA  
get  
Geographic Information Science

BE-CLME+ Project: Promoting National Blue Economy Priorities Through Marine Spatial Planning in the Caribbean Large Marine Ecosystem Plus (GEF Project ID 10211).  
National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform MSP

BARBADOS MAPPING EXERCISE FOR THE FISHERIES SECTOR

**Participants List**

#	Print Name	Organization or group you identify with
1	Paul de la Warren	artisan fisherfolk
2	Sandy Blackman	
3	MARINA DE LA ROSA	!!
4	RYAN BOURNE	
5	Neil Brown	
6	Camron Small	
7	Tony Brown	
8	Linda Harris	
9	Antonia Spangant-Powe	
10	Lita Drayton	
11	JEFFREY JONES	
12	Camron Morris	
13		
14		
15		
16		
17		

## Appendix 5. Participant's profile survey

CAF  
CENTROAMERICANA Y DEL CARIBE  
Food and Agriculture Organization of the United Nations  
ACREM  
AGRICULTURA Y PESQUERÍA  
get  
Geographic Information Science

National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform Marine Spatial Planning in Barbados.

**MAPPING EXERCISE - PARTICIPANTS SURVEY**

Please complete the following surveys. Your responses will be kept confidential. We will summarize and generalize information across multiple respondents to protect your privacy.

1. What is your age?  
 <18  
 18-30  
 30-50  
 50+

2. How long have you been fishing in Barbados?  
 <1 year  
 1-5 years  
 5-10 years  
 10+ years

3. What percentage of your last year income came from fishing (catching and selling fish)?  
 0%  
 1-25%  
 26-50%  
 51-75%  
 76-100%

4. Are you a member of a fishing association and/or cooperative?  
 Yes  
 No

5. What type of fisheries activities do you do?  
 Artisanal/subsistence fishing  
 Recreational fishing  
 Commercial fishing  
 Other \_\_\_\_\_

6. What type of boat do you use?  
 Longliner  
 Iceboat  
 Day boat  
 Open boat  
 Other NONE


7. What fishing gear do you use here?  
 Long line  
 Hand line  
 Gill net  
 Pots and traps  
 Spears  
 Other \_\_\_\_\_

8. How do you record the location of your fishing areas?  
 Phone  
 GPS  
 Buoys  
 Vessel Tracking Device  
 Other memory

9. What is your gender?  
 Male  
 Female  
 Prefer not to say

Thanks!

## Appendix 6. Mapping exercise instructions for each station



National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform MSP in Jamaica

**BARBADOS MAPPING EXERCISE FOR THE FISHERIES SECTOR**

**General instructions**

Day 1. Participants develop data sets based on local knowledge.

Day 2. Participants validate and add to information collected from Day 1.

Methodology for each station.

- Form groups based on random numbers (we will assign each participant to a group 1-6).
- Each group will begin the exercise at the first station based on their group number.
- Every 15 minutes groups will move to the next station in numeric sequence. For example, the group starting at station 2 will proceed to stations 3, 4, 5, 6 and 1.
- Each station has two maps for drawing information.
  - Map 1 is large scale map showing territorial waters up to 12 NM around Barbados.
  - Map 2 is a small-scale map showing the EEZ up to 200 NM around Barbados.
- Participants will use the two maps to identify zones of activities occurring within these boundaries.



**Station 1: Current Fishing Grounds (Shapes).** We want you to identify important areas where you currently fish and the main species targeted in those areas.

Step 1. Each group will be provided with a unique colored pencil that they will take with them from station to station.

Step 2. Facilitator will engage participants in a group discussion to collectively determine important fishing areas in the territorial waters of Barbados (Map 1) (5 minutes). We assume areas that the group identifies as being the most important to them.

- Be as detailed as possible when drawing the areas.
- Please identify the areas with a unique number from 1-20, or more depending on the number of areas drawn.

Step 3. Facilitator will engage participants in a group discussion to collectively determine important fishing grounds in the Exclusive Economic Zone of Barbados (Map 2). The group will draw shapes that they discussed as a group that are important to them (5 minutes).

Step 4. Facilitator: When participants draw and label areas, the facilitator will ask them to identify the species groups that they target in each area identified and check the appropriate boxes on the list. **There will be 1 list per station with enough columns to allow all six groups to add their information.** Columns in the species list table will correspond to numbers identified with the colored shapes marked on the maps.

For data collection use FORM A



**Station 2: Historical Fishing Grounds (Shapes).** We want you to identify any areas that you or your community used to fish but no longer do. And tell us why you not using that area anymore?

Step 1. Each group will be provided with a unique colored pencil that they will take with them from station to station.

Step 2. Engage participants in a group discussion to collectively determine and draw important historical fishing areas in the territorial waters of Barbados (Map 1) (5 minutes). We assume historical areas that you identify were once important but are no longer actively used. For example, have you lost access to an historically important area due to expansion of another sector (e.g., tourism, shipping).

- Be as detailed as possible when drawing the areas.
- Please identify the areas with a unique number from 1-20 depending on the number of areas drawn.

Step 3. Collectively, draw areas of historical fishing grounds in the Exclusive Economic Zone of Barbados (Map 2). Identify species prevalent for each shape that you discussed as a group that were historically important to your community (5 minutes).

Step 4. Facilitator: When participants draw and label areas, the facilitator will ask them to identify the species groups that they used to target in each area identified and check the appropriate boxes on the list. **There will be 1 list per station with enough columns to allow all six groups to add their information.** Columns in the species list table will correspond to numbers identified with the colored shapes marked on the maps.

For data collection use FORM A



**Station 3: Nursing Grounds (Shapes).** Areas where juvenile/young fish and other organisms grow.

Step 1. Each group will be provided with a unique colored pencil that they will take with them from station to station.

Step 2. Engage participants in a group discussion to collectively determine important current nursing grounds in the territorial waters of Barbados (Map 1) (5 minutes).

- Be as detailed as possible when drawing the areas.
- Please identify the areas with a unique letter from 1-20, depending on the number of areas drawn.

Step 3. Collectively, draw the shapes that you discussed as a group that represent important current nursing grounds in the Exclusive Economic Zone of Barbados (Map 2) (5 minutes).

Step 4. Facilitator: When participants draw and label areas, the facilitator will ask them to identify the species groups that are associated with the nursing grounds and check the appropriate boxes on the list. **There will be 1 list per station with enough columns to allow the facilitator to record info for all six groups.** Columns in the species list table will correspond to numbers identified with the shapes marked on the maps.

For data collection use FORM A



# Form B (FADs)



FADs

FADs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
TYPE																					
Anchored FAD (anchored to the seabed)																					
Drifting FAD (free floating)																					
I don't know																					
OWNERSHIP																					
Private owned																					
Government owned																					
Communal owned																					
I don't know																					

COMMENTS:

# Form C (User Conflicts)

USER CONFLICT

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Which groups were involved																					
Artisanal fisheries																					
Recreational Fisheries																					
Commercial fisheries																					
Wintersports (jet skis)																					
Tourist																					
Marine transportation (cargo ship, cruise ships)																					
Dive operators																					
How long ago did you learn about this conflict																					
Less than 1 year																					
1-3 years																					
3+ years																					

COMMENTS:

## Appendix 7. Digital data collection instructions

**BE-CLME+ Project: Promoting National Blue Economy Priorities Through Marine Spatial Planning in the Caribbean Large Marine Ecosystem Plus (GEF Project ID 10211).**
  
 National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform MSP in Barbados

### BARBADOS MAPPING EXERCISE FOR THE FISHERIES SECTOR

#### Digital Data Collection

How to install the app and collect data.

1. Open your phone or tablet.
2. Open the Google Play Store app.
3. In the search box, type Field Maps ArcGIS.
4. Click on the Install button for the Field Maps app.
5. Once the app is installed, click on the Open button.
6. The ArcGIS Field Maps app opens. Click on the Sign in with ArcGIS Online.
7. Enter the following information: Username: Password: Then click on the Sing in button.
8. The app opens with one project: BDOS. Click on the project to open it.
9. Now you see the original Map section and another item called EEZ in the Map areas section.

1

10. Click on the EEZ item download icon. Make sure that you have a good internet connection. If the download fails, try again.
11. Once the EEZ downloads successfully the item now appears in the On Device section.
12. Click on the EEZ to open the map. If asked, allow the app to use location while using the app.
13. The map is displayed. Your view might be different.
14. Let's look at the upper tools in the Field Maps. On the upper left area of your screen, you see the back arrow, then you can see the name of the map (EEZ). Below it, you see the GPS accuracy estimate.
15. On the upper right side of the screen, we have the sync icon, the layers icon, followed by the search and the menu icon (3 vertical dots).
16. Click on the layers icon to see all the layers that are contained in this map project. Click on the exit icon (upper right corner) to close the list.
17. Click on the menu icon (3 vertical dots). Some common settings are displayed. Click on Bookmarks. These are areas previously saved that help you to navigate on the map. Click on the Territorial Seas bookmark. The map zooms in/out to display Barbados coastal areas. In this view you can see other layers (landing sites, benthic habitat, etc.) that were not displayed when you are zoomed out.
18. Go back to Bookmarks but this time click on EEZ which displays the whole study area. In this view only the boundary and the bathymetry layers are displayed.

2


19. Using your fingers, zoom in until you see Barbados and the landing sites. This is another way to navigate through the map.
20. Keep zooming to an area between Barbados border and the benthic layer. The nearshore bathymetry layer displayed on top of the benthic layer. The near bathymetry layer is big, so it might take a couple of seconds for it to fully display (including its depth labels —feet).
21. With one finger, touch your screen. A window showing information about the section you touched appears. In the image below you can see that the area I touched has 1 bathymetry contour (-26 ft), and 1 benthic habitat (Seagrass).
22. Go to the menu icon and click on Legend, which shows what colors were given to the different features. You might need to scroll down to see all the layers. Close the legend window.
23. We are ready to collect a feature. Click or tap on the icon with the plus sign.
24. The list of items that can be edited appears.

3


25. With your finger, drag the box up to see all the editable items.
26. For this demonstration, I selected the Fish Spawning Areas by tapping on it.
27. I tapped on the Add Point button once to mark the 1<sup>st</sup> point, then I moved the map to the next point location. I tapped the add point button again to mark the second point.
28. I moved the map again to the third location and marked the point.
29. My area was done when I marked the 4 point. Then, I tap the Date and time box.
30. A calendar appears, and I clicked OK to set the default date and time.
31. I selected some species using the switch button. The default value is 0 (absent). When the switch is on the value changes to 1 (present).
32. I typed two species that were not on the list in the Other Species box. And enter my last name and a comment.
33. When I finished entering the data for this area, I tapped the submit icon (check mark on the upper right corner of the screen).

4


34. The screen updates, showing the recently created shape. Here it is possible to edit the shape and information if needed.




35. I tapped the Collect button again but this time I selected the user conflict layer. Unlike the previous one, this is a point layer (not a shape).




36. I clicked the Add Point button to add the location of the reported conflict. Then I completed the other requested information.




37. I added the collector's name and some other comments.



38. I submitted the point location of the user conflict by clicking on the check mark icon.




39. Continue entering other features (fishing grounds, FAD, etc.). If you have internet connection on your device, the data will be automatically submitted to the cloud. Below is the online map with the 2 recent entries.




5


40. If you are offline the data collected will be saved on your device. Click on the Sync icon. In the image below you see that I have 1 pending edit.




41. Turn off the Auto-sync setting (it could be annoying). Click the SYNC NOW button. Without Wi-Fi the app will ask if you would like to use your cellular data to sync this feature.



42. You could also wait until you have access to a Wi-Fi network to sync the information. The image below shows how the app is syncing the information.




43. The app finishes syncing the data, so now you see that there are no pending edits.



44. Now you are ready for data collection of spatial features (fishing grounds, nursing areas, etc.).

45. Go back to the Google play store and download the Survey123 app.



After you complete entering all these features, the Survey123 app will help you to collect information about the participants (age, fishing experience, etc.).

Click on the Sing in with ArcGIS Online button and enter the following information:  
 Username:  
 Password:  
 Then click on the Sing in button.

6

46. The Survey123 app opens but it is empty. In the search box click on the QR icon (right side of the search box) and use it to open the survey.



Alternatively, below is the link to the survey:



47. The survey form opens. The form has 2 pages. Answer the questions. When done, click on the next button (lower right corner).




48. Questions on the second page are displayed. Answer them and click on the submit icon (check mark at the bottom right corner).



49. A pop up window appears. If you have internet, then click on Send now.



50. When you don't have access to internet, then you only see two options. Click or tap Save in Outbox.



51. Now you have the form in your device. When you have access to internet you only see the collect and the sent options.



52. When you save the form without internet, you have 3 options:



53. When you have access to the internet, then you can click on the Outbox button and then click on Send.



54. Now you are ready to interview another fisherfolk.

7

Appendix 8. The contact list used to request input through interviews, emails, and during the participatory mapping exercise.

NAME	ORGANISATION	Method	Gender*
Shelly Cox	BFD	In-person interview	F
Colvin Taylor	BFD	In-person interview	M
Adriel Jackman	BFD	In-person interview	M
Jalisa King	BFD	In-person interview	F
Christopher Parker	BFD	In-person interview	M
Richard Suckoo	CZMU	In-person interview	M
Allison Wiggins	CZMU	Not available	
Jehroum Wood	CZMU	In-person interview	M
Ismail Desai	CZMU	In-person interview	M
Ramon Roach	CZMU	In-person interview	M
Fabian Hunte	CZMU	In-person interview	M
Aaron Gaskin	CZMU	In-person interview	M
Shonee Howell	CZMU	In-person interview	F
Derrick Brathwaite	Barbados Coast Guard	MSP Project Steering Committee	M
Leo Brewster	CZMU	MSP Committee	M
Jacqueline Pollard	Tourism Ministry	MSP Project Steering Committee	M
Jamar White	Energy Ministry	MSP Project Steering Committee	M
Maria Pena	CERMES	MSP Project Steering Committee	M
Lt Andrew Walcott	Barbados Coast Guard	Email unanswered	
Paul Hamel-Smith	Barbados Game Fishing Association	Email unanswered	

NAME	ORGANISATION	Method	Gender*
Susan Mahon	CORALL - Coral Reef Restoration Alliance	Email unanswered	
Debbie Roach	CORALL - Coral Reef Restoration Alliance	Email unanswered	
Tom Fountain	Barbados Divers Association	Email answered	M
Meike Joseph	WIRRED - Water Institute for Regenerative Research, Education, and Design	Email unanswered	
Ann-Marie Eversley	EPD, Marine Pollution Officer	Email unanswered	
Kim Baldwin	Marine Spatial Information Solutions	Email unanswered	
David Yawson	CERMES	Email unanswered	
Hazel Oxenford	CERMES	Email unanswered	
Patrick McConney	CERMES	Email answered	M
Julia Horrocks	CERMES	Email answered	F
Julian Walcott	CERMES	Email answered	M
Robin Mahon	Fisheries and Environmental Consulting	Email unanswered	

\*Gender is provided only for people that participated in the interviews and/or answered email request for information.

## Appendix 9. Questionnaire used to guide interviews

**Profile**

**Participants**

**Organization/Institution**

**Department**

**Position**

**What is your professional role?**

Leadership position (Chief officer/Director)

Technical officer

Data collector officer

Other

**What kind of employment position are you currently serving?**

Permanent employment

Contractual employment (1-5 years contract)

Contractual employment (1 year contract)

Contractual employment (less than 1 year contract)

Other

**What is your gender?**

Male

Female

Prefer not to say

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**Profile**

**Data management**

**What is your current level of expertise working with:**

	None	Basic	Novice	Intermediate	Advance
Designing PAPER data collection forms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Designing DIGITAL data collection forms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collecting data - Paper forms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Collecting data - Digital forms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data entry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Managing databases	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Data analysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creating data reports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Comments**

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### Spatial data

	None	Basic	Novice	Intermediate	Advance
Finding spatial data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Editing spatial data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creating spatial data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Analyzing spatial data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creating maps (as pictures or PDFs)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Creating online interactive maps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using satellite imagery data	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Comments

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### Data availability

Are you aware of any marine spatial layers related to the fisheries sector in your organization?

	Paper/Reports	Digital (shapefile)
Territorial sea (12nm)	<input type="radio"/>	<input type="radio"/>
EEZ (200nm)	<input type="radio"/>	<input type="radio"/>
Marine protected areas	<input type="radio"/>	<input type="radio"/>
Reefs distribution	<input type="radio"/>	<input type="radio"/>
Seagrass distribution	<input type="radio"/>	<input type="radio"/>
Mangroves distribution	<input type="radio"/>	<input type="radio"/>
Chlorophyll a concentration	<input type="radio"/>	<input type="radio"/>
Sargassum distribution	<input type="radio"/>	<input type="radio"/>
Algae distribution	<input type="radio"/>	<input type="radio"/>
Sea turtles distribution	<input type="radio"/>	<input type="radio"/>
Marine mammals distribution	<input type="radio"/>	<input type="radio"/>
Water depth (bathymetry)	<input type="radio"/>	<input type="radio"/>
Sea surface temperature	<input type="radio"/>	<input type="radio"/>

Do you know who might have any of these layers (shapefile)?

1000

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### Biological layers

	Paper/reports	Digital (shapefile)
Fish distribution	<input type="radio"/>	<input type="radio"/>
Fish nursing grounds	<input type="radio"/>	<input type="radio"/>
Fish spawning aggregation sites	<input type="radio"/>	<input type="radio"/>
Lobster distribution	<input type="radio"/>	<input type="radio"/>
Conch distribution	<input type="radio"/>	<input type="radio"/>
Sea cucumber distribution	<input type="radio"/>	<input type="radio"/>
Lionfish distribution	<input type="radio"/>	<input type="radio"/>

Do you know who might have any of these layers (shapefile)?

1000

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### Human distribution layer

	Paper/reports	Digital (shapefile)
Small scale fishing vessels distribution	<input type="radio"/>	<input type="radio"/>
Recreational fishing vessels distribution	<input type="radio"/>	<input type="radio"/>
Commercial fishing vessels distribution	<input type="radio"/>	<input type="radio"/>
Landing sites locations	<input type="radio"/>	<input type="radio"/>
Anchorage/mooring locations	<input type="radio"/>	<input type="radio"/>
FADs locations	<input type="radio"/>	<input type="radio"/>
Areas where user conflict have been reported	<input type="radio"/>	<input type="radio"/>

Do you know who might have any of these layers (shapefile)?

1000

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**Other layers**

	Paper reports	Digital (shapefile)
Vessel transit (cargo ships, cruisers, etc.)	<input type="radio"/>	<input type="radio"/>
Seafloor infrastructure (cables, pipes, etc.)	<input type="radio"/>	<input type="radio"/>
Buoys	<input type="radio"/>	<input type="radio"/>
Aids to navigation	<input type="radio"/>	<input type="radio"/>
Wrecks and obstructions	<input type="radio"/>	<input type="radio"/>
Pollution (trash, sewage, etc.)	<input type="radio"/>	<input type="radio"/>

Do you know who might have any of these layers (shapefile)?

1000

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**Profile**

**Working with spatial data**

Have you created products using spatial data (e.g. maps or spatial layers)?

Yes, I have created maps to show the location of a project or event

Yes, I have created maps to show statistical analysis results (e.g. density, hot spots, etc.)

Yes, I have worked with some spatial layers, but I did not produce a map from it

No, I haven't created any products (maps or layers) with spatial data

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**Profile**

Spatial data experience -SKIP if they said no to the previous Q

What is your level of expertise working with the following software?

	None	Basic	Novice	Intermediate	Advance
ArcMap (10.8 or earlier)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ArcGIS Pro	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ArcGIS Online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
QGIS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
R software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google Earth Pro	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Website maps (Google or Bing maps)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Have you ever bought spatial data?

Yes, we bought shapefile layers

Yes, we bought satellite imagery

Yes, we bought other spatial data (lidar, aerial imagery)

No, we haven't bought any spatial data

If your organization has bought spatial data, do you know where this data might be (organization/person)?

1000

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Have you use the following software/tools?

	No, I haven't used it	I heard about it, but I haven't used it	Yes, I use it a little	Yes, I use it a lot
Fisheries manager tool (CARICE)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ArcGIS Field Maps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ArcGIS Survey123	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Story Maps	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Online Dashboards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Open Data Kit (ODK)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
QField	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SeaSketch	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google forms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Kobo Toolbox	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Excel	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Add any other software/tool for managing data here:

1000

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**Profile**

**Data sharing**

Does your organization have a protocol for sharing data?

Yes, we have a written protocol for sharing data

Well, we follow some unwritten rules when sharing data

No, our organization does not have a written protocol for sharing data

I don't know

**Comments**

1000

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**Profile**

**Resources**

What type of computer do you have?

I don't use a computer. I use paper forms

Windows

Apple (Mac)

Other

How old is your work computer?

Less than 1 year

1-3 years

3-5 years

More than 5 years

Where do you save your data?

Computer memory

External drive

Cloud service (OneDrive, Dropbox)

I don't know

Does your computer have antivirus software?

Yes

No

How would you rate the internet service for your work computer?

	I don't have internet	Sad	Medium	Excellent
Internet speed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Internet reliability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Comments**

1000

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**Last section**

**What is your highest level of education you have completed?**

None

Primary

Secondary

Technical school

Bachelor's degree

Master's degree

Doctoral degree

**Have you taken any of the following trainings?**

Data collection

Data management

Excel

Basic GIS

Intermediate GIS

Advance GIS

Marine Spatial Planning

Statistics

**Comments**

1000

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**Future trainings**

**Would you be interested in participating in any of the following trainings?**

	Yes	No	Not sure
Data management (excel, R software, Power BI, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Field sampling techniques	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
GIS Fundamentals	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Suitability analysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Remote sensing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Facilitation techniques for meetings, workshops, etc.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Marine spatial planning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**If the cost of one training is US\$500 dollars. Would you be willing to cover its cost?**

Yes, I will be able to cover the cost

Yes, but just half of the cost

No

Not sure

**Comments**

1000

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**Profile**

**Data needs**

**List spatial layer that they think are important for the fisheries sector to inform MSP**

1000

**Final comments**

1000

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## Appendix 10. Working agenda of the national validation workshop



### National Consultancy to Conduct Data Gap and Needs Assessments for the Fisheries Sector to Inform Marine Spatial Planning in Barbados

#### National Workshop Working Agenda

##### Objectives:

- Present **results** of the data gap and needs assessment
- Discuss **synergies** with other national and regional activities and projects

Time	Dur (min)	Activity	Responsible
10:00 12:00	120	Blue Economy Roadmap Fisheries Sector Strategy and Implementation Plan Workshop	Dr. Susan Singh-Renton, FD, and CRFM team
12:00 12:45	45	Lunch	CRFM team
12:45 12:50	5	Data Gap and Needs Assessments for the Fisheries Sector to Inform Marine Spatial Planning in Barbados — Opening remarks	Dr. Cox and CRFM team
12:50 13:35	45	Assess the status of MSP processes in Barbados. Data currently available that could be used to inform MSP: • Fisheries distribution • Mapping exercise • Marine habitats • Species distribution • Oceanographic data • Other relevant data for the fisheries sector Activity 1: Are there any missing data?	Dr. Montes  Dr. Montes and CRFM team
13:35 14:15	40	Fisheries related data needs to inform MSP Activity 2: Discuss current data needs tables and provide input, validate information, and provide input related to national/regional partners to improve current spatial data catalog	Dr. Montes and CRFM team
14:15 14:35	20	Data access. Activity 3: Discuss synergies (national/regional level) for: • Data sharing mechanism • Trainings	Dr. Montes and CRFM team
14:35 14:45	10	Conclusions and recommendations	Dr. Montes
14:45 14:55	10	Next steps	FD and CRFM team
14:55 15:00	5	Closing remarks	FD

Consultant (Dr. Montes) will present/participate virtually. The Fisheries Division (FD) and CRFM team will participate and assist in the workshop in-person.

##### Activities methodology:

- Available fisheries related data that could be used to inform MSP

##### Activity 1: Are there any missing data?

While Dr. Montes is presenting the findings for the data currently available, she will ask participants to think if there are any data related with each of the topics (e.g., fisheries distribution, habitats, species distribution, etc.) that they are aware of, but it was not included in the presentation/document. Participants can provide feedback using the online form: <https://rb.gy/r9nk1v>

If there are any issues accessing the online form, FD/CRFM will have a memory stick (flash drive) with the Word version of the form. Optional: print out the form and provide a picture of the filled out form afterwards.

##### FD and CRFM team role:

**Preparation:** Bring a flash drive with the Word form <https://rb.gy/xt68qh>.  
**During the presentation:** Provide Word form to participants that are having issues using the electronic form. Collect any form if people are not able to send it via email.  
**After the presentation:** Send via email any forms filled out using the Word document.

- Fisheries related data needs to inform MSP in Barbados

##### Activity 2: Discuss current data needs tables and provide input

Depending on the number of participants, arrange 2-4 groups. Activity 2 has 5 tables. Each group will provide feedback on all tables. Dr. Montes will ask participants to download Activity 2 form from here <https://rb.gy/12e1f4>. As a group, participants can provide feedback by answering the following questions for each table:

- Are there any **other spatial layers** related to the fisheries sector that you think should be included in this list?
- Are there any **comments** related to the **Priority score** for these layers?
- Are you aware of **other methods** to collect this data?
- Who are the **partners** for collecting this data (synergies for improving current data catalog)?

At the end of the activity, participants can email the completed Activity 2 form to [nancymontes@gmail.com](mailto:nancymontes@gmail.com) or provide the file via flash drive to FD/CRFM.

If there are any issues accessing the online form, FD/CRFM will have a memory stick (flash drive) with the Word version of the form.

##### FD and CRFM team role:

**Preparation:** As a backup, bring a flash drive with the Word form for Activity 2 <https://rb.gy/12e1f4>.  
**During the activity:** Help participants to arrange into 2-4 groups. Help participants to download the form and motivate participants to provide feedback. Provide Word form to participants that are having issues downloading the electronic form. Collect any forms if people are not able to send it via email.  
**At the end of the activity:** Send via email any forms filled out using the Word document.

- Data sharing mechanism/platform and trainings

**Activity 3: Data sharing mechanism/platform and trainings**

We will use an online whiteboard (<https://fb.ly/5k3-7w>) for this activity. Dr. Montes will ask participants to provide feedback related to strengths, weaknesses, opportunities, and threats for developing a data sharing mechanism. Feedback can be provided by group (assuming not all of them will have access to a computer/laptop).

If there are any issues accessing the online form, FD/CRFM will have a memory stick (flash drive) with the Word version of the form.

**FD and CRFM team role:**

**Preparation:** As a backup, bring a flash drive with the Word form for Activity 3

<https://fb.ly/5k3-7w>

**During the activity:** Use same groups. Help participants to download the form and motivate participants to provide feedback. Provide Word form for activity 3 to participants that are having issues downloading the electronic form. Collect any forms if people are not able to send it via email.

**At the end of the activity:** Send via email any forms filled out using the Word document.

**APPENDIX**

**Activity 1: available fisheries-related data that could be used to inform MSP.**

Please print out the form (1 page) and cut it in half.

**Activity 2: Data needs for the fisheries sector to inform MSP in Barbados**

Please print out 4 copies (4 groups). Activity 2 contains 5 pages.

**Activity 3: Synergies for data sharing and trainings**

Please print out the form. Activity 3 contains 2 pages.

AVAILABLE FISHERIES RELATED DATA THAT COULD BE USED TO INFORM MSP	
<b>ACTIVITY 1: ARE THERE ANY MISSING DATA?</b>	
<i>Instructions: Please let us know if there are any SPATIAL data (e.g., maps, GPS coordinates, shapefiles, etc.) that you are aware of, but it was not included in the report/presentation.</i>	
1. Title of report/data layer:	
2. Brief description of the spatial data: <input type="checkbox"/> Fisheries distribution <input type="checkbox"/> Marine habitats (e.g., coral, sea grass, etc.) <input type="checkbox"/> Species distribution (e.g., sea turtles, fish species, etc.) <input type="checkbox"/> Oceanographic data (e.g., bathymetry, sea surface temperature) <input type="checkbox"/> Other relevant data for the fisheries sector	
3. Where can we find this data? Please list names/organizations as possible. Name: _____ Organization: _____	
4. Please provide your contact information in case we need more information about the data you are referring to. Your Name: _____ Your email address: _____	

AVAILABLE FISHERIES RELATED DATA THAT COULD BE USED TO INFORM MSP	
<b>ACTIVITY 1: ARE THERE ANY MISSING DATA?</b>	
<i>Instructions: Please let us know if there are any SPATIAL data (e.g., maps, GPS coordinates, shapefiles, etc.) that you are aware of, but it was not included in the report/presentation.</i>	
1. Title of report/data layer:	
2. Brief description of the spatial data: <input type="checkbox"/> Fisheries distribution <input type="checkbox"/> Marine habitats (e.g., coral, sea grass, etc.) <input type="checkbox"/> Species distribution (e.g., sea turtles, fish species, etc.) <input type="checkbox"/> Oceanographic data (e.g., bathymetry, sea surface temperature) <input type="checkbox"/> Other relevant data for the fisheries sector	
3. Where can we find this data? Please list names/organizations as possible. Name: _____ Organization: _____	
4. Please provide your contact information in case we need more information about the data you are referring to. Your Name: _____ Your email address: _____	

## Appendix 11. National validation workshop invitation (communication product)

# VALIDATION WORKSHOP

**Blue Economy Roadmap Fisheries Sector Strategy and Implementation Plan**  
Dr. Susan Singh-Renton, CRFM Consultant

**Data Gap and Needs Assessment for the Fisheries Sector to Inform Marine Spatial Planning in Barbados**  
Dr. Nancy Montes, CRFM Consultant

**TUESDAY AUGUST 20, 2024**  
10:00 to 15:00 EST

**Barbados Fisheries Division**

Fisheries - Blue Economy Stakeholder representatives are invited to join us at the **Fisheries Division Conference Room** Princess Alice Highway, Bridgetown, BB11144

Or if you are joining us online, please use the link below:  
**Link** <https://meet.google.com/zsw-vkmw-kam>  
**Or dial:** (US) +1 331-642-7027  
**PIN:** 426 789 873#

- BE-CLME+ Project: Promoting National Blue
- Economy Priorities Through Marine Spatial
- Planning in the Caribbean Large Marine
- Ecosystem Plus (GEF Project ID 10211).



## Appendix 12. National validation workshop list of participants.

Name	Job Title	Name of Organization
Ann-Marie Eversley	Senior Marine Pollution Officer	Environmental Protection Department
Ronnie Griffith	Chief Economist	Ministry of Economic Affairs and Investment
Susan Mahon	President	Coral Reef Restoration Alliance
Jacqueline Pollard	Senior Tourism Officer	Ministry of Tourism and International Transport Economist
Mitch Hartman	Economist	
Chemora Mc Knee	Climate Finance Access Network (CFAN) Advisor	Climate Finance Access Network
Ricardo Marshall	Director	Roofs to Reefs Unit, Prime Minister's Office
Henri Valles	Senior Lecturer	BCS-UWI
Mechelle Lynch	Admin/Assistant-Office Manager	Barbados Environmental Sustainability Fund Coastal Zone Management Unit
Shoneé Howell	Water Quality Technician	

## Appendix 13. MSP brochure (communication product)

<p>Section 4</p> <p><b>BENEFITS</b></p> <p>Overall, participatory mapping improves the decision-making processes, promotes sustainable resource use, and promotes collaboration among stakeholders, leading to more effective and reasonable marine spatial planning outcomes.</p> <p> <b>Empowerment and Engagement</b> Involving fishermen in mapping activities empowers them to actively participate in decision-making processes that affect their income.</p> <p> <b>Inclusion of Local Knowledge</b> It allows knowledge from fishermen and their communities to be included into planning processes, so decisions include practical experience.</p> <p> <b>Increase Awareness of Maps and Locations</b> It helps fisherfolks visualize and understand mapping and locations within marine environments.</p> <p> <b>Conflict Resolution</b> By identifying and understanding areas or locations of potential conflicts between ocean users, stakeholders can find solutions and compromises.</p> <p> <b>Improved Resource Management</b> Mapping activities and locations helps identify sustainable fishing practices and areas that require conservation efforts.</p>	<p>Back</p> <p><b>QUESTIONS?</b></p> <p>If you would like more information about the Barbados Marine Spatial Planning Process, please visit:</p> <p> <a href="https://barbadosmarinespatialplan.com">https://barbadosmarinespatialplan.com</a></p> <p> <a href="https://www.fisheries.gov.bb/">https://www.fisheries.gov.bb/</a></p> <p>Or contact the <b>Barbados Fisheries Division</b> Princess Alice Highway, Bridgetown BB11144 Tel: (246) 535-5800 Email: <a href="mailto:fisheries.division@barbados.gov.bb">fisheries.division@barbados.gov.bb</a></p> <p> <b>Barbados Fisheries Division</b></p> <p> <b>BANCO DE DESARROLLO DE AMÉRICA LATINA Y EL CARIBE</b></p> <p> <b>Food and Agriculture Organization of the United Nations</b></p> <p> <b>Caribbean Regional Fisheries Mechanism</b></p> <p> <b>global environment facility</b> INVESTING IN OUR PLANET</p>	<p>Cover</p> <p><b>Participatory Mapping for Marine Spatial Planning</b></p> <p></p> <p><i>Your input matters!</i></p>
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Section 1

### MARINE SPATIAL PLANNING

Marine Spatial Planning (MSP) helps to organize **where** and **when fishing** can occur to ensure sustainable fish populations and protect marine habitats.

MSP considers fisherfolk's needs alongside other ocean users to promote fair access and support long-term fishing opportunities.

The BE-CLME Project is providing support to the Government of Barbados in developing its MSP. The MSP aims to balance the uses of the marine space, preserving marine resources, lives and livelihoods.



Fig. 1. MSP ocean users.

The BE-CLME+ Project is a regional initiative aimed at promoting blue economy development in the Caribbean region through MSP and marine protected areas, ecosystem approaches to fisheries, development of climate-smart sustainable fisheries value chains, and knowledge management in six Caribbean countries—including Barbados.

Section 2—Center

### PARTICIPATORY MAPPING

#### What it is?

Participatory mapping allows stakeholders (including fisherfolks) to contribute their **knowledge and preferences** regarding fishing grounds, habitats, and other important marine features by mapping out marine areas.



Fig. 2. Mapping activity at Bridgetown (May 2024).

#### Why use it?

It helps ensure that the planning process **reflects the needs and views** of those directly affected by the management decisions, promoting more effective and inclusive marine resource management.



Fig. 3. Mapping activity at the Oistins Fisherfolk Association (May 2024).

Section 3

### How can you participate

When invited, **please participate** at the different **workshops, meetings, and interviews**. You will be **invited to draw, add notes and marks on maps** based on your knowledge of the area.



This can include marking important fishing grounds, areas with high biodiversity, or locations of specific habitats.

You could also contribute to the mapping activity by **providing location data** (for example coordinates or GPS data) on your fishing activities and locations.

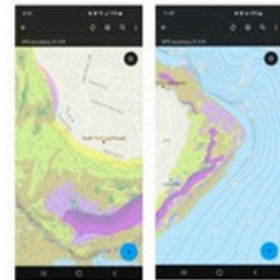


Fig. 4. Participatory mapping app.