Regional and International Good Practice for Marine Spatial Planning (MSP) Frameworks Implemented on Small Islands: A Review for the Turks and Caicos Islands (TCI)

Initially, this manuscript was planned as two manuscripts, one on the good practice of MSP and the other on successful small island MSP processes, however as there was significant overlap between the two, it was decided to combine them into one manuscript.

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List of abbreviations

ADP	Areas Designated for Preservation
APC	Areas of Particular Concern
BHI	Blue Halo Initiative
DEFRA	Department of Environment, Food and Rural Affairs
EEZ	Exclusive Economic Zone
FIG	Falkland Islands Government
FIMETI	Fair Isle Marine Environment & Tourism Industry
FIMSP	Falkland Island Marine Spatial Plan
GBRMPA	Great Barrier Reef Marine Park Authority
GIS	Geographic Information System
GLD	Geographic Location Designation
IUCN	International Union for Conservation of Nature
MPP	Marine Planning Partnership
NGO	Non-Governmental Organisation
NOAA	National Oceanic and Atmospheric Administration
RSPB	Royal society of the Protection of Birds
SAERI	South Atlantic Environmental Research Institute
SAMP	Special Area Management Plan
SAP	Spatial Access Priority
SEPA	Scottish Environmental Protection Agency
SIDS	Small Island Developing States
SIMSP	Shetland Island Marine Spatial Plan
SNH	Scottish Natural Heritage

Introduction

The marine environment plays a key role in everyone's lives, but the world's oceans and coastal ecosystems are under pressure. Fisheries are being depleted (Haedrich and Hamilton, 2000; Ulman *et al.*, 2016), coral reefs are bleaching (Brown, 1997) and are vulnerable to diseases such as the Stoney Coral Tissue Loss Disease (SCTLD) (Aeby *et al.*, 2019; Alvarez-Filip *et al.*, 2019; Meyer *et al.*, 2019), there is deforestation of mangroves (Chowdhury *et al.*, 2017; Feller *et al.*, 2017), seagrass meadows are disappearing at a rate of a football field every 30 minutes (Williams *et al.*, 2017), oceans are warming, sea levels are rising and ocean acidification is increasing, all impacting the formation of coral reefs (Andersson and Gledhill, 2013; Camp *et al.*, 2016) and the uptake of calcium carbonate in animals (Nagle *et al.*, 2018) and even on the dermal denticles of sharks (Dziergwa *et al.*, 2019).

With climate change and sustainable resource use being global challenges faced by all nations and territories, now, more than ever, it is essential that countries implement marine management strategies. Furthermore. it is important that marine management strategies are effective in organising the human uses of the ocean, while protecting the ecosystem services and resources it provides, and mitigating the effects of climate change. It is a challenge, but one proposed solution is Ecosystem-Based Management (EBM) encompassed within a Marine Spatial Planning (MSP) framework.

EBM is an approach that analyses and manages ecosystems by considering all components, including human society, pressures and impacts, with the aim of maintaining marine ecosystems in a healthy, productive and resilient condition so that they can provide goods and services, and sustain human uses of the ocean (Christensen *et al.*, 1996; Barange, 2003; Halpern *et al.*, 2008; McLeod and Leslie, 2009; Link and Browman, 2014). MSP is a spatial and temporal based process that can implement an EBM approach (Douvere, 2008; Ogden, 2010; Ansong, Gissi and Calado, 2017). As the name implies, MSP is spatial planning for the ocean and is defined as '*a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that usually have been specified through a political process*' (Ehler and Douvere, 2009). By combining governance and science MSP aims to identify the spatial distribution of activities and ecosystems in the ocean, so that existing and emerging uses can be maintained, conflicts reduced, and ecosystem health and services protected and sustained into the future (Douvere, 2008; Halpern *et al.*, 2008; Ehler and Douvere, 2009; Ogden, 2010; Domínguez-Tejo *et al.*, 2016). This is undertaken by considering the actions of those groups using the marine ecosystem services and resources, interactions between those groups and the cumulative effect their usage has on the marine environment (Halpern *et al.*, 2008; Ehler and Douvere, 2009). Consequently, MSP is a complex and challenging process because it involves the interaction of a diverse group of stakeholders, that are required to determine how to organise human uses in the marine environment (Pomeroy and Douvere, 2008). At present approximately 70 countries around the world are in some phase of implementing an MSP framework (International Oceanographic Commission and United Nations Educational Scientific and Cultural Organization, 2017) and about 20 countries have implemented integrated Marine Spatial Plans (Ehler, Zaucha and Gee, 2019). However, the implementation of MSP still faces conceptual and practical challenges, from political to institutional, social, economic, scientific and environmental sources (Frazão Santos *et al.*, 2019).

In order to a achieve a successful marine spatial plan it is essential that stakeholders are engaged during the development process (Ehler and Douvere, 2009). Regular communication and feedback are essential steps in successful MSP projects. However, there is no one size fits all for a good policy when engaging stakeholders in MSP. Stakeholder engagement has to be tailored to individual countries, societies, cultures, traditions, and political contexts (Ehler and Douvere, 2009). Transparency and openness with stakeholders are usually key principles for successful MSP (Lombard *et al.*, 2019). Stakeholders improve decisions, adding new information, ideas and analysis and have access to technical and scientific resources. The more intensive stakeholder processes are more likely to result in higher-quality decisions (Beierle, 2002). Engaging stakeholders helps to:

- encourage 'ownership' of the spatial planning process and final plan, engender trust among stakeholders and decision-makers, and encourage voluntary compliance with rules and regulations;
- gain a better understanding of the complexity (spatial, temporal, and other) of the marine management area;
- gain a better understanding of the human influences on the marine management area;
- deepen mutual and shared understanding about the problems and challenges in the marine management area;
- gain a better understanding of underlying (often sector-oriented) desires, perceptions and interests that stimulate and/or prohibit integration of policies in the marine management area;
- examine existing and potential compatibility and/or conflicts of multiple use objectives of the marine management area;
- generate new options and solutions that may not have been identified in single-sector planning; and
- expand and diversify the capacity of the marine planning team, in particular through the inclusion of secondary and tertiary information, for example, local knowledge and traditions. (Ehler and Douvere, 2009)

Science, an important component of the MSP toolkit (Dicks, Walsh and Sutherland, 2014; Churchyard *et al.*, 2016), can provide evidence for decisions that can help with cost-effective management and policies (Kelly *et al.*, 2014; Churchyard *et al.*, 2016). However, incomplete data and limited knowledge can lead to inadequate conservation and management decisions (Kingsford *et al.*, 2009; Shucksmith *et al.*, 2014; Churchyard *et al.*, 2016; Gill *et al.*, 2017). Consequently, collecting and collating data, such as the distribution of habitat and wildlife, human uses, coastal development and coastal cultural values, and identifying gaps in these data, are essential to feed into the MSP tools such that effective management decisions can be made (Shucksmith and Kelly, 2014; Gee *et al.*, 2017; O'Leary *et al.*, 2019).

To manage a marine spatial plan effectively the plan needs to be enforceable, and to do this it is generally necessary to create new legislation (Ehler and Douvere, 2009). One of the first examples of such an approach was in the 1970's when Australia created new legislation in the Great Barrier Reef Marine Park Act 1975, and established the Great Barrier Reef Marine Park Authority (GBRMPA) to develop and deliver Great Barrier Reef MSP (Great Barrier Reef Marine Park Act 1975, 2018). The UK implemented it's overarching MSP policy and legislation by introducing a Marine Stewardship Report in 2002 (Defra, 2002). Similarly, in Scotland, the Marine Scotland Act 2010 (Scottish Government, 2013) provided the legislation to develop MSP, while a government body 'Marine Scotland', was created in 2009, which is responsible for the integrated management of Scotland's seas and coordinating the Scottish MSP process. There are other ways to establish authority for MSP, such as re-interpreting or modifying existing legislation to provide a basis for MSP (Ehler and Douvere, 2009).

No one is more dependent on the ocean than that of small island nations. Small island populations generally have close links with the sea, that are built up over many years of interaction with it through commerce and culture. Small island nations often have limited natural resources, small and specialised economies, high transportation costs, small populations, and a disproportionately large marine area compared to the terrestrial area (Nurse *et al.*, 2001). Furthermore, small islands contribute less than one per cent to the world's greenhouse gas emissions (Nurse *et al.*, 2001), but they are among the first to experience the worst and most devastating impacts of climate change (Nurse *et al.*, 2001).

Like the rest of the world, human use of coastal and marine resources of small island nations, such as those in the Caribbean, is placing growing and often conflicting demands on natural resources. Consequently, important marine areas are under increasing pressure that threatens the health of coral reefs, wetlands, mangroves, and seagrass beds and the environmental services they provide, such as coastal protection from storms, fishing grounds, and tourism-based economies (Baldwin *et al.*, 2015). The application of MSP has been less prominent in small island developing states (SIDS) than in developed countries (Pomeroy, Baldwin and McConney, 2014). However, Caribbean islands are beginning to engage in the practice of MSP for the management of their marine environments, including Jamaica (Baldwin *et al.*, 2015), St Kitts and Nevis (Agostini *et al.*, 2015), Grenadine Islands (Baldwin and Oxenford, 2014), St Lucia (Soufriere Marine Management Area, 2018), Montserrat (Flower *et al.*, 2020) and Barbuda (Johnson *et al.*, 2020).

Turks and Caicos Islands (TCI)

The TCI, a small island nation, is one of 14 United Kingdom Overseas Territories (UKOT, 145 km north of Hispaniola (Haiti and the Dominican Republic) and 925 km south-east of Miami (Figure 1). The easterly occurring Turks Islands are separated from the Caicos Islands by a deep-water channel approximately 35km wide. TCI is relatively flat. Providenciales rises to a high point of 50 m above sea level and Flamingo Hill on the North Western point of East Caicos has an altitude of also approximately 50 m. Sinkholes, caves and ridge formations are common. The islands consist largely of Pleistocene oolitic limestone and unconsolidated Holocene sands. The is TCI population is 42,953 (2019), and the total area of the EEZ is 154,058 km². Tourism is the main contributor to the TCI economy, in 2019, from a combination of flights into Providenciales and cruise liners into Grand Turk, approximately 1.59 million tourists visited the islands (Turks and Caicos Islands Tourist Board, 2018), and the '*beautiful beaches*' and the marine environment are an important factors in people choosing to visit the islands (Department of Statistics Turks and Caicos Islands, 2018). The third largest contributor to the TCI economy is fishing for export to the US (mainly lobster and conch). The TCI is also on the tentative list to becoming a world heritage site (http://whc.unesco.org/en/tentativelists/5682/).

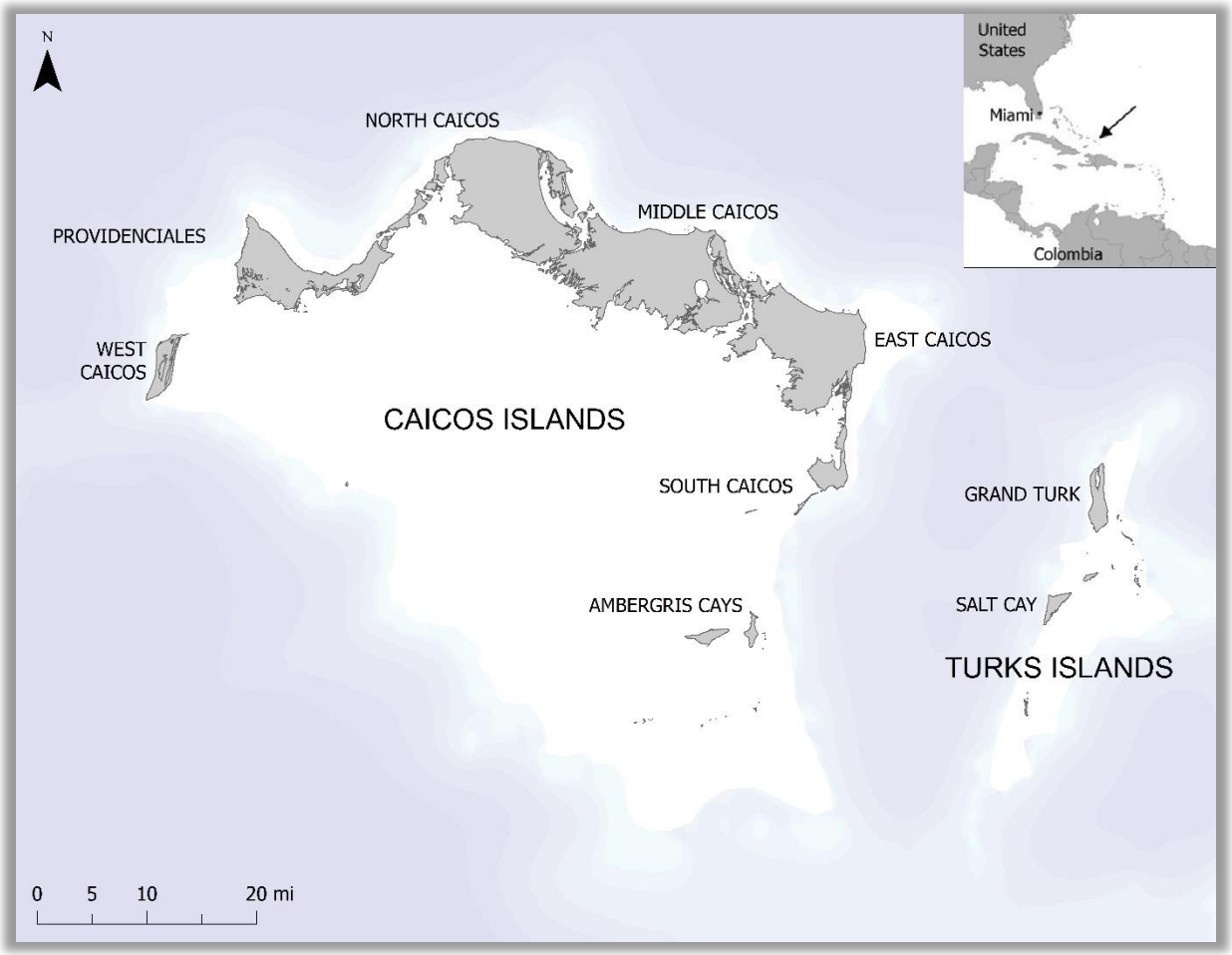

Figure 1 The Turks and Caicos Islands

As a small island nation, the TCI is dependent upon its natural marine environment and the services it can provide. Major threats to the area's marine ecology include unchecked coastal development, unsustainable fisheries practices (Lockhart, De Fontaubert and Clerveaux, 2007; Omori *et al.*, 2016; Ulman *et al.*, 2016), land-based sources of pollution (Goureau *et al.*, 2008; Diez *et al.*, 2019), rising ocean temperatures as a consequence of climate change (Trisos, Merow and Pigot, 2020), and the increasing intensity of hurricanes and other storm events (Bruckner and Bruckner, 2006). Such pressures are only likely to intensify.

Protected areas have been implemented as part of the TCI strategic plan since the 1980s (Mitchell and Barborak, 1991; Zuidema, Plate and Dikou, 2011). Marine parks were created to provide protection for the natural resources of the TCI and to provide management of marine areas for the benefit of tourism, fishing and boating (Logan and Sealey, 2013). In 2005, a review of the TCI protected areas determined, with few exceptions, that they were well designated.

The TCI now has 35 protected areas (see annex 1) consisting 11 National Parks, 11 Nature Reserves, four Sanctuaries and nine Areas of Historical Interest, all declared under the TCI National Parks Ordinance, 28 of which have a marine component, however these are about to be amended. After a public consultation process, amendments were made to the TCI National Parks Ordinance and a signed notice of change to the national parks order (Signed Notice of Change National Parks Order (2016)) plans to:

- remove sections of existing protected areas
- extend existing protected areas

- designate existing protected areas (or part thereof) under different categories of protection
- establish new protected areas

At present, there is no strategic approach to manage the marine environment in the TCI and the TCIG does not manage its marine protected areas holistically. Existing management, use and legislation needs to be improved to ensure sustainability. The TCIG are in the process of developing a framework and tools to bring together these functions and uses of the marine environment, which is essential for developing MSP in the TCI.

To help in the MSP development process it is often beneficial to review previous successful MSP implementations, in order to understand the MSP process and to determine the good practice for MSP in the TCI. Therefore, five successful MSP processes were reviewed for small island MSP frameworks that may be important to the development of an MSP framework in the TCI. In each of the cases reviewed here, the recurring steps in the MSP development process were stakeholder engagement, science and policy & legislation and how, they work collaboratively to develop an MSP framework to meet their MSP objectives.

Case Studies

Shetland Islands Marine Spatial Plan (SIMSP)

The aim of the Shetland Island Marine Spatial Plan was to ensure that the use of the marine and coastal environment of Shetland is sustainable. To enable dynamic economic activity supporting a prosperous community whilst maintaining and enhancing marine wildlife, habitats and ecosystems. Sustainable use should not lead to loss of biodiversity or ecological balance, or reduce the availability of natural resources for future generations (North Atlantic Fisheries College, 2008).

Engaging Stakeholders

In Scotland, the Marine Scotland Act 2010 (Scottish Government, 2013) provided the legislation to develop MSP (Figure 1). This represents a holistic and strategic approach and provides the ability to account for the views and interests of all key stakeholders and potential cumulative impacts. The development of the SIMSP was subject to substantial stakeholder consultation, consisting of local representation and expert advice. Stakeholders and the local community have been engaged in the SIMSP development since 2006 and have been instrumental in adding significant value to the MSP process in the Shetland Islands. The SMSP has been continuously reviewed, through regular monitoring and reporting of the SIMSP outcomes and outputs. Where necessary, this has informed periodic amendments and revisions.

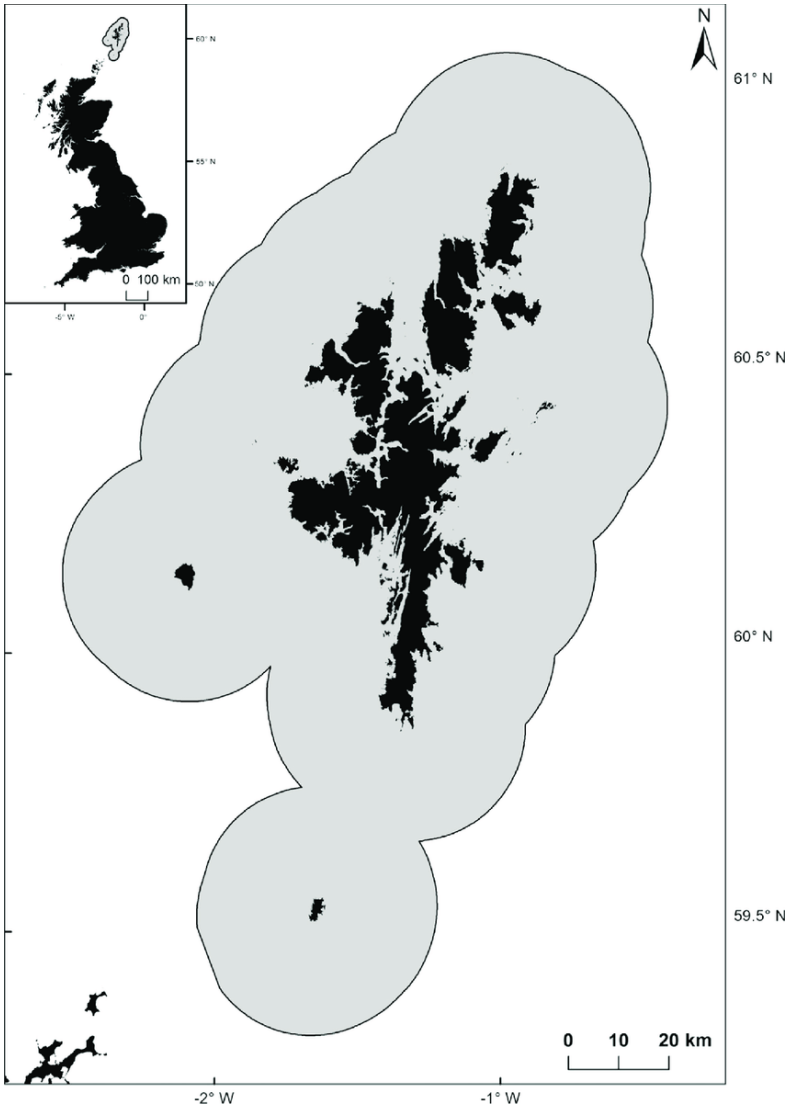

Figure 2 Location map of the Shetland Islands, the most northerly islands of the United Kingdom. The spatial extent of The Shetland Islands' Marine Spatial Plan (12 nautical miles out from Mean High Water Spring) is marked in grey(Kelly *et al.*, 2014)*. Contains Ordnance Survey data © Crown copyright and database right (2011). Contains UKHO data © Crown copyright and database rights.*

The Marine Spatial Planning team at the North Atlantic Fisheries College (NAFC) Marine Centre engage regularly with many key stakeholders, supported by a Local Advisory Group. The Local Advisory Group consists of decision-makers, regulators, non- Governmental Organisations (NGOs), local industry and community representatives. Currently there are 21 active members representing the Shetland Islands Council (planning, coastal zone management, natural heritage, ports and harbours ,elective representatives); NAFC Marine Centre marine spatial planning section staff; Marine Science (compliance); Shetland Community Councils; Scottish Environmental Protection Agency (SEPA); Scottish Natural Heritage (SNH); Fair Isle Marine Environment & Tourism Initiative (FIMETI); Shetland Amenity Trust (Biological Records & Archaeology); Royal Society for the Protection of Birds (RSPB); and marine industries including oil and gas, aquaculture, fishing (shellfish and finfish) and renewable energy.

Science

Although the NAFC Marine Centre provides the science for the plan (and advice about development licences) and the Shetland Islands Council provides the legal powers to the plan, it's the Scottish Government that is legally responsible for the plan. The NAFC led the development of the first edition of the Shetland Islands Marine Spatial Plan, under the steering of the islands' Coastal Zone Manager.

NAFC staff led data collection, produced the scientific mapping and drafted policies, using a sub-group of policy stakeholders and using a sub-group of specialists as required. The full stakeholder group was consulted for approval. The Plan has been revised 4 times over 9 years, with some changes in its content and reformulation of policies following feedback from stakeholders.

Feedback from the SIMSP users highlighted how useful the supporting GIS portal (Atlas) had been. The base-line SIMSP information was used to consider environmental restrictions/key sensitivities, cultural and heritage interests, industry/built infrastructure parameters and exclusion areas. The SIMSP could be referenced in supporting documentation for planning permission and licencing (Kelly *et al.*, 2014). Furthermore, the SIMSP provided developers with information that they were previously unaware of, saving them resources that would have been required to gather the information themselves, and preventing potential conflicts (Kelly *et al.*, 2014). Overall, users of the SIMSP have gained deeper understanding of the ecosystem services that the marine environment has to offer, which in-turn has helped with siting and planning stakeholder developments and reduced user conflicts (Kelly *et al.*, 2014).

Policy

SIMSP provides a policy framework and baseline spatial data to guide the placement of marine developments. The policies and spatial data encompass socio-economic, cultural and environmental uses and features. The SIMSP was voluntarily adopted by the local advisory group in 2008, including the Shetland Islands Council, government agencies (SNH, SEPA) and industry representatives; and since then has been consulted when assessing marine developments (Kelly *et al.*, 2014). This Marine Strategy Forum has the aim to "*Provide a strategic focus to ensure alignment and agreement of priorities and activities for integrated marine and coastal stewardship. Provide advice to Scottish Ministers on Marine Scotland's key strategies and business planning.*"

Legislation

The Scottish National Marine Plan applies to the entire EEZ. However, regions (such as the Shetland Islands) are given individual authority for their territorial seas (12nm from shore). Local government agencies are responsible for the delivery of regional marine spatial plans. The regional agencies conduct MSP under a Marine Planning Partnership (MPP) where stakeholder engagement is at the forefront of the process. The MPP includes the governmental agencies, the local government, NGOs, community groups, and industry representatives. Spatial data are a key element of the regional MSP process, along with the identification of policy areas.

Regional authorities (for instance, the Shetland Islands Council and the North Atlantic Fisheries College (NAFC) Marine Centre in the Shetland Islands) lead the MSP process with delegated powers given to these entities to deliver the Plan (Kelly *et al.*, 2014).

Falkland Islands MSP (FIMSP)

The aim of the Falkland Island MSP project (FIMSP) was to initiate the process of MSP by preparing data, tools and analyses, and by formulating a framework for MSP in the Falkland Islands. The results will inform the Falkland Islands Government (FIG) and its stakeholders on best practice and make

recommendations on priorities for management and for developing a sustainable MSP process for the Economic Exclusive Zone (EEZ, locally known as 'Conservation Zone') of the Falkland Islands (Auge, 2015).

The project is built around 3 major workshops as per the project mind map below (Figure 2)

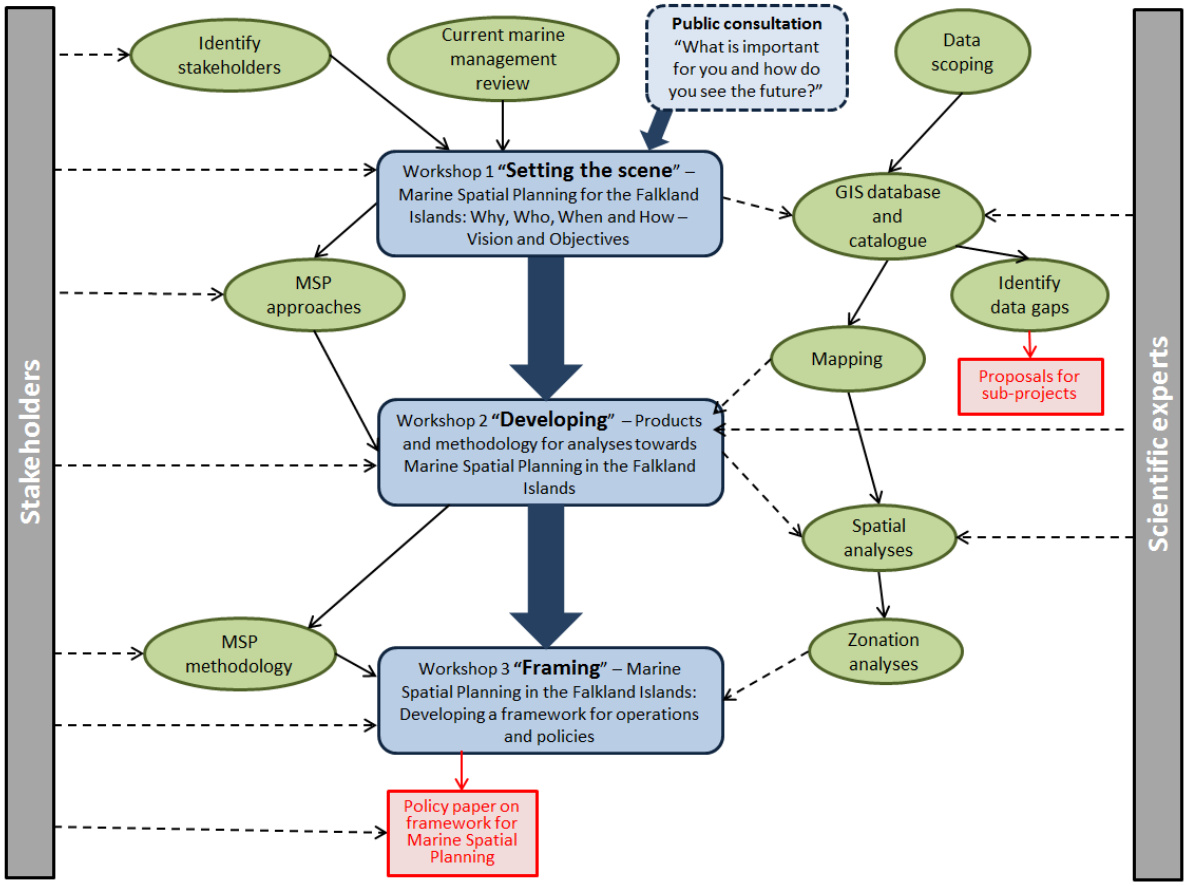

Figure 3 Conceptual map of the Falkland Islands MSP project over its two years

Engaging Stakeholders

In the Falkland Islands the MSP process was centred around the inclusion of a diverse range of stakeholders, including representatives of marine groups, industry, government, NGOS, and international experts in MSP (Figure 2). Regular communication, in the form of workshops, to and feedback from the stakeholders was essential in:

- developing the Falkland Island MSP GIS database and its range of tools for decision-support
- drafting the MSP format and framework
- determining the management priorities
- formatting the Plan
- understanding the complexity and inter-connectivity in the marine environment
- understanding the need for an ecosystem-based approach and that the inclusion of cumulative impacts in management are important to MSP.

As a result of the good communication to, and feedback from the stakeholder group, the main priorities for the MSP process in the Falkland Islands were to provide tools and protocols for:

- streamlining Environmental Impact Assessment (EIA) process
- managing shipping and boating
- facilitating emergency responses and safety protocols
- identifying ecologically important areas
- preventing introduction of marine invasive species (biosecurity).
- descriptions of the marine environment, it's uses and values
- existing management
- detailing the mechanisms and processes that form the MSP including policies and legislation

Shipping exclusion zones were an important management measure, in particular around the Jason Islands, Beauchene Island, Volunteer Point and Berkeley Sound, where large populations of seabirds and seals breed. There was also a need to improve maritime communication, and establish emergency and safe shelter zones for vessels to limit risks to ecological values was also a priority. The potential for the inshore areas around the islands (approximately 3nm) to be proposed as a Marine Managed Area (Dudley, 2008) was also identified as a priority for MSP.

Science

One of the recommendations emerging from the workshops was to develop a tool that would allow stakeholders to visualise the spatial data produced for MSP, and later management measures. The MSP team worked in partnership with the South Atlantic Environmental Research Institute (SAERI) IMS-GIS Centre to produce a WebGIS for MSP in the Falkland Islands. It allows users to display the different layers and peruse the area at different scales, and also to overlap different types of data such as environmental values and human activities.

As a result of the stakeholder workshops, and as part of the MSP project, data gaps were identified and further sub-projects were proposed to fill the gaps and these data where included in the WebGIS tool. Data collected during the development of the FIMSP were used to develop a framework for mapping key areas for marine megafauna around the Falkland Islands (Augé *et al.*, 2018). Temporal data were included on the annual life cycle stages at which the different species were at throughout the year, for example, southern elephant seals mate and pup from September to November (Augé *et al.*, 2018). The results highlighted that all the coastal waters up to the 200 m depth contour were key areas for marine megafauna in the Falkland Islands (Augé *et al.*, 2018). These data can then feed into the MSP tools to aid management in making informed MSP decisions (https://data.saeri.org/saeri_webgis/lizmap/www/index.php/view/map/?repository=04f&project=webGIS20170717)

Policy

The Falkland Islands Government (FIG) committed to producing the first FIMSP and the stakeholder engagement provided the platform for consultation and feedback on the proposed MSP framework. A paper was submitted to the FIG Executive Council, who subsequently agreed to support the implementation of MSP in the Falkland Islands and they, '*acknowledged the importance of implementing an MSP process for the long-term sustainable and safe management of the coastal and marine environments of the Falkland Islands and that such a process is grounded in objective and sound science; agreed to support and the creation of an MSP Plan.*' (Auge, 2016)

Legislation

The Falkland Islands Government (FIG) committed to producing the first FIMSP and further engagement with stakeholders in consultation on the proposed MSP framework. The outcomes of this report and the other outputs will inform the next phase of MSP implementation (Development Phase)

during which the first FIMSP will be developed, the MSP Forum formed, terms of reference produced, and the tools for FIG to implement and legislate MSP established.

Rhode Island's Ocean Special Area Management Plan (Ocean SAMP)

The Rhode Island Ocean Special Area Management Plan (Ocean SAMP), a marine spatial plan, and of the first in the United States, laid the groundwork for the siting and permitting of the nations first offshore wind farm (Smythe, Andrescavage and Fox, 2016)

Engaging Stakeholders

An essential part of the development of this SAMP was the engagement of stakeholders. They were involved in seminars and workshops that were designed to respond to issues by the public and specific stakeholder groups. The groups included:

- A 12-member scientific advisory committee provided a forum for discussion of the design of the research and the interpretation of the research findings.
- A State technical advisory committee that brought together all the state agencies with interests in the Ocean SAMP region.
- A Federal Technical Advisory Committee periodically bought together representatives of all federal agencies that will play a role in permitting new activities proposed in the Ocean SAMP region.
- An inclusive Stakeholder Group, accessed through a website and listserv, held monthly meetings at which research findings were presented, their implications discussed and the scope and contents of the Ocean SAMP chapters reviewed. When major issues surfaced meetings with individual parties and groups were arranged. This consultative process featured particular attention to the federally recognized Narragansett Tribe that has a special interest in the aesthetic values of the region and areas of potential ancient settlement.
- Technical Advisory Committees were established for each of the 11 chapters of the Ocean SAMP. These were composed of scientists, government agency representatives and resource users selected for their knowledge of the topics addressed by a given chapter. These committees advised and commented on the scope and content of each chapter. (Olsen, McCann and Fugate, 2014)

Science

Existing spatial data on the Ocean SAMP region were verified and transferred a geographic information system (GIS). When presented at initial public workshops, erroneous information and important data gaps were identified. Areas previously suitable for certain activities were found to be unsuitable. This procedure encouraged stakeholders with local traditional knowledge to work with members of the Ocean SAMP team with the GIS system to overlay and integrate traditional and scientific knowledge. The initial mapping provided a context for the compilation of technical information by teams of scientists and an extensive program of field observations, which was framed around two sets of issues that became the focal points of the spatial analysis.

Environmental and engineering issues

- What is the distribution and abundance of coastal and offshore bird populations? Terrestrial long-term trends are well documented but offshore surveys are almost non-existent; several bird species known to be present are classified as endangered.
- What is the distribution and abundance of marine mammals including several species of endangered and threatened whales.
- What are the baseline seasonal distribution patterns and species composition of plankton?

- What are the potential impacts of climate change of the ecology of the Ocean SAMP region and the human activities it supports?

Societal issues

- What is the distribution of commercial and recreational fishing?

Policy

The general policies address responses to the ecology of the Ocean SAMP region, climate change and the major categories of human activity including offshore renewable energy and other forms of offshore development. Regulatory standards detail policies and performance standards for Areas of Particular Concern (APCs) and for Areas Designated for Preservation (ADPs) and include standards for pre-construction and construction. Areas Designated for Preservation include all waters within the 20m depth contour. This belt of shallow waters has been found to be of exceptional value to sea ducks. All forms of large-scale offshore development are prohibited in the ADP zone. The ADP zone lies almost entirely in state waters where the Coastal Council exercises direct authority. The area that was found most suitable for wind turbines within state waters was classified as a Renewable Energy Zone.

To achieve the goal of "protecting and enhancing existing activities", the Ocean SAMP identifies APCs, which include areas:

- With unique or fragile physical features or important natural habitats
- Of high natural productivity
- Of significant historical or cultural value
- Of substantial recreational value
- Important for navigation, transportation, military or other human uses
- Of high fishing activity

Legislation

The Ocean SAMP was approved by the Coastal Council on October 19, 2010. The Ocean SAMP team worked closely with the National Oceanic and Atmospheric Administration (NOAA) to assure that the policies and regulations were consistent with the mandate and authority of both the Council and the federal coastal and ocean management program. As a result, federal approval of the Ocean SAMP in May 2011 was processed as a routine program change. Three months later, through a process termed the Geographic Location Designation (GLD), NOAA identified all federal activities that will be subject to the consistency clause and thereby to review by the state. This means that the Ocean SAMP compilations of information and implementing policies will be a basis for all decision making by federal agencies of government and thereby sets the stage for collaborative planning and decision making with the Rhode Island coastal management program (Olsen, McCann and Fugate, 2014).

Montserrat

In February 2015, the Government of Montserrat and the Waitt Institute signed a MOU to launch Blue Halo Montserrat, a comprehensive ocean and coastal management project with a goal of sustainable management of Montserrat's ocean and coastal waters; Montserrat has a UK "Territory to Territory" partnership to collaborate with the Falkland Islands on MSP and fisheries (Flower *et al.*, 2020).

Stakeholder Engagement

The Blue Halo Steering Committee was established as an advisory body to guide the MSP process, and was comprised of representatives from government, nongovernment, and private sector interest groups. The Committee's decisions provided guidance to Montserrat's Minister of Agriculture, Trade, Lands, Housing, and Environment (MATLHE) who had ultimate responsibility for the marine spatial

plan that would be put forward to legislators. Committee members played an important role in informing their businesses and the community more broadly and taking feedback to the committee meetings. The committee met regularly to review progress on the project and develop draft-zoning plans.

Science

A Scientific Advisory Team was established to provide scientific advice and technical assistance to the committee to help in decision making, and consisted of the Waitt Institute, the McClintock Lab (seasketch developers), and the Sustainable Fisheries Group at the University of California Santa Barbara. Data collection, scientific review and data analysis was undertaken over a series of nine meetings, and with advice from the Science Advisory Team, initial marine zoning options were developed, and a plan was released for and initial public consultation and comment (Flower *et al.*, 2020). Following the initial public feedback, the committee with advice from the Science Advisory Team, revised the plan and released it for a final round of public consultation.

Spatial data were obtained on demography, hazards, infrastructure, land cover, natural heritage, physical geography and tourism from the Government's GIS Centre, and fisheries data, including catch data from the Fisheries Division. A lack of marine environment data was identified and subsequently prompted additional data collection. This included marine scientific assessment to characterize Montserrat's marine habitats, benthic cover, and fish communities, ocean use surveys of stakeholders to determine the spatial distribution of fishing and diving activities, and community consultations to engage with residents and understand local priorities for ocean management. Fishermen (53) and divers (69) were interviewed and asked to indicate areas where they used for fishing and diving. Heat maps were developed and showing the distribution of fishing and diving values across the region. All spatial layers used for the MSP process were made publicly available in the SeaSketch web platform (montserrat.seasketch.org). These data were then used to view layers and draw boundaries of prospective zones, including no-take and partial take MPAs, port authority zones, multi-use zones and recreation zones. Analysis was undertaken to determine conservation priority zones. The committee then used this conservation priority zones to help guide their placement of MPAs.

Policy & Legislation

At present the marine plan has been submitted to the MATLHE for cabinet review (Flower *et al.*, 2020).

Barbuda

Barbuda engaged in a Blue Halo Initiative (BHI), an MSP process by which the Caribbean island engaged in an effort to restore and sustainably manage their waters, based on science and stakeholder priorities, and resulting in a comprehensive and legally-coded set of ocean zones. More specifically, the aim of this work was to (a) design and adopt coastal zones to balance various uses of ocean space, (b) improve the sustainability of fisheries management, and (c) protect vulnerable ecosystems and species (Johnson *et al.*, 2020)

Engaging Stakeholders

All Barbuda residents were considered stakeholders. Therefore, broad efforts were made to engage the island population in the process of developing and designing new ocean zones and management. However, as fishing and tourism are the island's primary marine activities, stakeholders from those sectors were engaged most deeply, which ensured that their voices would be appropriately considered in a new management system.

As an initial form of community engagement, 50 current and former fishers were interviewed. There were questions on types of boats and gear used, how catches have changed over time, causes of declining catches, locations of nursery habitats and spawning areas, and support for potential management measures. Initial interviewees were recommended by members of the Barbuda Council, Fisheries, and Lagoon Park staffs, then all interviewees were asked to recommend others to interview, in what is termed a snowball sampling approach. The interviews were focused on engaging key members of the fishing sector and those whose views politicians were most keen to hear from, including those expected to be most strongly in opposition. The survey included questions about fishing habits, how ecosystems and catches are changing, and support for current and potential management measures. The results were presented to the Council and community, and fishers' strong support for improving ocean management was critical to ensuring political will.

In consultation meetings, stakeholders were (1) informed about the goals and process of the Blue Halo Initiative, (2) provided with summary information on key fishing areas, areas of cultural use, spawning areas, and areas of illegal fishing, (3) offered technical support to sketch and evaluate prospective zoning plans, (4) provided information on complementary regulatory proposals for fishing restrictions and species protections, and (5) encouraged to discuss and debate the relative merits of alternative plans, restrictions and protections.

To ensure the community was aware of and could access the draft zoning maps, the maps were posted in prominent public places, in the local newspaper, and online. New drafts were also announced on the radio and via social media. Members of the BHI team were also regularly interviewed by the press. In addition, as approximately one-third of the population of Antigua and Barbuda had Facebook accounts, a Facebook page was created and advertised to residents of Antigua & Barbuda. There were twenty-two meetings of the Council where community feedback was discussed, with technical support from the Waitt Institute.

Science

The Waitt Institute organized community engagement and designed its approach with the understanding that, though invited, the Institute and associated experts were guests on the island. Thus, the key role of these outside experts was to compile community input, provide scientific information and technical support, and make recommendations in line with the approved principles and guidelines, with the understanding that, ultimately, the outcome would reflect the community's goals and priorities.

All available geographic information system (GIS) layers were gathered from government sources. This included place names, administrative boundaries, and infrastructure locations. Initially, the database was only comprised of terrestrial data as no geospatial data existed for Barbuda's coastal waters. New data were collected that described the ecology, habitats, and fishing value of the waters around the island. These data were transformed into map layers and input into SeaSketch, a web-based platform for participatory mapping developed at the University of California Santa Barbara. SeaSketch provided the publicly-available platform for visualizing maps, sketching and analysing prospective zones, and collaboratively designing comprehensive zoning scenarios.

A team of ten marine biologists conducted an ecological assessment of the marine resources around Barbuda in collaboration with local fishers and newly certified local SCUBA divers from Fisheries and the Lagoon Park. Data on lobster, conch, fish, corals, algae, and overall species diversity were collected at 234 sites around the island. Water samples were also collected to assess water quality. All data were georeferenced and loaded into SeaSketch, so they were available to inform the zoning process.

A seafloor habitat model was derived from IkONOS-2 satellite imagery collected in 2012, with a per-pixel spatial resolution of 4 by 4 m. Seafloor habitats were classified using Definiens eCognition software, which allows spectral, textural, edge-detection, and landscape properties of seafloor features to be applied in a classification workflow. This enabled the classification of seafloor habitats in waters up to 30 m depth, which includes approximately 90% of Barbuda's coastal waters. Ultimately, habitat was classified into six types: sand, seagrass, patch reef, continuous reef, and hard-bottom, with the rest categorized as deep water. This map was ground-truthed by the scientific divers, and refined to more accurately reflect habitat boundaries.

A map of fishing area value was developed and the BHI team developed a spatial access priority (SAP) map of Barbuda's coastal ocean by dividing the importance assigned to a fishing area by its size. The values for overlapping priority areas were summed to produce a cumulative SAP/km2. Therefore, small areas of high importance received a higher value than large areas of low importance, and areas that were important for multiple fishers received a high value. Fishers were also asked to identify spawning areas, areas where illegal fishing was common, and any areas of important cultural use (e. g., traditional community fishing locations). To maximize participation and promote candour from fishers, all individual contributions in SeaSketch were kept confidential and only the summary data product (i.e., the heatmaps) was shared publicly – first among the fishing community, and then with the Council and the general public. Fishers indicated the summary heatmap matched their understanding of the distribution of fishing value. These data were critical for ensuring fishers were not unduly impacted by new zones.

Policy

The Environmental Law Institute conducted a legal framework assessment as an initial step in this process, which was completed and made public. Key issues addressed in the assessment included how Barbuda's legal system operates in the context of the national laws of the twin island state of Antigua and Barbuda and, given that context, how the Barbuda Council could implement the zones developed through the planning process.

Legislation

Upon finalisation of the ocean zones and regulatory texts, the Barbuda Council adopted three sets of regulations to (a) create the coastal zones, (b) reform fisheries in coastal waters, and (c) establish a National Parks Authority for Barbuda. The Council signed into law the comprehensive zoning regulations as "The Barbuda (Coastal Zoning and Management) Regulations". The regulations include and legally codify the final zoning map, which represents a balance between community preferences, scientific guidelines, and legal constraints. The map reflects the key stakeholder priorities: (a) ensuring that several culturally and economically important areas remained open to fishing, (b) limiting damaging types of fishing, and (c) creating anchoring/mooring zones to limit where anchoring occurs and create a framework for charging fees.

Concurrent with the zoning regulations, the Council signed "The Barbuda (Fisheries) Regulations" and "The Barbuda (National Parks Authority) (Establishment) Regulations" to ensure that in addition to specific zones, there is a robust legal framework for sustainable use and conservation of coastal resources. The park regulations set up the composition and process for an Authority which became the legal management entity on Barbuda under the National Parks Act, and gave its officers enforcement authority inside Codrington Lagoon National Park. This was not initially envisioned as part of the initiative, but was identified during the MSP process as necessary to establish authority for implementation.

The Barbuda regulations provide additional restrictions on fishing in Barbuda's coastal waters and tools for local management and enforcement of fisheries. Management measures include (a) establishing a Barbuda fishing registration system to serve as a foundation for local management and to constrain illegal fishing; (b) fully protecting parrotfish and urchins (key herbivores needed to control algal overgrowth); (c) limiting capture of sharks to local consumption (no export of sharks or shark fins); (d) requiring use of escape gaps in fish traps; (e) potential to protect spawning aggregations; and (f) setting up a permitting framework for artificial reefs.

To ensure that stakeholder engagement is built into local marine resource management in the long term, beyond the extensive input into regulatory development, the fisheries regulations established a seven-member Barbuda Coastal Management Advisory Committee. The Committee has seats for representatives from the Council, fisheries, parks, fishing, conservation, tourism, and Coast Guard. Although the Committee has no regulatory authority, it has a broad advisory mandate (Johnson *et al.*, 2020)

Conclusion

Good practice for implementing an MSP framework is a step by step approach, whereby stakeholder engagement and science work together with policy and legislation to develop a framework under which the human uses of the marine environment can be managed. It should be noted, however, that good practice for one MSP process, does not necessarily mean it will be good practice for another.

Each of the five MSP cases reviewed here highlights the myriad of human activities that exploit the marine environment and they emphasise that one size does not fit all. The challenge in each case is to provide a framework under which the human uses of the marine environment can be managed to achieve ecological, social and economic objectives. They each demonstrate that in their cases the MSP process involves engaging stakeholders, and working with scientists in order to provide such a framework for the management agency to implement policy and legislation to manage the marine environment.

Engaging stakeholders is an essential element in the success of MSP, all of the five MSP processes reviewed here emphasise the importance of stakeholder involvement right from the beginning, and throughout the MSP development process. Furthermore, it is important that the stakeholders consist of a wide range of interest groups including government, non-government, the private sector, fishermen, tourism operators and local community. Anyone who has a vested interest in the marine environment should be invited to be a stakeholder, and regular stakeholder workshops and meetings should be held for project updates and to garner stakeholder feedback.

TCI's EEZ is rich in biodiversity, and provides important ecosystem goods and services including its vital disaster mitigation role (coral reefs, seagrasses and mangroves). There are a range of stakeholders working in the TCI marine environment and representatives from all interested groups should be invited to participate in regular stakeholder workshops and meetings to discuss the MSP project and to garner feedback. These meetings will help to provide a platform for stakeholders to air their concerns for discussion, highlight new datasets that may be available, garner support for the project and keep the MSP development process as transparent as possible. Given the need to ensure sustainable development of local marine resources in balance with conservation and protection of marine stocks, species, habitats and systems, TCIG and all stakeholders have a common interest in ensuring the future development and viability of this process.

Science

Understanding the marine environment and the ecosystem services it provides and what and where human activities occur in it, and how those activities interact with each other and how those activities affect the ecosystem services, is another essential element in the successful development of an MSP process. Science provides the evidence upon which effective management decisions can be made and potential conflicts resolved. It is therefore important to collect and collate existing marine spatial data, with the ability to visualise these data in order to examine any potential overlaps in human activities in the marine environment and potential overlaps in human activities and important habitats.

At present in the TCI there is no data manager or central data repository or metadata catalogue that identifies existing spatial data for the islands. All TCI spatial data should be collected and collated, a metadata catalogue, data portal and GIS database created to store and visualise the existing spatial data. Furthermore, these data should also include cultural aspects of the marine environment, what cultural ecosystem services does the TCI marine environment provide to the islands.

A condition of a research permit being granted in the TCI, is that a copy of the collected data should be lodged with the DECR prior to the researchers leaving the islands. However, this doesn't always happen and is something that needs to be addressed.

A working group of MSP experts should be convened to help with the modelling approaches to analyse the existing data and to identify data gaps. The TCI already has protected areas, these modelling approaches can also help to determine if the protected areas are suitably delineated.

Policy & Legislation

The TCIG is charged with enforcing a wide range of laws that aim to protect the environment of the country (Table 1). '*The Department of Environment and Coastal Resources (DECR) is mandated to ensure the sustainable use of the natural resources of the TCI and to protect and promote biodiversity and economic prosperity through a sustainable fisheries industry, environmentally sustainable development, a Protected Areas system and improved Maritime Affairs.*

The Department of Environment and Coastal Resources (DECR) has the responsibility of sustainably managing Protected Areas and Fisheries and overseeing all Maritime Affairs in the TCI. The Department is further mandated to preserve and improve the quality of the environment and maritime affairs of the territory. Towards achieving this goal, all activities and policies are developed without compromising the integrity and the well-being of man and environment.

The Department sets policy to ensure that natural resources are used wisely and sensibly, towards achieving sustainable development.'

Table 1 Ordinances executed by the DECR

Ordinance	Description
National Parks Ordinance (March 2018)	To provide powers to permit the establishment of (a) a national park; (b) a nature reserve; (c) a sanctuary; (d) an area of historical interest; (e) or a critical habitat reserve and generally for the conservation of the natural environment and ecology of the islands and for the purposes connected therewith. The Ordinance also

	provides some rules relative to use of these protected areas. The Governor may make Regulations: to place restrictions on activities that may cause pollution or disturbance to the ecology of a protected area; or for the preservation of any particular form
Coast Protection Ordinance (December 2014)	To provide for the protection of the coastline of Turks and Caicos Islands. It places restrictions on the taking of sand and other materials and prohibits the placing of offensive substances on the coast and littering of the coast.
Fisheries Protection Ordinance (March 2018)	To regulate, by Order, matters of conservation and management of marine fisheries resources of the Turks and Caicos Islands. The Governor may, among other things, place restrictions or prohibit the taking of any fish, aquatic animal or vegetable matter living in water including turtles, carcharinidae, cetacea, crustacea, molluscs and spongiae and regulate the exportation of such fish or aquatic animals.
Fisheries Limits Ordinance (December 2014)	To define the fishery limits of the Turks and Caicos Islands for the purpose of certain enactments relating to fishing, to make provision for the regulation of fishing with those limits and for other matters connected therewith.
Marine Pollution Ordinance (December 2014)	To protect the marine environment by minimising intentional and negligent discharges of pollutants in the marine environment; and for connected purposes.
Mineral Exploration and Exploitation Ordinance (December 2014)	To make provision as to the exploration for an exploitation of the mineral resources in, and surrounding, the Turks and Caicos Islands; and for matters connected with those purposes.
Plant Health Ordinance (December 2014) – should include seagrass as it is a flowering plant.	To prevent the introduction and spread of plant pests, to protect and promote plant health, to control movement of regulated articles into, from and within the Turks and Caicos Islands; and for connected purposes.
Wild Birds Protection Ordinance (December 2014)	To make provision for the protection of wild birds and for connected purposes.
Protection of Historic Wreck Ordinance (March 2018)	To provide for the protection of wrecks in certain cases and for purposes connected therewith.
Physical Planning Ordinance (February 2018)	To make provision for the planning and regulation of the development and use of land, and for matters connected therewith or incidental thereto.

It is also important to keep informed of legislative changes, as they can occur in parallel with MSP development and have implications on priority areas and policy. Furthermore, It has been suggested that enforcement and compliance are the primary drivers in the underperformance of Marine Protected Areas (MPA) (Kelaher *et al.*, 2015). When legislation has been amended to include the enforceable MSP legal framework, it is important that sufficient resources are available for the DECR to be able to enforce the new MSP policy for the TCI.

Annex 1 Turks and Caicos Protected Areas

Protected Area	Features of interest
National Parks	
1. Admiral Cockburn Land and Sea National Park	Excellent wall diving and representative coral reef ecosystems
2. Chalk Sound National Park	Scenic water, bonefish, boating and picnic area
3. Columbus Landfall Marine National Park	Excellent wall diving
4. Conch Bar Caves National Park	Extensive underground cave system containing large subterranean lagoons and bat colonies, once mind by slaves for guano
5. East Bay Islands National Park	Scenic islands and picnic area
6. Fort George Land and Sea National Park	Dive and picnic sites, 1798 English fort, shipwreck and cannons in shallow water, iguanas, osprey and wading birds
7. Grand Turk Cays Land and Sea National Park	Shallow dive sites, bird and fish nurseries, day outings and picnics
8. North West Point Marine National Park	Best wall diving off Providenciales
9. Princess Alexandra Land and Sea National Park	Dive and picnic excursions, iguanas, osprey mangroves and marine life
10. South Creek National Park	Wetlands, mangroves, viewpoint, tourist destination, picnic areas, small boat activities and harbourage
11. West Caicos Marine National Park	Excellent wall diving
Nature Reserves	
12. Admiral Cockburn Nature Reserve (Long Cay, Six Hills Cay and Middleton Cay)	Important for rare rock iguana, breeding terns and frigate birds
13. Bell Sound Nature Reserve	Bonefish reserve
14. Cottage Pond Nature Reserve	Bird nesting, rare aquatic plants, historic plantation ruins, sole source of permanent natural surface fresh water in area, crustaceans endemic only to this pond.
15. Dick Hill Creek and Bellefield Landing Pond Nature Reserve	Bird nesting, fish, conch, lobster nursery, mangroves.
16. Lake Catherine Nature Reserve	Area of scenic value and of interest to naturalists, large hyposaline lake supporting abundant pink bi-valve mollusks and black mussels, habitat for sea turtles and bird life including flamingoes, with old causeway and small islands offering bird nesting sites
17. North, Middle and East Caicos Nature Reserve (International RAMSAR Site)	A wetland site of international importance containing a variety of habitat types representative of the region. Noteworthy individual sites within the park

	include the Mally Pond Slough, Sawgrass Pond and Flamingo Pond wetland area which contains excellent natural mangrove swamp, rich and varied fauna and diverse bird life; the unique Ocean Hole off Middle Caicos, believed to contain diverse and unusual fauna; the Armstrong and Big Pond areas of Middle Caicos (hosting populations of endemic TCI heather), the former area including numerous Lucayan Taino village sites, and the Iguana Cay and Flamingo Pond area on and close to East Caicos. The whole area is a particularly good example of coastal wetland habitat in the Caribbean region It regularly supports 10% of the individuals in a population of one species of waterfowl (on Sawgrass Pond, the threatened West Indian Whistling Duck) it has special value as the habitat of animals at a critical stage of their biological cycles (submerged banks, creeks and lagoons used by endangered turtles and commercial fish species for feeding).
18. North West Point Nature Reserve	A prime example of red mangrove lagoon habitat with an abundance and diversity of lagoon fauna, serving as a nursery and food source for the neighbouring waters; an important feeding area for migrant wading birds and breeding area for locally common waterfowl species.
19. Pigeon Pond and Frenchman's Creek Nature Reserve	Wetland birds including West Indian whistling ducks; West Harbour Bluff rock carvings; Lucayan Taino sites; area utilised for mangrove replanting events for students and other groups.
20. Princess Alexandra Nature Reserve	Picnic excursions, endemic rock iguanas, ospreys and mangroves.
21. Pumpkin Bluff Pond Nature Reserve	Bird nesting, flamingo feeding area.
22. Vine Point (Man 'O War Bush) and Ocean Hole Nature Reserve	Frigate bird nesting area, and 220 feet deep by 1200 feet wide hole in 3 feet shallow sand bottom.
Sanctuaries	
23. Big Sand Cay Sanctuary	Nesting birds and turtles
24. French, Bush and Seal Cays Sanctuary	Nesting terns and frigate birds
25. Long Cay Sanctuary	Nesting terns, flora, restored habitat for reintroduced endemic rock iguanas.
26. Three Mary Cays Sanctuary	Osprey nest site
Areas of Historical Interest	

27. Boiling Hole Area of Historical Interest	Salinas, historic salt-production ruins, endemic plants, bird feeding areas, unusually human-acclimated flock of flamingos
28. Cheshire Hall Area of Historical Interest	ruins of 1790s plantation house and outbuildings
29. Fort George Area of Historical Interest	1798 English fort
30. HMS Endymion Wreck Area of Historical Interest	18th century ship wreck in shallow water
31. Molasses Reef Wreck Area of Historical Interest	Site of oldest known wreck in the western hemisphere
32. Salt Cay Area of Historical Interest	salt works, historic building including brown and white houses; whaling station due to ecological significance
33. Sapodilla Hill Area of Historical Interest	The rocks atop this hill bear inscriptions dating as early as 1767, including the names of some of the earliest pioneers and settlers of the Turks and Caicos Islands.
34. Town Pond Salina Area of Historical Interest	Salinas (salt pans) and old windmills from the salt industry, an Important Bird Area (IBA) with endemic and internationally important bird species, habitat for the endemic national flower, the Turks Heather (*Limonium bahamense*), home to "The Island", an old quarantine station dating back to the early 1800s with numerous graves from early ancestors of the Turks and Caicos Islands, nursery and permanent refuge for recreational and consumptive fish species such as mullet, snook and bonefish
35. Red Salina Area of Historical Interest	Salinas (salt pans) from the salt industry, , an Important Bird Area (IBA) with endemic and internationally important bird species including two (2) rare and endangered species protected under the wild birds ordinance (the American flamingo (*Pheonicopterus ruber*) and the brown pelican (*Pelecanus occidentalis*), East banks of the Salinas also home to a thriving population of the endemic national flower, the Turks Heather (*Limonium bahamense*), nursery and permanent refuge for recreational and consumptive fish species such as mullet, snook and bonefish

References

Aeby, G. S. *et al.* (2019) 'Pathogenesis of a Tissue Loss Disease Affecting Multiple Species of Corals Along the Florida Reef Tract ', *Frontiers in Marine Science* , p. 678. Available at: https://www.frontiersin.org/article/10.3389/fmars.2019.00678.

Agostini, V. N. *et al.* (2015) 'Marine zoning in St. Kitts and Nevis: A design for sustainable management in the Caribbean', *Ocean & Coastal Management*, 104, pp. 1–10. doi: https://doi.org/10.1016/j.ocecoaman.2014.11.003.

Alvarez-Filip, L. *et al.* (2019) 'A rapid spread of the stony coral tissue loss disease outbreak in the Mexican Caribbean', *PeerJ*. PeerJ Inc., 7, pp. e8069–e8069. doi: 10.7717/peerj.8069.

Andersson, A. J. and Gledhill, D. (2013) 'Ocean Acidification and Coral Reefs: Effects on Breakdown, Dissolution, and Net Ecosystem Calcification', *Annual Review of Marine Science*. Annual Reviews, 5(1), pp. 321–348. doi: 10.1146/annurev-marine-121211-172241.

Ansong, J., Gissi, E. and Calado, H. (2017) 'An approach to ecosystem-based management in maritime spatial planning process', *Ocean & Coastal Management*, 141, pp. 65–81. doi: https://doi.org/10.1016/j.ocecoaman.2017.03.005.

Auge, A. A. (2015) *Marine Spatial Planning for the Falkland Islands. 'Setting the Scene' Workshop Report*. Stanley, Falkland Islands.

Auge, A. A. (2016) *Marine Spatial Planning for the Falkland Islands 'Framing the Process' Workshop Report*.

Augé, A. A. *et al.* (2018) 'Framework for mapping key areas for marine megafauna to inform Marine Spatial Planning: The Falkland Islands case study', *Marine Policy*, 92, pp. 61–72. doi: https://doi.org/10.1016/j.marpol.2018.02.017.

Baldwin, K. *et al.* (2015) 'Developing Ecosystem-Based Information for Marine Spatial Planning on the Pedro Bank, Jamaica', *67th Gulf and Caribbean Fisheries Institute*.

Baldwin, K. and Oxenford, H. (2014) 'A Participatory Approach to Marine Habitat Mapping in the Grenadine Islands.', *Coastal Management*. Taylor & Francis Ltd, 42(1), pp. 36–58. Available at: http://10.0.4.56/08920753.2013.863725.

Barange, M. (2003) 'Ecosystem science and the sustainable management of marine resources: from Rio to Johannesburg', *Frontiers in Ecology and the Environment*. John Wiley & Sons, Ltd, 1(4), pp. 190–196. doi: 10.1890/1540-9295(2003)001[0190:ESATSM]2.0.CO;2.

Beierle, T. C. (2002) 'The Quality of Stakeholder–Based Decisions.', *Risk Analysis: An International Journal*. Wiley-Blackwell, 22(4), pp. 739–749. Available at: http://10.0.4.87/0272-4332.00065.

Brown, B. E. (1997) 'Coral bleaching: causes and consequences', *Coral Reefs*, 16(1), pp. S129–S138. doi: 10.1007/s003380050249.

Bruckner, A. W. and Bruckner, R. J. (2006) 'The recent decline of Montastraea annularis (complex) coral populations in western Curaçao: a cause for concern? ', *Revista de Biología Tropical* . scielo , pp. 45–58.

Camp, E. F. *et al.* (2016) 'Mangrove and Seagrass Beds Provide Different Biogeochemical Services for Corals Threatened by Climate Change', *Frontiers in Marine Science*. Lausanne: Frontiers Research Foundation. doi: http://dx.doi.org/10.3389/fmars.2016.00052.

Chowdhury, R. R. *et al.* (2017) 'Anthropogenic Drivers of Mangrove Loss: Geographic Patterns and Implications for Livelihoods BT - Mangrove Ecosystems: A Global Biogeographic Perspective:

Structure, Function, and Services', in Rivera-Monroy, V. H. et al. (eds). Cham: Springer International Publishing, pp. 275–300. doi: 10.1007/978-3-319-62206-4_9.

Christensen, N. L. *et al.* (1996) 'The Report of the Ecological Society of America Committee on the Scientific Basis for Ecosystem Management', *Ecological Applications*. John Wiley & Sons, Ltd, 6(3), pp. 665–691. doi: 10.2307/2269460.

Churchyard, T. *et al.* (2016) 'The biodiversity of the United Kingdom's Overseas Territories: a stock take of species occurrence and assessment of key knowledge gaps', *Biodiversity and Conservation*, 25(9), pp. 1677–1694. doi: 10.1007/s10531-016-1149-z.

Defra (2002) *Seas of Change: The Government's consultation paper to help deliver our vision for the marine environment. PB 7746.* London.

Department of Statistics Turks and Caicos Islands (2018) *Survey of Departing Visitors*.

Dicks, L. V, Walsh, J. C. and Sutherland, W. J. (2014) 'Organising evidence for environmental management decisions: a ‘4S’ hierarchy', *Trends in Ecology & Evolution*. Elsevier, 29(11), pp. 607–613. doi: 10.1016/j.tree.2014.09.004.

Diez, S. . *et al.* (2019) *Marine Pollution in the Caribbean: Not a Minute to Waste*. Washington D.C.

Domínguez-Tejo, E. *et al.* (2016) 'Marine Spatial Planning advancing the Ecosystem-Based Approach to coastal zone management: A review', *Marine Policy*, 72, pp. 115–130. doi: https://doi.org/10.1016/j.marpol.2016.06.023.

Douvere, F. (2008) 'The importance of marine spatial planning in advancing ecosystem-based sea use management', *Marine Policy*, 32(5), pp. 762–771. doi: https://doi.org/10.1016/j.marpol.2008.03.021.

Dudley, N. (Editor) (2008) 'Guidelines for Applying Protected Area Management Categories', in *Stolton, S., P. Shadie and N. Dudley (2013). IUCN WCPA Best Practice Guidance on Recognising Protected Areas and Assigning Management Categories and Governance Types, Best Practice Protected Area Guidelines Series No. 21*. Gland, Switzerland: IUCN.

Dziergwa, J. *et al.* (2019) 'Acid-base adjustments and first evidence of denticle corrosion caused by ocean acidification conditions in a demersal shark species', *Scientific Reports*, 9(1), p. 18668. doi: 10.1038/s41598-019-54795-7.

Ehler, C. and Douvere, F. (2009) 'Marine spatial planning: a step-by-step approach toward ecosystem-based management'. Paris, France: Unesco, p. 99. doi: http://dx.doi.org/10.25607/OBP-43.

Ehler, C., Zaucha, J. and Gee, K. (2019) 'Maritime/Marine Spatial Planning at the Interface of Research and Practice BT - Maritime Spatial Planning: past, present, future', in Zaucha, J. and Gee, K. (eds). Cham: Springer International Publishing, pp. 1–21. doi: 10.1007/978-3-319-98696-8_1.

Feller, I. C. *et al.* (2017) 'The state of the world's mangroves in the 21st century under climate change', *Hydrobiologia*, 803(1), pp. 1–12. doi: 10.1007/s10750-017-3331-z.

Flower, J. *et al.* (2020) 'Marine spatial planning on the Caribbean island of Montserrat: Lessons for data-limited small islands', *Conservation Science and Practice*. John Wiley & Sons, Ltd, n/a(n/a), p. e158. doi: 10.1111/csp2.158.

Frazão Santos, C. *et al.* (2019) 'Chapter 30 - Marine Spatial Planning', in Sheppard, C. B. T.-W. S. an E. E. (Second E. (ed.). Academic Press, pp. 571–592. doi: https://doi.org/10.1016/B978-0-12-805052-1.00033-4.

Gee, K. *et al.* (2017) 'Identifying culturally significant areas for marine spatial planning', *Ocean & Coastal Management*, 136, pp. 139–147. doi: https://doi.org/10.1016/j.ocecoaman.2016.11.026.

Gill, D. A. *et al.* (2017) 'Capacity shortfalls hinder the performance of marine protected areas globally', *Nature*, 543(7647), pp. 665–669. doi: 10.1038/nature21708.

Goureau, T. . *et al.* (2008) 'Turks and Caicos Islands 2006 coral reef assessment: Large-scale environmental and ecological interactions and their management implications', *Revista de Biologia Tropical*, 56, pp. 25–49.

Great Barrier Reef Marine Park Act 1975 (2018) 'Great Barrier Reef Marine Park Act 1975'. Canberra: Office of Parliamentary Counsel.

Haedrich, R. L. and Hamilton, L. C. (2000) 'The Fall and Future of Newfoundland's Cod Fishery', *Society & Natural Resources*. Routledge, 13(4), pp. 359–372. doi: 10.1080/089419200279018.

Halpern, B. S. *et al.* (2008) 'Managing for cumulative impacts in ecosystem-based management through ocean zoning', *Ocean & Coastal Management*, 51(3), pp. 203–211. doi: https://doi.org/10.1016/j.ocecoaman.2007.08.002.

International Oceanographic Commission and United Nations Educational Scientific and Cultural Organization (2017) *MSP Around the Globe*, *Webpage*. Available at: http://msp.ioc-unesco.org/world-applications/%0Aoverview/.

Johnson, A. E. *et al.* (2020) 'Marine spatial planning in Barbuda: A social, ecological, geographic, and legal case study', *Marine Policy*, 113, p. 103793. doi: https://doi.org/10.1016/j.marpol.2019.103793.

Kelaher, B. P. *et al.* (2015) 'Strengthened enforcement enhances marine sanctuary performance', *Global Ecology and Conservation*, 3, pp. 503–510. doi: https://doi.org/10.1016/j.gecco.2015.02.002.

Kelly, C. *et al.* (2014) 'Review and evaluation of marine spatial planning in the Shetland Islands', *Marine Policy*, 46, pp. 152–160. doi: https://doi.org/10.1016/j.marpol.2014.01.017.

Kingsford, R. T. *et al.* (2009) 'Major Conservation Policy Issues for Biodiversity in Oceania', *Conservation Biology*. John Wiley & Sons, Ltd (10.1111), 23(4), pp. 834–840. doi: 10.1111/j.1523-1739.2009.01287.x.

Link, J. S. and Browman, H. I. (2014) 'Integrating what? Levels of marine ecosystem-based assessment and management', *ICES Journal of Marine Science*, 71(5), pp. 1170–1173. doi: 10.1093/icesjms/fsu026.

Lockhart, K., De Fontaubert, C. and Clerveaux, W. (2007) 'Fisheries of the Turks and Caicos: Status and Threats', in *Proceedings of the 58th Gulf and Caribbean Fisheries Institute*. San Andres, pp. 66–71.

Logan, A. and Sealey, K. S. (2013) 'The Reefs of the Turks and Caicos Islands BT - Coral Reefs of the United Kingdom Overseas Territories', in Sheppard, C. R. C. (ed.). Dordrecht: Springer Netherlands, pp. 97–114. doi: 10.1007/978-94-007-5965-7_9.

Lombard, A. T. *et al.* (2019) 'Practical approaches and advances in spatial tools to achieve multi-objective marine spatial planning', *Frontiers in Marine Science*. Frontiers Media S.A., 6(APR). doi: 10.3389/fmars.2019.00166.

McLeod, K. L. and Leslie, H. M. (2009) 'Why Ecosystem-Based Management?', in McLeod, K. L. and Leslie, H. M. (eds) *Ecosystem-Based Management for the Oceans*. Island Press, pp. 3–12.

Meyer, J. L. *et al.* (2019) 'Microbial Community Shifts Associated With the Ongoing Stony Coral Tissue Loss Disease Outbreak on the Florida Reef Tract ', *Frontiers in Microbiology* , p. 2244.

Available at: https://www.frontiersin.org/article/10.3389/fmicb.2019.02244.

Mitchell, B. A. and Barborak, J. R. (1991) 'Developing coastal park systems in the tropics: Planning in the Turks and Caicos islands', *Coastal Management*. Taylor & Francis, 19(1), pp. 113–134. doi: 10.1080/08920759109362134.

Nagle, L. *et al.* (2018) 'Ocean acidification: effects of pH on ^{45}Ca uptake by lobster branchiostegites', *Journal of Comparative Physiology. B, Biochemical, Systemic, and Environmental Physiology*. Department of Biology, University of North Florida, Jacksonville, FL, USA ; Department of Biology, University of North Florida, Jacksonville, FL, USA: Springer Nature B.V., 188(5), pp. 739–747. doi: http://dx.doi.org/10.1007/s00360-018-1173-2.

North Atlantic Fisheries College (2008) *A Marine Spatial Plan for the Shetland Islands Part One: Policy Framework Consultative Draft*.

Nurse, L. A. *et al.* (2001) 'Small Island States', in McCarthy, J. J. et al. (eds) *Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group ll to the Third Assessment of the Intergovernmental Panel on Climate Change.* Cambridge, UK and New York, NY, USA: Cambridge University Press, pp. 843–876.

O'Leary, B. C. *et al.* (2019) 'Evidence gaps and biodiversity threats facing the marine environment of the United Kingdom's Overseas Territories', *Biodiversity and Conservation*, 28(2), pp. 363–383. doi: 10.1007/s10531-018-1660-5.

Ogden, J. C. (2010) 'Marine spatial planning (MSP): A first step to ecosystem-based management (EBM) in the Wider Caribbean ', *Revista de Biología Tropical* . scielo , pp. 71–79.

Olsen, S. B., McCann, J. H. and Fugate, G. (2014) 'The State of Rhode Island's pioneering marine spatial plan', *Marine Policy*, 45, pp. 26–38. doi: https://doi.org/10.1016/j.marpol.2013.11.003.

Omori, K. L. *et al.* (2016) 'Effects of underestimating catch and effort on surplus production models', *Fisheries Research*, 183, pp. 138–145. doi: https://doi.org/10.1016/j.fishres.2016.05.021.

Pomeroy, R. and Douvere, F. (2008) 'The engagement of stakeholders in the marine spatial planning process', *Marine Policy*, 32(5), pp. 816–822. doi: https://doi.org/10.1016/j.marpol.2008.03.017.

Pomeroy, R. S., Baldwin, K. and McConney, P. (2014) 'Marine Spatial Planning in Asia and the Caribbean: Application and Implications for Fisheries and Marine Resource Management', *Desenvolvimento e Meio Ambiente*, 32. Available at: http://ojs.c3sl.ufpr.br/ojs2/index.php/made/article/view/35627/24013.

Scottish Government (2013) *Marine (Scotland) Act 2010 (Commencement No. 3 and Consequential Provisions) Order 2013 and comes into force on 1st November 2013.*

Shucksmith, R. *et al.* (2014) 'Regional marine spatial planning – The data collection and mapping process', *Marine Policy*, 50, pp. 1–9. doi: https://doi.org/10.1016/j.marpol.2014.05.012.

Shucksmith, R. J. and Kelly, C. (2014) 'Data collection and mapping – Principles, processes and application in marine spatial planning', *Marine Policy*, 50, pp. 27–33. doi: https://doi.org/10.1016/j.marpol.2014.05.006.

Smythe, T., Andrescavage, N. and Fox, C. (2016) 'The Rhode Island Ocean Special Area Management Plan, 2008-2015: From Inception through Implementation.', in McCann, J. (ed.) *Case Studies of Marine Spatial Planning Report Series.* Coastal Resources Center and Rhode Island Sea Grant College Program, URI Graduate School of Oceanography. Narragansett, R.I., p. 80.

Soufriere Marine Management Area (2018) *St Lucia*, *Webpage*.

Trisos, C. H., Merow, C. and Pigot, A. L. (2020) 'The projected timing of abrupt ecological disruption from climate change', *Nature*. doi: 10.1038/s41586-020-2189-9.

Turks and Caicos Islands Tourist Board (2018) *Tourism Statistics Report*. Grand Turk and Providenciales.

Ulman, A. *et al.* (2016) 'Conched Out: Total Reconstructed Fisheries Catches for the Turks and Caicos Islands Uncover Unsustainable Resource Usage ', *Frontiers in Marine Science* , p. 71. Available at: https://www.frontiersin.org/article/10.3389/fmars.2016.00071.

Williams, S. L. *et al.* (2017) 'Species richness accelerates marine ecosystem restoration in the Coral Triangle', *Proceedings of the National Academy of Sciences*, 114(45), pp. 11986 LP – 11991. doi: 10.1073/pnas.1707962114.

Zuidema, C., Plate, R. and Dikou, A. (2011) 'To preserve or to develop? East Bay dredging project, South Caicos, Turks and Caicos Islands', *Journal of Coastal Conservation*, 15(4), pp. 555–563. doi: 10.1007/s11852-011-0144-5.