Seascape Management Plan for the Gulf of Tadjourah and Ghoubet-el-Kharab in the Republic of Djibouti

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June 2016

The lead organisations involved in developing this plan include: Cousteau Society, CORDIO East Africa and International Union for Conservation of Nature Eastern and Southern Africa Regional Office(IUCN-ESARO) The following authors are acknowledged: Melita Samoilys, Rebecca Klaus, David Obura, Leo Niskanen, Houssein Rayaleh, Benjamin Cowburn.

Citation:

Acknowledgements
This Seascape Management Plan was developed under the "Lower Awash-Lake Abbé Land and Seascape - Enhancing biodiversity conservation in transboundary ecosystems and seascapes" (IGAD Project ID: 77711-000; 2013 - 2017) implemented by IUCN-ESARO and funded by the European Union.
This document has been produced with the financial assistance of the European Union. The contents of this document are the sole responsibility of IUCN and can under no circumstances be regarded as reflecting the position of the European Union.

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Executive Summary

This document provides a spatial Management Plan for the Gulf of Tadjoura and Ghoubet-el-Kharab Seascape in the Republic of Djibouti...

1 Scope of planning

1.1 Introduction and seascape planning framework

This document is a Seascape Management Plan for the Gulf of Tadjourah and Ghoubet-el-Kharab in the Republic of Djibouti. This plan is a key deliverable of the Lower Awash-Lac Abbé land and seascape project implemented by IUCN and its partners and constitutes a component of the IGAD Biodiversity Management Programme funded by the 10th Environment and Development Fund of the European Union.

The primary goal for this Gulf of Tadjourah and Ghoubet-el-Kharab Seascape Plan is **to establish a spatial plan for managing the inshore marine waters of Djibouti to support the planning and development of the coastline**.

The Republic of Djibouti is responsible for an Exclusive Economic Zone (EEZ) covering 7,025km^2. The EEZ stretches from the Eritrean border in the north to the border with Somalia in the south (Figure 1.1). Djibouti's EEZ can be subdivided into four marine zones: i) the Red Sea coast, which extends from Ras Siyyan at the Bab al Mandeb to the border with Eritrea, (ii) the Gulf of Aden, which extends from Ras Siyyan to Ras Obock and southwards, (iii) Gulf of Tadjourah and; (ii) Ghoubet al Karab. The coastal and shallow marine ecosystems span a coastline of 372 km, stretching from the Isles Septe Fréres in the north east at the Ethiopian border to east of Djibouti city in the south, bordering Somalia. The present Seascape Plan is focused on the Gulf of Tadjourah, which also contains the Musha and Maskali Islands complex, and the Ghoubet-al-Karab (Figure 1.1).

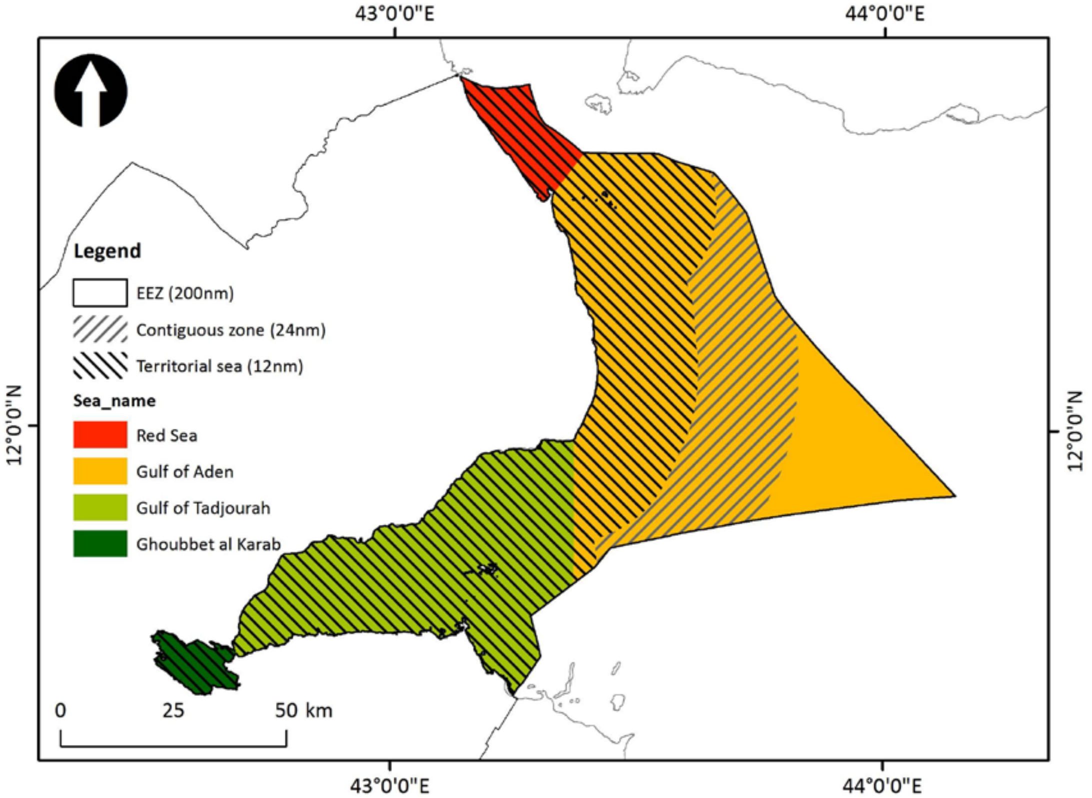


Figure 1.1. Map of the Republic of Djibouti showing (a) towns and the Gulf of Tadhjourah and the Ghoubet and (b) marine zones within the Djibouti EEZ.

The Gulf of Tadjourah and Ghoubet-el-Kharab Seascape contains regionally and globally important biodiversity and provides essential ecosystem services to the local and national economies. These coastal and marine ecosystems are a unique component of the Gulf of Aden and provide habitats for rare and threatened species including sharks, marine turtles and the Critically Endangered dugong. A key biodiversity feature of the shallow coastal waters are the coral reefs which have high levels of biodiversity and endemism for both corals and fish. They are part of a larger transboundary ecosystem of coral reefs and associated marine environments stretching from Sudan to Somalia which have been identified as potentially qualifying for World Heritage site status [1].

The shallow coastal waters of the Seascape provide a source of food and livelihoods for the local populations - in the city of Djibouti and in the towns of Tadjourah and Obock. They also offer opportunities for future economic development and diversification. However, pressure to develop this short coastline is now high from the current strategies for boosting the country's economy through the development of new ports and tourist hotels. At the same time the government of Djibouti in recognising its natural marine assets is determined to protect this unique natural marine heritage.

Djibouti's marine environment is already under pressure from unsustainable utilisation of natural resources linked to changes from predominantly pastoralist to more sedentary forms of land use, as well as unregulated fishing. Pollution from maritime activities, climate change, over-exploitation of mangroves, and tourism impacts (uncontrolled hotel development, coral damage from anchors and trampling, collection of shells) and illegal fishing of sharks and marine turtles were all cited by the stakeholder consultation workshop

[1] UNESCO, World Heritage Centre (http://whc.unesco.org/)

in June 2014. For example, the spectacular congregation of Whale Sharks in the Gulf of Tadjourah and the Ghoubet is threatened from uncontrolled tourism activities leading to harassment and injury of the animals. Human pressure on the marine environment is predicted to continue as the country plans major developments with the implementation of 'Vision 2035' [2]. Under this strategy there are five new ports to be constructed around Djibouti's coastline, a fivefold increase in fisheries landings and tenfold increase in tourism, all of which will place significant pressure on the fragile coastal habitats. These plans may also create conflicts of interest in the coastal zone as construction and development could threaten the habitats that provide the ecosystems services on which Djibouti's fisheries and tourism sector depend.

Despite the clear potential for development of nature based enterprises, particularly eco-tourism, there have been very few private sector investors or community-managed or co-managed activities in the seascape until recently. Current foreign investment in coastal tourism is now set to increase substantially. Fisheries legislation currently in preparation makes provision for community involvement through co-management of natural resources particularly fisheries, including community managed protected areas, though as yet there are no community based marine resource management projects in place[3]. Existing tourism infrastructure is also lacking and there is no clear strategy nor the resources or capacity to implement sustainable tourism strategies. Nevertheless, the rich biological resources and scenic values of the land and seascape provide ample opportunities for the creation of future benefit generating activities for local communities that can help achieve long term biodiversity conservation objectives. Many of the most scenic areas in the Gulf and the Ghoubet area are inaccessible, unexplored and the few existing ecotourism operations in the seascape need support and guidance to realise their full potential.

The challenges and opportunities for the marine environment are recognised and articulated in the government's National Biodiversity Strategy and Action Plan, which is currently undergoing revision. An Integrated Coastal Zone Management (ICZM) plan has also recently been developed. There are a number of projects and initiatives underway in the coastal and marine zone on mangrove conservation and restoration (UNEP funded), strengthening the management of Djibouti's marine protected areas (UNDP funded) and coastal fisheries (IFAD funded). The government has identified the Gulf of Tadjourah and the Ghoubet ecosystem, as priority areas for conservation. The Djibouti Seascape Plan has been designed to address these challenges and to capitalise on existing opportunities. Specifically, it provides a holistic and integrated marine conservation strategy that will help guide development while conserving biodiversity.

The Seascape Management Plan for the Gulf of Tadjourah and Ghoubet-el-Kharab presented in this document has been developed by applying a Systematic Conservation Planning approach recommended by the Marine Spatial Planning (MSP) community of expertise. The benefits of this approach is that it captures the multiple goals and pressures experienced in Djibouti, to identify how best to develop the coastline while sustainably managing the valuable marine resources. The aims of the Gulf of Tadjourah and Ghoubet-el-Kharab Seascape is to manage the inshore marine waters of Djibouti: the Gulf of Tadjourah, Ghoubet and the Musha/Maskali Islands, through an integrated, holistic and cross-sectoral approach that encompasses biodiversity conservation, development and economic growth.

[2] Vision 2035. Rebulique de Djibouti. pp. 1-116

[3] Fisheries Act and Regulations developed through ACP Fish II project, 2013, pending formal ratification by government (Djibril, 2015).

The structure of the Seascape Plan reflects the steps taken to develop it, represented as seven components (Table 1.1). The management planning process is not simple and linear, progressing from component 1 to component 7. Rather, discussions and consultation in some components then required revisiting earlier components of the plan. This planning framework and process are illustrated in Figure 1.2.

Table 1.1 Structure of and process in developing the Gulf of Tadjourah and Ghoubet-el-Kharab Seascape Management Plan.

Component	*Period of development*	*Activities*
1. Scope of planning	April-June 2014	Sourcing information and literature
2. Stakeholder participation	June 2014; October 2015	Scoping workshop with all major stakeholders;
3. Inventory and analysis of current conditions	September-October 2014; April 2015	Coral reef survey and habitat mapping; Coastal mapping and rapid resource use assessment
4. Drafting a Seascape Plan	May – September 2015; October -December 2015	
5. Negotiation, refinement and approval of Seascape Plan	October 2015; January-March 2016	Presentation of draft Plan to stakeholders for discussion, feedback & further planning
6. Implementation and enforcement of the Seascape Plan	After acceptance and implementation starts 2016-2017	
7. Monitoring, revision and adjustment of the Seascape Plan	To be decided - 2020	

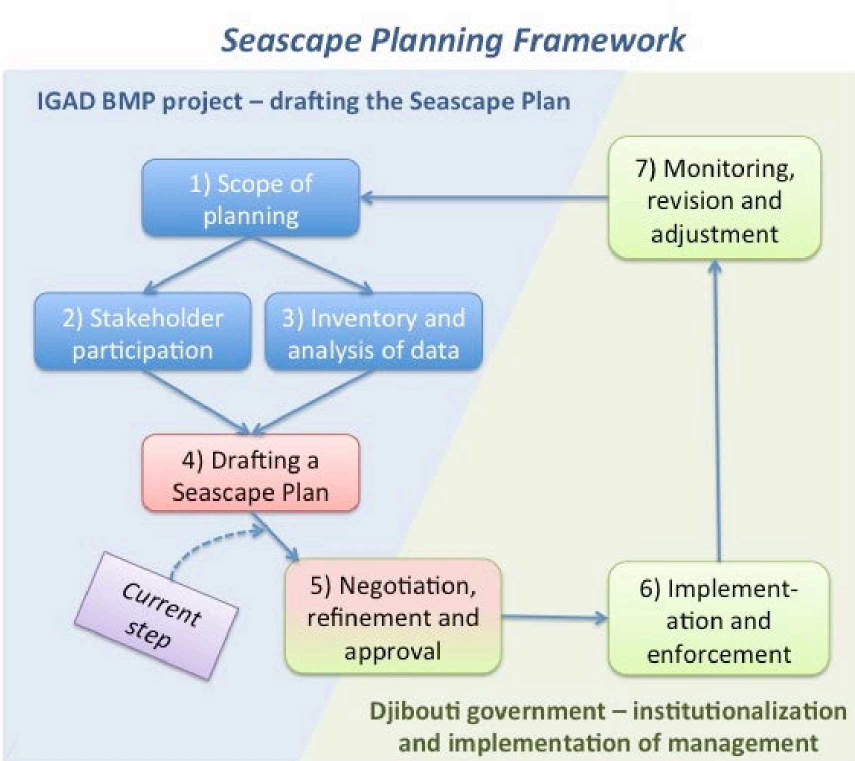


Figure 1.2. Planning framework for developing the Djibouti Seascape Management Plan.

1.2 Geographic scope of the Seascape Plan

The area of interest for the Djibouti Seascape Management Plan is the Gulf of Tadjourah and Ghoubet-el-Kharab (see Figure 1.3). The Gulf of Tadjourah is a deep east-west oriented triangular trench with a maximum depth of 883 m. The mouth of the Gulf of Tadjourah starts near the border with Somalia in the south (11°30'N) and extend 60 km north across to Ras Bir (11°54'N). The capital, Djibouti town, is situated on the south coast within the Gulf of Tadjourah, to the north of which are the Musha and Maskali Islands. The Ghoubet-el-Kharab is a shallow semi-enclosed basin located at the far western end of the Gulf of Tadjourah connected by a narrow channel. The boundaries of the planning domain extend inland by 5 km.

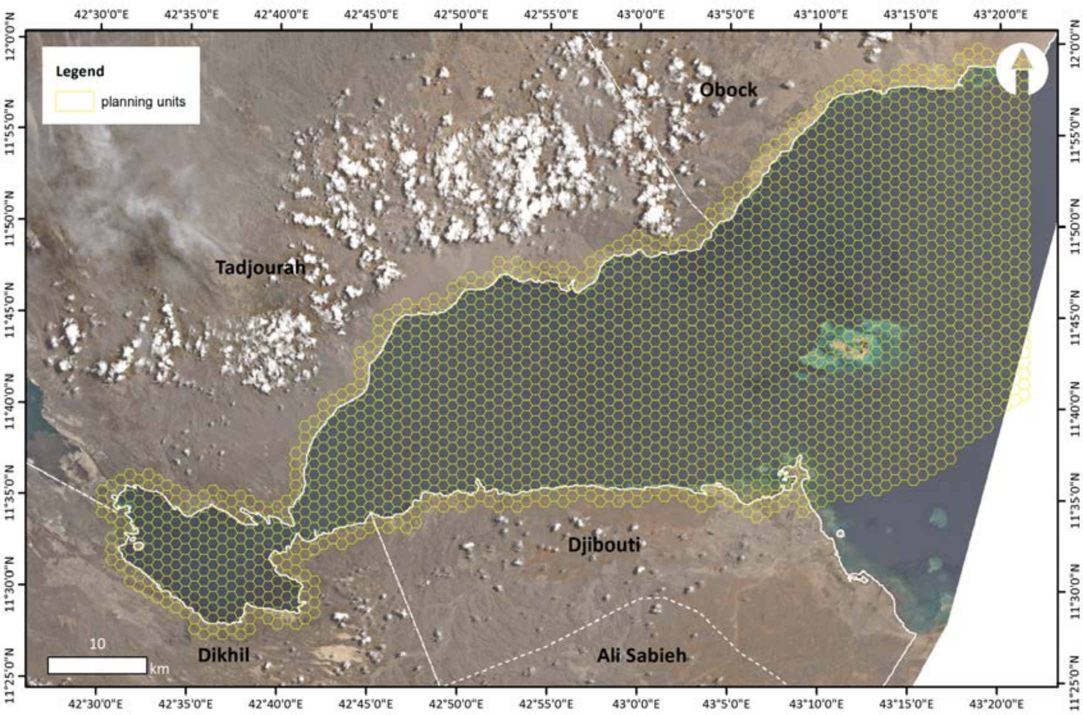


Figure 1.3 Map showing the boundaries of the planning domain adopted for the Gulf of Tadjourah and Ghoubel-el-Kharab seascape management plan, which includes a 5 km coastal buffer.

1.3 Data collected and compiled

The Djibouti Seascape Management Plan is based on primary data collected during a detailed coral reef survey conducted in September 2014, and best available secondary source data on other components of biodiversity and the environment, as well as drivers, human use and threats. The processes involved in collecting and compiling these various data sources are described in this section and the results are presented in Section 3.

1.3.1 Physical and chemical characteristics of the Seascape

In order to better understand the spatial variability in the environmental conditions within the Djiboutian EEZ, various satellite derived raster datasets were examined (Klaus 2016). These included datasets that illustrate the chemical and physical characteristics of marine waters (e.g. surface sea water temperature, salinity, dissolved oxygen, pH, chlorophyll-a concentration, diffuse attenuation coefficient, and nutrient content, such as nitrate, phosphate, silicate), and other satellite-derived atmospheric variables (e.g. cloud cover, photosynthetically active radiation). The satellite derived datasets were processed as follows: The raw raster datasets were re-projected to UTM grid and resampled to enhance the spatial resolution. The images were then clipped to the Djiboutian EEZ. Each variable was then rescaled from 0 to 1 to permit the comparison of relative values and the use of these datasets in the spatial modelling process. Examples of the maps produced through this process are provided in Section 3 and the Appendices.

1.3.2 Coral reef surveys and mapping

A marine biodiversity and habitat mapping survey was conducted by CORDIO EA and Cousteau Society in September 2014 to assess the biodiversity and population health of Djibouti's coastal coral reef ecosystem. The survey recorded coral and fish diversity and population abundance, and also mapped the benthic habitats through ground truthing satellite imagery to provide a comprehensive coverage of Djibouti's coastal environment. The purpose of the survey was to provide biodiversity and benthic mapping data for the Seascape Management Plan.

Djibouti has four clearly defined marine zones: i) coastal Gulf of Tadjourah; ii) the inshore Ghoubet; iii) the offshore reefs found at Musha and Maskali islands and iv) the offshore group of islands and reefs at Isles Sept Frères. All areas were surveyed (Fig. 1.4), except the Isles Sept Frères due to poor security in that area.

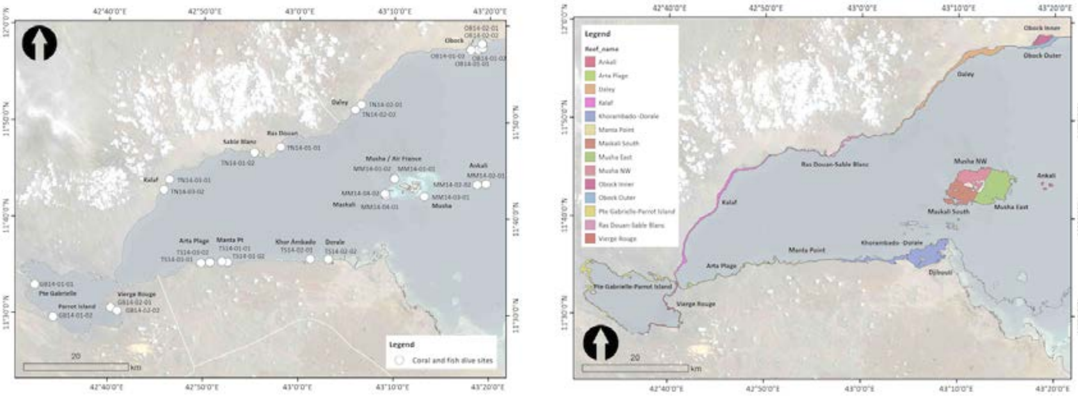


Figure 1.4 Coral reef sites surveyed in September 2014:
a) dive location points and b) habitat types.

1.3.2.1 Benthic and coral community data

The health of the coral reef benthic community was measured using methods derived from the reef resilience assessment approach developed by IUCN (Obura and Grimsditch 2009). Photo-quadrats of the benthos were collected to quantitatively measured the percent cover of principle benthic cover types, the principle ones being hard coral cover, and the cover of algal types (macroalgae, turf algae and coralline algae). In addition, a set of indicators were recorded that are indicative of general reef health and the influence of major anthropogenic stressors, including of coral population health, algal community structure, substrate suitability for corals, bleaching-related stress, sedimentation influence, general damage to corals and potential for recovery from impacts (see Appendix 2 for details).

Coral genera and species were identified in the field. The relative abundance of coral genera at each site was estimated on a 5-point scale (1- rare; 2- uncommon; 3- common; 4- abundant and 5- dominant). Note that for the purposes of this Seascape Plan the familiar old genus names for corals are used; many of these have been superseded and replaced by new names, though some of these are still in debate. As the new names are largely only known in the coral species research community, and not yet in use in the general monitoring and management literature, they are not used here. A full species list was developed for the entire seascape area based on field IDs (see Obura 2012, Sheppard and Obura 2004), for comparison with other regions.

1.3.2.2 Fish diversity and abundance

A complete checklist of all species present from a pre-determined list of 19 families was collected at each of the survey sites. Fish abundance and sizes were recorded at all survey sites from a pre-determined list of around 140 species providing a cross section of the entire fish community, based on a standardised method that has been used through the WIO (Samoilys and Randriamanantsoa 2011). These measures are also part of a method for measuring resilience of coral reefs to climate change and link with the coral and benthic data (see above).

1.3.2.3 Habitat mapping

In order to create habitat maps ground-truthed data were collected in coastal habitats to a maximum of 50m depth. The benthic characteristics of 248 sites were collected with the relevant GPS information. Three main data collection methods were used to characterise the benthos depending on the nature of the site and the level of detail required. These methods included:

- Manta tows: An observer was towed slowly behind a boat from the shoreline to the edge of the reef formation. Different habitat types were noted along the transect with the boundaries between these habitats recorded with GPS in the boat.
- Seaviewer video transect: Benthic video transects were recorded using a seaviewer, which is a camera unit attached to console in a boat with 50m of cable. As the boat drifts the camera is towed behind it and records a video of the benthos with geographic coordinates overlaid onto the image.
- Photo-quadrats: This method was used for the sites that required the highest level of detail. A diver using SCUBA gear photographed quadrats placed on the reef substrate. At each site photo quadrats were recorded from the reef edge (deepest point) to the reef flat (shallowest point). The location of each photo recorded by a GPS floating on the surface above the diver and attached to the diver with a reel of string.

For each of these methods the nature of the benthos was recorded as the percentage cover of major benthic types including, mud, sand, rubble, rock, hard coral, soft coral, macroalgae and sponge. Where appropriate the dominant morphology and/or genus of coral was noted. Percentage cover was visually estimated from manta tows and Seaviewer transects, and was measured in photoquadrats using the software Coral Point Count (CPCe).

1.3.3 Coastal mapping of shoreline

Biophysical characteristics of coastal sites were mapped from 14th April 2015 to 17th April 2015. This involved recording the GPS coordinates of 12 coastal sites (Fig. 1.5), taking photographs and assessing the geomorphological characteristics and presence of coastal and marine related flora and fauna. Observations of the socio-economic activities at the coastal sites were also noted.

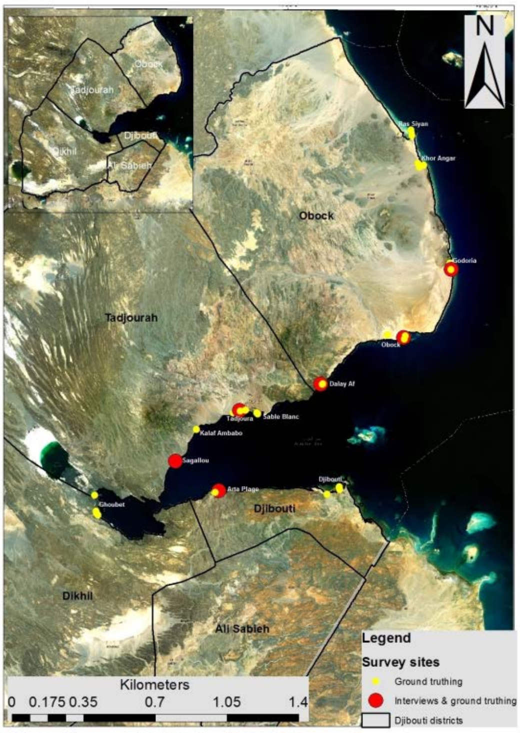


Figure 1.5 Map showing the coastal sites surveyed.

Human use activities

There is little current information on the socio-economic status of the coastal populations of Djibouti. Where possible literature was sourced [4] and supplemented with Key Informant interviews conducted in 2015 during the coastal mapping at six coastal sites (Fig. 1.5). The interviews were designed to determine resource use pattern at the site and local knowledge on any predominant environmental problems in the area.

Information on distribution of fishing effort was obtained from various sources, including the coastal mapping (section 1.3.3), which recorded the location of fishing villages and number of boats, and data provided by the Ministry of Fisheries and CERD. Additional information on fishing pressure was also obtained from global spatial datasets (e.g. Halpern et al. 2015). Information of distribution of dive tourism related activities was obtained from the main dive operator. Information on distribution of new ports was obtained from various sources, including the British Admiralty Charts and other information available from the internet. Information on shipping routes was obtained from global spatial datasets (e.g. Halpern et al. 2015). Information of distribution of military camps and associated security zones was obtained from British Admiralty charts.

A participatory mapping exercise was also carried out with stakeholders during the Seascape consultation workshop in Djibouti on 14-15th Oct 2015 which generated additional layers of information. The outputs are presented Section 4.

1.3.4 Secondary data sources

Other information on key processes and habitats (e.g. beaches, mangroves and wetlands etc), and key species, were obtained from the literature and transferred into GIS format (Klaus 2016).

[4] IUCN socio-economist consultant report 2015

2. Stakeholder participation

Management of natural resources is fundamentally about managing the activities of stakeholders to minimise impacts and maximise joint benefits. The involvement of all stakeholders in negotiation and decision-making is a fundamental factor affecting the willingness of stakeholders to abide by a plan, thus affecting compliance and costs of enforcement. Accordingly, stakeholders should be involved at all stages, including those from government (who may be the authorities and have legal power), vested users and income earners (e.g. tourism operators, fishers), other users (e.g. tourists), and those with indirect or secondary interests (such as neighbouring property owners, towns, educators).

The following stakeholders have been consulted or involved during the development of this Seascape Plan through: a) information collection; b) the first stakeholder consultation workshop (June 2014); c) during stakeholder feedback and negotiations on the draft plan presentation workshop (October 2015); and d) during the final phases of finalising the Seascape Plan. The sections below outline the main organisations and departments that were involved in this process and a key contact (where available) within these.

2.1 Government institutions

A total of 102 representatives from government departments were consulted at national, regional and local level in Ethiopia and Djibouti through two workshops held in Djibouti on 18-19 June 2014 and 14-15 October 2015.

Ethiopia	
Ministry of Environment and Forest Ethiopian Biodiversity Institute Tel. +251 (0) 911 728 143	Mr Motuma Didita Director, Forest and Rangeland Plants Biodiversity Process Email. motididita@gmail.com
Ministry of Environment and Forest Ethiopian Biodiversity Institute	Dr. Menassie Gashaw Ecologist Email. menassiemolla@gmail.com Tel. +251 (0) 912 093 330
Ministry of Culture and Tourism Ethiopian Wildlife Conservation Authority Tel. +251 (0) 911 374 861	Dr. Fanuel Kebede Technical Advisor to the Director General Email. Fanuel.kebede@gmail.com
Afar National Regional State Bureau of Pastoral and Agricultural Development Tel. +251 (0) 911 080 189	Mr. Mohammed Seid Focal person, Biodiversity Process core Owner Email. shehoumer@gmail.com

Djibouti	
Ministry of Housing, Urban affairs and Environment Directorate of Environment and Sustainable Development Tel. +253 21 35 1096	Mr. Abdoulkader Ahmed Aouled Deputy Director Email. sahalmed1@yahoo.fr Mobile. +253 7782 2660
Ministry of Housing, Urban Affairs and Environment Directorate of Housing and Urban affairs	Mr. Mohamed Elmi Kaourah Head Service Email. makdj1@gmail.com Mobile. +253 7784 7626
Ministry of Higher Learning and Research Djibouti Research and Study Centre Tel. +253 2135 2795	Mr. Mohamed Egueh Walie Researcher, Life Science Institute Email. medeguehdjib@yahoo.fr
Ministry of Higher Learning and Research University of Djibouti Tel. +253 7711 4950	Mr. Bassel Amoze Hassan Professor-Researcher
Ministry of Agriculture, Water, Fisheries, Animal and Maritime Resources Maritime Affairs Directorate Tel. +253 7783 3298	Mr. Ahmed Absieh Officer Email. absieh-10@hotmail.com
Ministry of Agriculture, Water, Fisheries, Animal and Maritime Resources Directorate of Agriculture and Forestry Tel. +253 2135 1025	Mr. Ahmed Mahamoud Mouhoumed Officer Email. ahmedmouhoumed@yahoo.fr
Ministry of Tourism Djibouti National Office of Tourism Tel. +253 2135 2800	Mr. Mohamed Abdillahi Wais Director Email. djiboutiwais@yahoo.fr Mobile. +253 7781 0381
Prefecture of Dikhil Tel. +253 7711 5614	Mr. Idriss Houssein Abass Accountant Email. idriss_abass@hotmail.com
Dikhil Regional Council Mobile. +253 7782 0412	Mr. Abdourahman Yonis Arreh President of the Council Email. arrehdjib@yahoo.fr
Prefecture of Arta Tel. +253 7765 0002	Mr. Hamad Ismael Hassan Deputy Prefect
Arta Regional Council Tel. +253 7708 6604	Mr. Mohamed Hassan Doualeh Councillor Email. doualehmed@hotmail.fr
Tadjoura Regional Council Tel. +253 2742 4433	Mr. Hassan Houssein Omar President of the Council Email. hassan.houssein@yahoo.fr Mobile. +253 7782 5131
Prefecture of Tadjoura	Mrs. Fatouma Mohamed Ahmed Deputy Prefect

2.3 Local community

Ethiopia	
Afar National Regional State Afambo local community Tel. +251 (0) 921 552 183	Mr. Esse Mohammed Hassan Afambo District Afar National Democratic Party : Deputy Chief and local community leader Afambo Email. Essemohammed1983@gmail.com
Afar National Regional State Harissa local community Tel. +251 (0) 911 089 515	Mr. Awita Ali Clan Leader

Djibouti	
Arta Region	Mr. Moumin Kalil Fisherman at Arta Plage
Tadjoura Region	Mr. Ali Ibrahim Fisherman at Sagallou Mr. Mohamed Ali Fisherman at Tadjoura city
Obock Region	Mr. Kamil Ahmed Omar Fisherman at Dalay Af Mr. Nasser Gaber Fisherman at Obock City Mr. Hanfare Mohamed Fisherman & Tourist camp manager At Godoria Tourist camp Mr. Hanish Ali Fisherman at Ras Siyyan

2.4 Local NGOs

Djibouti	
Caravan for Development of Dikhil Region Tel. +253 7782 3716	Mr. Habib Ebo Mohamed Treasurer Email. ebohabib@yahoo.fr
Association Entre-Aide Arta Tel. +253 7784 9071	Mr. Ali Mouhoumed Darar President Email. mouhoumed.ali@hotmail.com
Association Djibouti Nature/BirdLife in Djibouti Tel. +253 2135 6921	Mr. Robleh Osman Roble Vice-President Email. roblehosm1@gmail.com
Association pour le Developpement et la protection de l'environnement du day Tel. +253 7782 8869	Mr. Hamadou Dabale Mohamed Community Mobilization Officer
Association des Pecheurs de Tadjoura Tel. +253 7779 2256	Mr. Kamil Ali Otban Speaker

2.5 Regional and International Organisations

Djibouti	
IGAD-Intergovernmental Authority for Development Agriculture and Environment Division	Dr. Debalkew Berhe Manager, Environment Division Email. debalkew.berhe@igad.int
IGAD-Intergovernmental Authority for Development IGAD -Biodiversity Management Programme in the Horn of Africa –Technical Assistance team	Dr. Serge Darroze BMP - Technical Assistance team Leader Email. serge.darroze@igad.int
International Union for Nature Conservation-Eastern and Southern Africa Tel: +254 20 249 3561/65	Mr. Leo Niskanen Technical Coordinator, Conservation Areas and Species Diversity Programme Email. Leo.Niskanen@icun.org
Coastal Oceans Research and Development – Indian Ocean –East Africa Tel.+ 254 721498713	Dr Melita Samoilys Director, CORDIO East Africa Email. melita.samoilys@gmail.com
Equipe Cousteau / The Cousteau Society	Dr. Tarik CHEKCHAK Directeur Sciences & Environnement t.chekchak@cousteau.org
United Nation Development Programme - Djibouti Office Tel. +253 7781 0783	Mr. Hassan Ali Programme Specialist Email. hassan.ali@undp.org
United Nation Food and Agriculture Organization Tel. +253 7722 8973	Mrs. Maria Pia Rizzo Consultant

2.6 Tourism and dive operators in Djibouti

Djibouti	
The Ghoubet Agency/RIES Group –Djibouti Tel. +253 2135 4520	Mrs. Valerie Chaouche Officer Email. Valerie@riesgroup.dj & goubet@intnet.dj
Lake Abbe tourist camp Tel. +253 7781 3816	Mr Houmed Loita Ouguure Owner/Manager Email. houmed_asboley@hotmail.fr
Sable Blanc Tourist Camp/Tadjoura Tel. +253 7781 3816	Mr. Omar Houssein Omar Owner/Manager Email. omarhoussein2007@yahoo.fr
Dankalelo Tourist Camp/Ghoubet-Tadjoura Tel. +253 7781 4873	Mr. Omar Gadid Ibiro
Siyyan Traveland Leisure Tel. +253 7710 3674	Mr. Renzo Pirrello Tourism operator & Diving Sea Sports
Wild Sea Expedition LDT/Tourism with boat charter Tel. +253 7725 3585	Mr. Claudio Scarpellini Manager
Air Djibouti, Red Sea Airlines Tel. +253 7761 1415	Mr. Dawit Michael Geberab Manager Email. dawit@air-djibouti.com
Dolphin Excursions Tel. +253 2135 0313	Email. info@dolphin-excursions.com
Agency Dolphin Tel. +253 7781 2300	Email. dankali@hotmail.com
Le Lagon Bleu Tel. +253 7782 6119	GASSIRA Mohamed Email. gassira@hotmail.com

2.7 Military

Djibouti	
Djibouti Coast guard Tel. +253 7785 7858	Cpt Mohamed Adawa Deputy Commander
French Forces stationed in Djibouti French National Marine Tel. +253 7782 5347	Cdt Christophe Deldique Commander of French Navy Base Email. christophe.deldique@ffdj.defense.gouv.fr
French Forces stationed in Djibouti Headquarter Tel. +253 7783 4799	Cdt Damien Belleville
Camp Lemonier –US Army Base Tel. +253 7783 3307	Mr. Isman Mohmed Hadi Environmental Coordinator Email. isman.m.hadi.ctr@mail.mil

2.8 Hotels and accommodation

Djibouti	
Djibouti Kempinski Palace Hotel +253 21 32 5555	www.kempinski.com/en/djibouti/djibouti-palace/
Djibouti Sheraton Hotel +253 21 32 80 00	http://www.sheratondjibouti.com/
Les Acacias Hotel Djibouti +253 21 32 78 78	http://www.acaciashoteldjibouti.com/
Imperial Hotel & Resort Red Sea Djibouti +253 21 35 22 20	
Menelik Hotel +251 91 508 6763	
Le Plein Ciel Hotel +253 21 35 38 41	
La Bellevue Hotel +253 21 35 64 15	
The Royal Plaza Hotel +253 21 35 80 01	
The Residence of Europe Hotel +253 77 85 99 08	

2.9 Other

Djibouti	
Ports and Free Zones Authority Tel. +253 7719 5753	Mr. Mahad Abdi Project Engineer

3 Inventory and analysis of current conditions

The first part of this section of the Gulf of Tadjourah- Ghoubet-el-Kharab Seascape Plan summarises the status of the seascape's marine resources based on the information collated to date and the field surveys conducted in 2014-2015. The biophysical, ecological and biodiversity variables that were then used for the spatial modelling for the Seascape Plan are also summarised here

In the second part of this section the steps and procedures employed for planning the Seascape are described. A Systematic Conservation Planning (SCP) process was used to identify high priority areas for protection for inclusion in the Marine Spatial Plan (MSP).

3.1 Status of the Seascape - marine resources

This section summarises the state of Djibouti's Seascape as determined in 2014 from the coral reef survey. The reefs were surveyed using standard reef methods (see Samoilys and Carlos 2000, Green and Bellwood 2009, Obura and Grimsditch 2009) primarily investigating the fish and coral community. These data were analysed to determine the health, resilience and conservation importance of these habitats. In the following sections various coral reef variables that were measured are presented and the development of suitable indicators for the modelling and analyses of the Seascape are discussed. The key variables examined are briefly summarised here:

- *Benthic cover* - This is the most commonly used indicator of coral reef health. High percentage cover of hard coral cover and coralline algae are indicative of a healthy reef, whereas a reef with a high percentage cover of macroalgae and unconsolidated substrates (sand and rubble) would be considered less healthy with low ecosystem resilience.
- *Fish size and biomass* - The biomass of fish on the reef is indicative of fishing pressure, with reduced biomass and a dominance of smaller individuals demonstrating higher fishing pressure. This is especially true for fish such as groupers which are highly valued in reef fisheries and sensitive to overfishing.
- *Fish functional groups* - fish play various ecological roles on the reef that maintain the health of the whole ecosystem. For example, herbivores such as parrotfish feed on macro-algae that would compete with corals for light and space if left ungrazed. Other fish groups are indicative of ecosystem health, being sensitive to disturbances in the environment. Butterflyfish are often corallivorous (eat coral) and hence their abundance and diversity is indicative of the health of the coral community.
- *Coral genus composition* - The diversity and dominance of different coral genera is an important consideration in the ecosystem function of the reef and its resilience to climate change impact. For example, massive corals such as *Porites* are long-lived and can be dominant builder of macro-structure on the reef, as well as being highly resistant to bleaching and climate stress on the reef. Other genera such *Acropora* are less resistant to bleaching, with a lack of *Acropora* suggesting past climate stress, however these corals are nevertheless important for micro-structure on the reef and house many in-faunal species of fish and invertebrate reliant on their branching morphology.
- *Fish species diversity* – the diversity of species from a cross section of the most diverse families of reef fishes provides an index of the health of a reef; in addition high diversity confers resilience in the reef fish community to disturbance.
- *Coral recruitment* - The ability of a reef to recover from an acute disturbance (such as bleaching or a storm) is dependant on a number of factors, but of primary importance is the presence of new coral recruits to replace any adults that died during the disturbance. The number of coral recruits is therefore a key indicator of a reefs resilience.

- *Physical factors* - Different reefs are influenced by different physical factors, such as current, exposure, light, temperature profile, sedimentation etc. These factors influence the biotic community found there as well as the reefs resilience to climate impacts. For example an exposed fore-reef slope influenced by oceanic currents may not support finely branching corals, which are easily broken in this high energy environment, and may also be highly resilient to bleaching impacts as the flow of cooler oceanic water over the corals reduces the impacts of coral bleaching.
- *Community composition* - Not all reefs are the same, with different species compositions as a result of numerous natural factors. Distinct communities indicate conservation importance as they represent a unique component of biodiversity in an area. Endemic species are species that are unique to a certain area and hence their presence in an area may indicate high conservation importance, as does the presence of protected species..

3.1.1 - Corals, benthos and reef structure

Reef structure

The habitats focused on for the spatial analysis were restricted to the shallow coral reef communities – coral community on rock, fringing reef and submerged patch reefs (Figure 3.1.1 below), and excluded the broader shelf, slope and trench habitats, which are dominated by sand and rubble on rock.

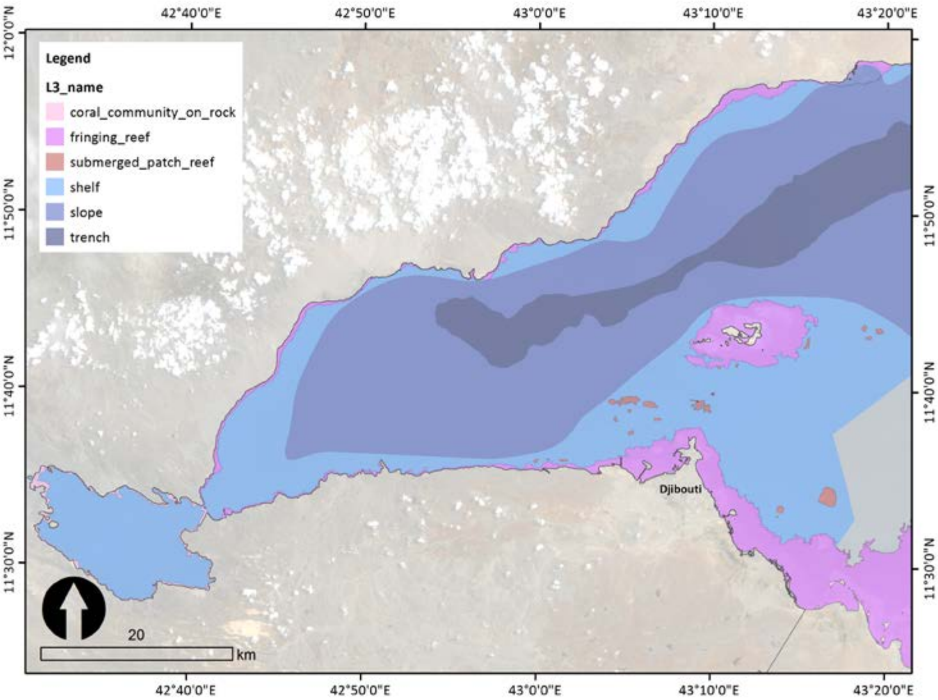


Fig. 3.1.1. Classification of benthic habitats in the Djibouti seascape (level L3).

Coral reefs in the seascape area are relatively homogeneous, varying from coral communities on rocky slopes to those where some reef accretion and structure has built up over time to form fringing reefs on the mainland shoreline, or more extensive banks with fringing reefs on the islands. The only exception to these are the deeper submerged banks, which nevertheless have the same coral community structure. Accordingly, we defined five main zones to the seascape, based on a combination of geographic location and reef structure (Figure 1.3.2):

- The northern fringing reef of the Gulf of Tadjourah
- The southern fringing reef of the Gulf of Tadjourah
- Fringing reefs around the Musha and Maskali islands
- Submerged patch reefs, off Djibouti town, Musha island and the Haramous area in the south, and
- Coral communities on the rocky slopes of the Ghoubet.

Benthic cover

Coral cover was generally high and consistent across all surveyed sites, averaging 57%, followed by turf algae (15%) and rubble (< 10%, Figure 3.1.2).

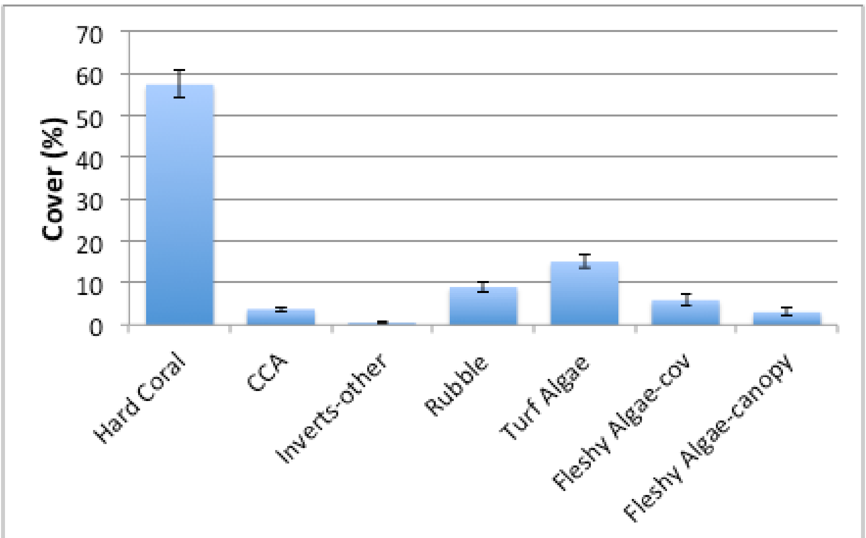


Figure 3.1.2. Benthic cover across all study sites (mean ± standard error).

Cluster analysis of the benthic data showed three groups of sites and one outlier (Table a1):

a) Sites with high coral cover, high rubble cover, and high cover of crustose coralline algae (7 sites).
b) Sites with high coral cover, high rubble cover, and high cover and height of fleshy algae (12 sites).
c) Sites with lower coral cover (though still relatively high, at 36%) and higher turf algal cover (7 sites).
d) One outlier site, Banc d'Ankali (MM14-02-1), with very high coral cover and the highest cover of coralline algae other invertebrates.

Table 3.1.1. Sites assigned to groups a, b and c (above).

Group a		**Group b**		**Group c**	
Site code	**Site name**	**Site code**	**Site name**	**Site code**	**Site name**
GB14-01-01	Pte Gabrielle	MM14-01-2	Musha NW	MM14-01-1	Air France
GB14-01-02	Parrot Island	MM14-02-2	Ankali Inner	MM14-03	Moucha I, E
GB14-02-01	Vierge Rouge	MM14-04-01	Maskali S	TN14-01-01	Ras Douan
GB14-02-02	Vierge Rouge inn	OB14-01-01	Obock fore	TN14-02-01	Daley (Oblal E)
OB14-01-02	Obock fore	OB14-01-03	Obock fore	TN14-02-02	Daley (Oblal E)
TN14-01-02	Sable Blanc	OB14-02-01	Obock patch	TS14-02-01	Khor Ambado
TS14-03-02	Arta Plage	OB14-02-02	Obock patch	TS14-02-02	Dorale
		TN14-03-01	Kalaf		
		TN14-03-02	Kalaf W		
		TS14-01-01	Manta Pt		
		TS14-01-02	Manta Pt W		
		TS14-03-01	Arta Plage		

In general, sites in groups a) and b) are in the best condition, with higher levels of coral cover. Bank d'Ankali is an exceptional outlier likely due to very low disturbance due to its greater depth and exposure to the open waters of the Gulf of Aden. Group c) contains the most impacted sites in the seascape, with higher levels of turf and fleshy algae – nevertheless, coral cover averaging 36% is still indicative of good health. There was no correspondence between these groups and the five zones of the study (fig. a2), indicating a good spread of healthy sites in all zones.

Coral genera

Fifty three coral genera were recorded, with the reefs being strongly dominated by *Porites*. *Acropora* and *Pocillopora* were also present at all sites, and sometimes dominant, while *Platygyra*, *Echinopora* and *Favia* were nest in abundance. As with the benthic data, coral genera showed very high consistency across all sites, with the exception of 4 reef types (Figure 3.1.3):

1. The Obock fore reef sites stood out as a small cluster, with deeper genera including *Diploastrea, Lobophyllia, Oulophyllia*
2. Obock lagoon had well developed sheltered reefs of *Galaxea astreata*, typical of sheltered reefs farther south in east Africa
3. The higher diversity Banc d'Ankali fore reefs
4. Unusual reefs on Musha platform (one severely degraded, the other dominated by *Galaxea astreata*)

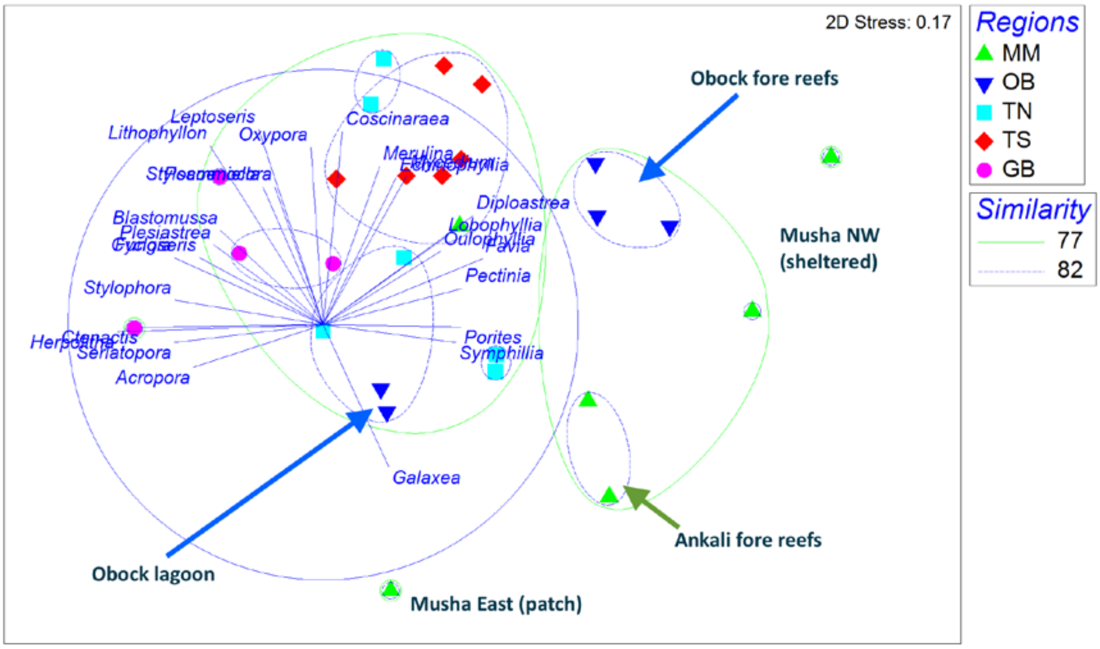
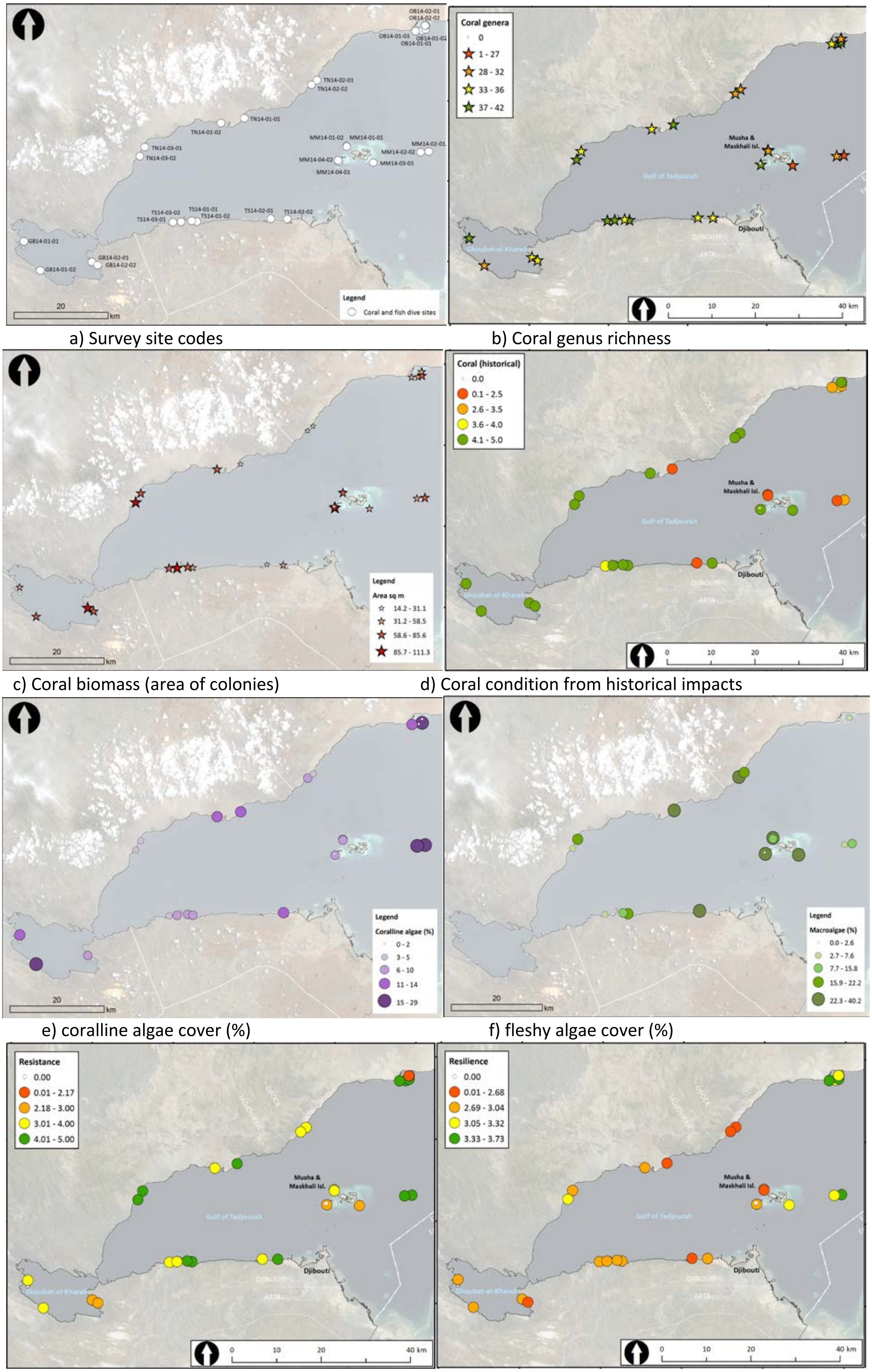


Figure 3.1.3. Non-parametric Multi-Dimensional Scaling (nMDS) plot of sites by coral genus relative abundance (Bray-Curtis similarity). Labels illustrate the four main outlier groups of sites (see text).

The overall findings from benthic and coral reef cover is that the condition of sites does not relate to regional or zonal differences in the seascape, but in factors affecting individual sites. Thus zoning plans can relate more to other factors in the spatial analysis, while management actions at individual sites can be developed based on their condition, and have a strong effect on local reef health.

Figure 3.1.4 shows how multiple variables of benthic health used in the spatial analysis vary across the study sites. In most cases, sites with high values are found spread throughout the seascape. A full list of variables per site is provided in Appendix 2.



a) Survey site codes
b) Coral genus richness
c) Coral biomass (area of colonies)
d) Coral condition from historical impacts
e) coralline algae cover (%)
f) fleshy algae cover (%)
g) Resistance to coral bleaching
h) Resilience (overall, of site)

Figure 3.1.4. Illustration of variables used in spatial prioritization, showing variation in the value of each variable across the study sites

3.1.2 Fish diversity and population abundance

Fish densities

The densities of fish species revealed some regional differences in fish species assemblages although there was no clear grouping and differences were not strong. The pattern suggests that fish populations on reefs in the Musha-Maskali Islands and Obock are similar and most different from those on reefs in the Gulf of Tadjourah and Goubet (Fig 3.1.5). The outlier site of Musha NW may reflects the high turbidity, high algae and dead coral, all features of a degraded reef, unlike other sites in the Musha Islands. However the reason for Arta Plage being an outlier is not so clear. Here the reef was narrow, there was some silt and low coral diversity and parrotfish were notably absent.

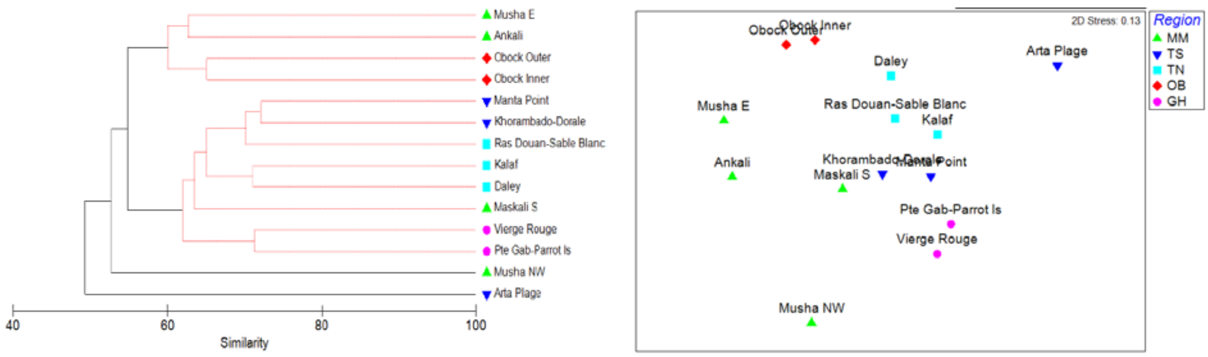


Figure 3.1.5: a) Cluster dendrogram and b) MDS plot of log (x+1) mean densities of fish species at 14 reef sites in Djibouti. The colour coded regions are Green (MM) = Musha-Maskali Islands, Light Blue (TS) = Tadjourah South, Dark Blue (TN) = Tadjourah North, Red (OB) = Obock, and Purple (GH) = Ghoubet.

Fish biomass

Fish biomass data showed similar regional differences in fish assemblages to the fish density data, with no clear groupings – sites were all relatively similar (Figure 3.1.6). The results do separate sites within Musha Islands and Obock from sites in the Gulf of Tajourah and Goubet more distinctly, and this time Arta Plage clusters with Manta Point. It is possible that fish sizes and hence biomasss are lower at these sites which are tourist/military recreational sites where reef fishing is occurring.

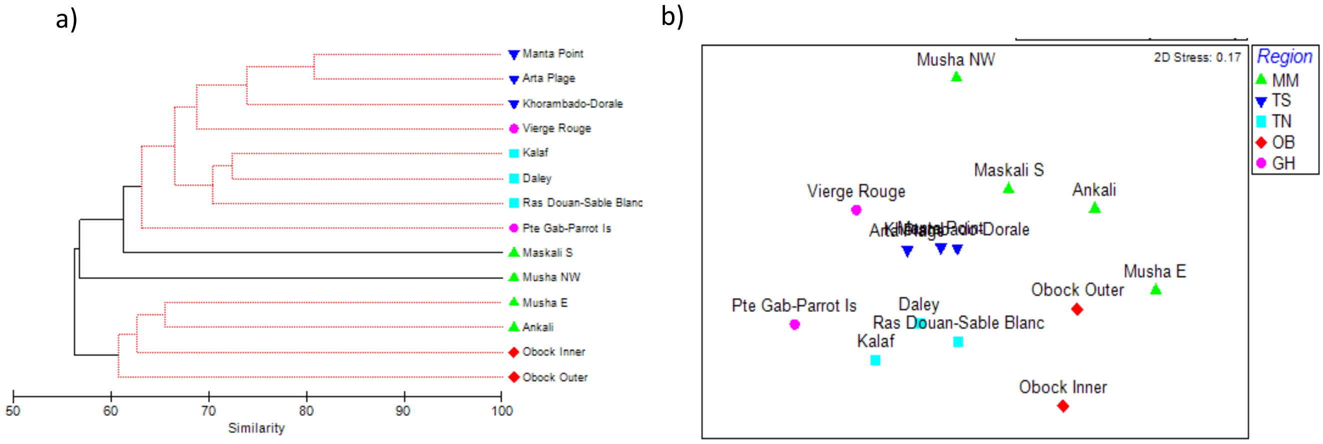
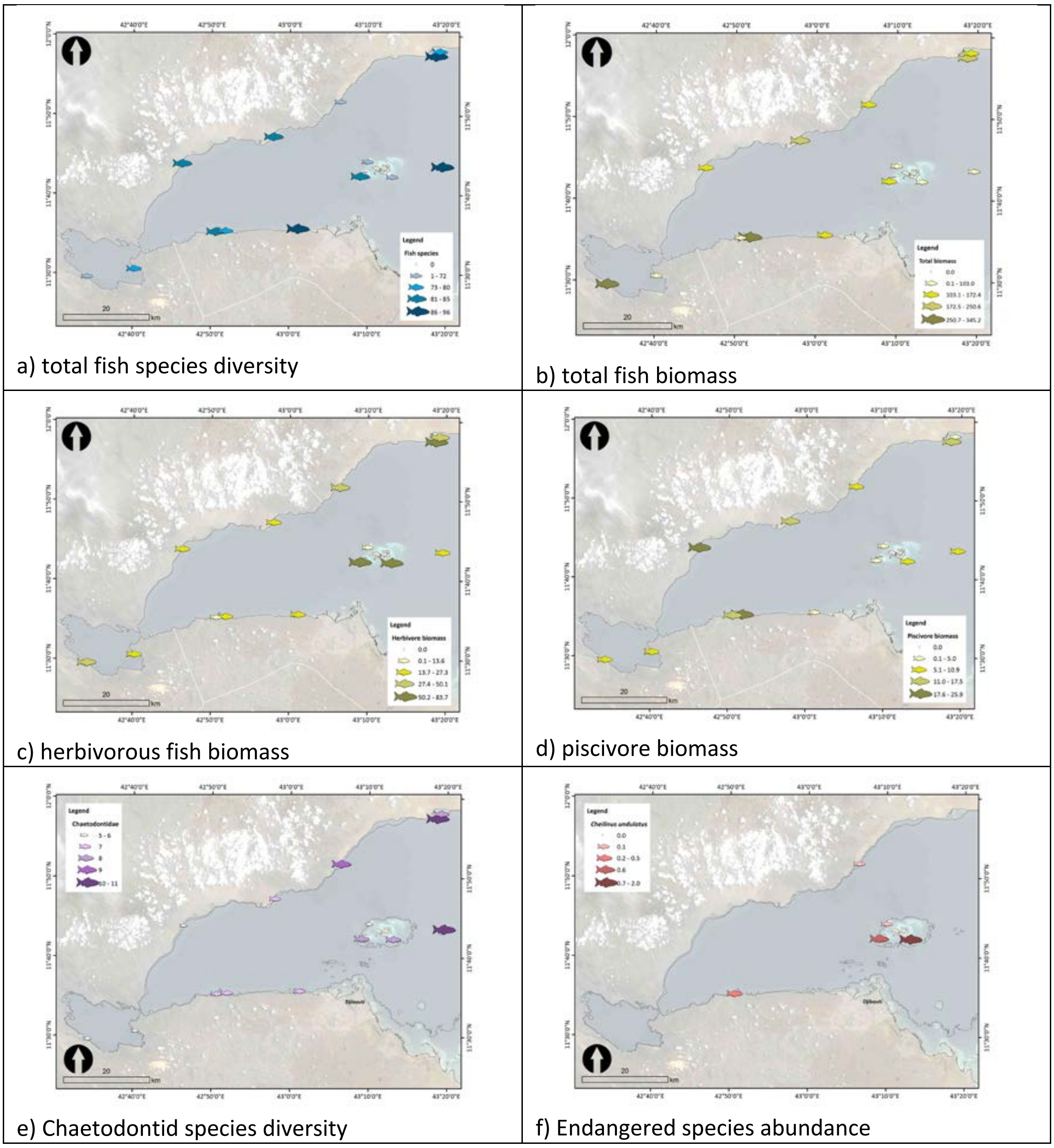


Figure 3.1.6: a) Cluster dendrogram and b) MDS plot of log (x+1) mean biomass of fish species at 14 reef sites in Djibouti. Symbols as per Figure 3.1.5.

To summarise the results of the reef fish surveys, 20 indices of fish species diversity and population abundance were selected for the spatial planning to help identify priority coral reef sites. These indices were based on a) analyses of the survey data (CORDIO survey report 2014) and b) results from other surveys in the WIO which have revealed fish population indices that best reflect the reef fish assemblage as a whole, including a focus on their functional role in conferring resilience to the reef. These include: total fish abundance and biomass; two species diversity indices; and species or taxa of ecosystem value: those that that play a key ecological role and are therefore functionally important for example in helping in reefs' resilience to climate change or drive trophic dynamics; or species that are rare or endemic. These fish population indices are listed in Appendix 2 together with their scored values in each of the survey sites (4=high, 1=low). A selection of these indicators are shown in Figure 3.1.7.



a) total fish species diversity

b) total fish biomass

c) herbivorous fish biomass

d) piscivore biomass

e) Chaetodontid species diversity

f) Endangered species abundance

Figure 3.1.7. Examples of fish species and abundance data used in spatial prioritization, showing variation in the value of each variable across the study sites.

A simple composite index from all the variables (see Appendix 2) shows the order of sites in terms of highest conservation priority, ie those that scored the highest across all indices:
i) Obock Outer; ii) Manta Point; iii) Sable Blanc – Ras Douan; iv) Obock Inner and Ankali (tied), v) Kalaf.

Of additional and global interest, the Endangered and valuable Napoleon Wrasse *Cheilinus undulatus* was seen in six sites, but their highest abundance and biomass was in the Musha Maskali Islands, with highest values at Musha East (Fig. 3.1.7) In addition, the surveys provided the first quantitative assessment of the rare and endemic species of grouper, *Epinephelus polylepis*, with populations only found in the Ghoubet.

3.1.3 Coastal surveys

Rocky and gravel substrate characterise coastal sites of Arta Plage, Ghoubet, Sagallou and Dalay Af while sandy substrates dominate sites of Sable Blanc, Tadjourah, Obock, Godoria, Khor Angar and Ras Siyyan. *Acacia* and *Prosopis* were the common plants encountered in most of the coastal sites. The highest cover of *Prosopis* was found between Tadjourah and Kalaf Ambabo, a stretch of about 15 km. Extensive mangroves were only found further north in Godoria, Khor Angar and Ras Siyyan.

Fishing and tourism were the main livelihood activities along the coastline of Djibouti. The fishery is largely artisanal operated from boats with outboard engines, or rafts. Boats are sometimes fitted with fluorescence lamps to aid in night fishing. The common fishing gears were handlines, monofilament nets and gillnets. Metallic basket traps also existed but were rarely used. There was limited large-scale fishing which was mainly concentrated in Djibouti town and Obock. Scombrids (*Euthynus affinis, Scomberomorus commerson*), carrangids (*Caranx sp*), sphyranids (*Sphyraena spp.*) showed significant contribution of the landed catches and were generally associated with higher prices at the fish market notably in Djibouti town, Obock and Tadjourah. Other coral reef-associated fish encountered at several landing sites consisted of groupers (*Epinephelus spp.*), emperors (*Lethrinus spp.*), snappers (*Lutjanus spp.*), and sweetlips (*Plenctorhinchus spp.*). Lobsters, sea cucumbers and sharks also formed part of the catch. At Tadjourah, fishermen were observed to sell their own catch i.e. no middlemen/traders. Fish price depended much on size (but generally 1kg = 500-700 DjF) though tuna-like fish fetched a higher price than emperors or snappers. Poor sanitation conditions were evident in the fish markets in Djibouti town and Tadjourah.

3.1.4 Human use activities

The majority of Djibouti's population live along the coast concentrated in the Capital city, Tadjourah and Obock. Outside these areas Djibouti's coast is sparsely populated with nomadic pastoralists. Current activities of the coastal zone include pastoralism, fishing, logistics, tourism and military usage.

- *Pastoralism*: This is the traditional livelihood of most Djiboutians and continues in most areas outside the capital city. In recent years people have become more sedentary leading to localised overgrazing, which causes increased erosion and changes to water flow around settled areas.

- *Fishing*: Despite having a rich and extensive coastline, fishing wasn't a major activity for Djiboutians traditionally and to the present day fish stocks remain relatively unexploited. Along the North-Eastern coastline from Obock to Khor Angar fishing activity is greater, because of historical and cultural links with Yemenis who engage in fishing and the trade of fish more than Djiboutians. The capital city has the main concentration of fishermen and fish trading because of better infrastructure for the industry (e.g. freezers and cheaper petrol) and access to a larger market, including the capital's various ex-patriot communities. No quantitative data of fishing pressure along the coast exist, but a fisherman may exploit anywhere along the coastline, with no defined fishing grounds for different settlements. Almost all fishing in Djibouti is artisanal using small vessels and simple fishing methods. However, increasingly there is pressure from illegal foreign fishermen using more hi-tech fishing methods.

- *Logistics*: Transport and storage of cargo is currently the main contributor to Djibouti's gross national product (GNP), with the Port of Djibouti in the capital city servicing vessels from around the world. Approximately 85% of the industry currently is for connecting landlocked Ethiopia to global trade. This sector is planned to increase dramatically in the next two decades with at least 5 new ports being planned. Currently a new port for processing and exporting salt from Lake Assal is being constructed in the Ghoubet and another port is under construction in Tadjoura to connect to areas of Northern Ethiopia.

- *Tourism*: While the coastal areas of Djibouti are amenable to tourism, with a range of attractions and potential activities, the sector is relatively limited. Most tourists currently come from the ex-patriot and foreign military communities found near the capital city with diving, water sports and sport fishing usually originating as excursions from the capital city or based on live-aboard boats. There are several accommodation options outside the city including encampments in the Ghoubet, White Sands, Obock and Godoria. However, these facilities are underused, exemplified by the closure of the encampment and diving centre on the islands of Mouch-Maskali due to lack of visitors. All nature-based business and enterprises that currently exist along the Djibouti Seascape all revolve around tourism and includes day-tourism to certain beaches, cottages/accommodation on some of the beaches, snorkelling and scuba diving on coral reefs, snorkelling and boat-watching for whalesharks.

- *Military usage*: Several foreign militaries are represented in Djibouti, with the majority of activity being concentrated in the capital city. There is a small multi-national base at Arta Plage and various parts of the coast are used sporadically for military activities.

Six key informants (KI) were interviewed to understand resource use pattern of the six coastal sites. All the KI reported the absence of fisheries officers and no collection of fisheries data. Other site-specific outcome of the KI discussions is presented below.

Arta Plage

Fishing and tourism (watching of whale shark and snorkeling) were the main livelihood activities mentioned by the KI. The site has 40 fishermen and 30 fishing vessels (boats) that were 7 m long. The KI mentioned presence of two trawlers fishing offshore. Fishing and tourism related activities were mentioned as the factors promoting environmental problems notably illegal fishing, littering of plastic wastes and conflicts between fishermen and whale sharks. There were no fisheries officers at the site however; surveillance of the Marine Protected Area is undertaken by the eco-guards. No fisheries data is collected at the site.

Sagallou

Pastoralism, fishing and gardening were the livelihood activities stated as important. According to KI, there are 80 pastoralists, 20 fishermen and 10 gardeners. Deforestation and erosion were environmental problems cited.

Tadjourah

Fishing is an important activity for income generation and sustenance at Tadjourah. There are 22 fishermen who fish either from boat, rafts or on foot. Ten fishing vessels were mentioned to exist at the site but the number could be more. The use of fishing nets was perceived by KI as an environmental problem in Tadjourah. A fishing cooperative also exists and is involved in the local organisation of fishing activities. Construction of a fish market is on-going.

Dalay Af

Pastoralism and fishing were the main livelihood activities at the site. The KI stated that 90 community members engage in pastoralism while 30 members do fishing. Fishing is done for sustenance but where possible fish are sold locally or in other markets in Tadjourah and Djibouti towns. Fishermen at the site have formed a fishing association to help in the organization of fishing activities. Illegal fishing and the use of nylon nets are regarded as the main environmental problems.

Obock

Fishing was the main livelihood activity undertaken by 80 fishermen. The activity is carried out from boats (> 10) fitted with outboard engines. Each boat carries up to 10 fishermen. Main environmental problems as mentioned by KI included trawling, illegal fishing and net fishing.

Godoria

Tourism and fishing were the main activities at site. About 80 community members engage in tourism activities. The KI reported presence of 20 fishermen and 20 boats that use handlines, gillnets and monofilament nets. The KI also stated a downward trend in fish catches though higher catches are recorded during summer months (May – October). Godoria Environment Management Association is responsible for the management and organization of fishing activity at the site. Main environmental problems as mentioned by KI include trawling, illegal fishing and net fishing.

According to the KI, the mangroves at the site cover an estimated area of 20 ha. Four species exist: *Avicenia marina, Rhizophora mucronata, Brugierria gymnorrhiza* and *Ceriops tagal*. These mangroves are not only habitats for fish but also fodder crop for pastoral community.

3.2 Systematic Conservation Planning Process

3.2.1 Introduction

As part of the planning process for the Gulf of Tadjourah- Ghoubet-el-Karab seascape a Systematic Conservation Planning (SCP) process has been used to identify high priority areas for protection, for inclusion in the Marine Spatial Plan (MSP). This section of the plan summarises the steps and procedures employed in the SCP for the Gulf of Tadjourah and Ghoubet-el-Kharab seascape. Further details describing the data processing steps are presented in Klaus (2016).

SCP is the process of deciding where, when and how to allocate limited biodiversity conservation resources to minimize the loss of biodiversity, ecosystem services and other valuable aspects of the natural environment. The benefits of this robust evidence-based, conservation planning approach have been demonstrated in marine and terrestrial environments across the globe.

SCP first emerged in the 1990's (Margules & Pressey, 2000). Since then the process has been coupled with decision support software such as the MARXAN[5] (Ball, Possingham, & Watts, 2009) and GIS-based SCP has become an important tool for planning biodiversity conservation across different scales. With SCP the aim is to achieve efficient spatial solutions to resource allocation problems, to identify ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures. SCP also aims to be cost efficient and to reduce conflicts by minimizing spatial competition between resource use activities.

The GIS-based SCP process involves a sequential series of data integration methods as illustrated in Figure 3.2.1 below. The processes builds upon the input of best available data, adding value to existing dataset and creating outputs that feed into the next step. While illustrated as a sequential process, each individual step consists of a number of iterative steps that often require adaptive feedback loops, involving stakeholder consultation and expert input, especially in data-deficient areas.

Figure 3.2.1 Systematic Conservation Planning Process

[5] MARXAN is freely available from the University of Queensland (http://www.uq.edu.au/MARXAN/) and the process is reviewed in the Conservation Land-Use Zoning (CLUZ) website http://www.kent.ac.uk/dice/cluz/index.html

GIS based SCP processes depend on the input of several different types of geospatial data, and these data should be the best available and preferably current. There are six main types of data required that include three broad types of environmental data (habitats, species and processes) and three broad types of socio-economic data (pressures, protection status and opportunities / constraints) (Figure 3.2.2) as follows:

- **Habitats**: Terrestrial and marine areas need to be mapped and an integrated habitat map created for the entire planning domain. Conservation targets are then set against the original extent of each habitat type (i.e. the baseline is the extent of each habitat prior to anthropogenic impacts). Often these types of data are not available for whole planning area and need to be constructed from the 'best available data' or derived from different sources.
- **Species**: Data is also needed on the distribution of key species, derived either from direct field observations, satellite tracking studies or other means, and information on the distribution of key sites, provide an important means of refining the spatial prioritization. The IUCN Red List is often used to guide the selection of priority species for inclusion in the planning process, along with any national lists that identify locally threatened and/or culturally important species.
- **Ecological Processes**: The presence of species and even habitats is not always sufficient to ensure the long term persistence of biodiversity. Important ecological processes that support the persistence of species can also be included in the planning process. As the direct mapping of ecological processes is challenging, proxies or surrogates are often used.
- **Pressure / Condition**: Data on the current status or condition of habitats and/or other biodiversity features is required. In the terrestrial realm this is often obtained from land use maps. In the marine realm this may be represented by the main patterns of resource uses (e.g. fishing effort and shipping), and other indirect pressures, but it might also include transformed habitats (e.g. reclaimed land, harbours).
- **Protection Status**: The existing protected areas need to be mapped. Djibouti has declared several protected areas.
- **Opportunities / Constraints**: Opportunities in the context of SCP might include areas where there are existing conservation initiatives that have not been legally declared as protected or areas that are protected from resources uses for other reasons (e.g. cultural sites, security exclusion zones). Constraints in the context of SCP might include areas flagged for development and infrastructure projects, or oil and gas exploration.

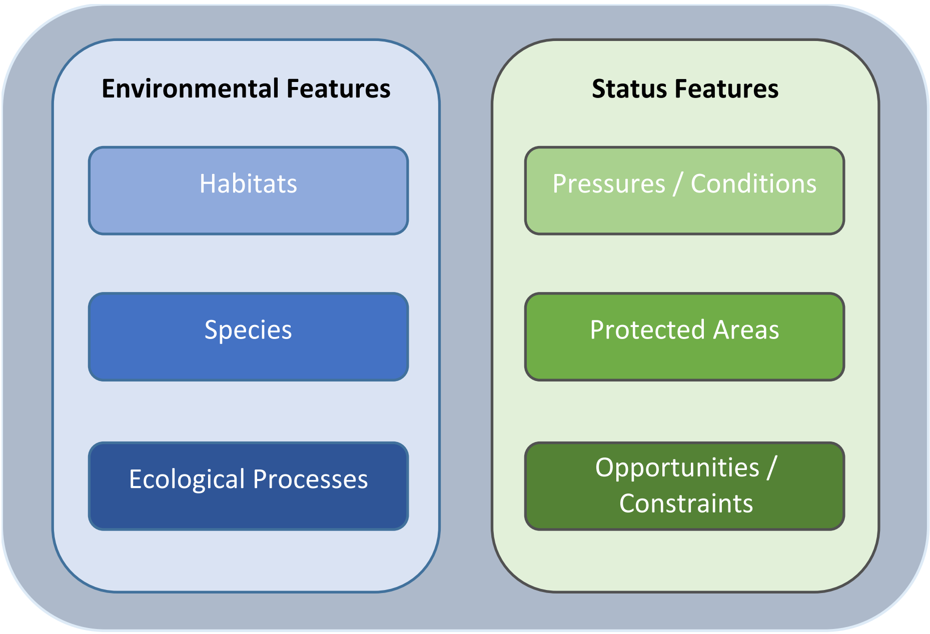


Figure 3.2.2 Main data types required as inputs into Systematic Conservation Planning Process.

3.2.2 Definition of the Planning Domain

The first step before commencing any planning process is the definition and characterisation of the planning domain. The Republic of Djibouti's claims an EEZ that covers 373 km^2. Other maritime claims within the EEZ (Figure 1.2 and Table 3.2.1) include the Territorial Sea extending to a distance of 12 nm offshore, covering an area of 4717.23 km^2 and a Contiguous Zone, extending up to 24 nm, covering an additional 1511.99 km^2. The EEZ spans four different areas of sea, which includes the Red Sea, the Gulf of Aden proper, within which is the Gulf of Tadjourah and the Ghobet-el-Karab (Table 3.2.1).

The planning domain for the current SCP and MSP process covers the Gulf of Tadjourah and Ghoubet-el-Kharab and extends inland by 5 km (Figure 1.4 and Table 3.2.2). The marine area (2277.89 km^2) is wholly within the Territorial Sea and represents 32.42% of the total EEZ. The land area (1199.40 km^2), which includes both coastal and terrestrial habitats represents 74.55 % of the total coastal area to 5 km inland (Table 3.2.2) (Klaus 2016).

Table 3.2.1: Republic of Djibouti's sea areas (Klaus 2016)

Zone / Sea area	Area (km^2)	Percentage of EEZ
Red Sea	314.01	4.47%
Gulf of Aden	4433.33	63.12%
Gulf of Tadjourah	2118.46	30.16%
Ghoubet-el-Karab	159.38	2.27%

Table 3.2.2: Republic of Djibouti's maritime claims (Klaus 2016)

Maritime claim	Area (km^2)	Percentage of EEZ
Exclusive Economic Zone (EEZ)	7025.19	
Territorial Sea	4717.23	67.15%
Contiguous Zone	1511.99	21.52%

3.2.3 Data Sourcing

Data scoping

Data scoping is the process of identifying and defining the types of data needed and the potential sources of those data for use in the planning process. The Data Scoping phase for the project commenced in December 2014 and continued through into 2015. The process drew upon four main sources of information (Klaus 2016):

- (i) consultations with potential data holders, including individual researchers, non-governmental or private organizations, parastatals, and government authorities,
- (ii) a review of the available literature (web-based resources, grey literature reports and scientific publications),
- (iii) new primary data collected during the project and
- (iv) a review of global / regional datasets available from external organisations and web sources

Consultations at the national level commenced during the first stakeholder workshop, which was held in 18th-19th June 2014. After this first workshop, the Cousteau team representative and national IUCN project coordinator organised a series of one-to-one consultation meetings with individual researchers, ENGOs, parastatals, and government authorities.

The collection of primary data was mostly completed during the field survey between 13th-26th September (Klaus et al. 2014a, Newman et al. 2015, CORDIO 2015). A second field phase permitted the collected of data on coastal resources (CORDIO 2015). During this time the compilation of secondary data was continued remotely via email. National or international data holders identified through the consultation process or the literature were sent an introductory email, together with background materials to explain the project and request their collaboration in sharing data.

Datasets obtained through this process included both raw and published data from national organisations and individuals, as well as from other regional and global sources. The datasets were reviewed and then converted into an appropriate geospatial format so that they could be used in the GIS. Where possible common datasets were processed and combined so as to create a new harmonised dataset covering a larger area, although this was not always possible.

The second stakeholder workshop held on 14th to 15th October 2015 (IUCN 2015), provided the opportunity for the compiled datasets to be presented and reviewed by national stakeholders. After this workshop, the Cousteau team representative, carried out further face-to-face consultations with national organisations assisted by the IUCN National Coordinator to attempt to fill some of the key data gaps.

The feedback and data obtained following the second workshop were then compiled and used in second series of model runs.

Stakeholder Workshops

The First Workshop which was held in 18th-19th June 2014 provided the opportunity to meet key representatives from national organisations to introduce the planning process and discuss the need to share data for use in the modelling process. The Second Workshop held on 14th to 15th October 2015 (IUCN 2015), provided the opportunity to discuss the following:

- the datasets already compiled for use in creating the derived data layers;
- the derived data layers that are already available for review;
- the overarching goal and specific objectives of the planning process;
- the priority features for inclusion in the model;
- the specific targets for each feature of concern (e.g. 20% seagrass);
- the methods and/or means to fill critical data gaps (e.g. expert knowledge)

The initial results of the modelling process were presented. The design principles and objectives for the protected area network were discussed and with national stakeholders at the second workshop. These discussions included identifying the priority marine and terrestrial habitats and targets for the protected status of these habitats were agreed. This same workshop also provided the opportunity to discuss the priority species for inclusion in the model.

3.2.4 Data Review and Cataloguing

When data was received from a data holder the following steps were undertaken (Klaus 2016):

- The data was placed in a folder;
- The data was recorded in the 'Data Register', including the date of receipt, source and format.
- The data was reviewed and spatial data uploaded to the base 'Data Catalogue';
- Non spatial data / information was further reviewed as outlined below.

A review of all of these data was repeated in processing final set of derived layers.

Data Review

The data was reviewed before it was loaded into the GIS Data Catalogue to check the format against the data format criteria described in the background documentation. Datasets that were not in a geospatial format (e.g. *.pdf, word documents, excel files) were checked to see if they could be re-worked into an appropriate format within the project timeframe, and only the most appropriate and relevant spatial data were reworked and incorporated into the Data Catalogue.

3.2.5 Preparation of Derived Layers

The datasets collected and prepared were used to create a series of derived data layers for the marine and coastal environment for use in the SCP process (Klaus 2016). The derived datasets included spatial data layers illustrating the distribution of marine and coastal habitats, the condition of those habitats, species distribution, ecological processes, protected areas, opportunities and constraints. These data layers then provide the basis for protection assessments, threat assessments, and spatial prioritisation.

Mapping of Habitats

The first set of data that is needed for SCP is habitat map which ideally is a high resolution, fully integrated, hierarchically nested, habitat map illustrating the distribution of biotopes, defined as the physical habitat in combination with their associated biological communities. These types of habitat / biotopes maps are rarely available at a national level and more commonly it is necessary to use proxy datasets, derived from other data sources such as geomorphological features among others.

While there are some maps showing terrestrial habitats, vegetation types, soil types and geology for Djibouti, the data was supplied in *.pdf format and there was insufficient time within the project to redigitise these data. In the marine environment, the nearshore shallow marine habitats around Sept Frères and Ras Siyyan were previously mapping using satellite imagery (PERSGA / GEF 2004a). These maps did not cover the planning domain, hence the reason why a new habitat map was prepared using Landsat 8 satellite data under the current project (Klaus et al. 2014, Newman et al. 2015).

Additional work was needed to fill in the gaps to create the final integrated habitat representing coastal and marine features as described in Klaus (2016). In the marine environment this included mapping depth categories beyond those mapped using the Landsat 8 satellite imagery. As no terrestrial habitat maps were available, new features were created for key features in the coastal terrestrial environment. This included mapping man-made habitats, including urban areas, roads, and infrastructure, as well as beaches, rivers / wadis, wetlands and mangroves and the invasive *Prosopis*.

The final steps in the process was to compile both the coastal and marine habitat maps into an integrated habitat map. The classification scheme developed for this purpose is a fully integrated hierarchical scheme that transgresses both marine and terrestrial domains, and in which the different biotopes (physical and biological classes) are nested within larger geomorphological units (Klaus 2016).

The integrated classification scheme has 5 main levels, each of which can be subdivided into a number of distinct classes. The first three levels are primarily geomorphological while the fourth level represents the key biotopes (physical habitat types and associated biological communities). Each level in the classification scheme can be used independently or the classes can be integrated across all levels to provide the highest level of resolution. The levels used in the classification scheme are presented in Figure 3.2.3 explained below:

- **Level 1** in the classification scheme identifies whether or not the area of interest is located on the 'Land' or in the 'Sea'. These data were derived from the Landsat satellite imagery.
- **Level 2** in the classification scheme subdivides the area into four broad geomorphological features, in which the land is subdivided into mainland and islands, and the sea is subdivided into 'shallow' or 'deep', the boundary of which is the continental shelf (200m).
- **Level 3** in the classification subdivides the coastal area into beaches, wetland and land. The sea is subdivided into six geomorphological sub-units including: coral communities on rock, fringing reef, and submerged reefs, shelf, slope and trench. The first three shallow water classes were derived from the Landsat satellite data and the latter three deep water classes were derived from using the SRTM bathymetric data and Harris et al (2014).
- **Level 4** in the classification subdivides the coastal and marine areas into a further 17 distinct habitat types. There were 7 broad subtidal habitats mapped that included: silt, sand, seagrass, hard coral and coral on rock. Coastal habitats mapped include: sand, volcanic rock, coralline rock, mangrove, *Prosopsis*, waterways and water bodies.
- **Level 5** in the classification scheme aggregates all of the previous levels together with the two main modifiers which included location and depth / elevation to produce the final class type. The Level 5 code and name is created by concatenating codes and names from the previous four Levels together with the codes and names for the location and depth modifiers.

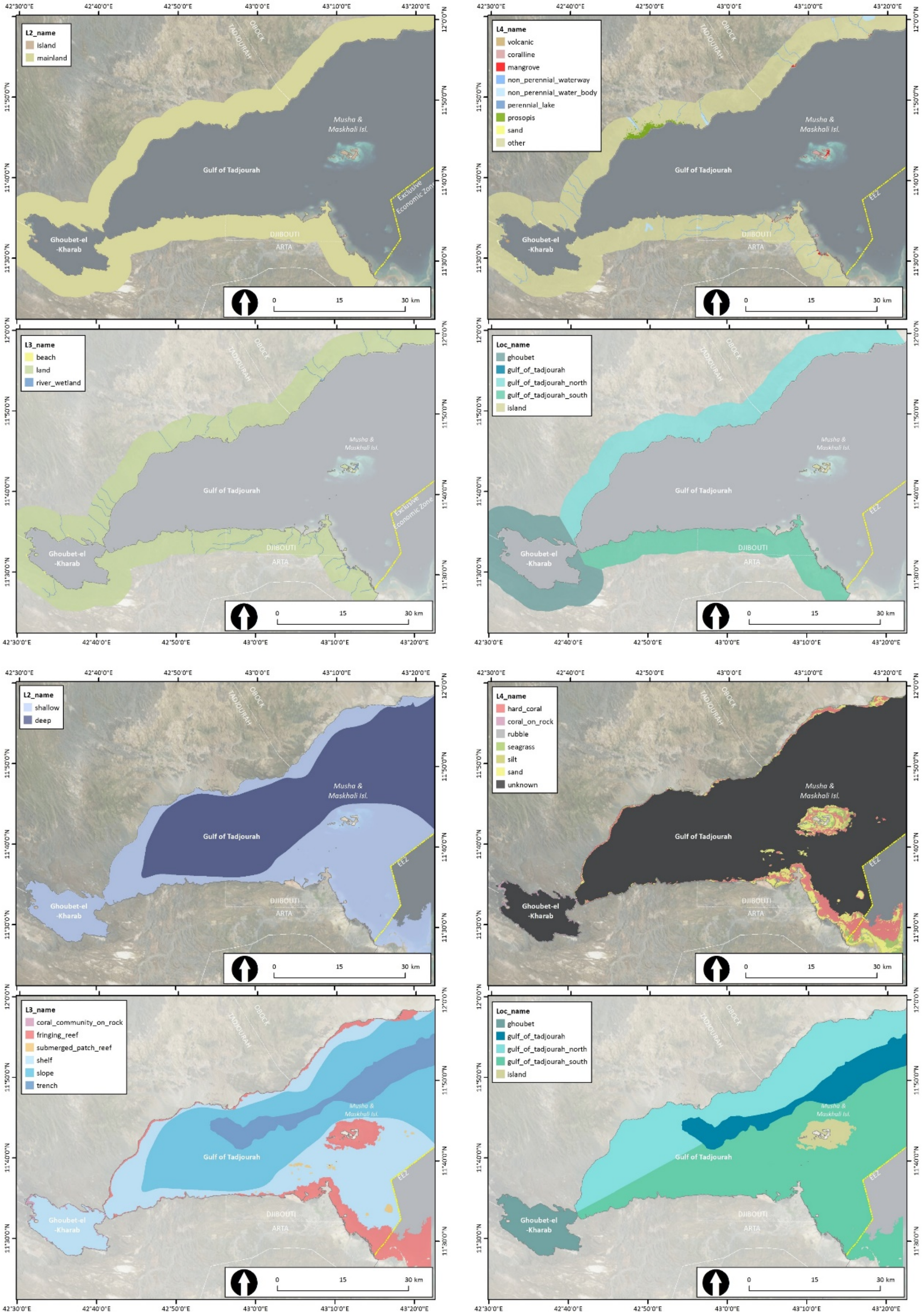


Figure 3.2.3 Representation of the levels used in the integrated habitat classification scheme for the coastal and marine environment within the planning domain.

Mapping of Conditions

The second set of data needed for SCP is data that reflects the condition of the habitats. Spatial data on ecological condition is often not available in a directly accessible form and has to be inferred from other datasets representing resource use or pressures on the coastal and marine environments. This requires consideration of the major drivers of change or pressures on ecosystems differ in coastal and marine environments, and their relative importance varies across habitat types. Mapping ecological condition is thus complex, and requires the use of different approaches on the land and in the sea.

In the terrestrial environment, ecosystem condition is often inferred from a land cover or land use maps where available. In the marine environment, this data layer usually needs to be created through mapping the different major pressures on marine and coastal ecosystems.

There were no land use maps available for Djibouti in geospatial format for use in the project. The terrestrial condition data layer was therefore prepared by digitising urban features, infrastructure, including roads, waste disposal sites etc. The features mapped were then classified as being either 'transformed', 'degraded, or 'natural'. Transformed areas were those where there was limited possibility of returning the habitat to a natural state. The 'degraded' areas were adjacent areas subject to a certain level of impact (e.g. adjacent to roads). All remaining areas were classed as being in a 'natural' state. The resulting coastal / terrestrial condition layer is illustrated in Figure 3.2.5a.

In the marine environment a different approach was used, as represented schematically in Figure 3.2.4. Data layers were created to represent both direct pressures (e.g. reclamation, dredging) and indirect pressures (e.g. fishing effort, shipping, outfalls etc.). These data layers were prepared using a standard grid. Each pressure was mapped through creating raster data layers, using the standard grid which were scaled 0 to 1, where 0 represents no pressure and 1 represents full pressure. Both the direct and indirect data layers were then combined by calculating the mean value times by the maximum value to represent the cumulative impact. Further details of the data types and processing step used to prepare the condition layers in the marine and terrestrial environments is described in full in Klaus (2016).

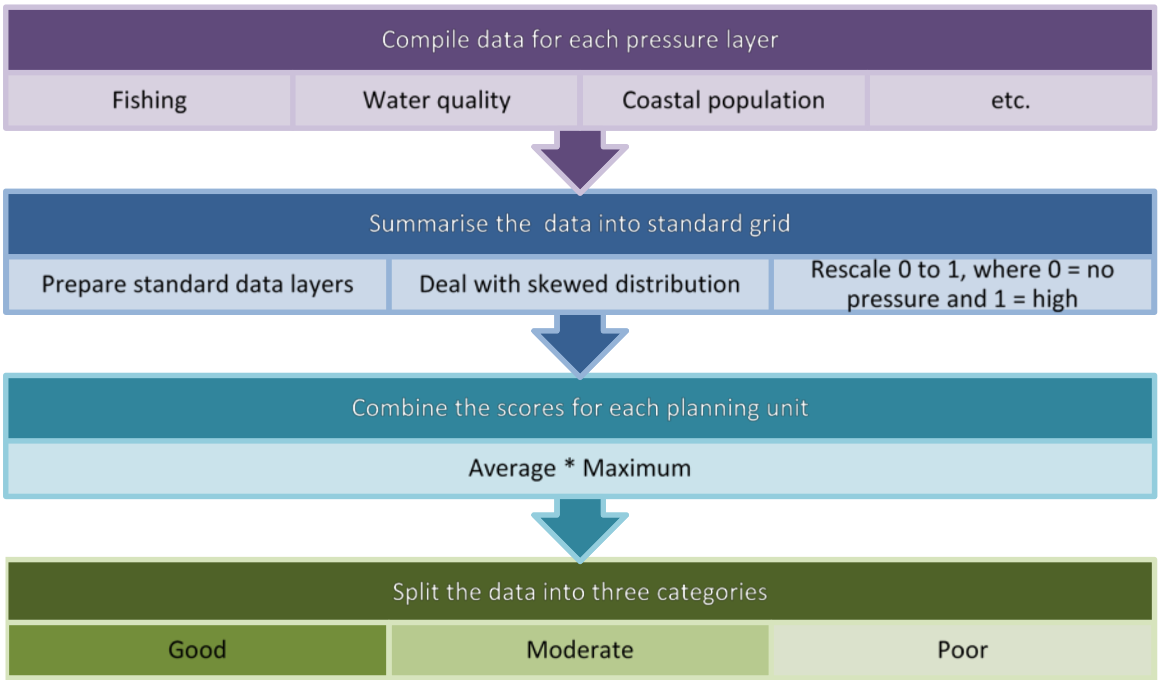
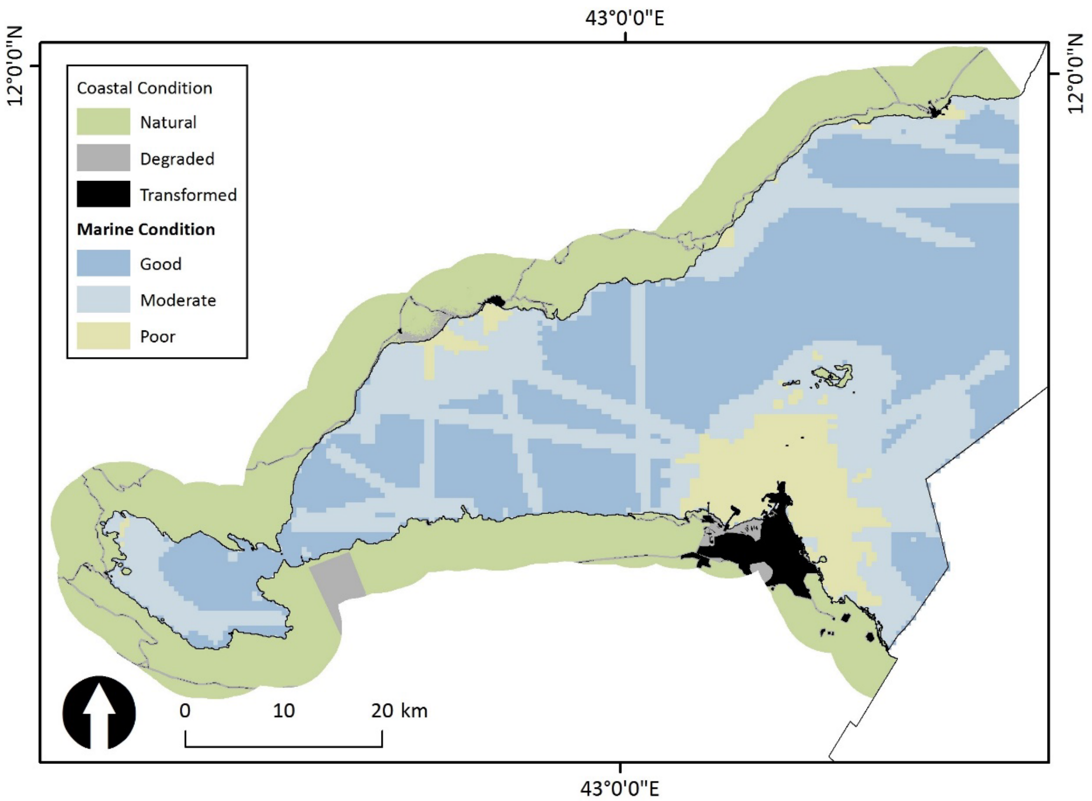


Figure 3.2.4. Schematic diagram show the data processing steps used to create the marine condition data layer.

(a)



(b)

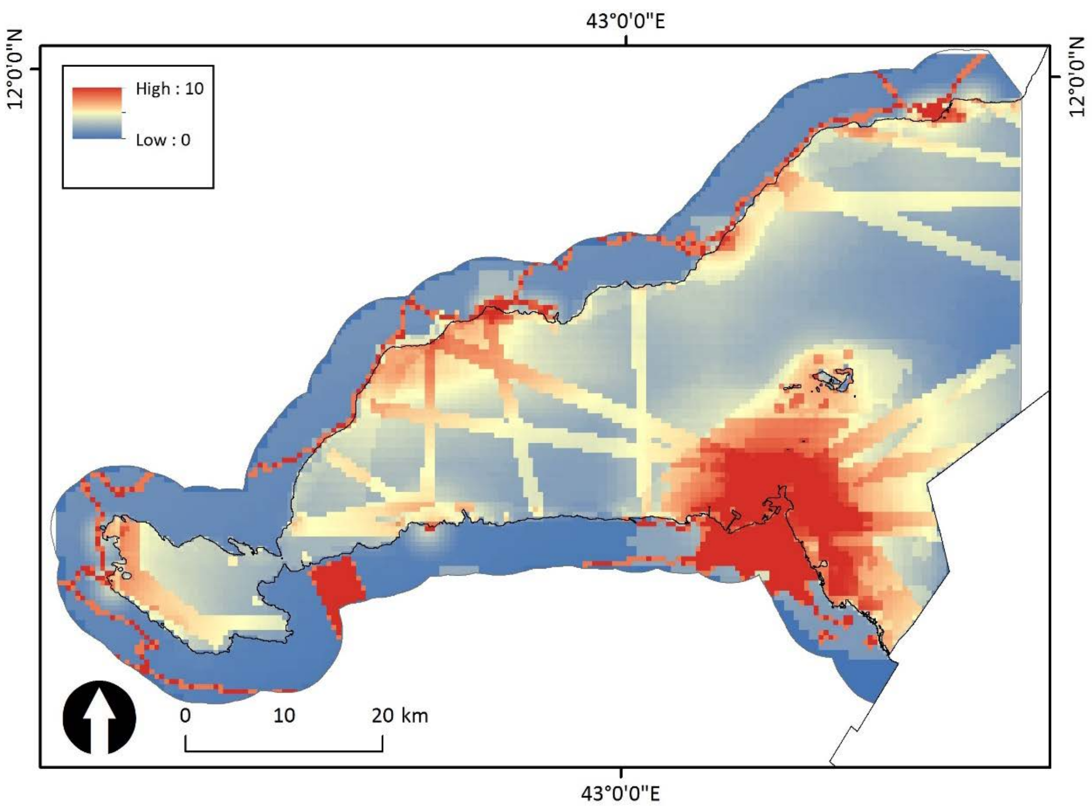


Figure 3.2.5. Condition layer showing (a) the classification of pressure scores in both coastal and marine environment and (b) combination of all pressure layers in the coastal and marine environment re-scaled 0 to 10 in preparation for use in the model.

Mapping of Protected Areas

The third set of input data needed for SCP is the extent and status of existing protected areas. This dataset is used to determine the extent of habitats that are already protected and the extent of habitats that remain unprotected, the results of which can then be used to refine targets used in the models. Djibouti has three legally declared MPAs declared under GoD (2004a) which include:

- Musha and Maskhali Islands MPA
- Sept Frères, Ras Siyyan and Godoria MPA
- D'Haramous MPA

In addition to this GoD (2004a) also declared four terrestrial protected areas, one of which, the Day Forest, borders the planning domain.

Maps illustrating the spatial extent of the legally declared protected areas were obtained from different sources (PERSGA/GEF 2004, Roux 2013) and the GIS data files and maps prepared (Figure 3.2.6). In preparing the GIS files, it was apparent that there were different versions of the boundary coordinates for the existing MPAs and the boundaries have not been legally declared[6].

Notably the coordinates given in the Master Plan for Sept Freres (PERSGA/GEF 2004) delineate a significantly larger area than those in Roux (2013). While this MPA is outside the planning domain it affects the calculation of total national protected area coverage and hence the expansion targets.

The MPA area and percentage coverages calculated using PERSGA/GEF (2004a) and Roux (2013) are shown in Table 3.2.3 and 3.2.4 (Klaus 2016). The MPA coverage in Djibouti calculated using either set of biodiversity coordinates does not currently meet the recommended 10% for the marine environment, as specified in Aichi Target 11 of the Strategic Plan for Biodiversity agreed at the 10th Conference of the Parties to the Convention on Biodiversity in October 2010[7] and Target 14.5 of the 2030 Agenda for Sustainable Development, agreed in September 2015[8].

The total existing coverage within the planning domain using the coordinates included in Roux (2013) is 69.55km^2 (35.46km^2 for Musha and Maskhali MPA and 31.39km^2 for D'Haramous MPA). Achieving a coverage of 10% within the planning domain, would require a total MPA coverage of 227.79 km^{2,} which would require an additional 160.84 km^2 to be added to the protected area network.

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[6] Article 7 of Law No. 45/AN/04/5 (GoD 2004a) states that the protected areas states that the boundaries will be defined in a separate regulation[6]. From discussions with national stakeholders it transpired that although Roux (2013) was prepared as the basis for the preparation of these regulations to gazette the boundaries for these MPAs, they have not been finalised by government, which was confirmed during a recent legal review (Djibril 2015).

7 Target 11 "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes" CBD (2010) Strategic Plan for Biodiversity 2011-2020: COP 10 Decision X/2 https://www.cbd.int/decision/cop/?id=12268.

[8] Target 14.5 "*By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information*". UN (2015). Transforming our world: the 2030 Agenda for Sustainable Development. September 2015. https://sustainabledevelopment.un.org/post2015/transformingourworld

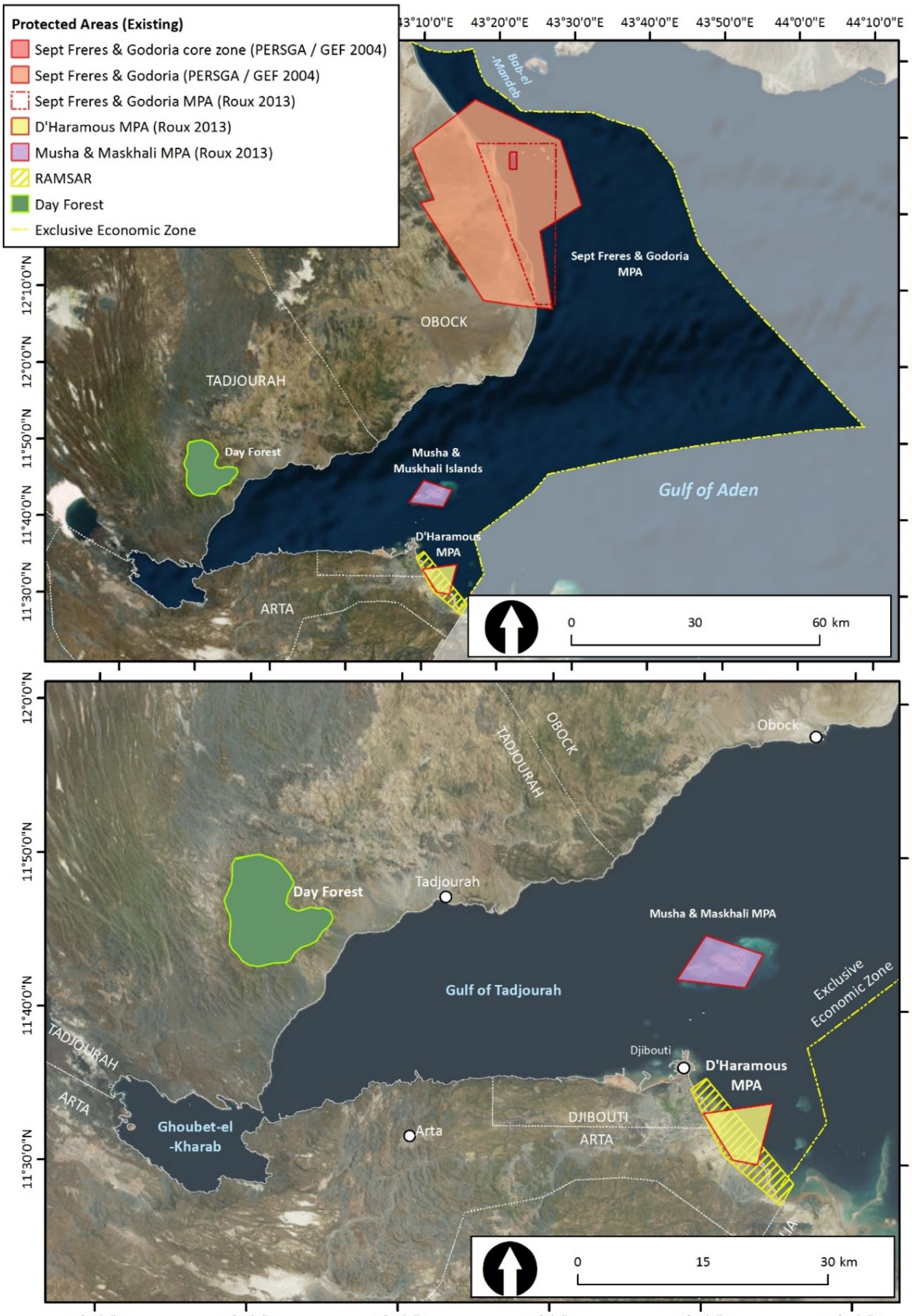


Figure 3.2.6 The existing terrestrial and marine protected areas in Djibouti (Klaus 2016).

Table 3.2.3. Area and percent coverage of existing MPAs using the boundaries for Sept Frères as per PERSGA /GEF (2004) and others from Roux (2013), showing the total area of each MPA, the area of land and sea within each MPA, and as percentage of the whole coastal strip to 5 km and Exclusive Economic Zone (EEZ) and as a percentage of the Gulf of Tadjourah and Ghoubet-el-Kharab (GoT-GeK) planning domain.

Name	Total Area (km^2)	Land Area (km^2)	Percent Coast	Percent Coast GoT-GeK	Sea Area (km^2)	Percent EEZ	Percent GoT-GeK
Musha & Maskhali	39.87	4.41	0.27	0.02	35.46	0.50	1.56
Sept Frères, Ras Siyyan, Godoria	1,279.87	729.64	45.35	na	550.23	7.83	na
D'Haramous	36.94	5.45	0.34	0.03	31.49	0.45	1.38
TOTAL	**1,356.68**	**739.50**	**45.96**	**0.05**	**617.18**	**8.79**	**2.94**

Table 3.2.4 Area and percent coverage of existing MPAs using the boundaries from Roux (2013), showing the total area of each MPA, the area of land and sea within each MPA, and as percentage of the whole coastal strip to 5 km and Exclusive Economic Zone (EEZ) and as a percentage of the Gulf of Tadjourah and Ghoubet-el-Kharab (GoT-GeK) planning domain.

Name	Total Area (km^2)	Land Area (km^2)	Percent Coast	Percent Coast GoT-GeK	Sea Area (km^2)	Percent EEZ	Percent GoT-GeK
Musha & Maskhali	39.87	4.41	0.27	0.02	35.46	0.50	1.56
Sept Frères, Ras Siyyan, Godoria	459.57	85.23	5.30	na	374.35	5.33	na
D'Haramous	36.94	5.45	0.34	0.03	31.49	0.45	1.38
TOTAL	**536.39**	**95.09**	**5.91**	**0.05**	**441.30**	**6.28**	**2.94**

Mapping of Species

Data illustrating the distribution of species is typically used to refine or enhance the spatial prioritization process. For this reason, the species included are normally those species with either a restricted range distribution or a particular habitat requirement, as common or widespread species are accommodated for through the habitat representation data layers. Priority species are often those recognised as threatened or near-threatened on the IUCN Red List together with other national or local assessments of threat and /or culturally significant species. In sourcing these information, the preference is for data sets derived from observations or surveys, preferably over the entire planning domain, and/or data on key sites. However, these types of data are often not available at a consistent resolution over the entire planning domain. Other datasets that can be used include outputs from species habitat modelling.

There was limited species level data available for Djibouti, apart from those data obtained during the recent field surveys, which included data on the distribution of 108 fish species and 53 coral genera. The site level data were attributed to reef polygons within the vicinity of each survey site. Examples of the mapping of these species are shown in the previous section 3.1, Figures 3.1.4 and 3.1.7.

Mapping of Ecological Processes

The presence of species, and even habitats, is often not sufficient to ensure long term persistence of biodiversity. Important ecological processes on which the persistence of biodiversity depends are also included in these types of spatial prioritisation models. The mapping of dynamic ecological processes is a challenge; so proxy data are developed to represent particularly productive habitats, potential migratory corridors, areas of potential importance for climate change adaptation, and areas of high biodiversity heterogeneity. Examples of the process habitats mapped within the planning domain are seen in Figure 3.2.3 and in Klaus 2016.

Mapping of Opportunities

Opportunities in the context of this type of planning process include areas that are not yet formally protected but offer the potential to enhance a protected area network due to existing sympathetic land use or other management practices. These areas are very important to identify for the spatial prioritization process.

The primary opportunities identified for Djibouti included areas that have not identified as protected area but not legally declared (e.g. Arta Plage). Other opportunities identified included areas that have been recognised as important for the conservation of species or habitats through other regional or international processes (e.g. Birdlife International Important Bird Areas, Important Seabird Areas, and Ecologically and Biological Significant Areas). The seabed cable area and military exclusion areas already act as effective no take zones as no fishing is permitted in those zones so could also be considered a low-level opportunity.

The opportunities were mapped and ranked as follows: 3 = strong opportunity (e.g. Arta Plage), 2= moderate opportunity and 1 = weak opportunity (e.g. seabed cable zone).

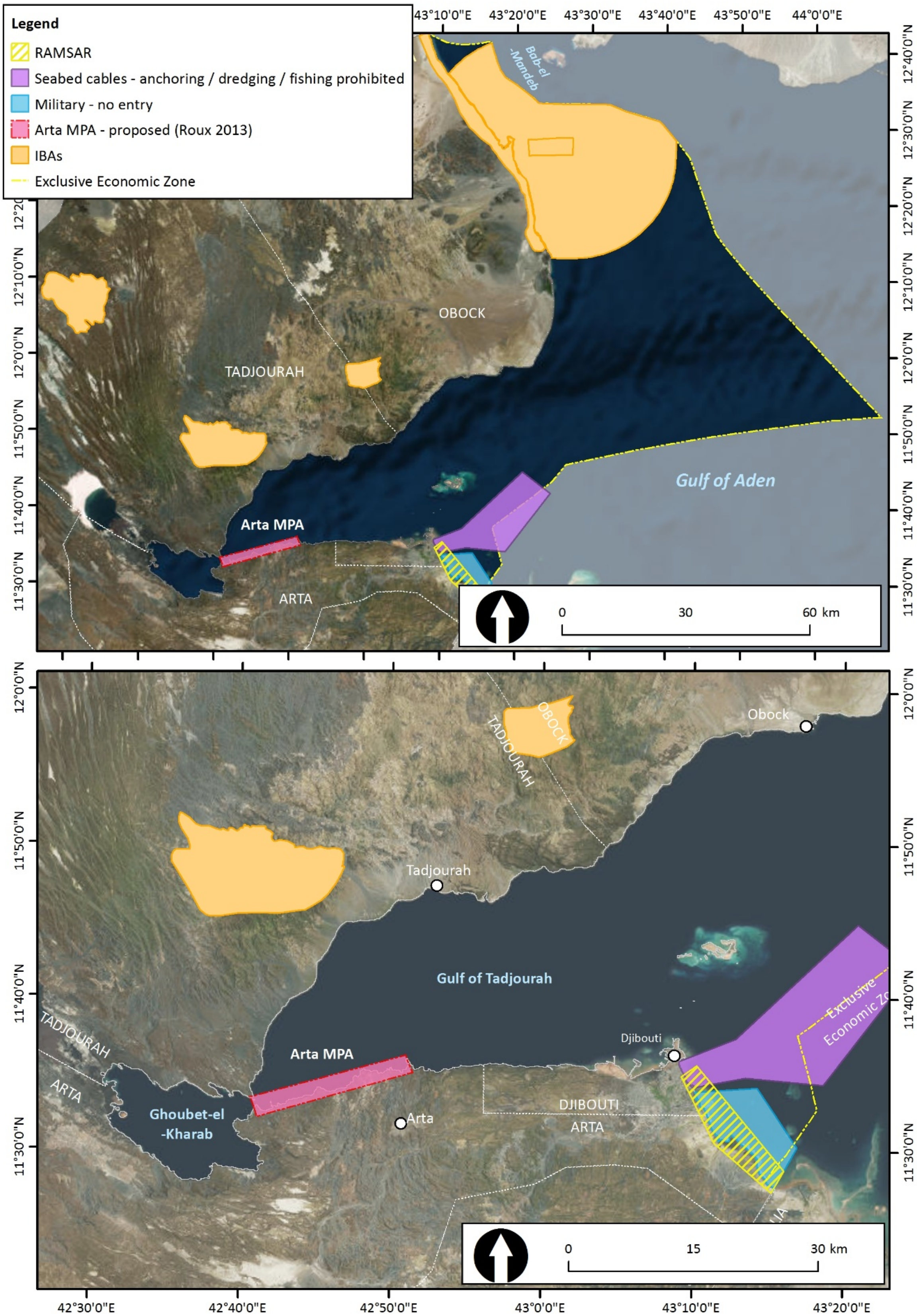


Figure 3.2.9 Opportunity areas mapped within the planning domain in Djibouti (Klaus 2016).

Mapping of Constraints

Constraints are areas where there are existing human resource uses or areas that have been proposed for a different use in the future (e.g. those that have been earmarked for residential or infrastructure development, or areas where developments have already been approved, or where other factors may reduce potential for effective conservation actions). Various constraints were identified in relation to fisheries, potential future oil and gas development, and new port developments. These constraints were mapped as described in Klaus (2016).

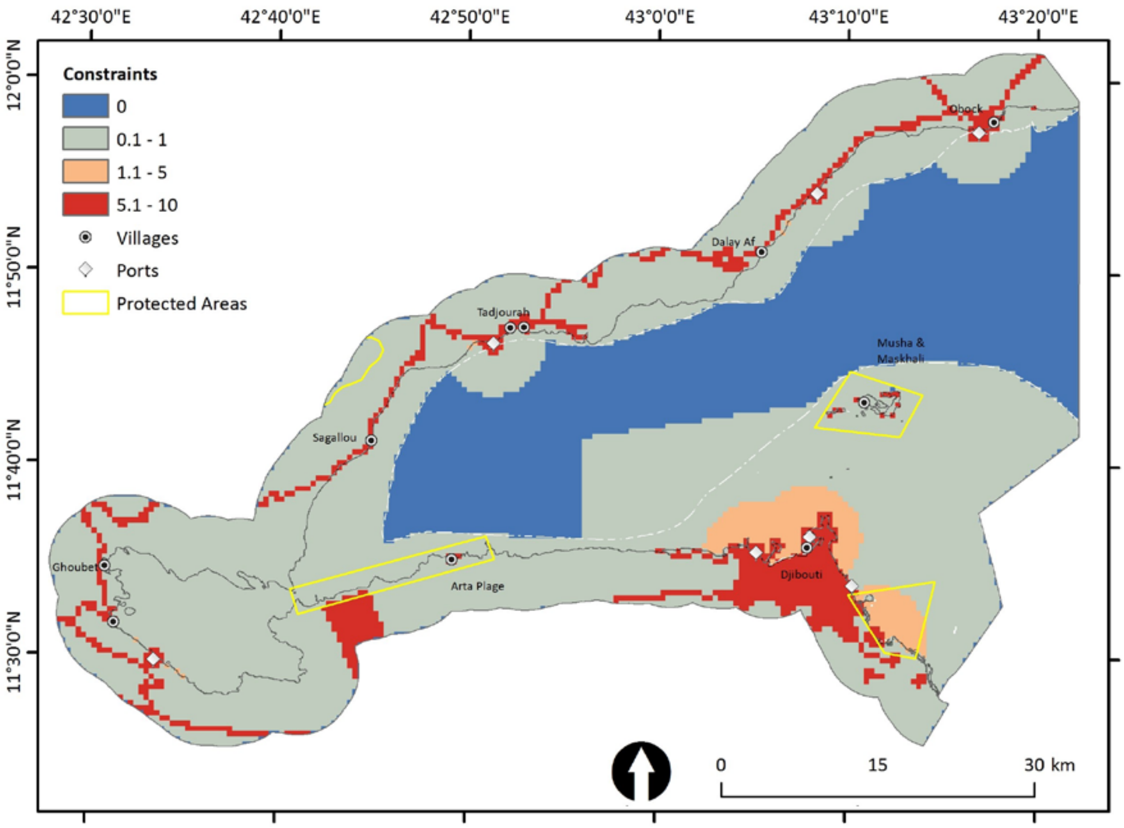


Figure 3.2.10 Constraint areas mapped within the planning domain in Djibouti (Klaus 2016).

Mapping of Costs

In order to minimise the potential cost of protected area expansion, while still achieving the conservation goals and specific targets, different 'cost' data layers were constructed to represent trade-offs that might be required. Four different 'cost' surfaces were prepared for use in the MARXAN model scenarios. In the first cost layer (scenario 01), the 'cost' of all the planning units was set as being equal to 1. In this scenario, the cost of protected area expansion is determined by the number of planning units irrespective of other socioeconomic uses. The second cost data layer was area. The third cost data layer was threat, which used the condition data layer. The mapping of the fourth cost layers was achieved using the following equation: [basic cost + constraints + conditions – opportunities]. The full cost data layer is illustrated in Figure 3.2.11.

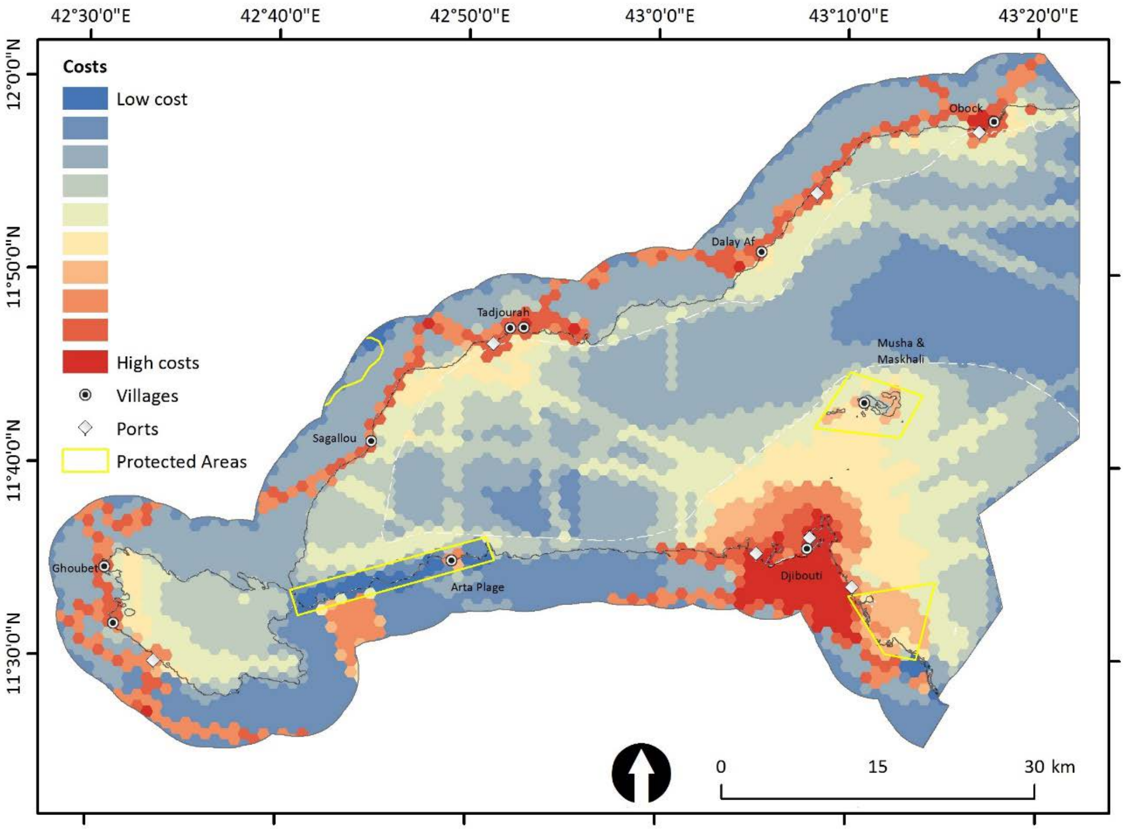


Figure 3.2.11 Costs mapped within the planning domain in Djibouti (Klaus 2016).

3.2.6 Systematic Conservation Planning

The derived data layers described above were used to conduct a systematic conservation assessment for the Gulf of Tadjourah and Ghoubet-el-Kharab planning domain. The systematic conservation assessment involved three main analyses using the data layer as shown in the Table 3.2.4 below and included: an assessment of ecosystem protection, ecosystem threat, followed by the spatial prioritisation process, using Marxan.

Table 3.2.41: Summary of the data layers included in each of the three primary analyses

	Protection Assessment	Threat Assessment	MARXAN Prioritisation
Habitats	●	●	●
Protected Areas	●		●
Condition		●	●
Species			●
Processes			●
Opportunities and constraints			●

Assessment 1: Protection

The habitats and protected area data layers were used to evaluate the current coverage of different habitat types within the existing protected area network. This assessment goes beyond stating overall percentages of land or sea area that are protected, and examines the habitat representativeness achieved within the existing network at an ecosystem wide level. For this purpose, *protected* means those areas that are formally proclaimed or declared, and have a formal legal status, within the planning domain even if they are not effectively enforced.

At present, the legally declared protected areas within the Djibouti cover a total of 536.39 km^2 which includes a marine component of 441.30 km^2 and a coastal component of 95.09 km^2, equivalent to 6.28% of the EEZ or 2.94% of the planning domain, and 5.91% of the whole coast or 0.05% of the planning domain (Klaus 2016).

The existing protected areas, although primarily designated for biodiversity conservation, are equivalent to sustainable use areas as artisanal fishing is allowed (Djibril 2015)[9].

The representativeness of habitat coverage within the existing protected areas was calculated and the habitats were then classified using the scheme in Table 3.2.5. If more than 90% of a habitat was within an existing protected area, the habitat type was considered to be 'Well protected'. Conversely, if the habitat type did not occur in any protected area or if the coverage was less than 5%, the ecosystem was considered 'Not protected'. The results of the assessment and proportion of each habitat type that is protected within the existing n network are presented in Klaus (2016) and summarised below.

- In the marine realm: Of the 49 marine habitats mapped none would qualify as being "Well protected", 5 habitats would qualify as 'Moderately protected' (50-90%), and 11 habitat types would be considered to be 'Poorly protected' (5-49%), while the rest are 'Not protected' (<5%).
- In the terrestrial realm: Of the 23 coastal habitats mapped, three of the coastal habitat types would qualify as being "Well protected", one habitats would qualify as 'Moderately protected' (50-90%), and one habitat type would be considered to be 'Poorly protected' (5-49%), while the rest are 'Not protected' (<5%).

The habitats that are currently not protected or poorly protected within the planning domain thus need to be prioritised within the spatial prioritisation process.

Table 3.2.5: Protected Assessment Classes and Habitat Protection Status (Klaus 2016)

Category	Quantity	Marine Habitats	Terrestrial Habitats	Combined
Not protected	0 or <5% of protection	67.34% (33)	78.26% (18)	70.83% (51)
Poorly protected	5-49% of protection	22.45% (11)	4.35% (1)	16.67% (12)
Moderately protected	50-89% of protection	10.20% (5)	4.35% (1)	8.33% (6)
Well protected	>90% of protection	0.00% (0)	13.04 (3)	4.17% (3)

Assessment 2: Threat

The assessment of ecosystem threat status aims to evaluate the degree to which habitats are still intact or degraded. The threat assessment uses the habitat and the condition data layer to evaluate what area of habitat remains in a natural or near-natural state.

In this step the condition data layer is used to classify the habitat data layer. Each habitat type was then classified, using a scheme similar to that used in the IUCN Red List criteria (i.e. critically endangered, endangered, threatened, vulnerable etc.) based on the proportion of each habitat that remained in a natural / good condition.

The results presented in Klaus (2016) show is that there are fewer coastal / terrestrial habitats that are classified as threatened as compared to marine habitats. The threatened coastal / terrestrial habitats include the coralline islands of Musha and Maskhali, which is classed a 'Vulnerable' and the southern volcanic islands, which are classed as 'Endangered'.

The threatened marine habitats include 7 'Critically Endangered' habitats, 21 'Endangered' habitats, 5 'Vulnerable' habitats and the remaining habitat classes are classified as being of 'Least Concern' using the current classification scheme.

[9] Article 4 of Law No. 45/AN/04/5 (GoD 2004a) specifies that *"Land and Marine Protected Areas are not enclosed areas and are not denied access. Livestock and fishing activities practiced in the traditional way and crafts, and ecotourism are allowed but regulated and controlled in order to preserve biodiversity"*.

The ‘Critically Endangered’ marine habitats include hard corals on the fringing reef on the south coast, the submerged patch reefs, island fringing reefs, and coral communities on rock within the Ghoubet. The ‘Endangered’ habitats include the full range of habitat types found on the fringing reef (sand, seagrass and hard corals), on the north coast and south coast and around the islands and coral communities within the Ghoubet.

The deeper habitat classes such as the shallow shelf area between 30m to 200m water depth, is classed as ‘Endangered’ on the south coast, which also encompasses the islands of Musha and Maskhali, whereas the shelf to the north is considered ‘Vulnerable’. The shallow shelf within the Ghoubet is considered to be ‘Least Concern’. The deep slope on the north and south of the Gulf of Tadjourah and the trench are all considered to be of ‘Least Concern’.

The threat status classification of the habitats will be used alongside the protection status in setting targets for protection in the spatial prioritisation assessment using Marxan.

Assessment 3: Spatial Prioritisation

MARXAN conservation planning software was designed as a decision support tool to help planners to solve complex conservation planning problems in both landscapes and seascapes. More specifically MARXAN was originally designed to help solve a minimum cost model, which aims to identify the most spatially efficient system of protected areas that both meet the conservation design targets while minimising the total socio-economic cost of protected area expansion to other resource users. While ideally these cost surfaces would be prepared using the monetary value for each specific sector and or the total ecosystem goods and services this is often not technically feasible. More commonly, the 'cost' surfaces are derived using the best available data to represent relative socio-economic costs which takes into consideration that habitat condition, as well as potential opportunities and constraints data layers. In this context areas in good condition and opportunities are considered to be lower cost, while poor condition or degraded areas and areas with existing or proposed socio-economic constraints are considered to higher costs.

The analyses followed standard Marxan processes as outlined in the good practices handbook (Ardron et al. 2008). The 64-bit Marxan (version 2.4) (Ball et al. 2009) was used to map areas to meet representation targets for conservation features. The conservation features and input files were setup using the QMarxan in QGIS 1.8.0 Lisboa. The software Zonae Cognito was used to assist in the initial calibration of the Marxan input parameters prior to running Marxan. Further calibrations used an iterative approach to identify appropriate Species Penalty Factor (SPF) values and Boundary Length Modifier (BLM). The scenarios used 100 runs of 1,000,000 iterations each, and the outputs were used to define site selection frequency for the spatial prioritization.

Irreplaceability Model

Six trial ‘irreplaceability’ trial scenarios were run in preparation for a stakeholder workshop (IUCN 2015) and before the final runs as presented below. The six demonstration trial runs included 275 conservation features, including the geomorphological units, habitat types, various ecological process habitats (e.g. mangroves and wetlands, turtle nesting beaches, birds, fish spawning sites), 108 fish species and 53 coral genera data layers across six bioregions. The focus of these trials was to demonstrate: (a) potential configurations to achieve a protected area estate with 5%, 10%, 15%, 20%, 25% and 30% coverage of the sea, (b) the use of fixed or variable percentage targets for conservation features, (c) the influence of planning unit status and (d) the use of a cost data layer. The six demonstration scenarios run were then run as follows (Klaus 2016):

- Irreplaceability 01: cost =1, targets = fixed geographical targets with coverage of 5%, 10%, 15%, 20%, 25%, and 30%, protected areas = 0 (not ‘locked-in’)
- Irreplaceability 02: cost =1, targets = fixed geographical targets with coverage of 5%, 10%, 15%, 20%, 25%, and 30%, protected areas = 2 (‘locked-in’)
- Irreplaceability 03: cost =1, targets = fixed geographical targets with coverage of 5%, 10%, 15%, 20%, 25%, and 30%, with variable targets for higher priority species, protected areas =0 (not locked in)

- Irreplaceability 04: cost =1, targets = fixed geographical targets with coverage of 5%, 10%, 15%, 20%, 25%, and 30%, with variable targets for higher priority species, protected areas = 2 ('locked-in')
- Irreplaceability 05: cost = threat, targets = fixed geographical targets with coverage of 5%, 10%, 15%, 20%, 25%, and 30%, with variable targets for higher priority species, protected areas = 0 (not 'locked-in')
- Irreplaceability 06: cost = threat, targets = fixed geographical targets with coverage of 5%, 10%, 15%, 20%, 25%, and 30%, with variable targets for higher priority species, protected areas = 2 ('locked-in')

In all of the above scenarios, the model was run six times with fixed geographical target of either 5%, 10%, 15%, 20%, 25% and 30% for all features and protected areas were either not locked in or locked in. In the first four scenarios the cost of all planning units was set to 1, whereas threat was used in the final two scenarios. The results of the trial runs were presented to the expert participants at the stakeholder workshop (IUCN 2015). Percentage coverage targets used for the habitats were discussed.

Final 'Minimum Cost' Models

The final version of the model combined 296 features, which includes 73 marine and coastal habitat features, 53 coral genera, 108 fish species and a further set of data layers representing either ecological process habitats (e.g. productivity) or indicators (see **Appendices).** These datasets include the current best available data for both terrestrial and marine species and / or their critical habitats (e.g. foraging, nesting / spawning grounds). Two final scenarios were then run which tested the influence of the cost data layers on potential configuration of protected areas. The cost surfaces were used to ensure preferential selection of least transformed, high opportunity and least conflict sites.

3.2.7 Results

Marxan analyses produce several outputs. The two key outputs are the:

(i) The '**Best Solution**' which shows the best result from all of the runs (i.e. when the Marxan model for any particular scenario is repeated 100 times, Marxan identifies which out the 100 runs was the best run or 'Best Solution') and;

(ii) the '**Sum Solution**' map which shows the number of times each planning unit was selected (i.e. when the Marxan model for any particular scenario is repeated 100 times, the planning unit can then have a 'Sum Solution' value of 0 to 100, often represented by a percentage. A unit that is selected 100 times is likely to contain a high proportion of the conservation features of priority concern with minimal associated costs, where costs are used, while a unit that is never selected likely contains little of conservation value or has a high associated cost, where costs are used).

The 'Sum Solution' maps, which are the focus of these analyses, are rather like heat maps, in that they highlight the areas that Marxan has identified repeatedly as being important for meeting the targets between each of the runs regardless of the geographical coverage targets (5%, 10%, 15%, 20%, 25% and 30%). These maps thus represent the cumulative total number of times that a planning unit has been selected to meet the targets while also minimizing costs.

The 'Best Solution' and 'Sum Solutions' results for each of the runs included in the Irreplaceability scenarios 01 to 06 are presented in Appendix X.1 to X.6. The maps show the results for each of the runs using 5%, 10%, 15%, 20%, 25% and 30% as targets.

Figure 3.2.12 and Figure 3.2.13 show the total sum of all of the 'Sum Solutions' maps for the six runs completed within each scenario (i.e. sum solution 5% + sum solution 10% + sum solution 15% + sum solution 20% etc). The highest achievable selection score within these maps is thus 600 (6*100).

These cumulative 'Sum Solution' maps consistently highlight several large blocks of planning units that Marxan has repeatedly identified as being important to meeting the protected area targets irrespective of total percentage coverage and whether or not protected areas were locked in or not.

In Scenario 01 (Figure 3.2.12a), where costs were equal, fixed coverage targets were used, and the existing MPA network was not locked in, the selection frequency was highest around the entrance to Ghoubet and around Obock, but important areas were also identified around Tadjourah, Djiboutiville and Musha and Maskhali Islands. These results suggest that Ghoubet and Obock are particularly high priority areas for conservation purposes.

In Scenario 02 (Figure 3.2.12b), where costs were equal, fixed coverage targets were used, and where the existing protected areas were locked in, the selection frequency was highest around the existing MPA network at Arta, Musha and Maskhali, D'Haramous, but also around other areas that are not currently protected within Ghoubet and Obock. These results also suggest that Ghoubet and Obock are high priority areas for conservation purposes, additional to the existing MPA coverage.

In Scenario 03 (Figure 3.2.12c), where costs were equal, fixed geographical coverage targets were used together with higher targets for species of particular conservation concern, and protected areas were not locked in, the selection frequency was highest around the western end of Ghoubet, near Arta, but also around Musha and Maskhali, and Obock. These results also suggest that the western end of Ghoubet and Obock are high priority areas for conservation purposes, additional to the existing protected areas.

In Scenario 04 (Figure 3.2.12d), where costs were equal, fixed coverage targets were used together with higher targets for species of particular conservation concern, and protected areas were locked in, the selection frequency was highest around the western end of Ghoubet, and around Arta, but also around Musha and Maskhali, and around Obock. These results suggest that the western end of Ghoubet and Obock are high priority areas for conservation purposes.

In Scenario 05 (Figure 3.2.13a), costs were set to reflect the condition or degree of threat. Fixed coverage targets were used together with higher targets for species of particular conservation concern, and protected areas were not locked in. The selection frequency was highest around the entrance to Ghoubet and around Obock, to the east of Musha and Maskhali, and the east of Tadjourah. Areas around Djiboutiville, including areas to the west around D'Haramous were not selected frequently because of the higher costs associated with this area.

In Scenario 06 (Figure 3.2.13b), costs were again set to reflect the threat. Fixed coverage targets were used together with higher targets for species of particular conservation concern, and protected areas were locked in. The selection frequency was highest at the western end of Ghoubet, at the entrance to Ghoubet and Arta, to the east of Musha and Maskali, and around Obock. Although there were some areas around D'Haramous and Musha and Maskhali selected most of the area was not selected frequently even though it was locked in because of the higher costs associated with this area. These results also suggest that the western end of Ghoubet and Obocok are high priority areas for conservation purposes.

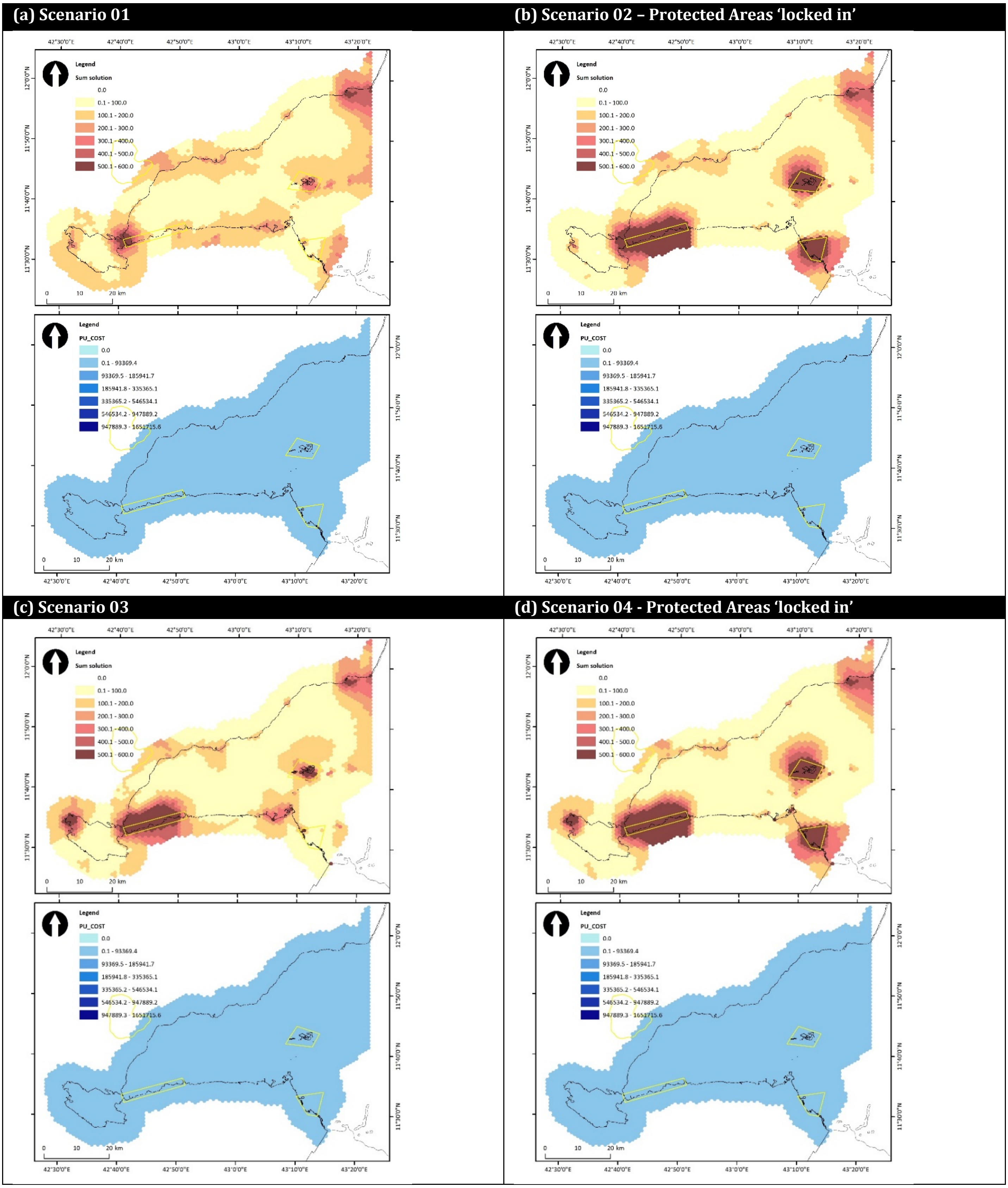


Figure 3.2.12: Maps showing the sum solutions and costs from (a) Scenario 01 and (b) Scenario 02 which used fixed percentage coverage targets (5 to 30%), and (c) Scenario 03 and (d) Scenario 04, which used fixed percentage coverage targets (5 to 30%) and variable feature targets. Costs for all scenarios =1 and Protected Areas locked in for (b and d)

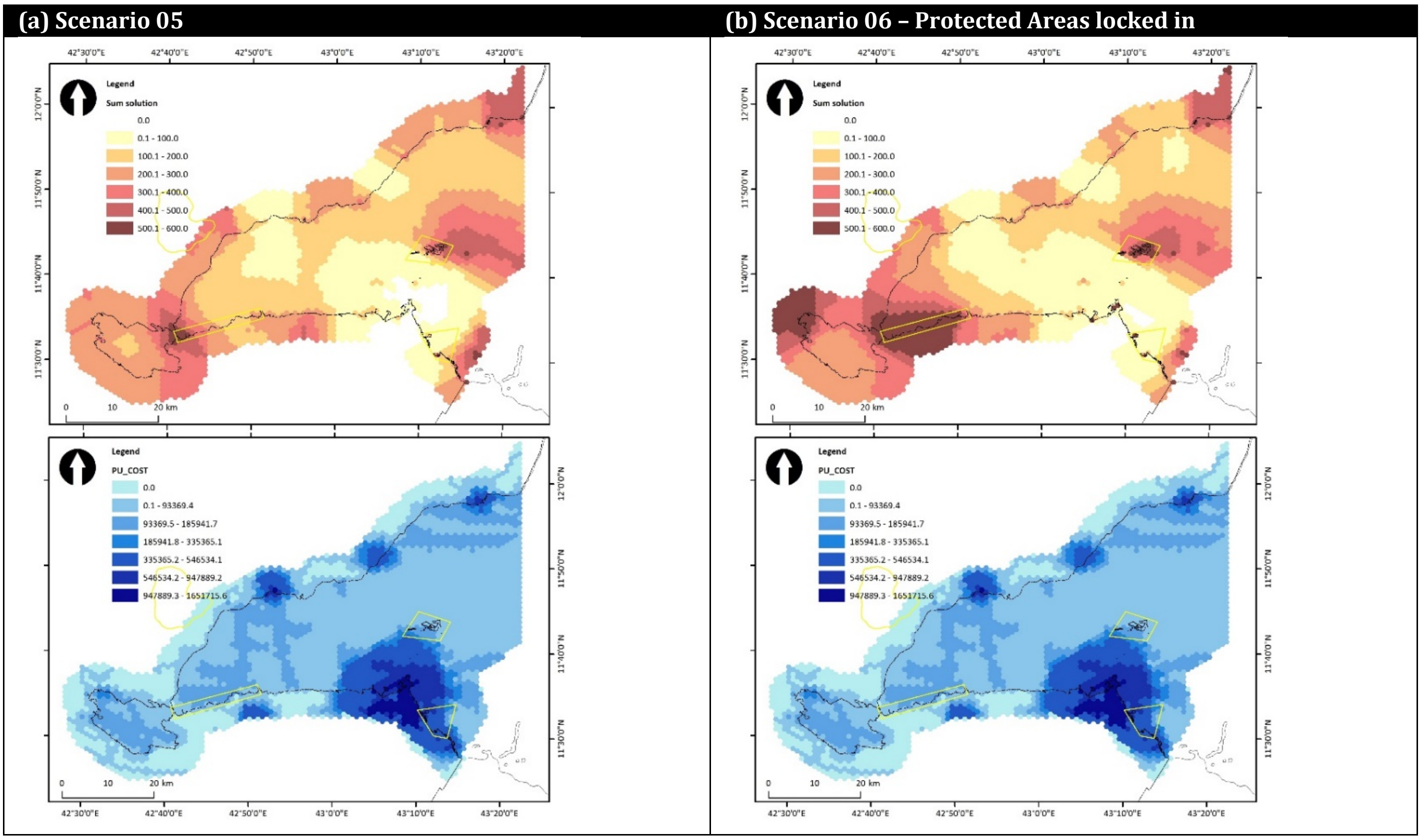


Figure 3.2.13: Maps showing the sum solutions and costs from (a) Scenario 05 and (b) Scenario 06 which used fixed percentage coverage targets (5% to 30%), and variable feature targets for conservation features of higher priority concern. Costs for all scenarios = threat and Protected Areas locked in for (b).

The results of the final runs for Scenario 07 are shown in Figure 3.2.14 and 3.2.15, for Scenario 08 in Figure 3.2.16 and 3.2.17 and for Scenario 09 in Figure 3.18. In these two scenarios the cost used were the final 'Condition' data layer (Cost03) and final relative cumulative cost data layer (Cost04) respectively. In Scenario 08 protected area fishing and port areas were locked out, while in Scenario 09, infrastructure and military were locked out.

The priority areas identified through these model runs were similar between the scenarios, and the results consistently highlighted areas as being important for the protected area expansion in Djibouti.

In Scenario 07, when protected areas were not locked in (Figure 3.2.14a), the areas identified included an area of the Ghoubet, which extended along the south coast around Arta Plage, an area around D'Haramous, Musha and Maskhali Islands, Ankali, the Day Forest, Tadjourah, and Obock. The results were similar when the model was run with the existing protected areas (Figure 3.2.14b) or both existing and proposed protected areas (Figure 3.2.15a) locked in.

In Scenario 08, when protected areas were not locked in (Figure 3.2.16a), similar areas were identified as in Scenario 07, with areas around Ghoubet and Arta Plage, D'Haramous, Musha and Maskhali Islands, Ankali, the Day Forest, Tadjourah, and Obock. The results were similar when the model was run with the existing protected areas locked in (Figure 3.2.14b), or both existing and proposed protected areas were locked in (Figure 3.2.15a).

These high priority areas include a suite of areas which could potentially be declared as core areas with a higher protection status, embedded within a set of larger priority areas which could be declared as sustainable use areas with a lower protection status, for use in tourism and low level artisanal fisheries.

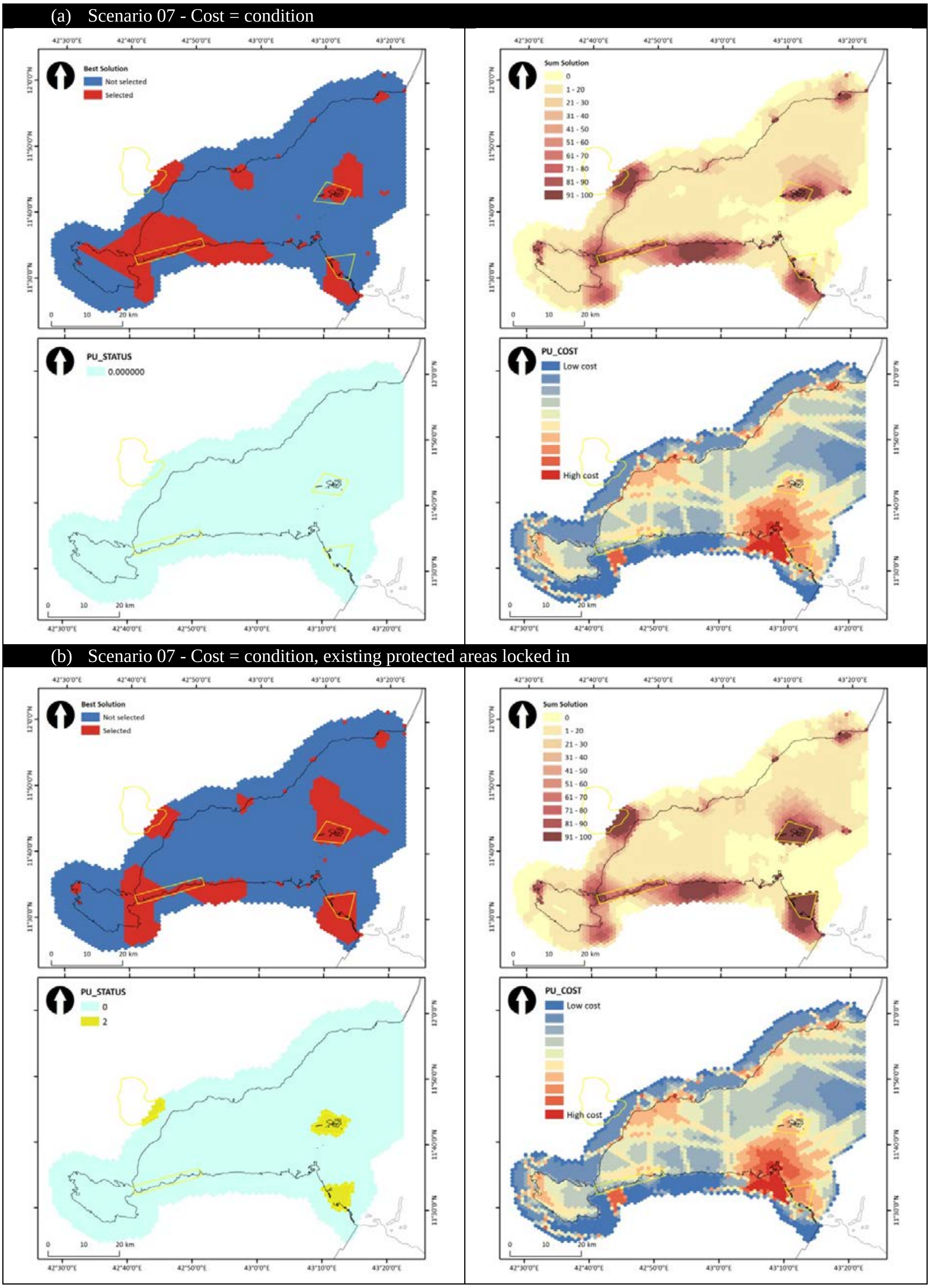


Figure 3.2.14: Maps showing the results of Scenario 7, showing the 'best solution', 'sum solution, planning unit status (pu_status) and relative costs (pu_costs), where the legally declared protected areas were (a) not locked in and (b) locked in

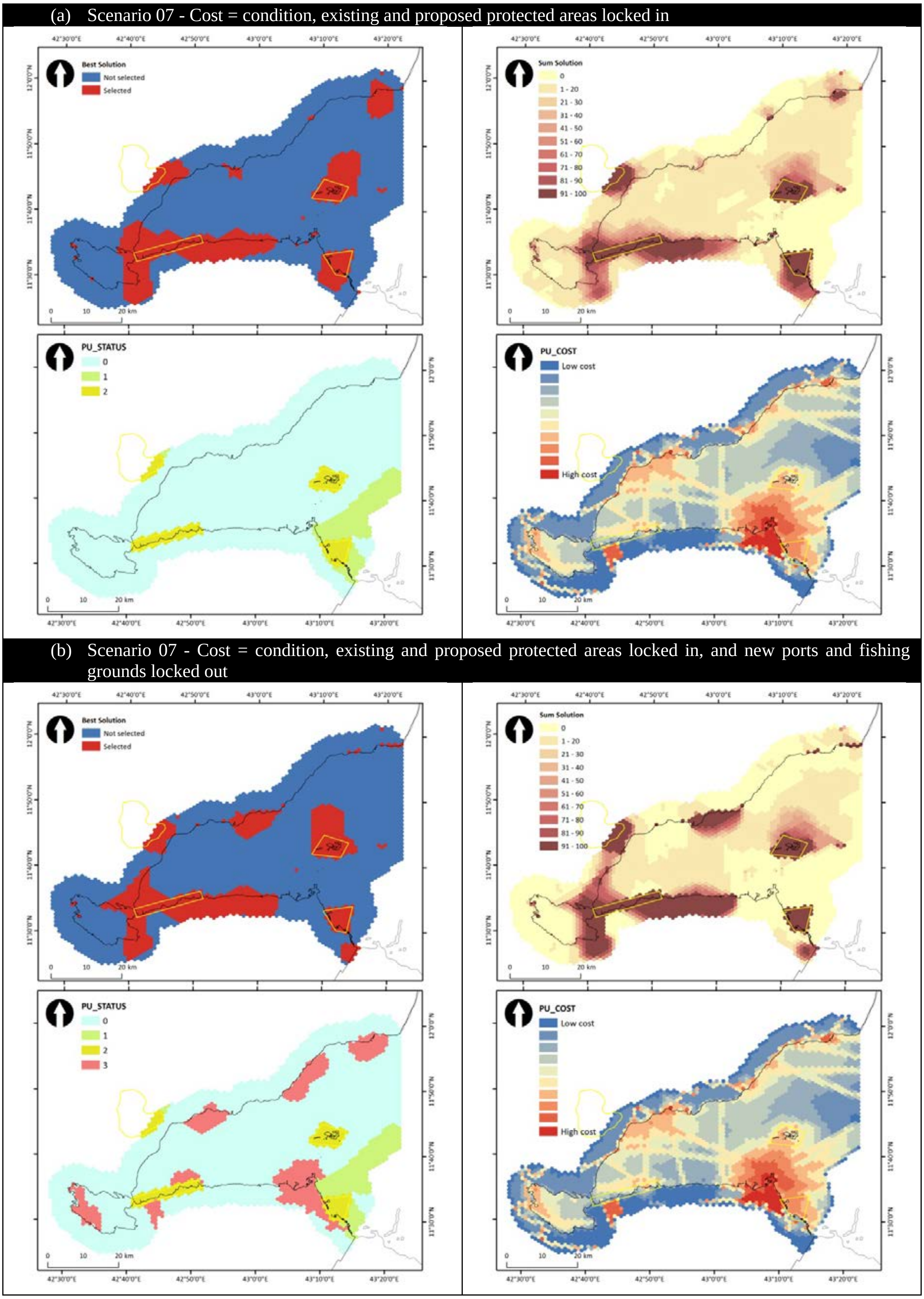


Figure 3.2.15: Maps showing the results of Scenario 7, showing the 'best solution', 'sum solution, planning unit status (pu_status) and relative costs (pu_costs) where both proposed and existing protected areas were (a) locked in and (b) where new ports and fishing grounds were locked out.

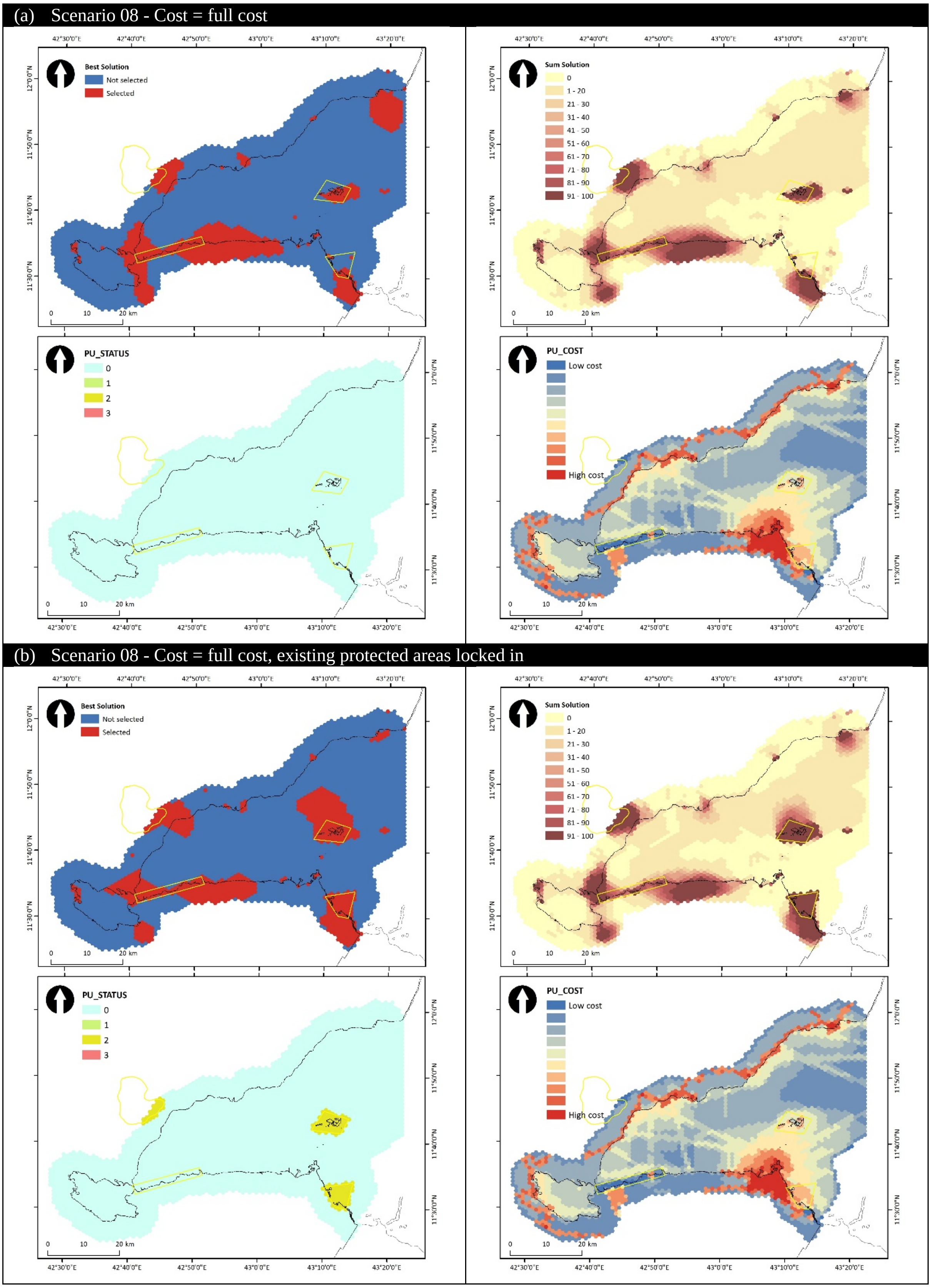


Figure 3.2.16: Maps showing the results of Scenario 08, showing the 'best solution', 'sum solution, planning unit status (pu_status) and relative costs (pu_costs) where the legally declared protected areas were (a) not locked in and (b) locked in

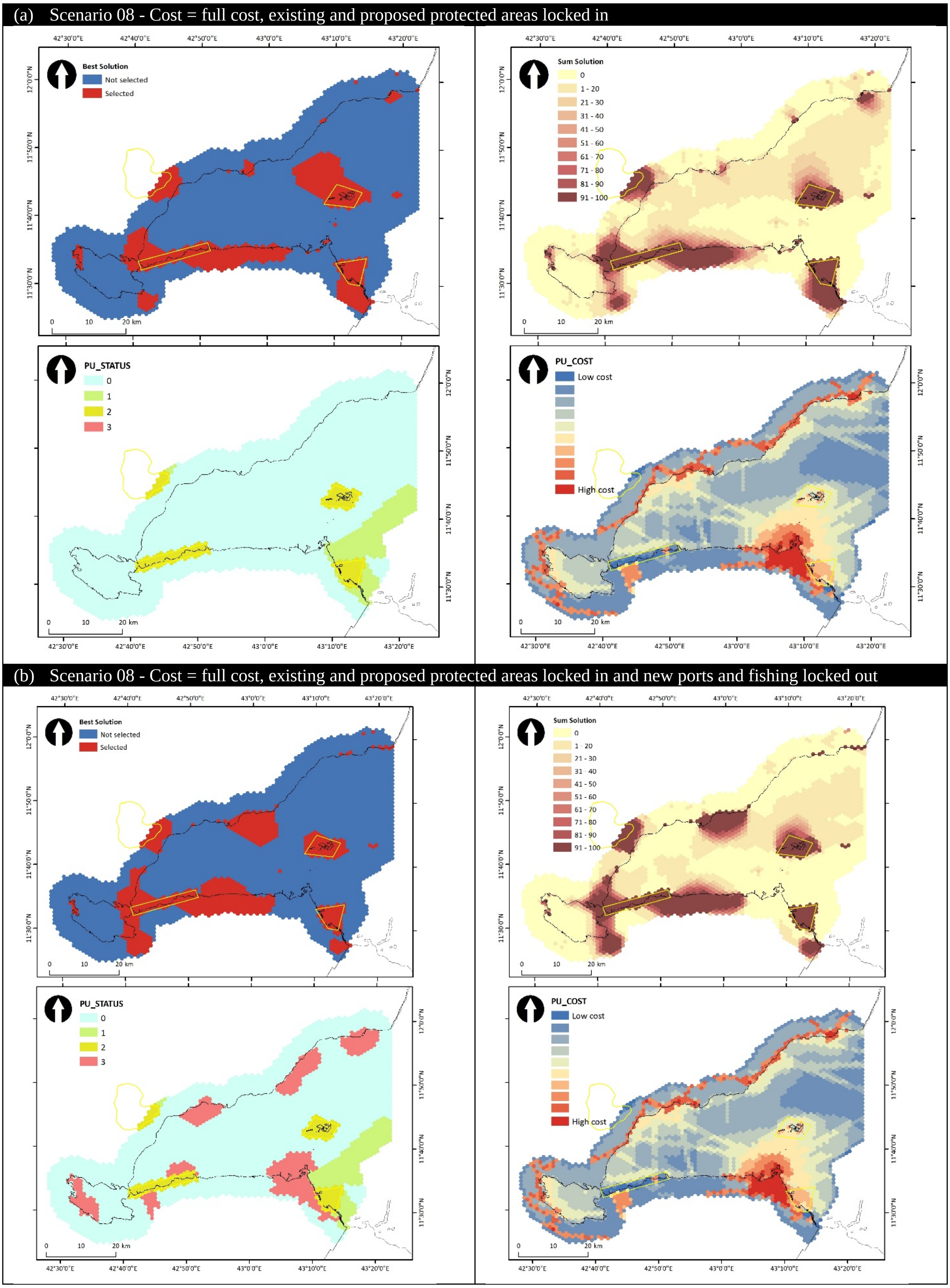


Figure 3.2.17: Maps showing the results of Scenario 08, showing the 'best solution', 'sum solution, planning unit status (pu_status) and relative costs (pu_costs) where both proposed and existing protected areas were (a) locked in and (b) where new ports and fishing grounds were locked out.

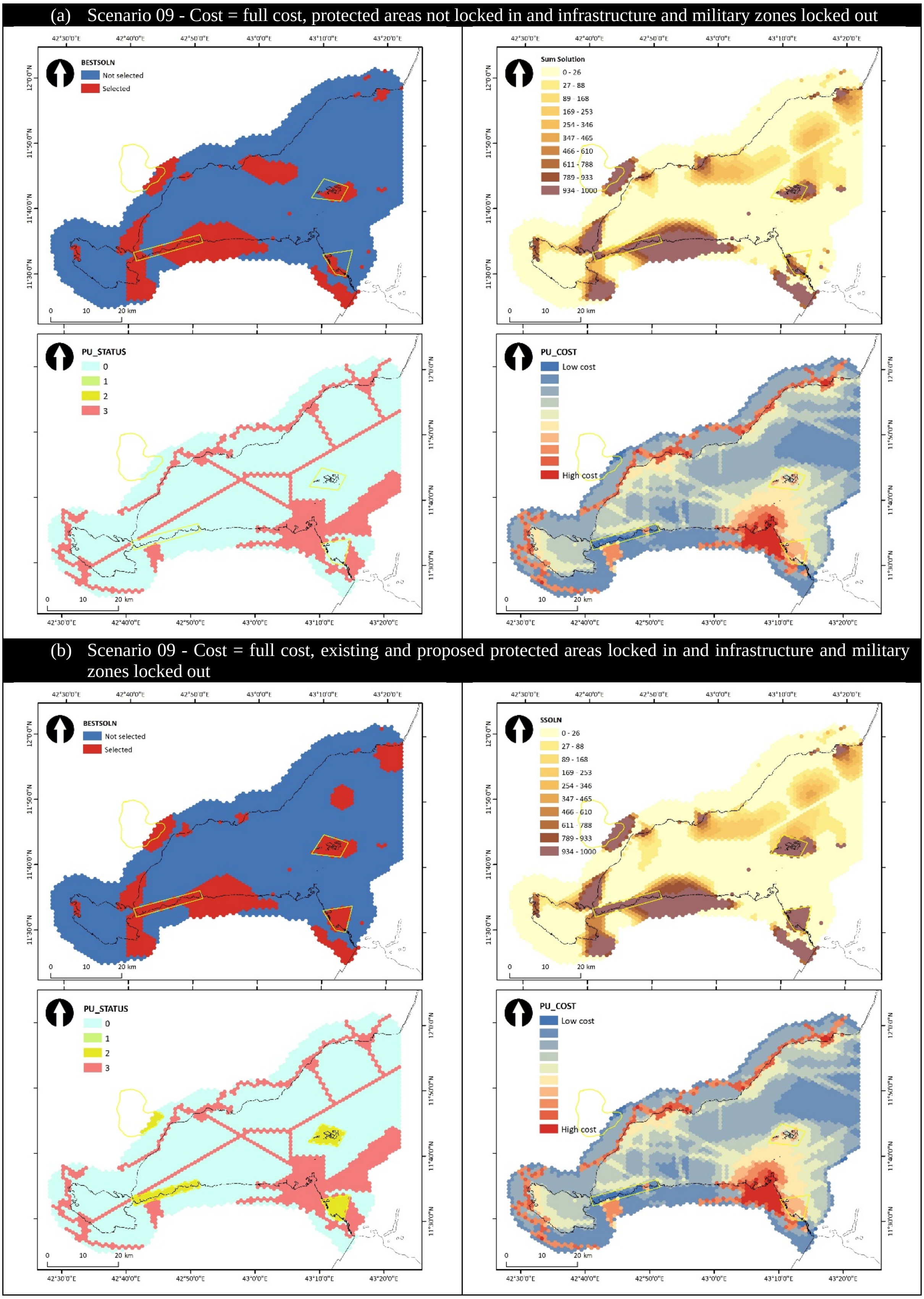


Figure 3.2.18: Maps showing the results of Scenario 08, showing the ‘best solution’, ‘sum solution, planning unit status (pu_status) and relative costs (pu_costs) where the legally declared protected areas were (a) not locked in and (b) locked in

4. Draft Seascape Plan

4.1 Introduction

Developing the Seascape Plan required three principal steps to guide the allocation of space among different sectors and activities and for these to be discussed in detail at a stakeholder workshop which was held in October 2015. The steps are listed here and the process detailed in the following sections.

a) agreement on the rules or decision-making criteria to be used to allocate space (and time) for each of the different marine uses, or sectors. Some generic principles were used to guide this process.
b) Visioning of the desired nature of each sector and its development over time.
c) Establishing the compatibility matrix among sectors and activities.

4.2 Marine Spatial Planning Principles and process

Marine Spatial Planning (MSP) is a "*public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process*" (Ehler and Douvere 2009). It can be used in the context of ecosystem-based management to address both human and ecosystem needs and moves from a sector-by-sector approach to an integrated management approach. MSP processes can vary because of the differences in public policies and legislation. In addition, marine areas may have different objectives and management agencies may use different combinations of tools, including zoning.

A multi-objective MSP process requires agreement on the rules or decision-making criteria that will be used to allocate space (and time) for each of the different marine uses. Eight generic guiding principles for the process are listed in Table 4.1 and were presented at the Seascape planning workshop (IUCN 2015) to discuss and seek agreement from all user groups that these principles are useful to guide the development of the Djibouti Seascape.

Table 4.1 Marine Spatial Planning Principles (after Ehler and Douvere 2009).

Principle	Description
Integrated	Address the interrelationship among issues and sectors and between nature and development; integration can help create complementary and mutually reinforcing decisions and actions.
Ecosystem-based	Safeguard ecosystem processes, resilience and connectedness, recognising that ecosystems are dynamic, changing and sometimes poorly understood (therefore requiring precautionary decision-making).
Public Trust	Marine resources are part of the public domain, not owned exclusively or benefited by any one group; decisions should be made in the interest of the whole community and not any one group or private interest.
Sustainability	Decision making should take into account environmental, economic, social and cultural values in meeting the needs of the present without compromising the ability of future generations to meet their needs.
Transparency	The processes used to make decisions should be easily understood by the public, allow citizens to see how decisions are made, how resources have been allocated, and how decisions have been reached that affect their lives.
Participatory	Communities, persons, and interests affected by marine resource or activity management should have an opportunity to participate in the formulation of ocean management decisions.
Precautionary	Article 15 of the Rio Declaration on Sustainable Development states that: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".
Adaptive	MSP is a continuing, iterative process that learns and adapts over time.

Stakeholders agreed that a multi-sectoral, integrated and holistic approach was absolutely essential in light of the rapidly developing seascape. It was noted that the data generated through the MSP process could be invaluable in informing future environmental impact assessments and environmental management plans. It was also recognised that the polarisation of environment and development issues is unhelpful and should be turned around to look at the externalities and tradeoffs involved for different trajectories of economic development, and that MSP can help such processes.

Other observations from the stakeholder workshop noted that the true value of environment and ecosystem services are often not properly incorporated into economic development accounting. There is therefore a need to consider natural capital e.g. values of ecosystems services provided by coral reefs, whale sharks and other assets, and instruments such as carbon taxes, to steer development towards sustainability. It was also noted that the focus should not just be on biodiversity but rather on the wider sustainable development goals for the seascape. Further, some of the large new developments in the Djibouti seascape, including a Chinese naval base, are initiatives that need close coordination with the objectives of other sectors and that it is extremely important to try and reduce conflicts between these developments and sustainable development objectives. Full details of stakeholder feedback and inputs to the Seascape Planning process can be found in the workshop report (IUCN 2015).

4.3 Visioning and Developing a Zoning Design

The following six steps were taken to identify the first draft zoning design.

1. **Develop a vision**. Identify all current and possible future uses within the planning domain. The visioning process should ensure that all user groups are represented and an overall vision for the space is agreed. The outputs are used to then draft the zone types and their goals and objectives.
2. **Create maps showing existing and future uses**: Spatial GIS datasets are created to represent existing and possible future uses. Some of the uses have already been mapped and were presented to stakeholders; validation of these datasets and identification of gaps were discussed. Participatory mapping techniques were used to fill the gaps during the workshop and to create maps for uses that are not currently represented. This may also involve making decisions about how each use can be best represented e.g. using distances or other metrics to represent tourism as being most intense within 2 km of beaches with nearby hotels. Through this process it was important to try and ensure future uses are spatially represented e.g. areas identified as suitable for wind power generation if applicable.
3. **Assess compatibility between user group / zones**: A compatibility matrix planning tool was used to assess compatible uses and to identify conflicts between groups.
4. **User groups identify the "priority areas" for a particular use.** Once all the areas have been mapped the highest priority or core areas need to be identified if these are not already apparent. The outputs of the systematic conservation planning process was used here to represent high priority biodiversity areas combined with the participatory planning exercise in the workshop.
5. **Discuss and agree on representation goals and objectives:** This step discusses and agrees upon the percentage of each area that needs to be included. For example some zones will be fixed (e.g. security areas, port areas) while others can change. For example, with the high priority biodiversity areas, what percentage needs to be protected? Are the existing protected areas sufficient or are there gaps? What percentage of high priority fishing areas needs to be maintained for food security? This step has not been taken in the current Seascape Plan and needs to be led by government as captured in Section 5 of this report.
6. **Minimize overlap between zones**. The compatibility matrix and information gathered above was then used to inform zoning with the aim of minimising the overlap between conflicting zone types. With the high priority areas identified for each of the given uses, areas where there are potentially conflicting uses were identified and the distance between conflicting uses was maximised. Finally, there was a focus on containing development to specific areas to minimize impacts on biodiversity.

Six sectors were used to develop a vision for the Djibouti Seascape Plan and these broadly equate to zones in the Seascape Plan:

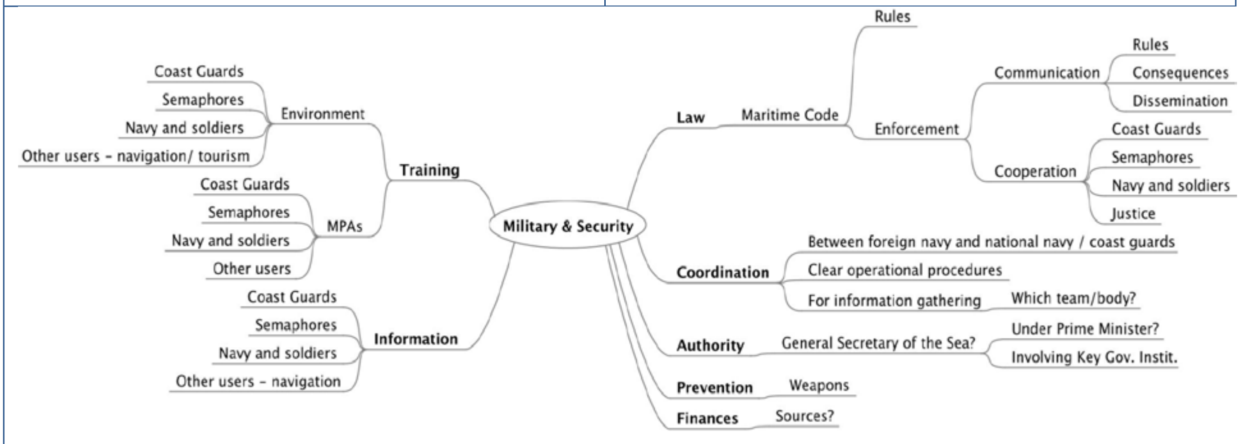
A. Fisheries and Mariculture
B. Biodiversity and Conservation
C. Infrastructure and Utilities
D. Non-renewable resources
E. Tourism and recreation
F. Military and Security

The vision for each sector was guided by two questions: 1) what aspects of each sector are most important now; and 2) how would participants like to see the sectors develop in the future. This was done through group activities in the stakeholder workshop with the resulting outcomes grouped under general thematic goals and objectives for each sector/zone. The resulting vision per zone or sector are summarized in Table 4.2.

Table 4.2. Vision for marine sectors in the Djibouti Seascape, developed during the stakholder planning workshop, October 2015.

Zone A: Fisheries and Mariculture	Zone B: Biodiversity conservation
Thematic Goal A1: Develop sustainable national commercial fisheries • To authorize /develop (national?) industrial / commercial fishing • Develop plans and policies to protect fisheries investments ***Thematic Goal A2: Strengthen co-management framework for small scale fisheries*** • Improve organization of existing and new fishing cooperatives • Provide financial support to small scale artisanal fisheries ***Thematic Goal A3: Improve small scale fisheries efficiency*** • Equip artisanal fishers • Develop the fishing profession • Develop fishing marketing and sales of fish i.e. commercialization of fishing • Increase the profitability of fish resources for Djibouti ***Goal A4: Promote fish for food security*** • Develop sensitization /awareness raising on the benefits of fish as a food source • Raise awareness and lobby for increased fish and seafood consumption	***Thematic Goal B1: Restoration and rehabilitation*** • Mangroves suffering from mortality (remove dead trees to allow for regrowth) and desertification/sand movements covering the mangroves and needing removal. More generally, this could be interpreted as promoting restoration/rehabilitation through enhancing natural processes, but where necessary, direct actions. Also discussed in relation to heavily used beach areas, many of which are degraded. ***Thematic Goal B2: Invasive species management and control (especially Prosopis juliflora)*** • Conflicting views expressed: on the one hand, *Prosopis* is invasive/destructive, and on the other may be a useful resource. Rather than eradication, the group discussed the need for control, to minimize invasive impacts, but where it is present, explore valuable uses (charcoal, livestock feed).) ***Thematic Goal B3: Awareness raising activities for local communities and tourists about conservation*** • There is an urgent need to raise awareness of the marine environment in coastal communities/populations first, and then more broadly for tourists/visitors, etc. This was also discussed in terms of the value of conservation. ***Thematic Goal B4: Rare/emblematic species conservation*** • This was discussed in relation to creating sanctuaries for emblematic species – Napoleon wrasse was mentioned, and turtles. Discussion was also relevant for other key species for which there is national pride and the sense that Djibouti is special for their conservation.
Zone C: infrastructure and utilities	**Zone E: Tourism**
Thematic Goal C1: Resilient / resistant infrastructure • Put in place resilient / resistant infrastructure • LNG terminal and refinery in Damerjog area / Coal plant in Doraleh • Construct ports which will create jobs (conversely some suggested there was no need for more ports) ***Thematic Goal C2: Infrastructure to support fisheries development*** (move to ZONE A?) • Develop infrastructure for fishing cooperatives and markets • Increase fish landing sites ***Thematic Goal C3: Infrastructure to support tourism development*** (move to ZONE E?) • Put in place regional tourism office in the seascape to help raise awareness and understanding of the importance of marine protected areas • Develop ecotourism in beach and other coastal areas • Clean beaches ***Thematic Goal C4: Infrastructure to support improved solid and waste water management*** • Develop desalination plants • Improve waste water treatment facilities to reduce marine pollution	***Thematic Goal E1: Develop ecologically sustainable tourism*** • A broad discussion was had which revolved around the recognition that eco-tourism is desired rather than mass tourism. The basis was that there are limits to e.g. visitation to a site, but this was also in relation to more abstract ideas, that limits do need to be identified and incorporated into management/regulations. ***Thematic Goal E2: Community-based support and involvement*** • Projects/assistance focused on fishers and small scale tourism businesses is needed, as a primary axis in overall planning for the marine/coastal environment.

Zone F: Military & Security	Zone D: non-renewable energy
Group F articulated their vision in the form of a "mind map", below, with the following main sections. ***Thematic Goal F1: Training*** ***Thematic Goal F2: Information*** ***Thematic Goal F3: Law / Legislation*** ***Thematic Goal F4: Coordination*** ***Thematic Goal F5: Authority (including the suggestion to establish a General Secretariat of the Sea)*** ***Thematic Goal F6: Prevention*** ***Thematic Goal F7: Finances***	There were no suggestions relating to in this group, but the group dealing with infrastructure (C) did mention wind energy installation (e.g. at Arta) and development of geothermal energy



4.3 Participatory Mapping and Compatibility Matrix

In addition to the biodiversity and ecosystem health data collected (see Section 3) participatory mapping by participants at the spatial planning workshop (IUCN 2015) was used to fill gaps in the data sets and specify locations, resources and activities of particular importance to stakeholders. The responses provided a great deal of useful information about existing and planned activities, potential conflicts and areas of concern. The participants responded to the following questions:

- What areas do you use?
- What are the best areas / highest priority for you?
- Are there areas that are important at different times of year?
- Are there existing concerns / conflicts?
- Do you have concerns about conflicts in the future

The responses were mapped and then summarized in spreadsheet format (see Appendix 4) and taken forward into the final spatial planning analyses.

The first round of spatial planning was undertaken on a matrix of compatibilities developed by participants in the Marine Spatial Planning workshop in October 2015 (IUCN 2015) and summarised in that report. The compatability matrix is reproduced in Annex 4. The sectors and activities within them have certain incompatibilities that the zoning plan needs to address as well as others that have not yet been assessed ("needs to be completed"), as listed below and detailed in Annex 4.

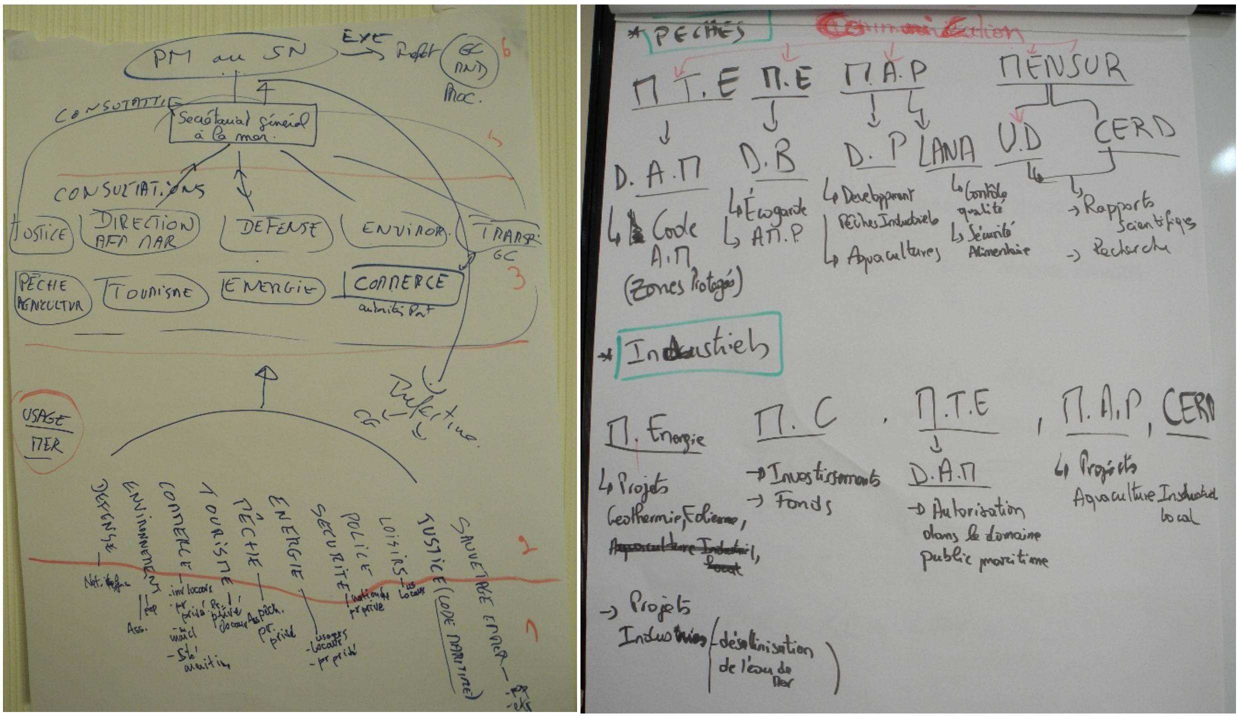
- Maybe compatible (temporary)
- Maybe compatible (permanent)
- Not compatible
- No overlap
- Needs to be completed

Several steps of refinements will be necessary to iron out key incompatibilities and/or compatibilities that are context dependent at particular locations. These refinements are part of the process outlined in Section 5.

The participatory mapping and compiling the compatability matrix represented the first consultative zoning exercise for Djibouti's Seascape Plan. Further iterations and consultations will be needed as part of a longer term process. Zones and conflicting uses will have to be regulated through legislation which takes time and the planning needs to evolve through time. Many data gaps remain, for example, there was little information available regarding the compatibility of the use of non-renewable resources with other uses. These issues are to be taken forward in Section 5 of the Seascape Plan.

4.4 Governance framework

Three working groups on governance arrangements for the Seascape Plan were held at the Seascape planning workshop. Elements from each (Figure 4.1) may be relevant to the final Seascape Plan. These arrangements need to be reviewed during the negotiation, refinement and approval phase (Section 5). Items addressed in the groups included identifying key institutions and individuals that would be needed to take the process forward with clear roles and responsibilities. They were also asked to consider links with existing government processes, policies, legislative frameworks, relevant strategies and plans.



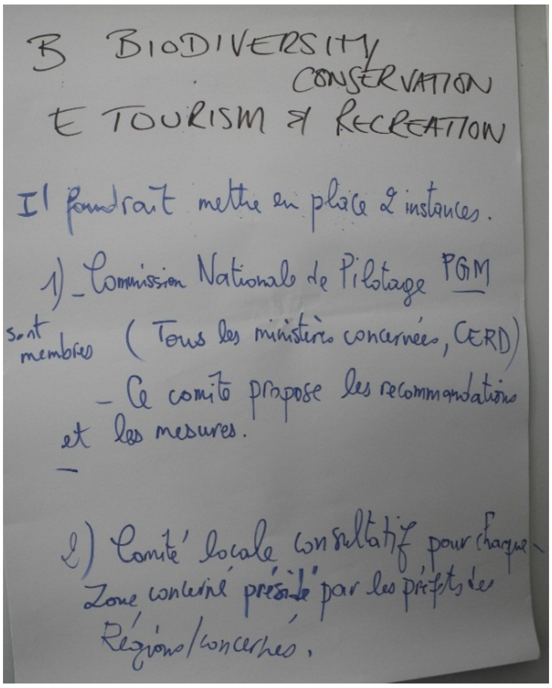


Figure 4.1. Potential governance frameworks for the Djibouti Seascape proposed by the workshop Seascape Planning participants, October 2015.

The first model envisages the creation of a new coordinating authority a “Secretariat of the Sea” which would be under the Prime Minister’s Office and would have the responsibility for coordinating the activities in the seascape with key ministries (justice, maritime affairs, defence, environment, fisheries, agriculture, commerce, energy). The second group proposed two structures: one coordinating the “fisheries sector” (encompassing the ministries of transport & equipment, environment, agriculture, higher learning & research), the other the “industrial sector” (encompassing the ministries of commerce/trade, transport & equipment, environment, agriculture and higher learning & research) with regular communication between the relevant ministries. There would also be a platform to share information between the two structures. The third group proposed two levels for coordinating structures, a steering committee at the national level, established under the Prime Minister’s office that would have representation from all the concerned ministries, and consultative committees at local level at each of the zones for detailed consultations about different proposed projects.

Several key issues arose from these discussions:

- There is considerable convergence between the different models; details can be worked out later through more widespread consultation and the involvement of additional stakeholders; however, there is a need for new mandated coordinating structures that bring together all the various sectors that have an influence and impact on the seascape;
- Coordination and enforcement are two different things and it would have to be carefully worked out whether the proposed structures should/could be mandated to do both;
- It was felt that the Ministry of Housing, Urban Affairs and Environment should be the main lead and the catalyst in driving the process forward for establishing a coordination mechanism for the seascape; this makes sense within the impetus for the Seascape Plan and MHUE is the national partner in the project; however, other key ministries (Maritime affairs, agriculture, fisheries, justice, energy, transport and equipment, defence, etc.) clearly have to be involved and be supportive of these efforts;

- Key laws, regulations and other resource documents are needed to further develop the Seascape plan and to improve coordination mechanisms, which include:
    - Maritime regulations (code maritime)
    - Fishing regulations/code
    - Tourism master plan
    - Environmental regulations (2009, governs EIA, marine protected areas)
    - Extractive industries (code minier/mining code)
    - Port regulations
    - Trade regulations
    - Djibouti's National Biodiversity Strategy and Action Plan
    - Marine charts from Society SHOM
    - Environmental Action Plan
    - Master Plan for Djibouti City
    - Master plan for regions
    - Port development plans
    - Maritime affairs plans
    - Navy/military plans
  - The coastal set back zone (where no building is allowed) is 300 meters from high water mark
  - A review of maritime jurisdiction and laws governing different ministries was recently done and is available from the Ministry of Maritime affairs
  - The Maritime code (Code Maritime 1982) is currently being updated. This was noted as an opportunity to link this with the seascape planning process to try and address the current weaknesses in the Maritime code with respect to environmental considerations;
  - Whatever coordinating mechanism is established needs to consider the devolution of authority to the regions; coordination and decision-making must occur at national and local regional levels

Again these governance issues need to be discussed within government as the Seascape Plan is refined and developed further as indicated in Section 5.

4.5 Draft Zoning Plan for Djibouti

The compilation and analyses of data described in Section 3, together with the visioning, participatory mapping and complementarities matrix from the stakeholder driven Seascape planning workshop (IUCN 2015) as described in this section, were taken forward to develop a first Draft Zoning Plan for the Djibouti Seascape.

The outputs of the Systematic Conservation Planning process were used to devise the biodiversity conservation zone as described in Klaus (2016). Other pre-existing zone types were taken into account in this process (e.g. port boundaries, military and security zones). Maps illustrating the different proposed zone types as discussed at the October workshop (IUCN 2015) are shown below (Figures 4.2 - 4.5). These include Zone A Fisheries Zone, Zone B Biodiversity, Zone C Infrastructure Zone, Zone E Tourism and Zone F Military / Security Zone. There was no discussion about Zone D Renewable Energy during the workshop, so this zone was disregarded. These maps are presented together with the existing and proposed MPAs.

The combined map which shows the interactions between the proposed zones is shown in Figure 4.6. These zones and the interaction and overlap between them requires further discussion between the different stakeholder groups as planned during the verification workshop in Djibouti on 10th October 2016

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Zone A Fisheries and Mariculture

The draft goals for this zone were:

- ***Goal A1: Develop sustainable national commercial fisheries***
- ***Goal A2: Strengthen co-management framework for small scale fisheries***
- ***Goal A3: Improve small scale fisheries efficiency***
- ***Goal A4: Promote fish for food security***

The map illustrates the location of existing fishing villages and three potential fishing zones, and the protected areas. The draft zones aim to separate out the artisanal small scale fisheries (Zone A2 and A3) from any potential future commercial pelagic operations (Zone A3). The zones were created based on the assumption that the shelf in proximity to each village is more heavily targeted. The boundary between Zone 1 and 2 is thus set at a maximum distance of 5 km from the fishing village or the edge of shelf, depending on which is closest to the village. Zone A3 could be further sub-divided into shelf-fisheries and off-shelf pelagic-fisheries and mariculture. Areas already excluded from these zones include the existing infrastructure seabed cable zones and the marine security zone.

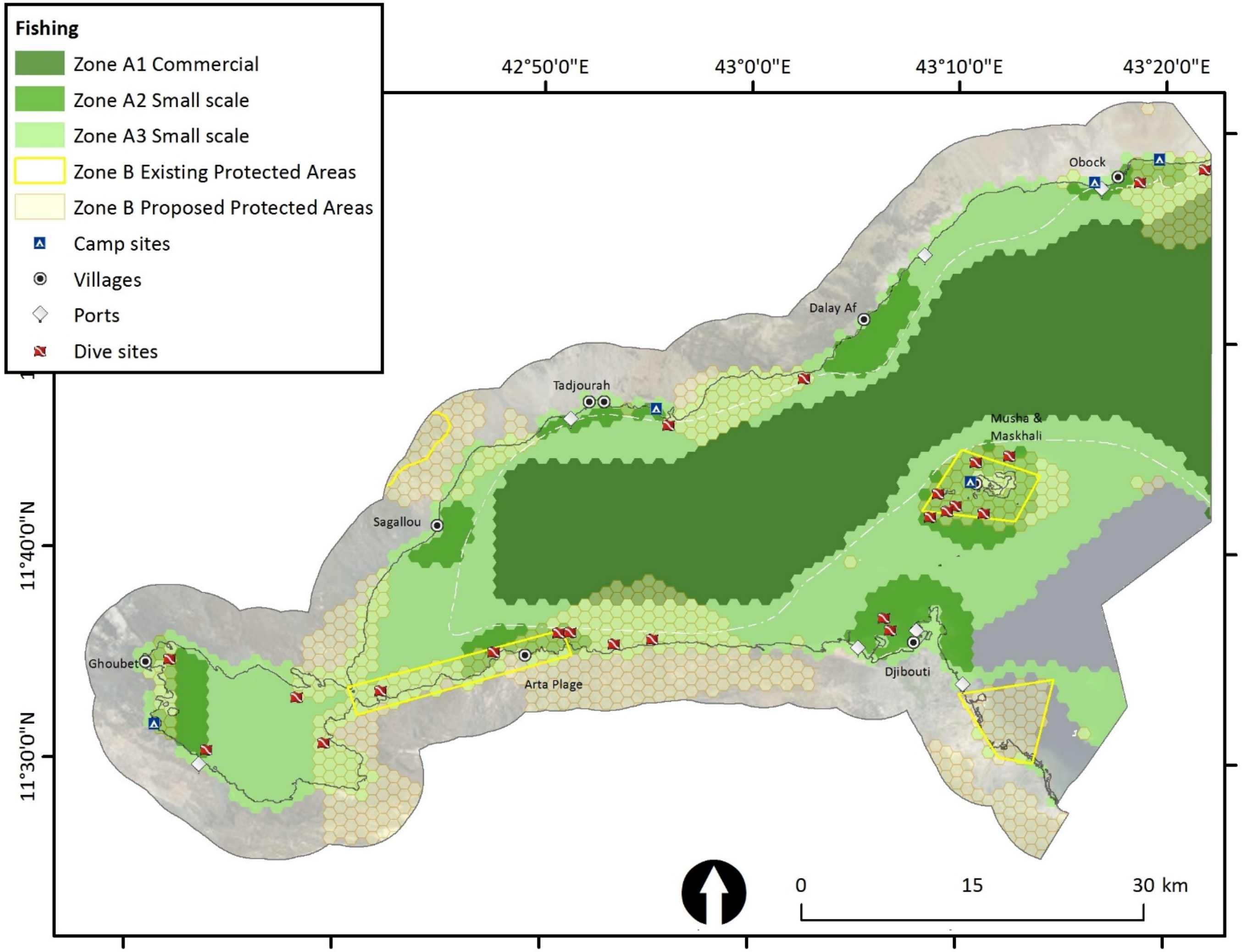


Figure 4.2. Draft Map for Zone A for Fisheries and Mariculture.

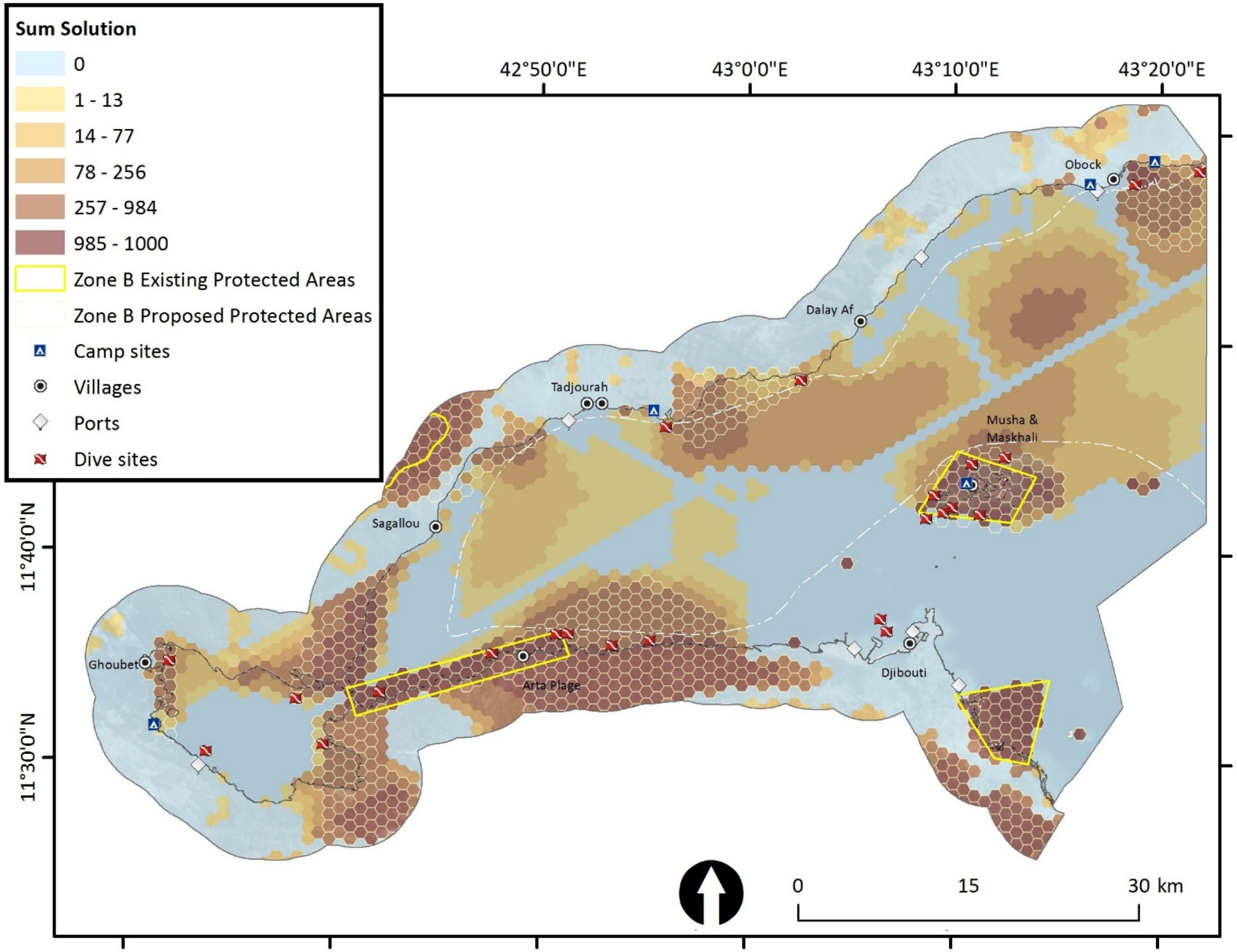
Zone B: Biodiversity conservation	
The draft goals for this zone were: • ***Goal B1: Restoration and rehabilitation*** • ***Goal B2: Invasive species management and control*** • ***Goal B3: Awareness raising activities for local communities and tourists about conservation*** • ***Goal B4: Rare/emblematic species conservation*** This map shows the results of the Systematic Conservation Planning process (Scenario 08) where the existing and proposed protected areas were locked in and the other proposed zone types were locked out. The highlighted areas indicate the potential areas for the expansion of the protected area network within the planning domain. As explained in Klaus (2016), these include the following areas: (i) Ghoubet (ii) Arta - extension (iii) Kalaf/Sagallou – new and (iv) Day forest – extension (v) Tadjourah - new (vi) Obock – new (vii) Musha & Maskhali – extension (viii) Ankali (ix) D'Haramous	

Figure 4.3. Draft Map for Zone B for Biodiversity Conservation (Scenario 08 with existing and proposed protected areas locked in, see Section 3, Klaus 2016).

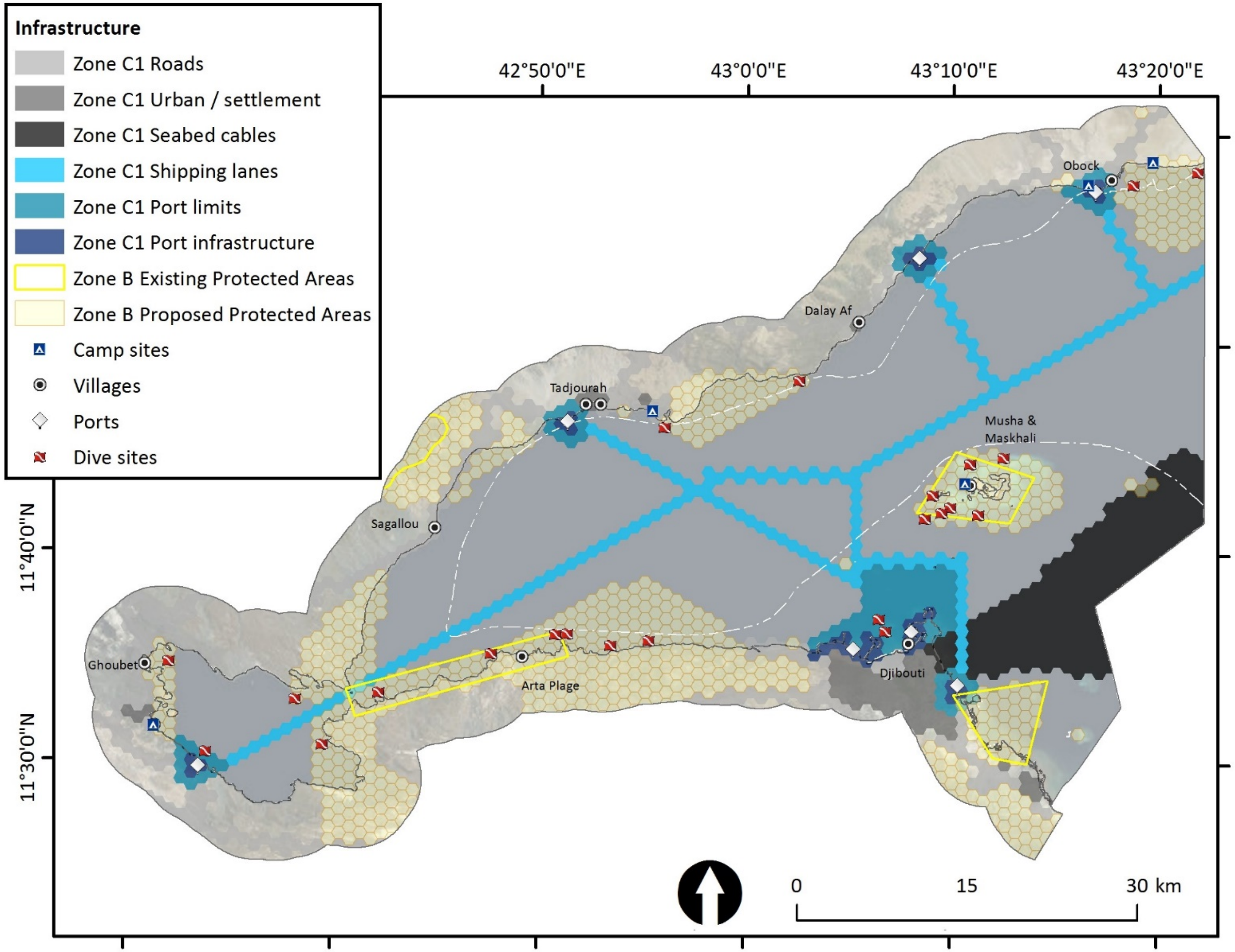
Zone C: Infrastructure and utilities	
The draft goals for this zone were: • ***Goal C1: Resilient / resistant infrastructure*** • ***Goal C2: Infrastructure to support fisheries development*** (move to ZONE A?) • ***Goal C3: Infrastructure to support tourism development*** (move to ZONE E?) • ***Goal C4: Infrastructure to support improved solid and waste water management*** The map illustrates the distribution of existing known infrastructure, including ports and shipping. All of these zones relate to Goal C1. As there were no suggestions relating to Zone D Renewables, this zone was integrated with the infrastructure zone, as Group (C) did mention wind energy installation (e.g. at Arta) and development of geothermal energy. The suggestion was for infrastructure related to fisheries and tourism development be moved to their respective zones. .	

Figure 4.4. Draft Map for Zone C for Infrastructure

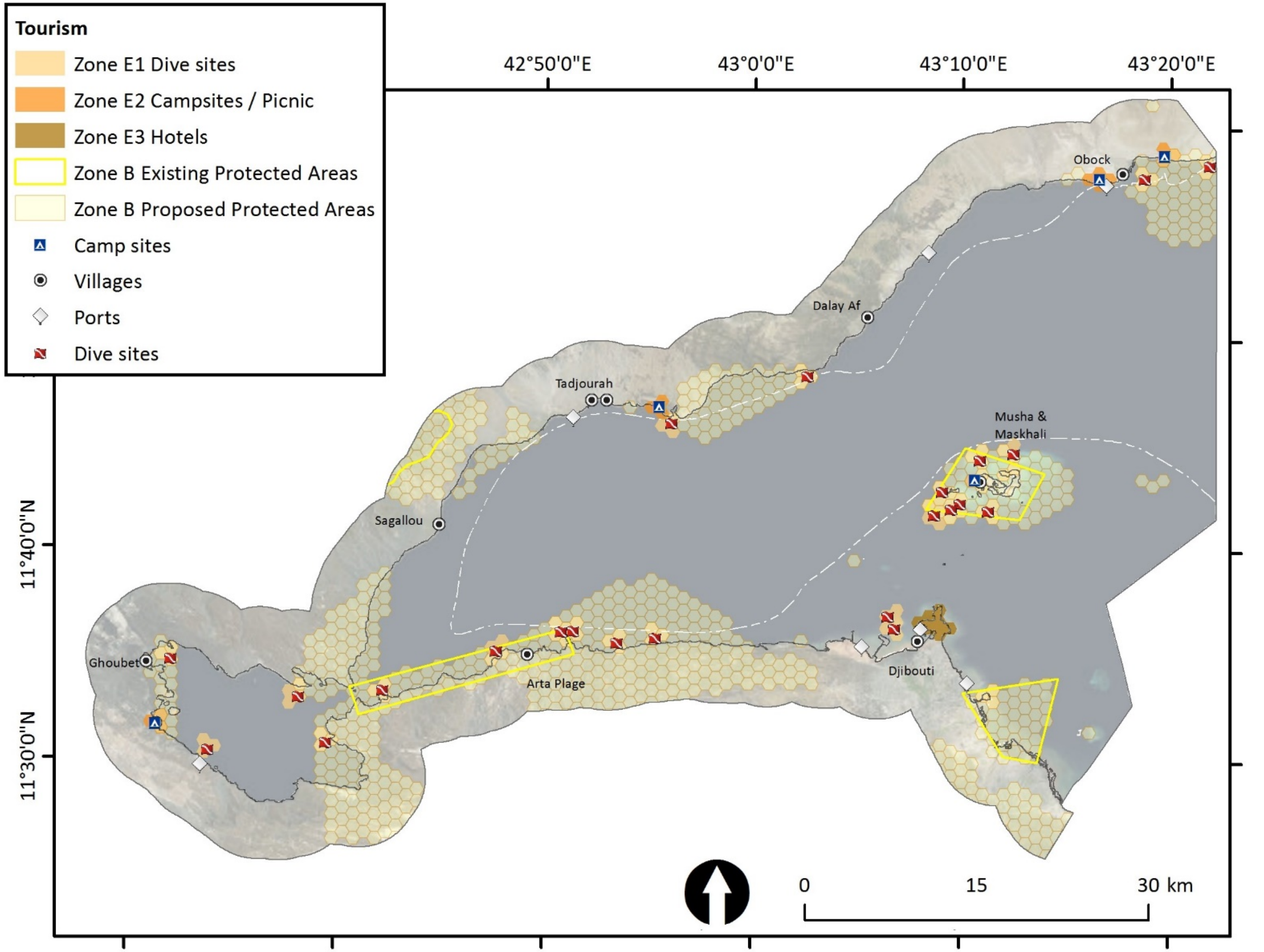
Zone E: Tourism	
Thematic Goal E1: Develop ecologically sustainable tourism ***Thematic Goal E2: Community-based support and involvement*** This map shows the known distribution of existing tourism activities, which includes hotels (in Djiboutiville), camp sites and dive sites and a few other locations which are used for kayaking, and other non-motorised watersports. The existing protected areas are shown to illustrate the overlap between these areas.	

Figure 4.5. Draft Map for Zone E Tourism

Zone F: Military & Security

Thematic Goal F1: Training
Thematic Goal F2: Information
Thematic Goal F3: Law / Legislation
Thematic Goal F4: Coordination
Thematic Goal F5: Authority
Thematic Goal F6: Prevention
Thematic Goal F7: Finances

The map shows the distribution of known military / security zones. These include a maritime exclusion zone to the east of Djiboutiville and the firing range near Arta.

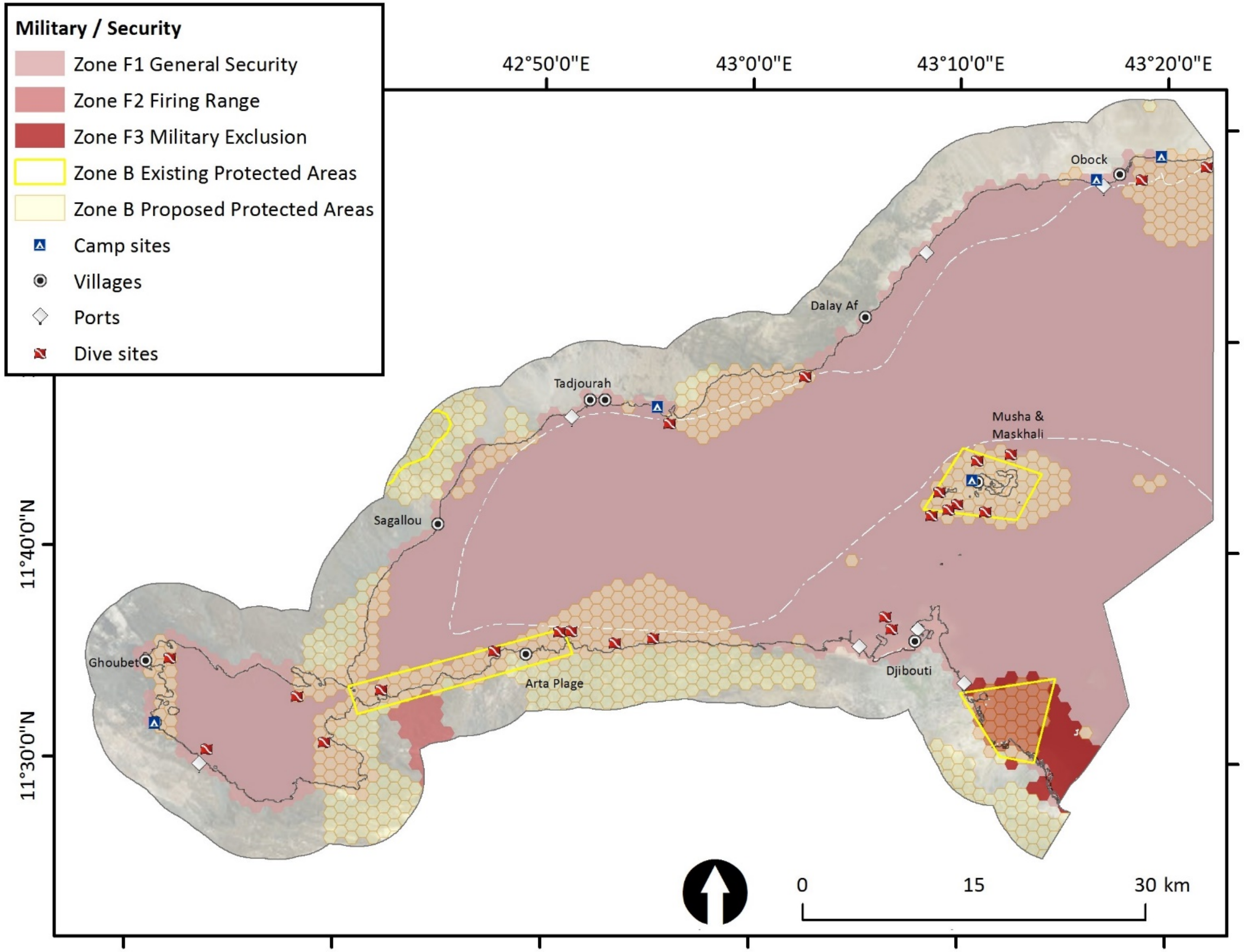


Figure 4.5 Draft Map for Zone F for Military / Security

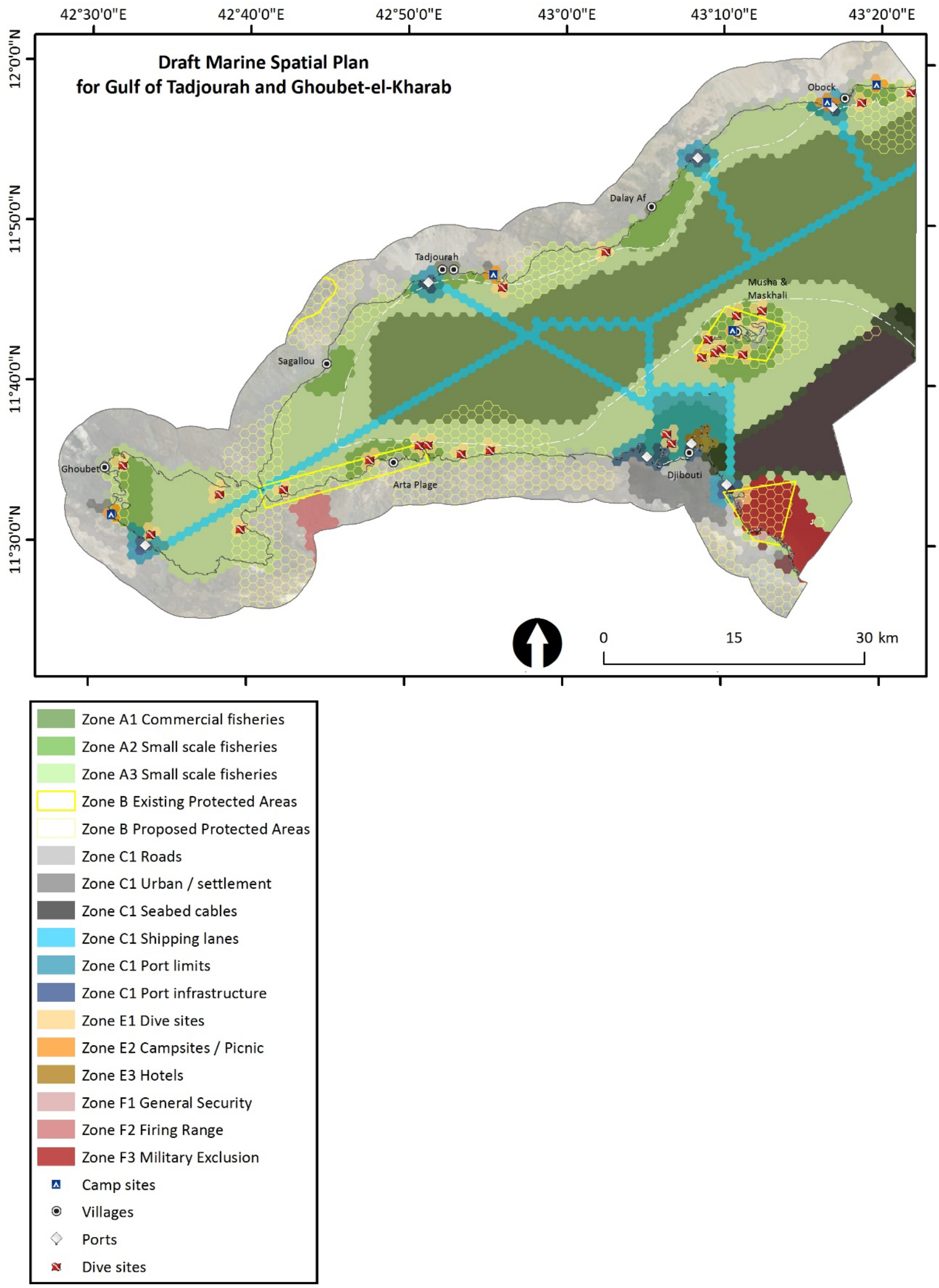


Figure 4.6 First Draft Marine Spatial Plan for Gulf of Tadjourah and Ghoubet-el-Karab Seascape.

5. Negotiation and refinement of Seascape Plan

This section of the Seascape Plan has not been completed as it needs to be taken forward by the government of Djibouti to lead on refining the Plan and the final negotiations. This will require discussion with various sectors within government as well as key stakeholders.

The following provides a list of steps that need to be included during this refinement process.

1. *Discuss and agree on representation goals and objectives for each sector or zone*

For example, with the high priority biodiversity areas, what percentage needs to be protected? Are the existing protected areas sufficient or are there gaps? What percentage of high priority fishing areas needs to be maintained for food security?

2. *Complete the compatability matrix and resolve key incompatibilities*

The participatory mapping represented the first zoning exercise, but further iterations and consultations are needed as part of a longer term process. Zones and conflicting uses will have to be regulated through legislation and this takes time and the planning needs to evolve through time as well as well data gaps remain to be filled. Several steps of refinements will be necessary to iron out any incompatibilities that are context dependent at particular locations.

3. *Management Plans and Regulations*

Once the Seascape Plan is it will require supportive in-depth information on regulations for each of the given zone types and other recommended management practices. This may be in the form of more detailed management plans for different regions with a description of the regulations for each zone showing the permitted and prohibited uses for each zone,

4. *Governance arrangements*

A governance framework will need to be defined for operationalising the Seascape Plan and its sub-components (eg regional management plans), for decision-making in the event of conflicts and for periodic review and adaptation.

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Appendix 1. Bio-physical variables used marine spatial planning using MARXAN for developing the Seascape base maps

The following table lists the features mapped and included in the Marxan model (see Klaus 2016 for more details).

CODE	Description	Source	Notes
PU_ID	Unique identifier	Klaus (2016)	
PU_COST	Cost	Klaus (2016)	
PU_STATUS	Status	Klaus (2016)	
AREA	Planning unit area	Klaus (2016)	
PERIMETER	Planning unit perimeter	Klaus (2016)	
SIDELENGTH	Planning unit sidelength	Klaus (2016)	
SEA_TERR	Shallow terrace	Klaus (2016)	
SEA_CONT	Deep water	Klaus (2016)	
SEA_1	Ghoubett-el-Karab	Klaus (2016)	
SEA_2	Gulf of Tadjourah	Klaus (2016)	
SEA_3	Neck of the Gulf of Tadjourah	Klaus (2016)	
L1_1	Sea	Klaus (2016)	
L1_2	Land	Klaus (2016)	
L2_1	Mainland	Klaus (2016)	
L2_2	Islands	Klaus (2016)	
L2_3	Continental shelf	Harris et al. (2014)	
L2_4	Deep water	Harris et al. (2014)	
L3_1	Land	Klaus (2016)	
L3_2	River_wetland	Klaus (2016)	
L3_3	Beach	Klaus (2016)	
L3_4	Fringing_reef	Klaus (2016)	
L3_5	Submerged_patch_reef	Klaus (2016)	
L3_6	Coral_community_on_rock	Klaus (2016)	
L3_7	Shelf	Harris et al. (2014)	
L3_8	Slope	Harris et al. (2014)	
L3_9	Trench	Harris et al. (2014)	
L4_2	Sand	Klaus (2016)	
L4_8	Volcanic_rock	Klaus (2016)	
L4_9	Limestone_rock	Klaus (2016)	
L4_10	Mangrove	Klaus (2016)	
L4_11	*Prosopis*	Klaus (2016)	
L4_15	River	Klaus (2016)	
L4_16	Perennial_lake	Klaus (2016)	
L4_17	Non_perennial_water	Klaus (2016)	
L4_1	Silt	Klaus (2016)	
L4_4	Rubble	Klaus (2016)	
L4_5	Seagrass	Klaus (2016)	
L4_6	Hard_coral	Klaus (2016)	
L4_7	Coral_on_rock	Klaus (2016)	
ELEV_0	Elevation 0000m	SRTM	
ELEV_1	Elevation 0001 to 2m	SRTM	
ELEV_2	Elevation 0003 to 6m	SRTM	
ELEV_3	Elevation 0007 to 10m	SRTM	
ELEV_4	Elevation 0011 to 20m	SRTM	
ELEV_5	Elevation 0021 to 50m	SRTM	

CODE	Description	Source	Notes
ELEV_6	Elevation 0051 to 100m	SRTM	
ELEV_7	Elevation 0101 to 300m	SRTM	
ELEV_8	Elevation 0301 to 500m	SRTM	
ELEV_9	Elevation 0500m +	SRTM	
L5_1314012	marine_shallow_north_fringing_reef_silt_2m	Klaus (2016)	
L5_1314013	marine_shallow_north_fringing_reef_silt_2_5m	Klaus (2016)	
L5_1314022	marine_shallow_north_fringing_reef_sand_2m	Klaus (2016)	
L5_1314023	marine_shallow_north_fringing_reef_sand_2_5m	Klaus (2016)	
L5_1314024	marine_shallow_north_fringing_reef_sand_5_10m	Klaus (2016)	
L5_1314025	marine_shallow_north_fringing_reef_sand_10_15m	Klaus (2016)	
L5_1314052	marine_shallow_north_fringing_reef_seagrass_2m	Klaus (2016)	
L5_1314062	marine_shallow_north_fringing_reef_hard_coral_2m	Klaus (2016)	
L5_1314063	marine_shallow_north_fringing_reef_hard_coral_2_5m	Klaus (2016)	
L5_1314064	marine_shallow_north_fringing_reef_hard_coral_5_10m	Klaus (2016)	
L5_1317997	marine_shallow_north_shelf_unknown_30_200m	Klaus (2016)	
L5_1324012	marine_shallow_south_fringing_reef_silt_2m	Klaus (2016)	
L5_1324013	marine_shallow_south_fringing_reef_silt_2_5m	Klaus (2016)	
L5_1324022	marine_shallow_south_fringing_reef_sand_2m	Klaus (2016)	
L5_1324023	marine_shallow_south_fringing_reef_sand_2_5m	Klaus (2016)	
L5_1324024	marine_shallow_south_fringing_reef_sand_5_10m	Klaus (2016)	
L5_1324043	marine_shallow_south_fringing_reef_rubble_2_5m	Klaus (2016)	
L5_1324053	marine_shallow_south_fringing_reef_seagrass_2_5m	Klaus (2016)	
L5_1324062	marine_shallow_south_fringing_reef_hard_coral_2m	Klaus (2016)	
L5_1324063	marine_shallow_south_fringing_reef_hard_coral_2_5m	Klaus (2016)	
L5_1324064	marine_shallow_south_fringing_reef_hard_coral_5_10m	Klaus (2016)	
L5_1324072	marine_shallow_south_fringing_reef_coral_on_rock_2m	Klaus (2016)	
L5_1325023	marine_shallow_south_submerged_patch_reef_sand_2_5m	Klaus (2016)	
L5_1325024	marine_shallow_south_submerged_patch_reef_sand_5_10m	Klaus (2016)	
L5_1325053	marine_shallow_south_submerged_patch_reef_seagrass_2_5m	Klaus (2016)	
L5_1325063	marine_shallow_south_submerged_patch_reef_hard_coral_2_5m	Klaus (2016)	
L5_1325064	marine_shallow_south_submerged_patch_reef_hard_coral_5_10m	Klaus (2016)	
L5_1325065	marine_shallow_south_submerged_patch_reef_hard_coral_10_15m	Klaus (2016)	
L5_1327997	marine_shallow_south_shelf_unknown_30_200m	Klaus (2016)	
L5_1334022	marine_shallow_island_fringing_reef_sand_2m	Klaus (2016)	
L5_1334023	marine_shallow_island_fringing_reef_sand_2_5m	Klaus (2016)	
L5_1334024	marine_shallow_island_fringing_reef_sand_5_10m	Klaus (2016)	
L5_1334053	marine_shallow_island_fringing_reef_seagrass_2_5m	Klaus (2016)	
L5_1334063	marine_shallow_island_fringing_reef_hard_coral_2_5m	Klaus (2016)	
L5_1334064	marine_shallow_island_fringing_reef_hard_coral_5_10m	Klaus (2016)	
L5_1334065	marine_shallow_island_fringing_reef_hard_coral_10_15m	Klaus (2016)	
L5_1346023	marine_shallow_ghoubet_coral_community_on_rock_sand_2_5m	Klaus (2016)	
L5_1346024	marine_shallow_ghoubet_coral_community_on_rock_sand_5_10m	Klaus (2016)	
L5_1346025	marine_shallow_ghoubet_coral_community_on_rock_sand_10_15m	Klaus (2016)	
L5_1346043	marine_shallow_ghoubet_coral_community_on_rock_rubble_2_5m	Klaus (2016)	
L5_1346063	marine_shallow_ghoubet_coral_community_on_rock_hard_coral_2_5m	Klaus (2016)	
L5_1346072	marine_shallow_ghoubet_coral_community_on_rock_coral_on_rock_2m	Klaus (2016)	
L5_1346073	marine_shallow_ghoubet_coral_community_on_rock_coral_on_rock_2_5m	Klaus (2016)	
L5_1347997	marine_shallow_ghoubet_shelf_unknown_30_200m	Klaus (2016)	
L5_1367997	marine_shallow_east_shelf_unknown_30_200m	Klaus (2016)	

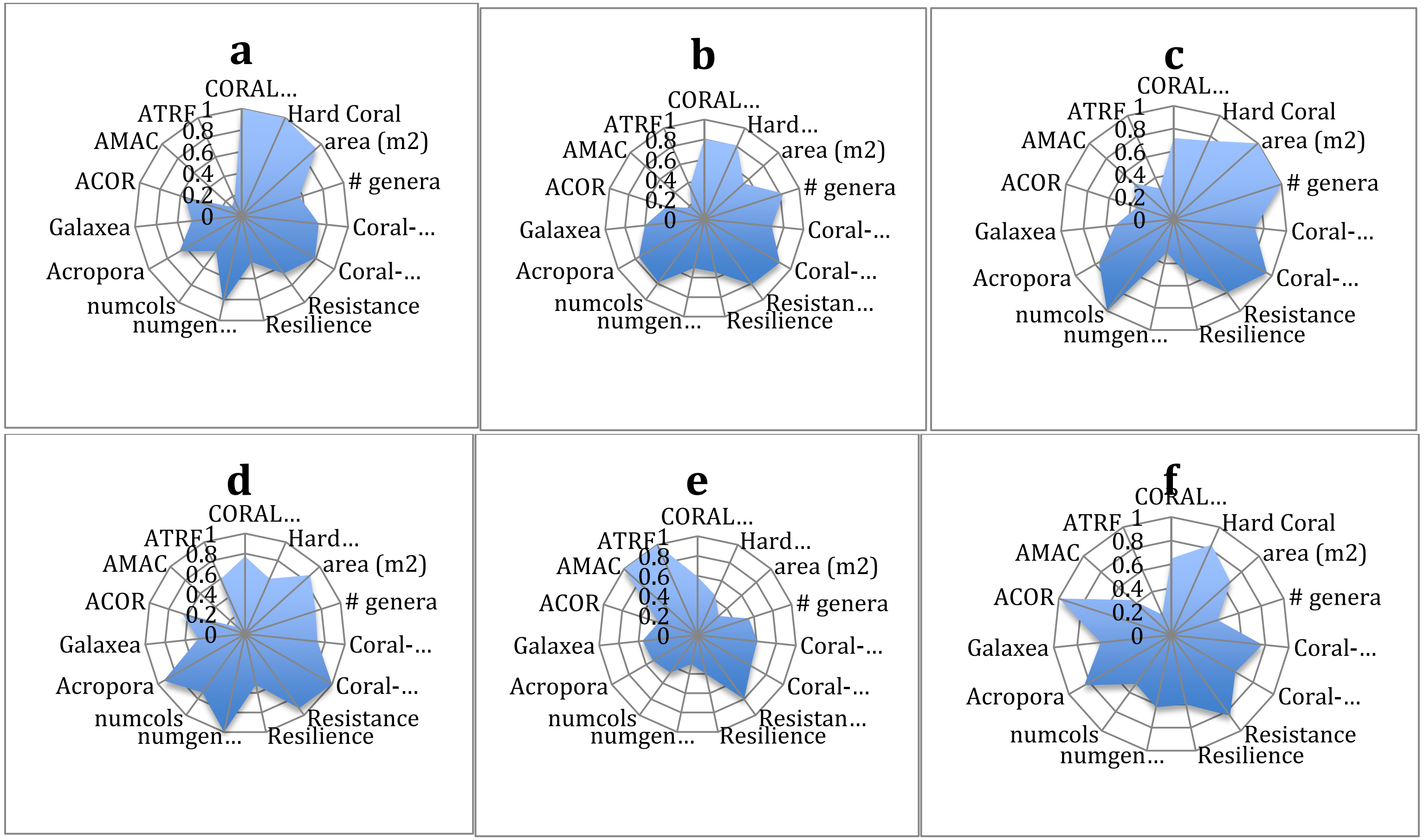
CODE	**Description**	Source	Notes
L5_1418998	marine_deep_north_slope_unknown_200_1000m	Klaus (2016)	
L5_1428998	marine_deep_south_slope_unknown_200_1000m	Klaus (2016)	
L5_1459999	marine_deep_gulf_of_tadjourah_trench_unknown_1000m	Klaus (2016)	
L5_1468998	marine_deep_east_slope_unknown_200_1000m	Klaus (2016)	
L5_111210	marine_mainland_north_river_wetland_mangrove	Klaus (2016)	
L5_112210	marine_mainland_south_river_wetland_mangrove	Klaus (2016)	
L5_123210	marine_island_islands_river_wetland_mangrove	Klaus (2016)	
L5_211117	terrestrial_mainland_north_land_non_perennial_water_body	Klaus (2016)	
L5_211215	terrestrial_mainland_north_river_wetland_river	Klaus (2016)	
L5_211302	terrestrial_mainland_north_beach_sand	Klaus (2016)	
L5_212117	terrestrial_mainland_south_land_non_perennial_water_body	Klaus (2016)	
L5_212215	terrestrial_mainland_south_river_wetland_river	Klaus (2016)	
L5_212302	terrestrial_mainland_south_beach_sand	Klaus (2016)	
L5_214302	terrestrial_mainland_ghoubet_beach_sand	Klaus (2016)	
L5_214215	terrestrial_mainland_ghoubet_river_wetland_river	Klaus (2016)	
L5_214302	terrestrial_mainland_ghoubet_beach_sand	Klaus (2016)	
L5_216117	terrestrial_mainland_east_land_non_perennial_water_body	Klaus (2016)	
L5_221109	terrestrial_island_north_land_coralline	Klaus (2016)	
L5_222108	terrestrial_island_south_land_volcanic	Klaus (2016)	
L5_222109	terrestrial_island_islands_land_coralline	Klaus (2016)	
L5_223109	terrestrial_island_south_land_coralline	Klaus (2016)	
L5_223302	terrestrial_island_islands_beach_sand	Klaus (2016)	
L5_224108	terrestrial_island_ghoubet_land_volcanic	Klaus (2016)	
LOC_01	north_ gulf_of_tadjourah	Klaus (2016)	
LOC_02	south_ gulf_of_tadjourah	Klaus (2016)	
LOC_03	island	Klaus (2016)	
LOC_04	ghoubet-el-karab	Klaus (2016)	
LOC_05	gulf_of_tadjourah	Klaus (2016)	
HC_NO	number of hard coral genera	CORDIO (2014)	
HC_STY	Stylophora spp.	CORDIO (2014)	
HC_FUN	Fungia spp.	CORDIO (2014)	
HC_COS	Coscinaraea spp.	CORDIO (2014)	
HC_MIL	Millepora spp.	CORDIO (2014)	
HC_CYP	Cyphastrea spp.	CORDIO (2014)	
HC_GAR	Gardineroseris spp.	CORDIO (2014)	
HC_CTE	Ctenactis spp.	CORDIO (2014)	
HC_HER	Herpolitha spp.	CORDIO (2014)	
HC_LES	Leptoseris spp.	CORDIO (2014)	
HC_HYD	Hydnopohora spp.	CORDIO (2014)	
HC_SER	Seriatopora spp.	CORDIO (2014)	
HC_DIP	**Diploastrea spp.**	CORDIO (2014)	
HC_OXY	Oxypora spp.	CORDIO (2014)	
HC_LIT	Lithophyllon spp.	CORDIO (2014)	
HC_MER	Merulina spp.	CORDIO (2014)	
HC_MYC	Mycedium spp.	CORDIO (2014)	
HC_GOP	Goniopora spp.	CORDIO (2014)	
HC_CYC	Cycloseris spp.	CORDIO (2014)	
HC_TUR	Turbinaria spp.	CORDIO (2014)	
HC_AST	Astreopora spp.	CORDIO (2014)	

CODE	Description	Source	Notes
HC_EPH	Echinophyllia spp.	CORDIO (2014)	
HC_OUL	Oulophyllia spp.	CORDIO (2014)	
HC_MON	Montastrea spp.	CORDIO (2014)	
HC_PAC	Pachyseris spp.	CORDIO (2014)	
HC_BLA	Blastomussa spp.	CORDIO (2014)	
HC_SYM	Symphillia spp.	CORDIO (2014)	
HC_PLS	Plesiastrea spp.	CORDIO (2014)	
HC_STC	Stylocoeniella spp.	CORDIO (2014)	
HC_ACA	Acanthastrea spp.	CORDIO (2014)	
HC_POD	Podabacea spp.	CORDIO (2014)	
HC_ALV	**Alveopora spp.**	CORDIO (2014)	
HC_BAR	**Barabattoia spp.**	CORDIO (2014)	
HC_PAR	**Parasimplastrea spp.**	CORDIO (2014)	
HC_LEO	Leptoria spp.	CORDIO (2014)	
HC_PLG	**Plerogyra spp.**	CORDIO (2014)	
HC_PEC	Pectinia spp.	CORDIO (2014)	
HC_SID	Siderastrea spp.	CORDIO (2014)	
HC_CAU	Caulastrea spp.	CORDIO (2014)	
HC_HOR	**Horastrea spp.**	CORDIO (2014)	
HC_ANO	**Anomastrea spp.**	CORDIO (2014)	
FISH01	A. dussumieri	CORDIO (2014)	
FISH02	***A. gahhm****	CORDIO (2014)	Black surgeonfish, Acanthurus gahhm, LC, Red Sea Gulf of Aden
FISH03	***A. sohal****	CORDIO (2014)	Red sea surgeonfish, Acanthurus sohal, LC, Red Sea endemic
FISH04	*A. xanthopterus*	CORDIO (2014)	
FISH05	*N. brevirostris*	CORDIO (2014)	
FISH06	*N. hexacanthus*	CORDIO (2014)	
FISH07	*C. bajad*	CORDIO (2014)	
FISH08	*C. ferdau*	CORDIO (2014)	
FISH09	*C. fulvoguttatus*	CORDIO (2014)	
FISH10	*C. sexfasciatus*	CORDIO (2014)	
FISH11	*Caranx heberi*	CORDIO (2014)	
FISH12	*Elagatis bipinnulata*	CORDIO (2014)	
FISH13	*Trachinotus blochii*	CORDIO (2014)	
FISH14	***C. fasciatus****	CORDIO (2014)	Diagonal butterflyfish, Chaetodon fasciatus, LC, Red Sea endemic, generalist
FISH15	***C. larvatus****	CORDIO (2014)	Orangeface butterflyfish, Chaetodon larvatus, LC, Red Sea endemic, corallivore
FISH16	*C. lineolatus*	CORDIO (2014)	
FISH17	*C. melannotus*	CORDIO (2014)	
FISH18	***C. melapterus****	CORDIO (2014)	Melon butterflyfish, Chaetodon melapterus, LC, Southern Arabia, corallivore
FISH19	***C. semilarvatus****	CORDIO (2014)	Blue-cheeked butterflyfish, Chaetodon semilarvatus, LC, Red Sea Gulf of Aden, corallivore
FISH20	*C. trifascialis*	CORDIO (2014)	
FISH21	*C. vagabundus*	CORDIO (2014)	
FISH22	*Heniochus acuminatus*	CORDIO (2014)	
FISH23	*Heniochus diphreutes*	CORDIO (2014)	
FISH24	***Heniochus intermedius****	CORDIO (2014)	
FISH25	*A. melanurus*	CORDIO (2014)	
FISH26	*A. meleagrides*	CORDIO (2014)	
FISH27	*A. twistii*	CORDIO (2014)	
FISH28	*An. lineatus*	CORDIO (2014)	
FISH29	*Anampses caeruleopunt*	CORDIO (2014)	

CODE	**Description**	Source	Notes
FISH30	*B. axillaris*	CORDIO (2014)	
FISH31	*C. fasciatus*	CORDIO (2014)	
FISH32	***C. undulatus***	CORDIO (2014)	Napoleon wrasse, Cheilnus undulatus, EN
FISH33	*Cheilinus chlorourus*	CORDIO (2014)	
FISH34	***Cheilinus lunulatus****	CORDIO (2014)	Broomtail wrasse, Cheilinus lunulatus, LC, Arabian Peninsular,
FISH35	*Cheilio inermis*	CORDIO (2014)	
FISH36	*Coris cuvieri*	CORDIO (2014)	
FISH37	***Coris variegata****	CORDIO (2014)	Dapple coris, Coris variegata, LC, Red Sea
FISH38	*Epibulus insidiator*	CORDIO (2014)	
FISH39	*Gomphosus caeruleus*	CORDIO (2014)	
FISH40	*H. hortulanus*	CORDIO (2014)	
FISH41	*H. lamarii*	CORDIO (2014)	
FISH42	*H. nebulosus*	CORDIO (2014)	
FISH43	*H. scapularis*	CORDIO (2014)	
FISH44	*Hemigymnus fasciatus*	CORDIO (2014)	
FISH45	*Hemigymnus melapterus*	CORDIO (2014)	
FISH46	*Hologymnosus annulatus*	CORDIO (2014)	
FISH47	*L. dimidiatus*	CORDIO (2014)	
FISH48	*Labrichthys unilineatus*	CORDIO (2014)	
FISH49	*Labropsis xanthonota*	CORDIO (2014)	
FISH50	***Larabicus quadrilineatus****	CORDIO (2014)	Fourline wrasse, Larabicus quadrilineatus, DD, Red Sea
FISH51	*Oxycheilinus digrammus*	CORDIO (2014)	
FISH52	*Oxycheilinus mentalis*	CORDIO (2014)	
FISH53	*Oxycheilinus rhodochrous*	CORDIO (2014)	
FISH54	***Paracheil. octotaenia****	CORDIO (2014)	Red Sea eightline flasher, Paracheilus octotaenia, DD, Red Sea
FISH55	*Pseudocheilinus hexataenia*	CORDIO (2014)	
FISH56	*Stethojulis albovittatus*	CORDIO (2014)	
FISH57	*T. lunare*	CORDIO (2014)	
FISH58	*Westmorella albofasciata*	CORDIO (2014)	
FISH59	*L. bengalensis*	CORDIO (2014)	
FISH60	*L. bohar*	CORDIO (2014)	
FISH61	***L. coerulineatus****	CORDIO (2014)	Blue line snapper, Lutjanus coerulineatus
FISH62	*L. ehrenbergi*	CORDIO (2014)	
FISH63	*L. fulviflamma*	CORDIO (2014)	
FISH64	*L. gibbus*	CORDIO (2014)	
FISH65	*L. kasmira*	CORDIO (2014)	
FISH66	*L. monostigma*	CORDIO (2014)	
FISH67	***Apolemichthys xanthotis****	CORDIO (2014)	Red Sea Anglefish, Apolemichthys xanthotis, LC, Red Sea-Gulf of Aden
FISH68	***P. asfur****	CORDIO (2014)	Arabian Angelfish, Pomacanthus asfur, LC, western Indian Ocean
FISH69	*P. imperator*	CORDIO (2014)	
FISH70	*Pygoplites diacanthus*	CORDIO (2014)	
FISH71	***A. bicinctus****	CORDIO (2014)	Two-band clownfish, Amphiprion bicintus, Red Sea, western Indian Ocean
FISH72	*A. sexfasciatus*	CORDIO (2014)	
FISH73	*A. vaigiensis*	CORDIO (2014)	
FISH74	*Abudefduf septemfasciatus*	CORDIO (2014)	
FISH75	***Amblygl. flavilatus****	CORDIO (2014)	
FISH76	*Amblygl. indicus*	CORDIO (2014)	
FISH77	***C. flavaxilla****	CORDIO (2014)	Arabian chromis, Chromis flavaxilla, Southern Arabia
FISH78	*C. lepidolepis*	CORDIO (2014)	

CODE	Description	Source	Notes
FISH79	*C. trialpha*	CORDIO (2014)	
FISH80	*C. viridis*	CORDIO (2014)	
FISH81	*Chromis pembae*	CORDIO (2014)	
FISH82	*D. trimaculatus*	CORDIO (2014)	
FISH83	***Dascyllus marginatus****	CORDIO (2014)	Marginate dascyllus, Dascyllus marginatus,
FISH84	*Dascylus aruanus*	CORDIO (2014)	
FISH85	*N. cyanomos*	CORDIO (2014)	
FISH86	*Neoglyphid. melas*	CORDIO (2014)	
FISH87	***Neopom. xanthurus****	CORDIO (2014)	Red sea demoiselle, Neopomacentrus xanthurus
FISH88	***P. albicaudatus****	CORDIO (2014)	White fin damselfish, *Pomacentrus albicaudatus*
FISH89	*P. sulfureus*	CORDIO (2014)	
FISH90	*P. trichrourus*	CORDIO (2014)	
FISH91	*P. trilineatus*	CORDIO (2014)	
FISH92	*Pomacentrus leptus*	CORDIO (2014)	
FISH93	***Pristotis cyanostigma****	CORDIO (2014)	Bluespotted damsel, *Pristotis cyanostigma,* LC, Red Sea and Gulf of Aden
FISH94	*S. lividus*	CORDIO (2014)	
FISH95	*S. nigricans*	CORDIO (2014)	
FISH96	*Cetoscarus ocellatus*	CORDIO (2014)	
FISH97	***Chlor. genazonatus****	CORDIO (2014)	Purple streak parrotfish, Chlorurus genazonatus, LC, Red Sea
FISH98	*Anyper. leucogramm.*	CORDIO (2014)	
FISH99	*C. miniatus*	CORDIO (2014)	
FISH100	***C. oligosticta****	CORDIO (2014)	Vermillion hind, Cephalopholis oligostica, LC, northern Red Sea
FISH101	*Cephalopholis argus*	CORDIO (2014)	
FISH102	*Diploprion drachi*	CORDIO (2014)	
FISH103	*E. areolatus*	CORDIO (2014)	
FISH104	*E. fasciatus*	CORDIO (2014)	
FISH105	***E. fuscoguttatus***	CORDIO (2014)	Brown marbled grouper, Epinephelus fuscoguttatus, NT
FISH106	***E. malabaricus***	CORDIO (2014)	Malabar grouper, Epinephelus malabaricus, NT
FISH107	***E. polylepis****	CORDIO (2014)	Small scale grouper, Epinephelus polylepis, NT and endemic to Red Sea-Gulf of Aden
FISH108	*E. summana*	CORDIO (2014)	
BIRD_PTE_O	Pternistis ochropectus	Birdlife International	
BIRD_STR_M	Struthio molybdophanes	Birdlife International	
TURTLE	Turtle nesting (historical records)	IUCN (2016)	
WS_AGG	Whale shark aggregations	Rowat (2011)	Whale shark, Rhincodon typus VU
WS_MIG	Whale shark migrations	Rowat (2011)	Whale shark, Rhincodon typus VU
SEABIRD	Seabird	IUCN (2016)	
SEAB_NEST	Seabird nesting	IUCN (2016)	
FISH_AGG	Spawning aggregation for Cheilinus undulatus	CORDIO (2014)	
DUGONG	Dugong (historical records)		
RAMSAR	RAMSAR site	RAMSAR	
IBAS	Important Bird Areas	Birdlife International	
COR_CON_A_	Coral reefs within group A* from the cluster analysis results of benthic data	CORDIO (2014)	
COR_CON_A	Coral reefs within group A from the cluster analysis results of benthic data	CORDIO (2014)	
COR_CON_B	Coral reefs within group B from the cluster analysis results of benthic data	CORDIO (2014)	
COR_CON_C	Coral reefs within group C from the cluster analysis results of benthic data	CORDIO (2014)	

Appendix 2. Benthic variables used in mapping of priority sites



a - highest coral cover, not dominatd by acropora/galaxea but with moderate diversity, with some evidence of past impacts, high number of rare genera, low algal community

b - moderate for most values, no outstanding varaible, low algal cover

c- high area and abundance of coral colonies, maximum coral diversity, moderate current condition of corals, no evidence of past impacts

d- Acropora dominant, high diversity of rare genera, high coralline algal cover, high resistance to bleaching and no evidence of past mortality.

e- algal-dominated sites, with high dominance by Galaxea, poor scores for most coral variables

f- highest coralline algae cover and galaxea/Acropora dominance, moderate scores for other variables

Appendix 3: Fish population indices for prioritising sites in the Seascape

Overall indices - description	**Variables' criteria**	**Obock Out**	**Manta Pt**	**Sab.Blan-R. Douan**	**Obock In**	**Ankali**	**Kalaf**	**Maskali**	**Arta Plage**	**Musha E**	**Pt Gab-Parrot Is**	**Daley**	**Kh Amb-Dorale**	**Vierge Rouge**	**Musha NW**
Species diversity - Total no. species per site	Biodiversity	4	2	3	2	4	3	3	3	1	1	1	4	2	1
CFDI - Gerry Allen's index of species diversity	Biodiversity	4	1	4	4	3	2	3	4	2	3	2	4	3	1
Chaetodon species number	Biodiversity	4	1	1	2	4		2	1	2		3	1		
Total Fish biomass per site	Overall population health	3	4	4	2	1	2	2	1	1	4	2	2	1	1
Total fish abundance per site	Overall population health	4	4	4	4	2	1	2	3	1	3	2	3	3	1
Piscivores abundance	High fishery species value and top trophic level	3	4	3	1	2	4	1	3	2	2	2	1	2	1
Piscivore biomass	High fishery species value and top trophic level	3	4	3	1	2	4	1	3	2	2	2	1	2	1
Herbivore abundance (not included)	Reef health - resilience (ecological function)														
Herbivore biomass	Reef health - resilience (ecological function)	4	2	2	3	2	2	4	1	4	3	3	2	2	1
species level indices - abundance & biomass:	*VU/EN/ target fishery sp/endem/ecological function*														
Epinephelus fuscoguttatus - abund	Near Threatened; high fishery value & top trophic level		4	2			3								
Epinephelus summana -abund	abundant RS serranid - possible fishery sp.	1	3	1		2	4		2	2	3	2	1	2	1
Epinephelus summana - biomass	abundant RS serranid - possible fishery sp.	2	3	1		3	4		1	2	4	2	2	1	2
Lutjanus fulviflamma - abund	abundant small lutjanid - possible fishery sp.	3	2	4	4	1	1	1	2	1	3	2	2		1
Carangidae - biomass	important in pelagic fisheries		1	2	4	4	3	1	3		2	3	1	1	1
Naso hexacanthus - abund	large planktivore - ecological role	4													
Chlororus genazonatus - abund	endemic scarid - ecological function - excavator				4			1							
Chlororus genazonatus - biomass	endemic scarid - ecological function - excavator				2			1							
Cetoscarus ocellatus - abund	large scarid - ecological function - excavator	3	2		1	3		4		4					
Cetoscarus ocellatus - biomass	large scarid - ecological function - excavator	3	2		1	2		4		3					
Acanthurus gahhm - abund	endemic surgeon - ecological function - grazer-detritivore			2			1		3			2			
Cheilinus undulatus – biomass	Endangered; high biomass species							3	2	4		1			1
E. polylepis	Rare and restricted range species										1			1	
overall total (all categories)		45	39	36	35	35	34	33	32	31	30	29	24	19	13
biodiversity total		12	4	8	8	11	5	11	10	9	4	7	9	5	3
population health total		7	8	8	6	3	3	4	4	2	7	4	5	4	2
fishery value		12	21	16	10	14	23	4	14	9	16	13	8	8	7
ecological function		14	6	4	11	7	3	14	4	11	3	5	2	2	1

Appendix 4. Participatory mapping results from stakeholder consultation (October 2015)

Participatory mapping survey 14/10/15

Number	Location	What is special?	Habitat characteristics	Activities	January	February	March	April	May	June	July	August	September	October	November	December	Comments
1	Arta Plage	Military training	Sandy beach	F	*	*	*	*	*	*	*	*	*	*	*	*	French navy
		Whale sharks		B	*	*									*	*	MPA
		Tourism		E	*	*		*	*	*	*	*	*		*	*	Ecotourism, snorkling, possible conflicts with F. Ongoing rehab of sites
		Small scale Fisheries		A	*	*	*	*	*	*	*	*	*	*	*	*	
		Inland wind turbines		C													Not close to the coastal zone
2	Musha	Military training	Islands	F													Occasional, by French Navy
		Tourism dev planned		E													Chinese + ethiopian investors
3	CHOM area	Shipping lanes	open sea	C	*	*	*	*	*	*	*	*	*	*	*	*	
4	Godoria	Small scale Fisheries	coast	A	*	*	*	*	*	*	*	*	*	*	*	*	
5	7 frères MPA	Small scale Fisheries	Islands	A	*	*	*	*	*	*	*	*	*	*	*	*	
		Diving tourism		E			*	*	*	*	*	*	*	*			
5 bis	7 frères MPA - Ras Siam	Small scale Fisheries	Coastal	A													
		Military navy base ?		F													Maybe a chinese naval base nearby ?
6	Goubeth	Tourism	Bay	E			*	*	*	*	*	*	*	*			Diving + Tourism camp
		Inland wind turbines		C													Planned
7	Tadjoura / Sables Blancs	Tourism	Beach	E	*	*	*	*	*	*	*	*	*	*	*	*	Lower activity between June and August
	Tadjoura / Harbour dev	Port		C													Port for shipping minerals and goods. Existing road to the port, and railway planned coming

																	from Ethiopia
	8	Obock + mangrove	Tourism	E	*	*	*	*	*	*	*	*	*	*	*	*	including snorkling, lower activity between June and August
			Mangrove	B													
			Military navy base ?	F													Maybe a chinese naval base nearby ?
	9	Loyada	Small scale Fisheries	A													Lot of fish, fish processing factory
			RAMSAR	B													
			Seagrass	B													Dugongs?
			Mariculture	A													Planned, Tilopia?
			Oil pipeline	C													From Ethiopia to Djibouti
			Port for livestock	C													New port + quarantine zone
			Waste waters	C													From Djibouti, only 50 % treated
	11	Djibouti port	sub marine cables	C													
			Port	C													Old port will be only a marine
Block 1			oil exploration	C													
	12	Doraleh	New port	C													planned for shipping + military
			New port	F													
			Desalination plant														planned
	13	Alol	Cold mining	C													planned (Lake Assal)
			Geothermal Energy	C													planned (Lake Assal)
	14	Sagaliou	Small scale Fisheries	A													existing

Appendix 5. Compatbility Matrix used to design zones

Zones and Suggested Names	Targeted Uses in each zone (f = future)	Small Scale Fisheries	Industrial	Small Scale Mariculture (f)	Industrial Mariculture (f)	Biodiversity	*Strict Nature Reserve (IUCN 1a)*	*Ecological Reserve (IUCN IV)*	*National Park (IUCN II)*	*Protected Landscape/Seascape (IUCN V)*	*Sustainable Use Area (IUCN VI)*	International shipping lanes	Shipping waiting areas	Ports, harbours, marinas	Ferry lanes	Reclamation	Sub-marine cables	Waste disposal-at-sea	Renewable Energy: wind (f)	Minerals and Aggregates	Natural Gas Exploration	Shipping: Petroleum	Petroleum Exploration: seismic	Petroleum extraction	Recreation (motorised)	Recreation (non-motorised)	Sport fishing	Tourism (motorised)	Tourism (non-motorised)	Military compound	Marine security zone	Firing range
A Fishing and mariculture	Small Scale Fisheries																															
	Industrial Fisheries	1																														
	Small Scale Mariculture (f)	2	32																													
	Industrial Mariculture (f)	3	33	61																												
B Biodiversity and conservation	Biodiversity protection	5	34	62	89																											
	(IUCN 1a)	6	35	63	90	116																										
	(IUCN IV)	7	36	64	91	117	142																									
	(IUCN II)	8	37	65	92	118	143	167																								
	(IUCN V)	9	38	66	93	119	144	168	190																							
	(IUCN VI)	10	39	67	94	120	145	169	191	213																						
C Industrial & Public Utility	International shipping lanes	11	40	68	95	121	146	170	192	214	235																					
	Waiting area for shipping	12	41	69	96	122	147	171	193	215	236	256																				
	Ports, harbours, marinas	13	42	70	97	123	148	172	194	216	237	257	276																			
	Ferry lanes	14	43	71	98	124	149	173	195	217	238	258	277	295																		
	Reclamation	15	44	72	99	125	150	174	196	218	239	259	278	296	313																	
	Sub-marine cables	16	45	73	100	126	151	175	197	219	240	260	279	297	314	330																
	Waste disposal-at-sea	17	46	74	101	127	152	176	198	220	241	261	280	298	315	331	346															
	Renewable Energy: wind (f)	18	47	75	102	128	153	177	199	221	242	262	281	299	316	332	347	361														
D - Non-renewable Resources	Mining: Minerals and Aggregates (f)	19	48	76	103	129	154	178	200	222	243	263	282	300	317	333	348	362	375													
	Natural Gas Development (f)	20	49	77	104	130	155	179	201	223	244	264	283	301	318	334	349	363	376	388												
	Petroleum shipping / storage	20	50	78	105	131	156	180	202	224	245	265	284	302	319	335	350	364	377	389	400											
	Petroleum exploration including seismic (f)	21	51	79	106	132	157	181	203	225	246	266	285	303	320	336	351	365	378	390	401	411										
	Petroleum Extraction (f)	22	52	80	107	133	158	182	204	226	247	267	286	304	321	337	352	366	379	391	402	412	421									
E Tourism & Recreation	Recreation (motorised)	24	53	81	108	134	159	183	205	227	248	268	287	305	322	338	353	367	380	392	403	413	422	430								
	Recreation (non-motorised)	25	54	82	109	135	160	184	206	228	249	269	288	306	323	339	354	368	381	393	404	414	423	431	438							
	Sport fishing	26	55	83	110	136	161	185	207	229	250	270	289	307	324	340	355	369	382	394	405	415	424	432	439	445						
	Tourism (motorised)	27	56	84	111	137	162	186	208	230	251	271	290	308	325	341	356	370	383	395	406	416	425	433	440	446	451					
	Tourism (non-motorised)	28	57	85	112	138	163	187	209	231	252	272	291	309	326	342	357	371	384	396	407	417	426	434	441	447	452	456				
F Military & Security	Military compound	29	58	86	113	139	164	188	210	232	253	273	292	310	327	343	358	372	385	397	408	418	427	435	442	448	453	457	460			
	Marine security zone	30	59	87	114	140	165	189	211	233	254	274	293	311	328	344	359	373	386	398	409	419	428	436	443	449	454	458	461	463		
	Firing / operation range/ military exercices	31	60	88	115	141	166	190	212	234	255	275	294	312	329	345	360	374	387	399	410	420	429	437	444	450	455	459	462	464	465	

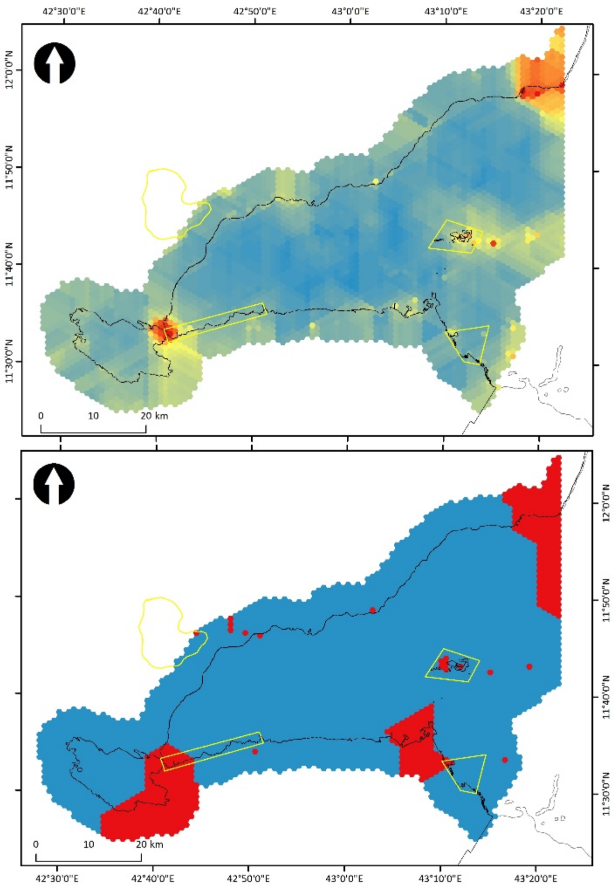
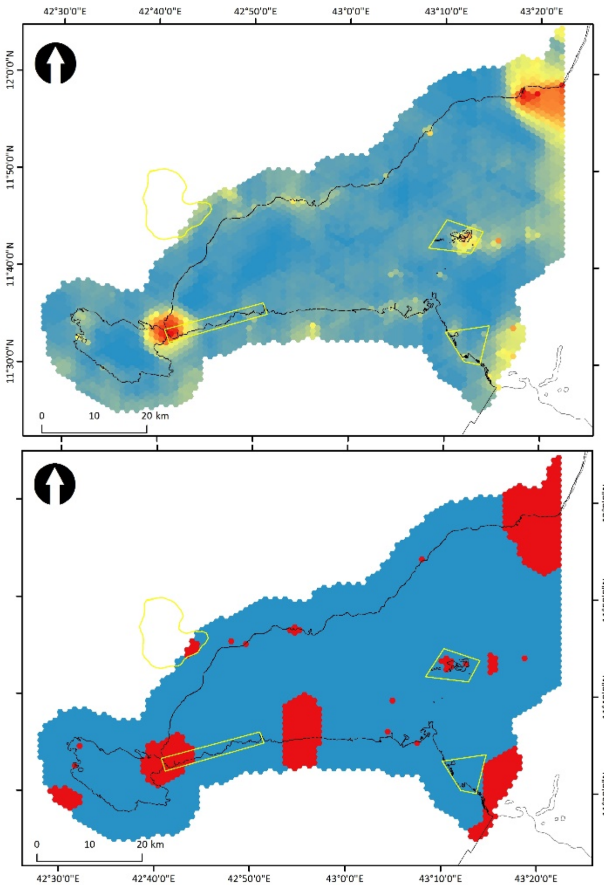
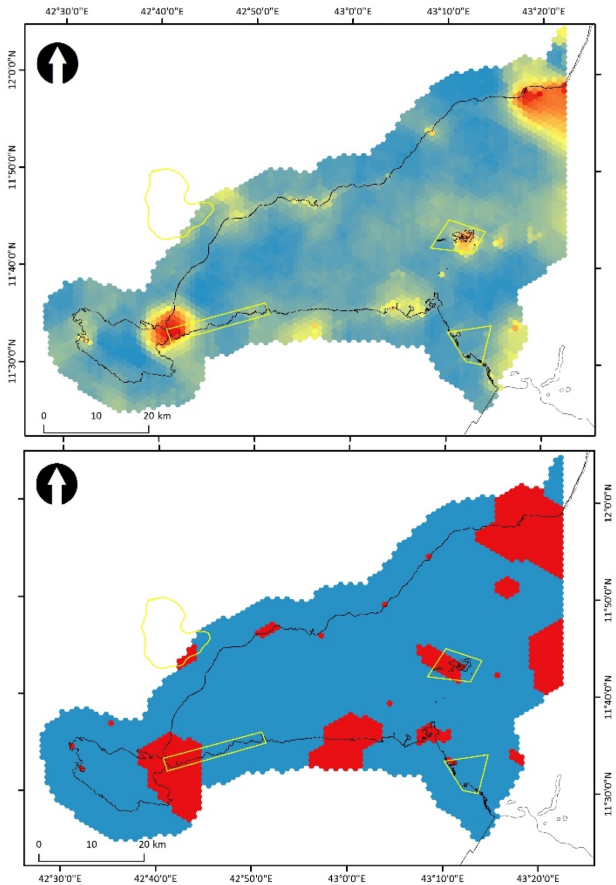
KEY

YELLOW HIGHLIGHTED TEXT	Changes made by facilitator
Yes compatible	YC
Maybe compatible (temporary)	MCT
Maybe compatible (permanent)	MCP
Not compatible	NC
No overlap	
Needs to be completed	GAP

Appendix 6. Marxan Scenarios

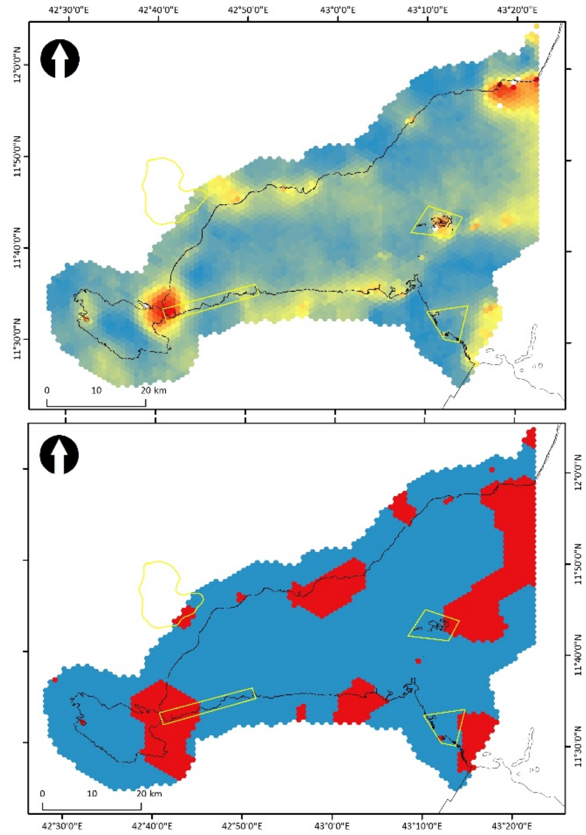
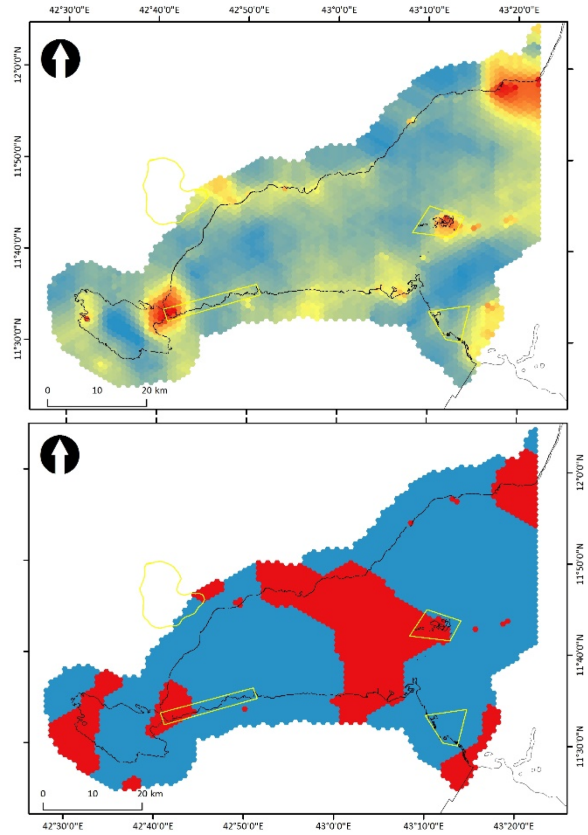
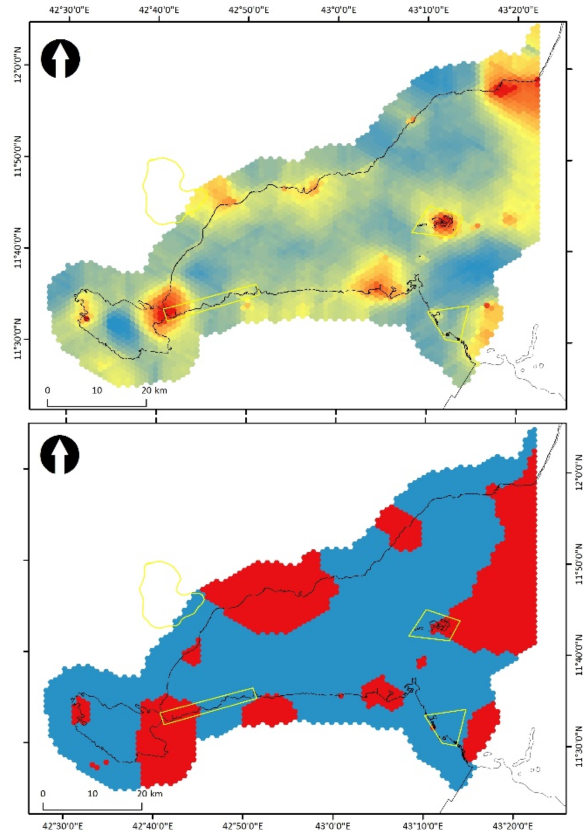
Scenario 01

Maps showing the 'sum solution' and 'best solution' outputs for Scenario 1, for the fixed percentage coverage and feature targets of 5%, 10% and 15%, where cost =1 and protected areas are not locked in

5 percent	10 percent	15 percent
		

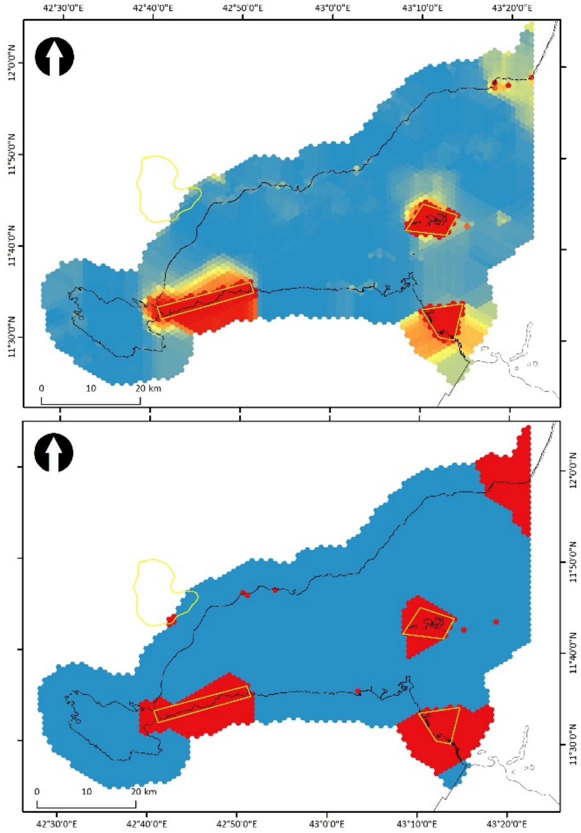
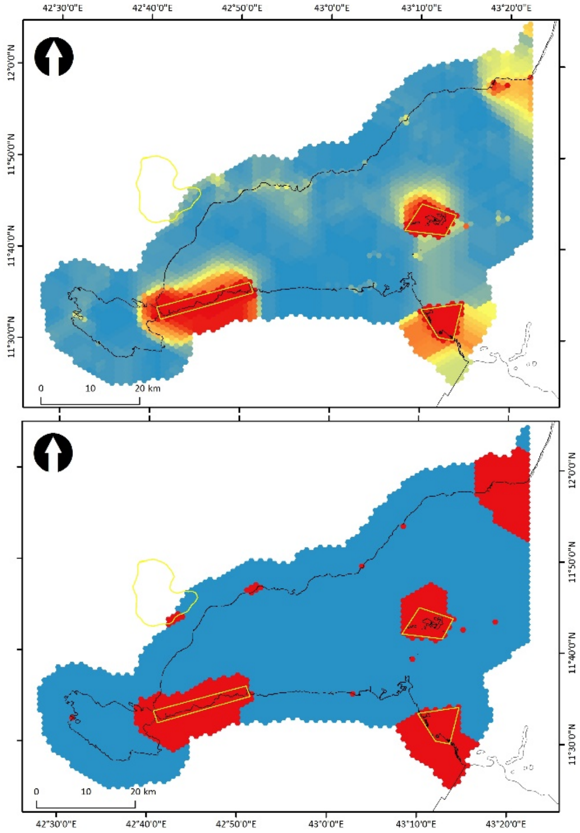
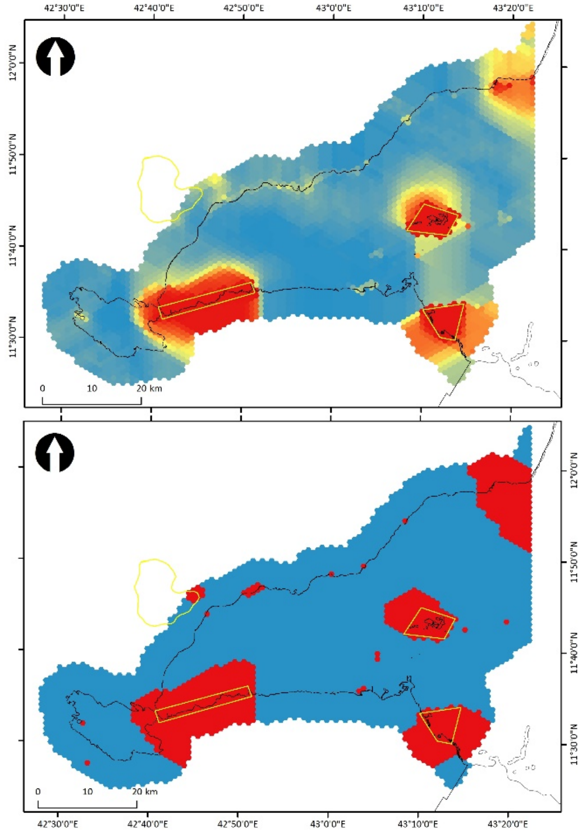
Scenario 01

Maps showing the ‘sum solution’ and ‘best solution’ outputs for the fixed percentage coverage and feature targets of 20%, 25% and 30%, where cost =1 and protected areas are not locked in

20 percent	25 percent	30 percent
		

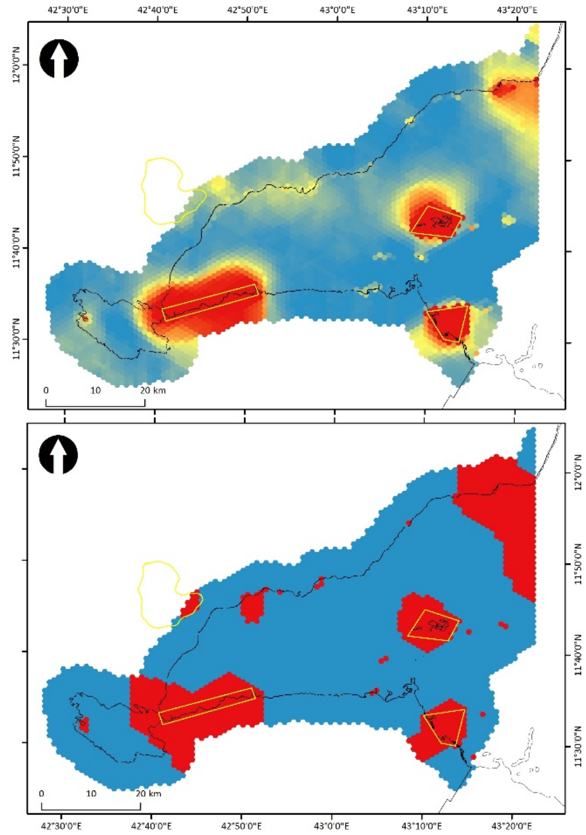
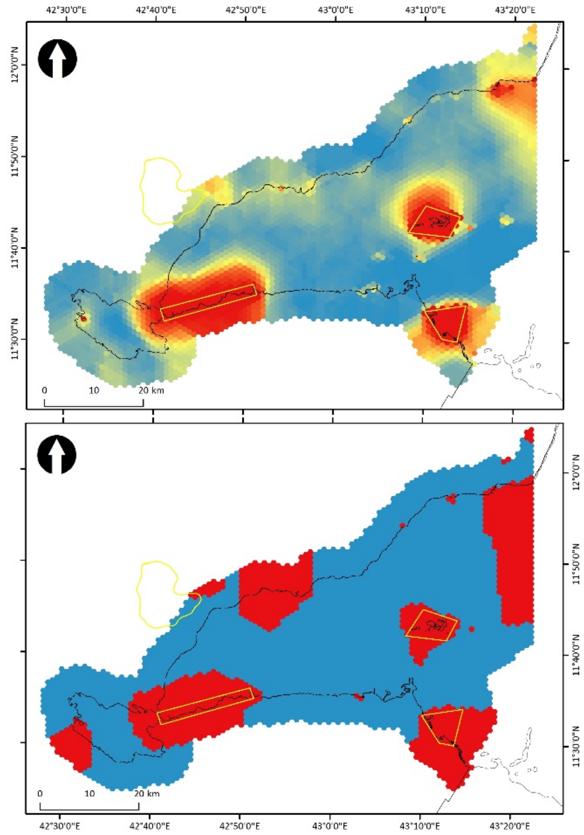
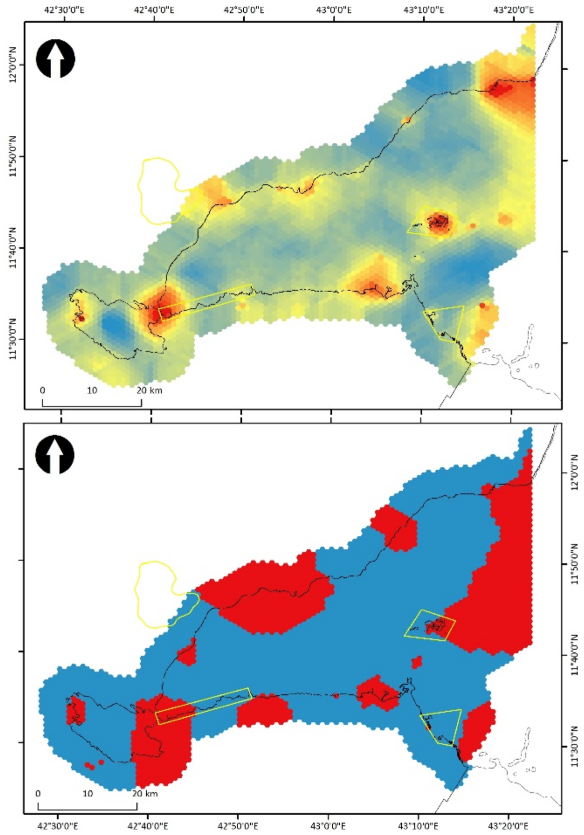
Scenario 02

Maps showing the ‘sum solution’ and ‘best solution’ outputs for Scenario 2, for fixed percentage coverage and features targets of 5%, 10% and 15%, where cost =1 and protected areas are locked in

5 percent	10 percent	15 percent
		

Scenario 02

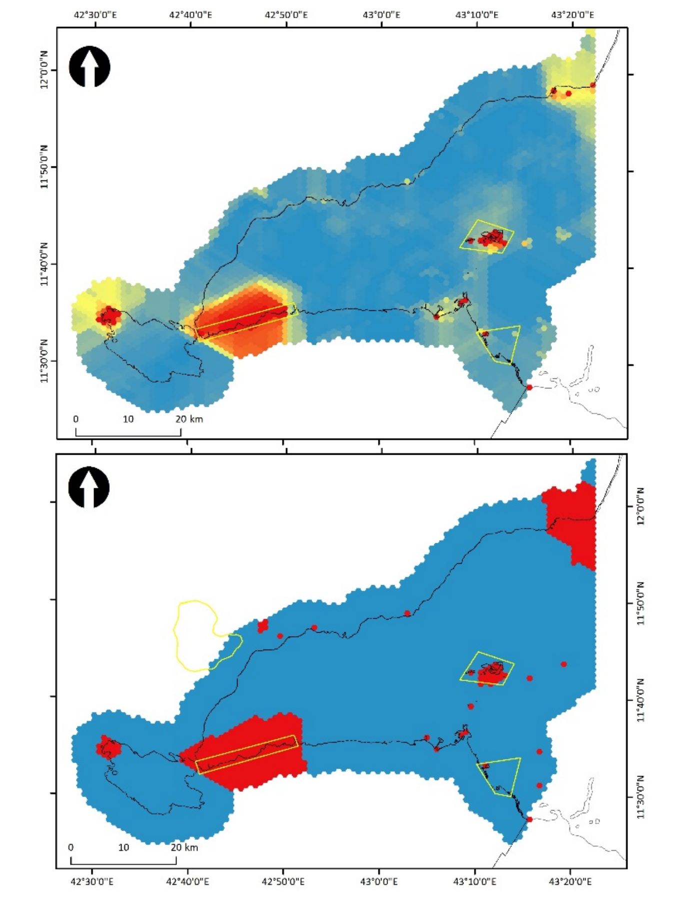
Maps showing the ‘sum solution’ and ‘best solution’ outputs for Scenario 2, for fixed percentage coverage and features targets of 20%, 25% and 30%, where cost =1 and protected areas are locked in

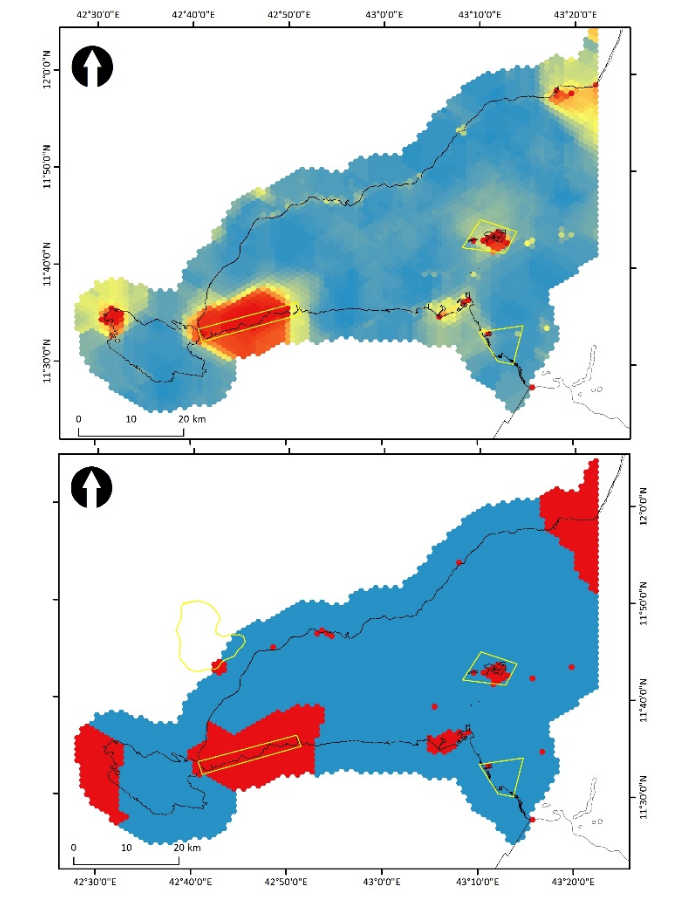
20 percent	25 percent	30 percent
		

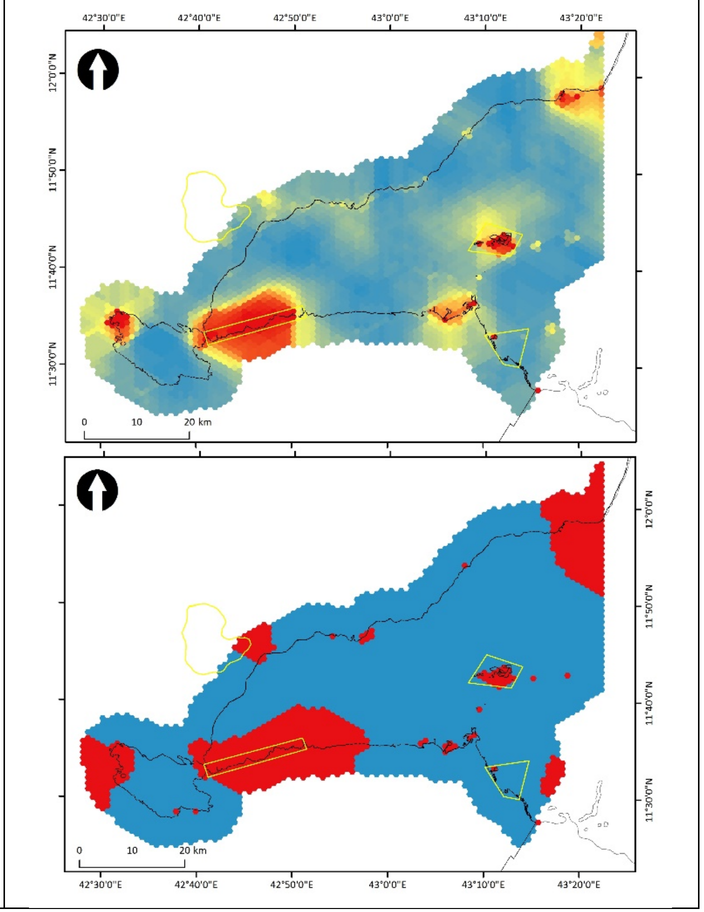
Scenario 03

Maps showing the 'sum solution' and 'best solution' outputs for Scenario 3, using fixed coverage targets of 5%, 10% and 15%, and variable percentage targets for higher priority features of conservation concern, where cost =1 and protected areas are not locked in

5 percent	10 percent	15 percent



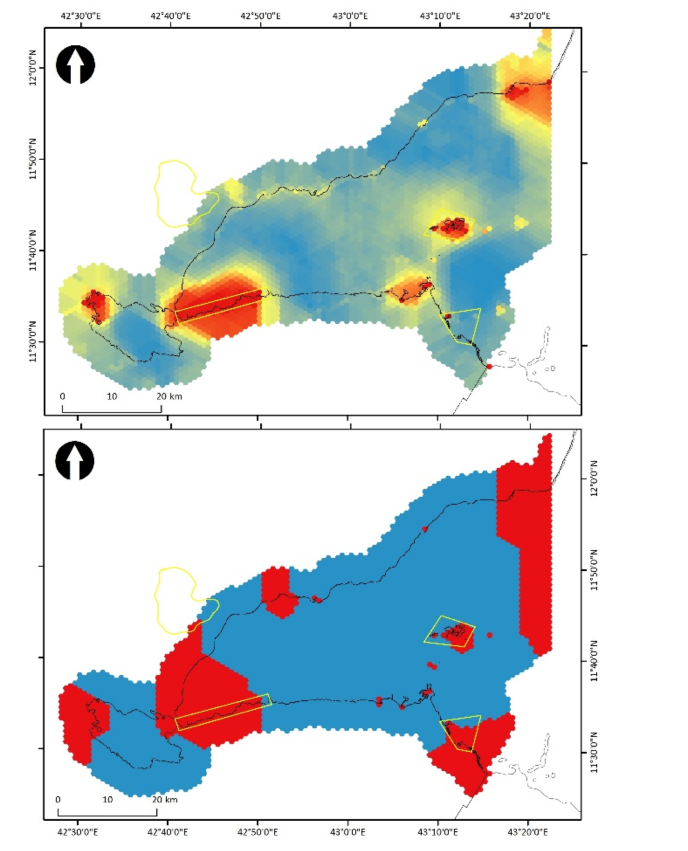




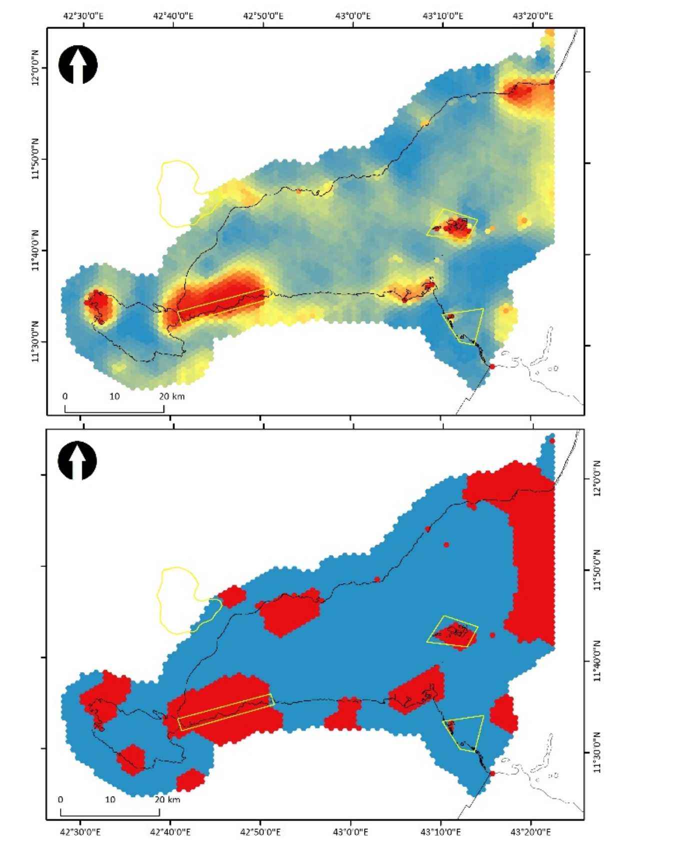
Scenario 03

Maps showing the ‘sum solution’ and ‘best solution’ outputs for Scenario 3, using fixed coverage targets of 20%, 25% and 30%, and variable percentage targets for higher priority features of conservation concern, where cost =1 and protected areas are not locked in

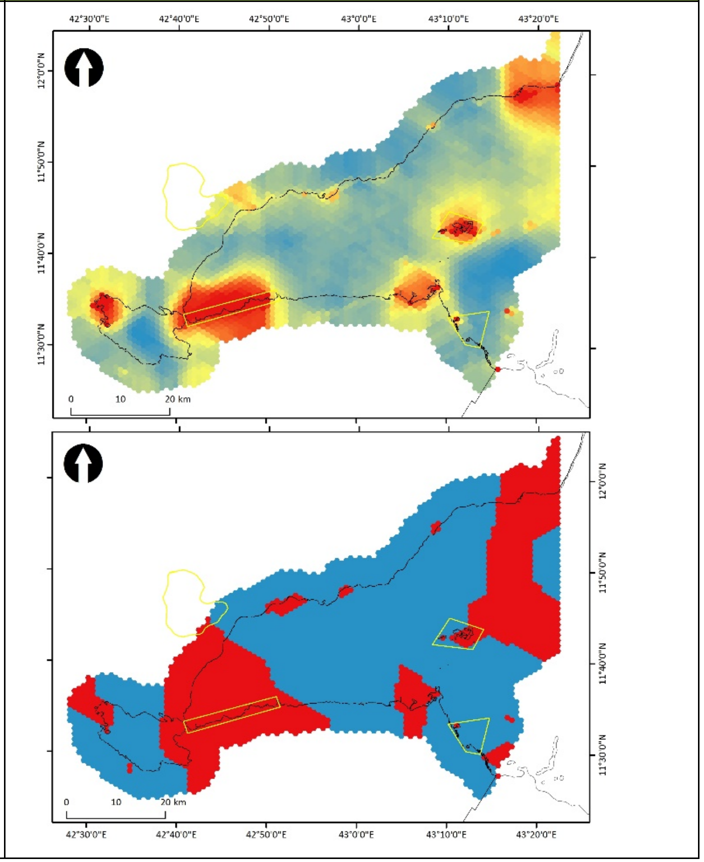
20 percent



25 percent

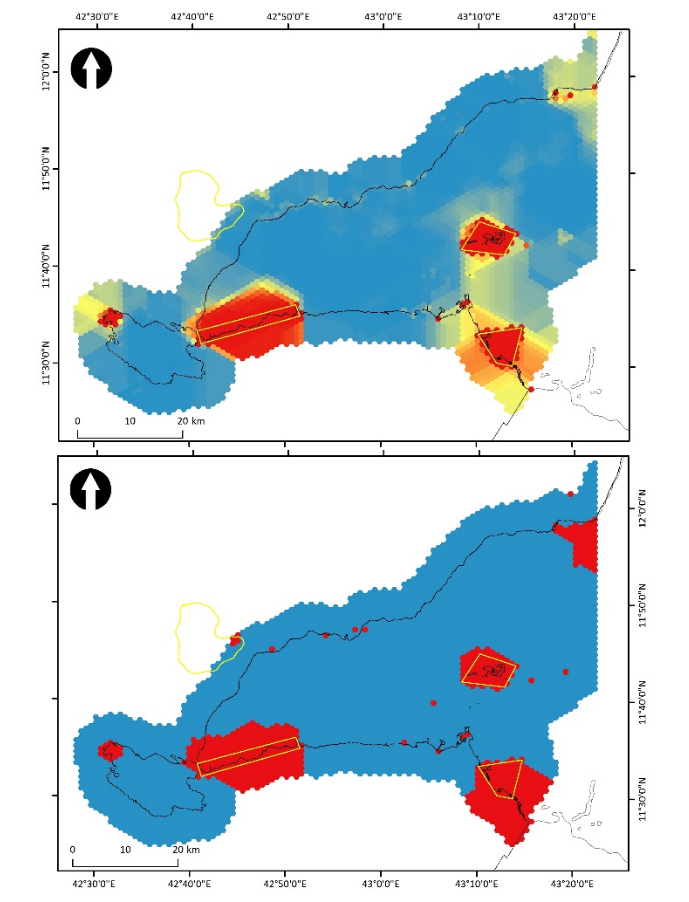
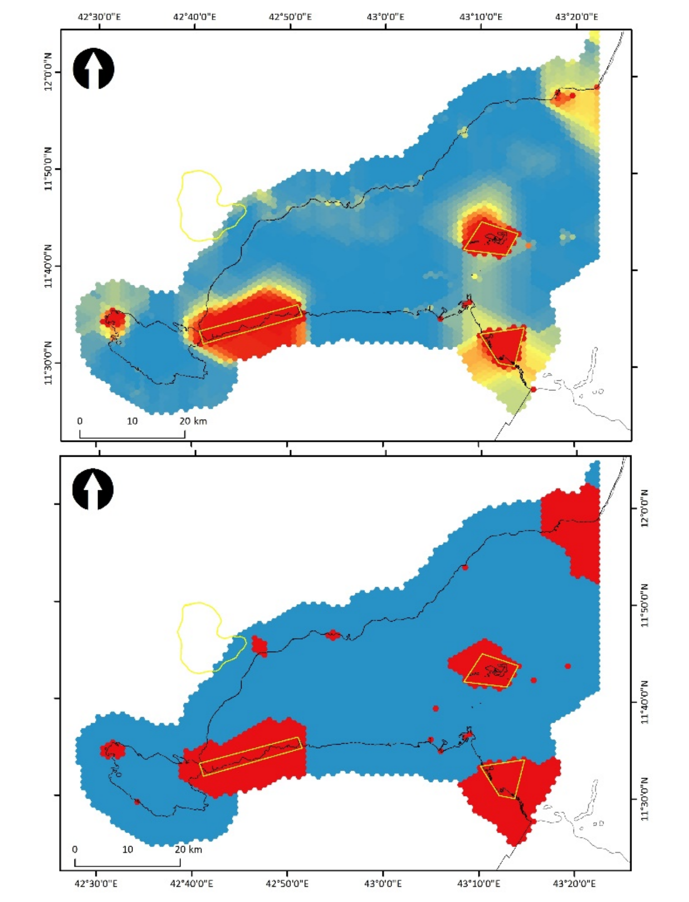
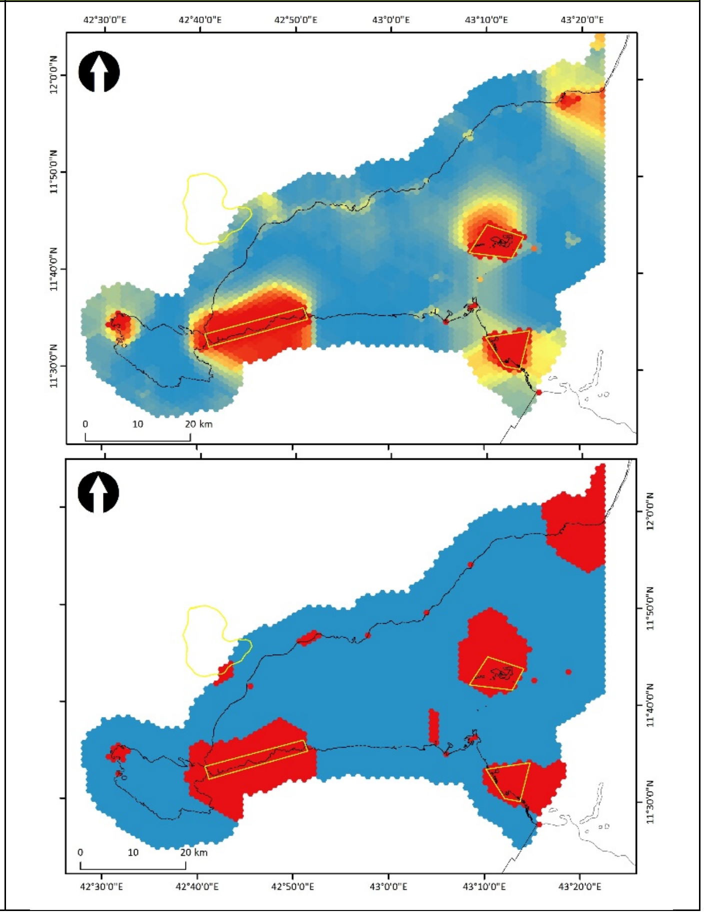


30 percent



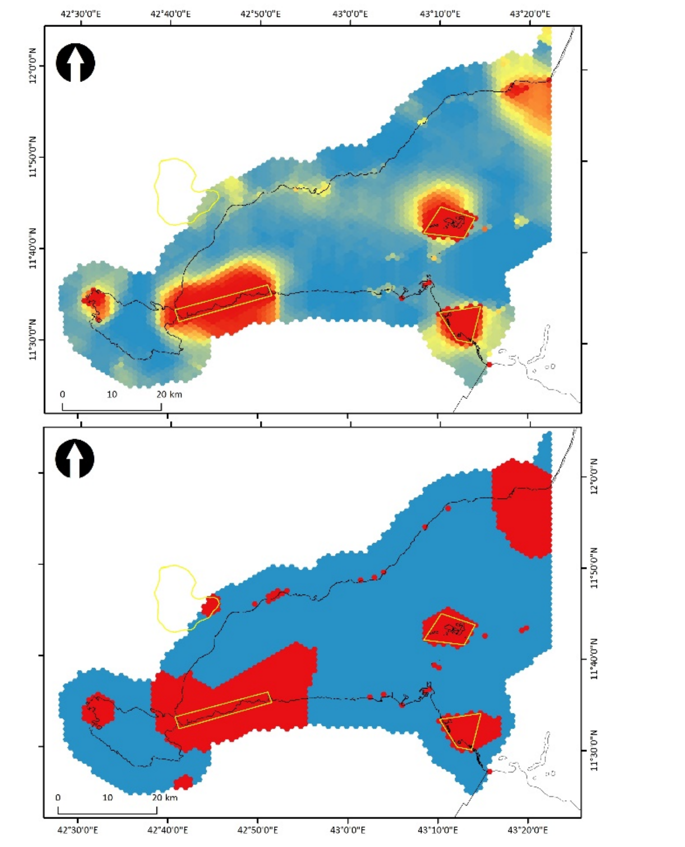
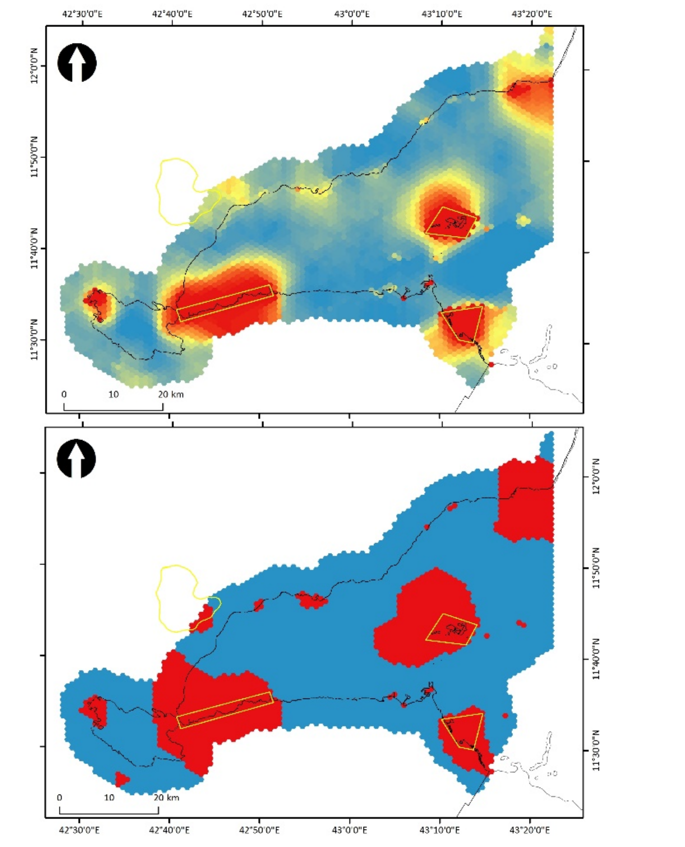
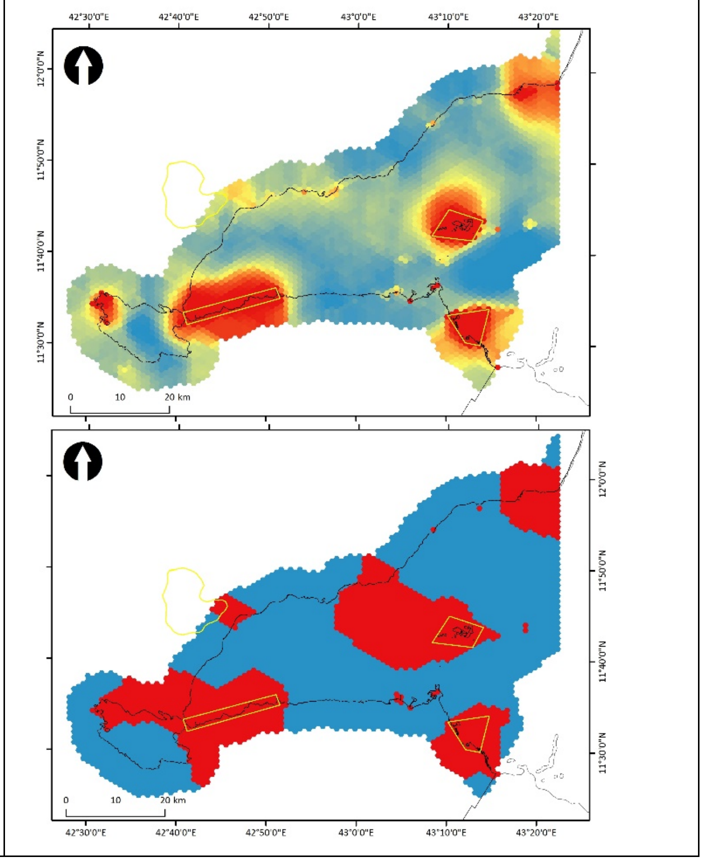
Scenario 04

Maps showing the 'sum solution' and 'best solution' outputs for Scenario 4, using fixed coverage targets of 5%, 10% and 15%, and variable percentage targets for higher priority features of conservation concern, where cost =1 and protected areas are locked in

5 percent	10 percent	15 percent
		

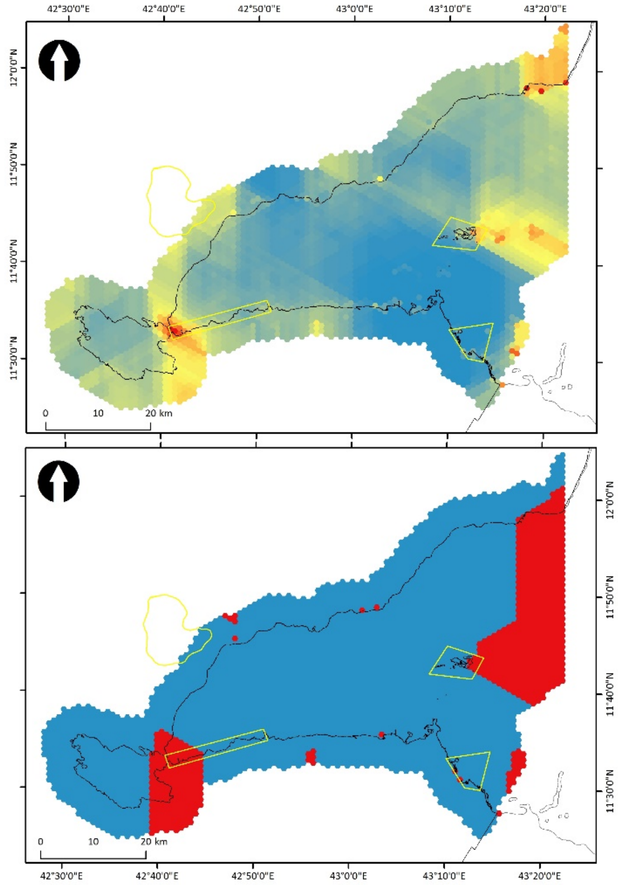
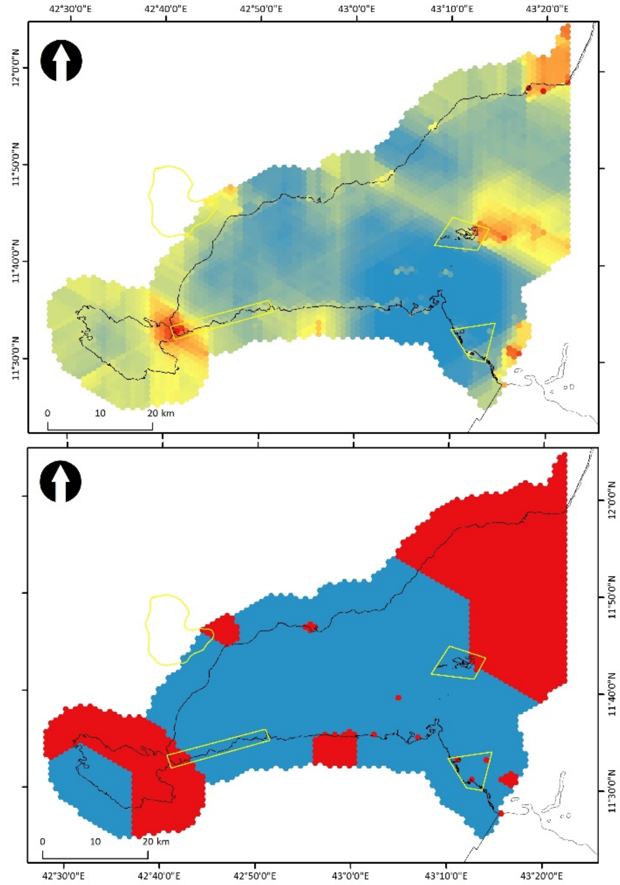
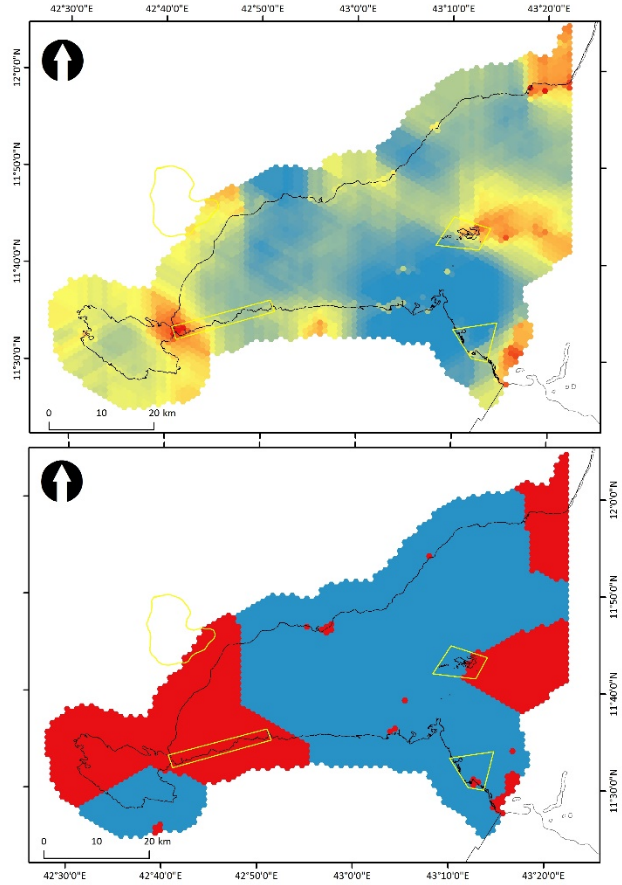
Scenario 04

Maps showing the 'sum solution' and 'best solution' outputs for Scenario 4, using coverage targets of 20%, 25% and 30%, and variable percentage targets for higher priority features of conservation concern, where cost =1 and protected areas locked in

20 percent	25 percent	30 percent
		

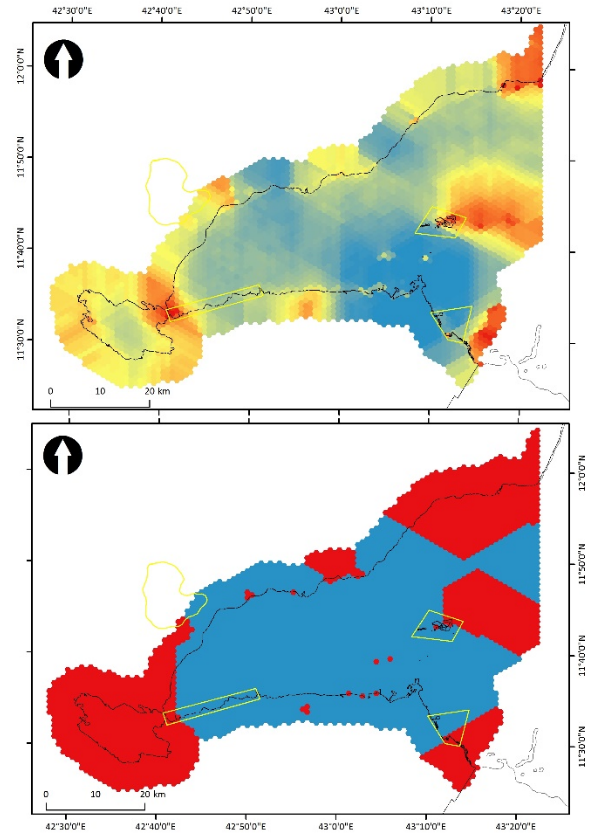
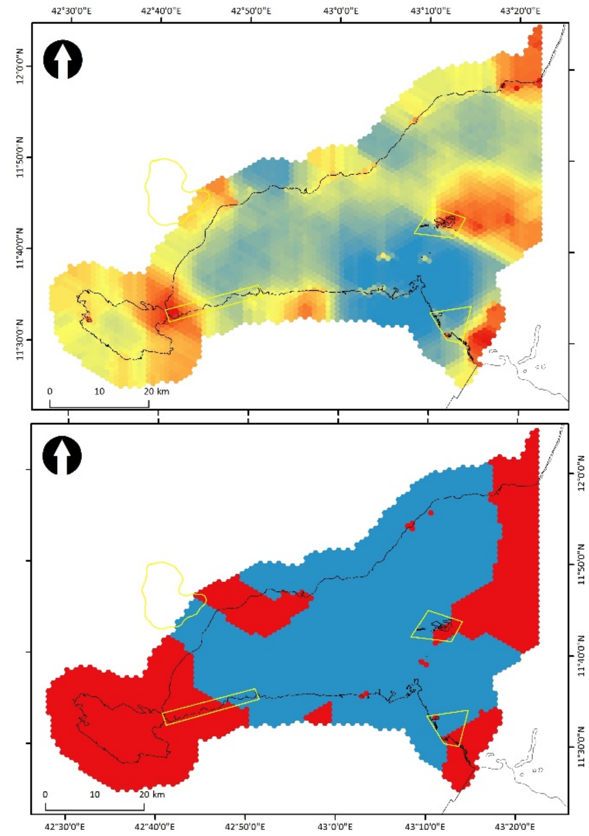
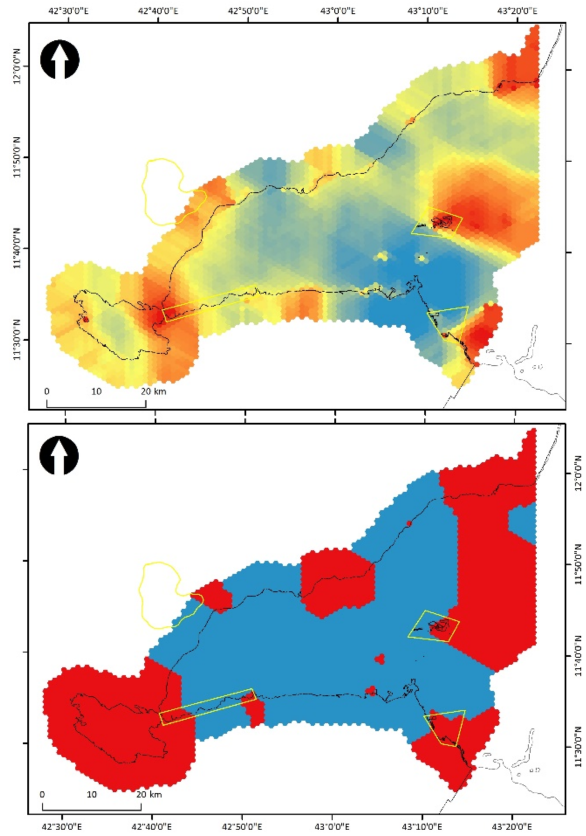
Scenario 05

Maps showing the ‘sum solution’ and ‘best solution’ outputs for Scenario 5, using fixed percentage coverage targets of 5%, 10% and 15%, and variable percentage targets for higher priority features of conservation concern, where cost = threat and protected areas are not locked in

5 percent	10 percent	15 percent
		

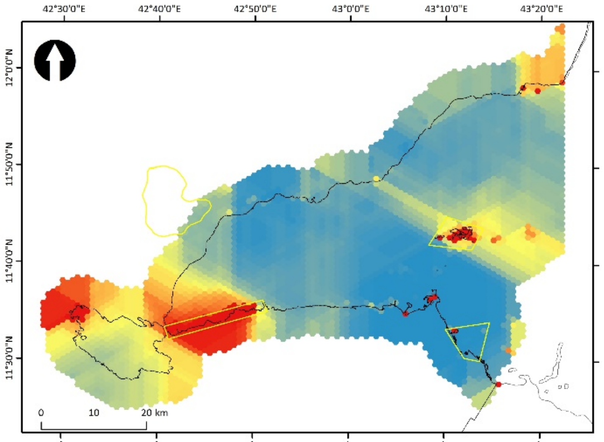
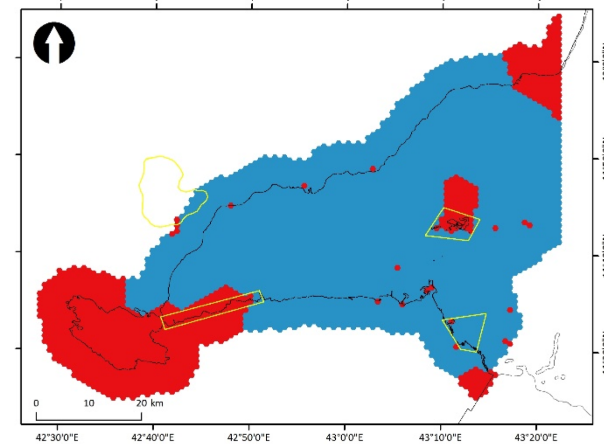
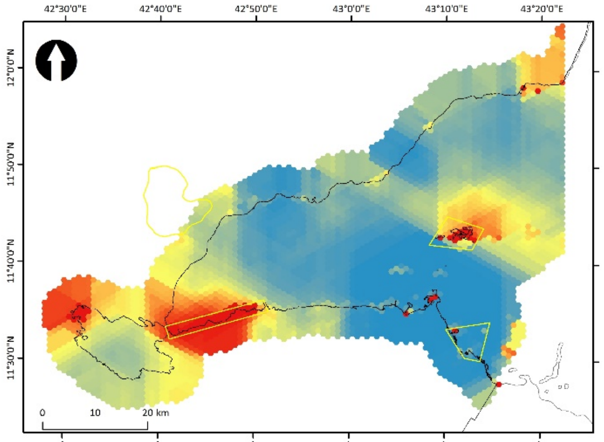
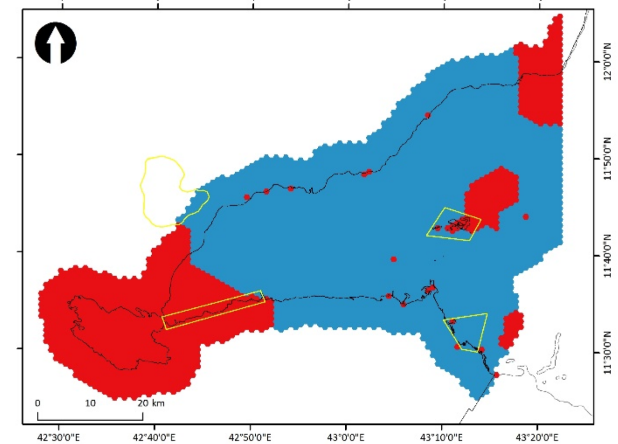
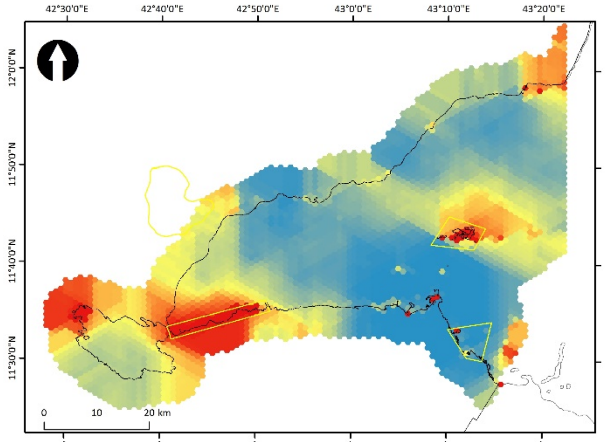
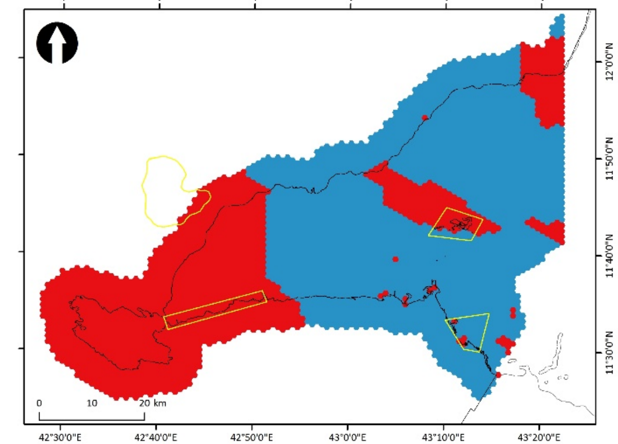
Scenario 05

Maps showing the ‘sum solution’ and ‘best solution’ outputs for Scenario 5, using fixed percentage coverage targets of 20%, 25% and 30%, and variable percentage targets for higher priority features of conservation concern, where cost = threat and protected areas are not locked in

20 percent	25 percent	30 percent
		

Scenario 06

Maps showing the ‘sum solution’ and ‘best solution’ outputs for coverage targets of 5%, 10% and 15%, using variable percentage targets for higher priority features of conservation concern, where cost = threat and protected areas are locked in

5 percent	10 percent	15 percent
 	 	 

Scenario 06

Maps showing the 'sum solution' and 'best solution' outputs for coverage targets of 20%, 25% and 30%, using variable percentage targets for higher priority features of conservation concern, where cost = threat and protected areas are locked in

20 percent	25 percent	30 percent