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Abu Dhabi Global Environmental Data Initiative

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Environment Agency - ABU DHABI

Systematic Conservation Planning Assessments and Spatial Prioritizations

for the Emirate of Abu Dhabi, the United Arab Emirates and the Arabian Peninsula

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Front cover: Dunes at Umm az-Zamool, UAE © Drew Gardner and Arabian humpback whale *Megaptera novaeangliae* © Robert Baldwin
Back cover: Hawksbill turtle *Eretmochelys imbricata* © Fareed Krupp and Jabal Tuwayq, Saudi Arabia © Othman Llewellyn (SWA)

Systematic Conservation Planning Assessments and Spatial Prioritizations

for the Emirate of Abu Dhabi, the United Arab Emirates and the Arabian Peninsula

GIS data and maps for Habitat, Habitat Condition and Protected Areas together with the outputs from the spatial assessments are available on the AGEDI website www.agedi.ae.

Extensive desert habitats such as the Ar-Rub' al-Khali cover large parts of the Arabian Peninsula. These habitats support a limited but distinctive and largely endemic flora and fauna and in most cases are not threatened by human development. Many of the larger mammal species, and some birds, became either extinct in the wild or significantly depleted by excessive hunting but are now subject to large-scale conservation programmes.

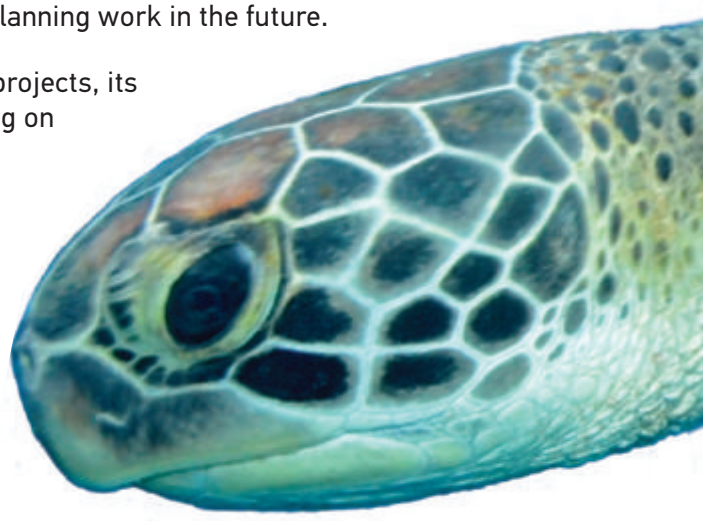
Contents

Preface

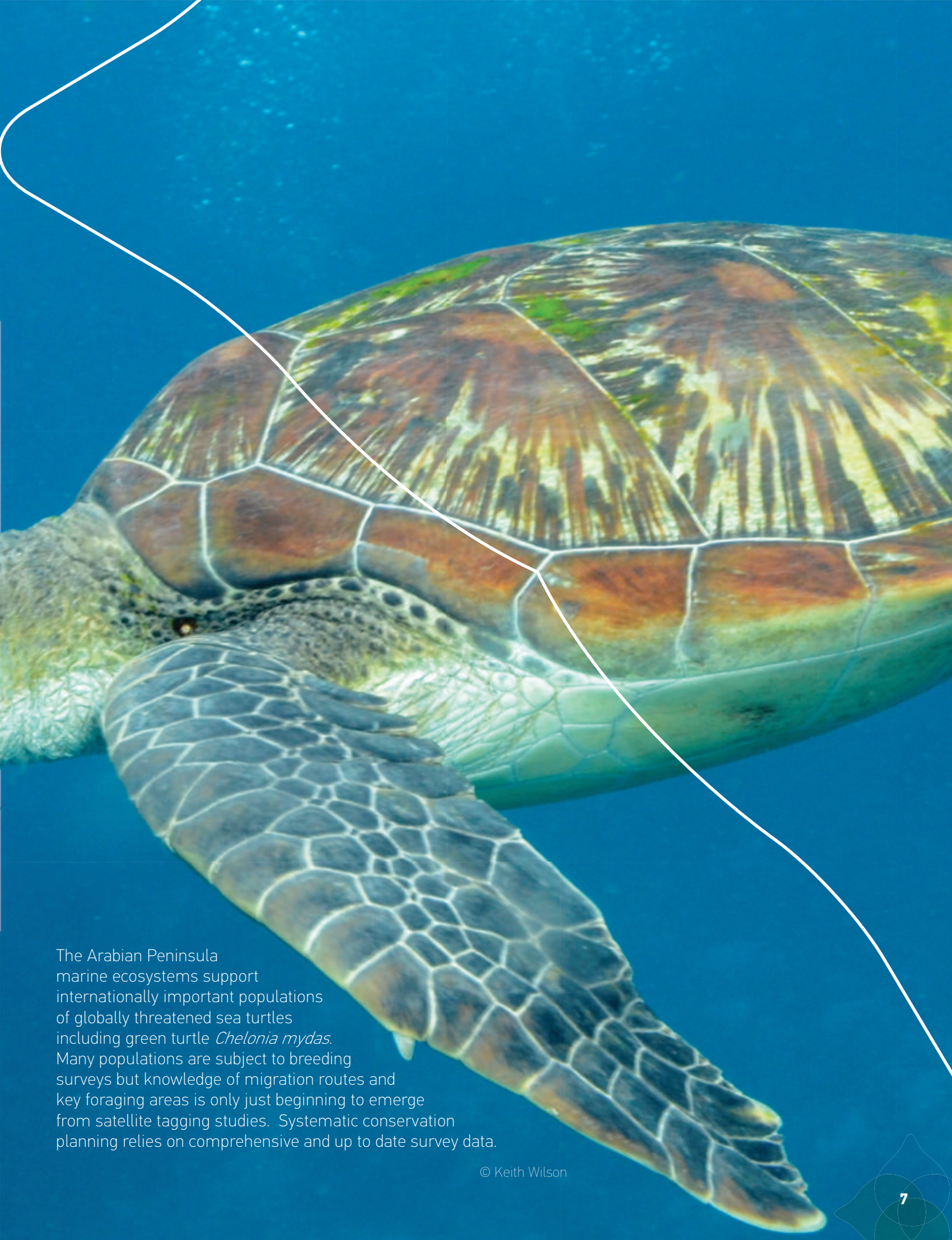
AGEDI's role is to promote the sharing of environmental data to enable better decision-making. This project has successfully promoted and enabled data sharing by a wide range of stakeholders with a common purpose Locally, National and Regionally. That purpose has been the production of Systematic Conservation Plans for Abu Dhabi Emirate, the United Arab Emirates (UAE) and the Arabian Peninsula Region.

These plans and their constituent derived spatial data layers are a sound basis for Protected Area planning by decision-makers throughout the region. It is AGEDI's wish that these outputs both stimulate further cooperation and lead to improved environmental outcomes. The project has at its heart a strong method based on sound science. The results are ground-breaking and useful but also repeatable with an ongoing improved baseline of data. It is AGEDI's strong intention that the institutional and technical capacity within the region is developed further to take forward such systematic conservation planning work in the future.

AGEDI will continue to share and disseminate the results of such projects, its methodologies and the lessons learnt. We look forward to building on the collaborative efforts of this project and beyond as we continue to bridge the environmental data gap between developed and developing countries.



Dr. Frédéric Launay
Acting Director, AGEDI
May 2013



The Arabian Peninsula marine ecosystems support internationally important populations of globally threatened sea turtles including green turtle *Chelonia mydas*. Many populations are subject to breeding surveys but knowledge of migration routes and key foraging areas is only just beginning to emerge from satellite tagging studies. Systematic conservation planning relies on comprehensive and up to date survey data.

Executive Summary

Systematic Conservation Planning (SCP) seeks to assess biodiversity in a robust, repeatable and scientific manner and thereby identify the best places in a landscape to undertake conservation activities such as Protected Area expansion. Systematic Conservation Plans were prepared, during a 15 month project, using available spatial data for the marine and terrestrial areas within the Emirate of Abu Dhabi (Abu Dhabi), the United Arab Emirates (UAE) and the Arabian Peninsula region, comprising the UAE together with the Hashemite Kingdom of Jordan (Jordan), the Kingdom of Bahrain (Bahrain), the Kingdom of Saudi Arabia (Saudi Arabia), the Republic of Yemen (Yemen), the State of Kuwait (Kuwait), the State of Qatar (Qatar), and the Sultanate of Oman (Oman). The Abu Dhabi and UAE analyses were run at a finer scale than the Arabian Peninsula.

Intensive and wide ranging stakeholder involvement, which eventually extended to 149 institutions and 270 individuals, was undertaken. This was required to obtain the range of biodiversity and other associated data from across the region. Draft outputs were peer-reviewed through a series of technical workshops (four for Abu Dhabi/UAE and two for the region) which enabled experts to improve the mapping, fill data gaps, contribute to the Spatial Prioritization, and review and confirm findings.

The project collated available spatial data into six summary derived layers on GIS that were then used to run the spatial analyses. The six derived layers were: Habitat, Habitat Condition, Protected Areas, Species, Ecological Processes, and Opportunity and Constraints. As the project followed a SCP approach, targets were set for biodiversity features including for ecosystems, habitats and species.

The analysis phase of the project had three major components:

- Ecosystem Threat Status assessed the proportion of ecosystems that were in a natural or intact state compared to targets.
- Protection Level assessed the representation of ecosystems within the current Protected Area network (i.e. a gap analysis).
- Spatial Prioritizations using MARXAN were generated using the six derived layers.

The Ecosystem Threat Status and Protection Level assessments provided robust, objective, data-derived headline indicators which inform a range of assessments and planning processes. The outputs of the MARXAN analyses were used to identify Priority Focus Areas to undertake area-based conservation activities such as Protected Area expansion and other mechanisms for securing areas for biodiversity and managing them sympathetically. In the finer scale analysis for the UAE, 22 Priority Focus Areas were identified, while 35 Priority Focus Areas were identified across the Arabian Peninsula.

The derived layers, particularly Habitat, Protected Area and Habitat Condition for the UAE and Arabian Peninsula have a value beyond the SCP analyses. The UAE and Arabian Peninsula Habitat maps are the first comprehensive maps of their kind for the region and useful for many aspects of ecology work including survey design and stratification.

The headline indicators from the Ecosystem Threat Status and Protection Level assessments are the first objective measure of conservation priority for Arabian Peninsula ecosystems and are linked to the emerging process of Ecosystem Red Listing. These indicators are ideal for reporting against international commitments, such as Convention on Biological Diversity targets, and potentially form the basis for the biodiversity component of national State of Environment reporting and national biodiversity assessments. The Spatial Prioritizations provide a range of products for planners to use in determining local spatial priorities, including identifying national and transboundary priority areas for Protected Area expansion, as well as identifying the areas where finer scale planning would be beneficial. These project outputs provide a sound basis for more detailed biodiversity and land use planning and a foundation for SCP in the future for Abu Dhabi, UAE and Arabian Peninsula.

The outputs are by no means the final conservation plans and represent the first iteration of a continually evolving process which can be strengthened by improved data inputs. Key data gaps include species data collected through atlas work and well-designed surveys. There is also an urgent need to better measure marine condition and terrestrial degradation. A critical impact on terrestrial ecosystems that is currently under-estimated in these analyses is that of overgrazing.

AGEDI is enthusiastic for the project outputs to be shared throughout the region with all stakeholders that contributed data and the wide range of planners and others whom determine the fate of ecosystems and their constituent species.

Dragon's blood tree *Dracaena cinnabari* in the uplands of Socotra is both iconic and endemic. The Socotra Archipelago is classified as a Centre of Plant Diversity by WWF/IUCN and an Endemic Bird Area by BirdLife International.

Acknowledgements

AGEDI's outputs rely on the willingness of stakeholders to share data and expertise. This project has resulted in a collaboration of a wide range of organisations and individuals across the Arabian Peninsula and further afield as listed below.

The contribution of every data focal point and facilitator, data provider, workshop attendee and photographer is gratefully acknowledged.

UAE Organisations
Abu Dhabi City Municipality (ADM)
Abu Dhabi Company for Onshore Oil Operations (ADCO)
Abu Dhabi Distribution Company (ADDC)
Abu Dhabi National Oil Company (ADNOC)
Abu Dhabi Systems & Information Centre (ADSIC)
Abu Dhabi Tourism & Culture Authority (ADTCA)
Abu Dhabi Urban Planning Council (UPC)
Ajman Municipality
Aldar Properties
Border Affairs Council
Breeding Centre for Endangered Arabian Wildlife (BCEAW)
Critical Infrastructure and Coastal Protection Authority (CICPA)
Department of Municipal Affairs - Abu Dhabi (DMA)
Department of Transport - Abu Dhabi (DoT)
Dive Mahara, Abu Dhabi
Dubai Desert Conservation Reserve (DDRC)
Dubai Municipality
Emirates Bird Records Committee (EBRC)
Emirates Diving Association
Emirates Marine Environmental Group (EMEG)
Emirates Nuclear Energy Corporation (ENEC)
Emirates Wildlife Society - Worldwide Fund for Nature (EWS-WWF)
Environment Agency - Abu Dhabi (EAD)
Environment & Protected Areas Authority - Sharjah (EPAA)
Fujairah Municipality
Gulf Elasmo Project, Dubai
Ministry of Environment & Water (MoEW)
Ministry of Foreign Affairs (MoFA)
Mubadala
National Media Council, Abu Dhabi (NMC)
Nautica Environmental Associates
New York University - Abu Dhabi (NYUAD)
Ras al-Khaimah Environment Protection and Development Authority (RAK-EPDA)
Supreme Petroleum Council (SPC)
Tourism Development & Investment Company (TDIC)
Umm Al Quwain Municipality
University of Sharjah
United Arab Emirates University (UAEU)

Regional & International Organisations
Agricultural Research & Extension Authority, Taiz, Yemen (AREA)
American University Madaba, Jordan (AUM)
Arabian Gulf University, Bahrain (AGU)
BirdLife International, UK
Central Informatics & Telecommunications Organisation, Bahrain (CITO)
Centre for Middle East Plants, Royal Botanic Garden Edinburgh, UK (CMEP)

Environment Protection Authority, Yemen (EPA)
Environment Public Authority, Kuwait (EPA)
Environment Society of Oman (ESO)
Environmental Balance, Saudi Arabia
Environmental Monitoring Information System of Kuwait (eMISK)
Foundation for the Protection of the Arabian Leopard, Yemen
Ibb University, Yemen
International Union for Conservation of Nature, Switzerland (IUCN)
IUCN Regional Office for West Asia, Jordan (IUCN – ROWA)
IUCN-Conservation International Biodiversity Assessment Unit, USA (IUCN-CI)
King Khalid Wildlife Research Centre, Saudi Arabia (KKWRC)
Kuwait Institute for Scientific Research (KISR)
Lebanese International University, Yemen (LIU)
Marine Research Foundation, Malaysia (MRF)
Ministry of Environment, Jordan (MoE Jordan)
Ministry of Environment, Qatar (MoE Qatar)
Ministry of Municipality & Urban Planning, Qatar (MMUP)
Ministry of Water & Environment, Yemen (MWE)
National Wildlife Research Center, Saudi Arabia (NWRC)
Oman Botanic Garden
Public Commission for the Protection of Marine Resources, Environment & Wildlife (PCPMREW)
Qatar Natural History Museum (QNHM)
Regional Organization for the Protection of the Marine Environment, Kuwait (ROPME)
Royal Botanic Gardens, Kew, UK (RBG Kew)
Royal Society for the Conservation of Nature, Jordan (RSCN)
Sana'a University, Yemen
Saudi Wildlife Authority, Saudi Arabia (SWA)
Sultan Qaboos University, Oman
United Nations Environment Programme - Regional Office for West Asia, Bahrain (UNEP-ROWA)
UNEP-World Conservation Monitoring Centre, UK (UNEP-WCMC)
United Nations Educational Scientific & Cultural Organisation, Arab Region Office, Qatar (UNESCO ARO)
University of Jordan (UoJ)
UoJ Marine Science Station, Aqaba, Jordan
University of Warwick, UK

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Mr. Gary Feulner (UAE)
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Mr. Kevin Budd (UAE)
Mr. Othman Llewellyn (Saudi Arabia)
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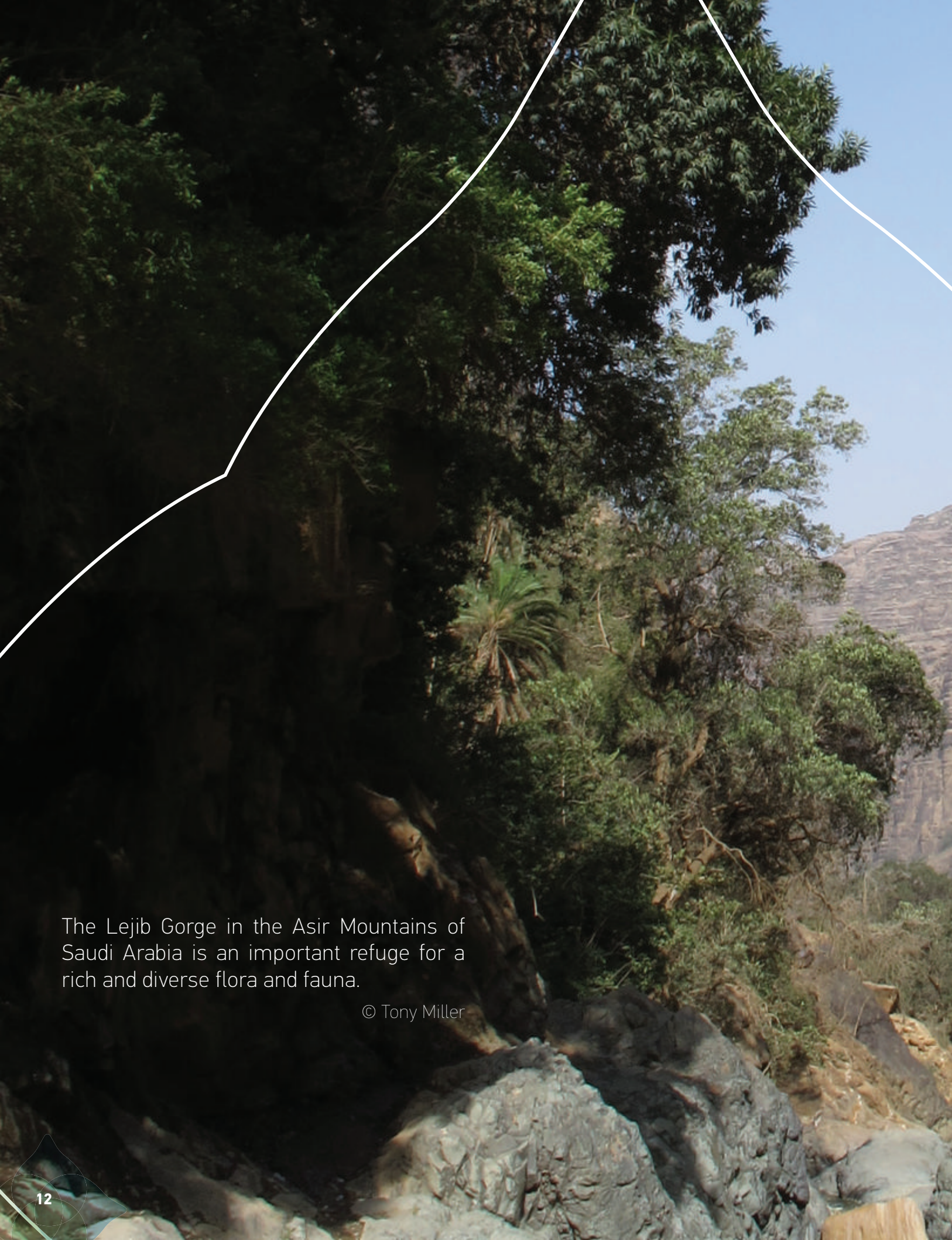
Dr. Eddy De Pauw (Belgium)



The Lejib Gorge in the Asir Mountains of Saudi Arabia is an important refuge for a rich and diverse flora and fauna.

© Tony Miller

Introduction

"The realization of conservation goals requires strategies for managing whole landscapes including areas allocated to both production and protection. Reserves alone are not adequate for nature conservation but they are the cornerstone on which regional strategies are built. Reserves have two main roles. They should sample or represent the biodiversity of each region and they should separate this biodiversity from processes that threaten its persistence. Existing reserve systems throughout the world contain a biased sample of biodiversity, usually that of remote places and other areas that are unsuitable for commercial activities. A more systematic approach to locating and designing reserves has been evolving and this approach will need to be implemented if a large proportion of today's biodiversity is to exist in a future of increasing numbers of people and their demands on natural resources."

Margules & Pressey (2000)

Existing Protected Areas are the basis for building further ecosystem protection through Systematic Conservation Planning. Al Dhulaima Protected Area with ghaf trees *Prosopis cineraria*, Sharjah Emirate, United Arab Emirates.

Systematic Conservation Planning

This Local, National and Regional Rapid Biodiversity Assessment Project was based on the Systematic Conservation Planning (SCP) approach. This is a 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 such a robust evidence-based, target driven, conservation planning approach have been demonstrated around the globe, from whole ecoregions to reserves, and across marine and terrestrial environments.

This Project gathered available spatial data to derive six initial layers comprising Habitats, Habitat Condition, Protected Areas, Species, Ecological Processes and Opportunities and Constraints. These derived layers were used to generate two headline indicators for all terrestrial and marine habitats; an Ecosystem Threat Status which examined to what extent habitats remain in an intact or natural condition; and an Ecosystem Protection Level Assessment which examined whether each habitat type was sufficiently represented in the Protected Area network (i.e. a gap analysis).

Following this, a Spatial Prioritization to identify focus areas for conservation implementation was undertaken. The prioritization used the MARXAN decision support tool, which is the most widely adopted site-selection tool used by conservation groups globally, having been applied to local and regional planning efforts in over 60 countries around the world (Ball, Possingham, & Watts, 2009). MARXAN is designed to provide an objective approach to site prioritization which is adaptable and repeatable. A systematic biodiversity assessment for the region was first proposed at the 11th Conservation Workshop for the Fauna of Arabia in Sharjah in 2010.

The workshop produced a first rapid biodiversity assessment for the Arabian Peninsula (Holness, Knights, Sorensen, & Othman, 2011) and demonstrated that the approach could be applied to the region. This Project commenced in January 2012 and completed its work in April 2013. This document provides a summary of the work undertaken; it is important to note that the analyses for the Emirate of Abu Dhabi (Abu Dhabi), which are a detailed but similar subset of those for the United Arab Emirates (UAE), are not covered separately here.

Heavy fishing pressure is a key impact on many marine ecosystems within the Arabian Peninsula, but along with other marine pressures is difficult to quantify spatially. This is an inshore fishing boat near Ras al Sawadi, Oman.

© Steve Parr

Figure 1 The three planning domains were nested within one another, with analysis taking place at a finer scale for Abu Dhabi and the UAE compared to the Arabian Peninsula assessment.

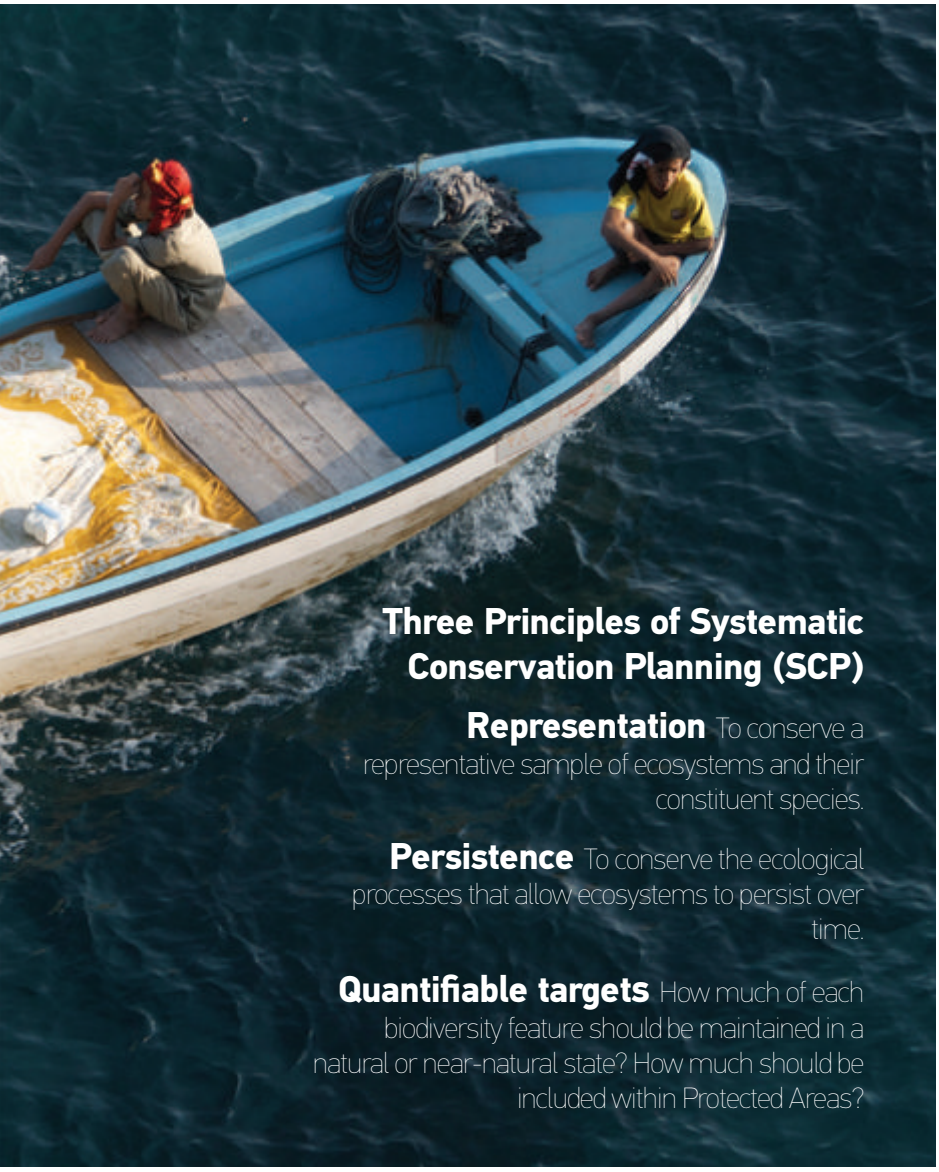
Planning Extent and Scale

The Project was delivered at three scales – Abu Dhabi (Local), the UAE (National) and the Arabian Peninsula (Regional) which includes Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, UAE and Yemen (Figure 1).

The Spatial Prioritizations undertaken for the Local and National assessments were run at a finer scale than the Regional assessment. The planning domain (i.e. the area of coverage and interest of the project) included all terrestrial areas and marine Exclusive Economic Zones (EEZ) of each country.

Planning units for the analyses were iteratively developed taking into account the resolution of the input datasets and the size of the different planning domains. Hexagonal units with a side length of 2km and an area of 10km^2 were used for Abu Dhabi and the UAE, while the Arabian Peninsula analysis used hexagons with approximately 6km side length and an area of 100km^2.

The Project integrated all available biodiversity data received either through stakeholder engagement or desktop research. Therefore the maps are as accurate as the current data permit. In all areas the data quality was adequate for the purposes of this SCP process, while in some areas the data were of a much higher quality. As a result the UAE and Abu Dhabi maps and data are good for inspection and analysis at 1:100,000 scale and at the Arabian Peninsula scale, analysis at 1:250,000 is achievable.



Three Principles of Systematic Conservation Planning (SCP)

Representation To conserve a representative sample of ecosystems and their constituent species.

Persistence To conserve the ecological processes that allow ecosystems to persist over time.

Quantifiable targets How much of each biodiversity feature should be maintained in a natural or near-natural state? How much should be included within Protected Areas?

Assessment Methods

The SCP process followed a sequential data integration method (Figure 2) that was built on the input of the best available data, and supplemented where necessary with expert inputs. The first stage was the acquisition of spatial data which were then assembled into a number of summary derived layers. To be included, data had to be spatial and preferably in GIS format as they needed to be integrated into map products.

Where data gaps existed, expert knowledge was sought through a series of technical workshops which also peer-reviewed each stage of the assessment and assisted in locating other relevant data. The derived layers were then utilised within the three assessments which were the core outputs of the SCP process.

Reefs off Musandam in Northern Oman support rich marine communities. This is a large shoal of red-toothed triggerfish *Odonus niger.*

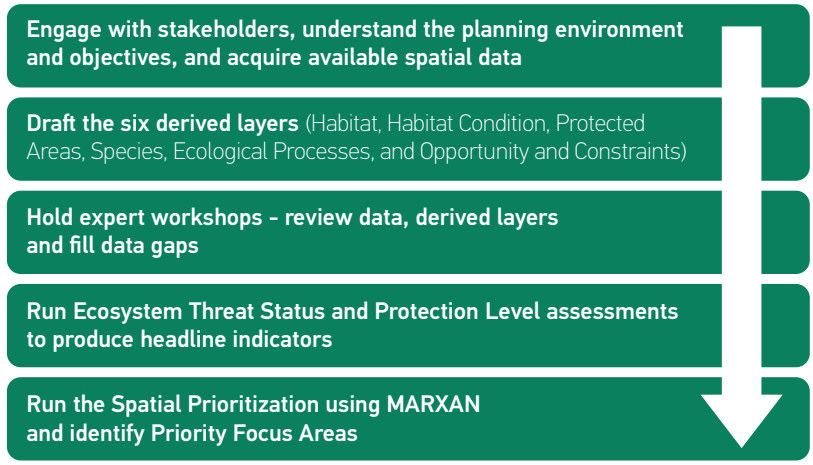
Stakeholder Engagement

The scale of the Project and the number of stakeholders spread across many countries and institutions dictated that planning and prioritisation of engagement activity was important. Hence the Project produced a Stakeholder Liaison Plan that identified key data focal points within a wide range of local, national and regional agencies, experts and other data providers. At the same time, potential data sources were scoped and the strengths and weaknesses of available data assessed.

Following these preparatory stages, formal letters of notification were sent out and followed up with more detailed requests for information. This was followed by extensive communications via face-to-face meetings, email and telephone. Dedicated email and data transfer portals were utilised for the Project. All interactions were tracked and new contacts added to build a comprehensive stakeholder database.

Stakeholder engagement extended to communications with 149 institutions and 270 individuals over a period of 10 months.

Figure 2 The Systematic Conservation Planning process follows a number of sequential steps. The diagram is a summary of the process that is both iterative and adaptive.



Crab plover *Dromas ardeola* breeding colonies are found on offshore islands around the Arabian Peninsula including here on Bubiyan Island, Kuwait.

Data Collation and Management

As biodiversity, land use and spatial planning data were required, the Project team had to interact with both environmental organisations and the organizations responsible for land use planning and management. The data focal points identified within the environmental agencies often helped the Project access other departments and agencies where such land use and land cover data were maintained.

The Project received data from a wide array of sources. For Abu Dhabi, the extensive biodiversity survey data collected by EAD and held within an Environmental Baseline Database was extremely valuable. At the UAE level, cooperation with the Northern Emirates was positive, however resources were more limited especially for marine data.

Global data, especially on threatened species, geology, topography, and bathymetry was vital. The contributions of global conservation organisations including International Union for Conservation of Nature (IUCN), Worldwide Fund for Nature (WWF), United Nations Environment Program – World Conservation Monitoring Centre (UNEP-WCMC), IUCN-Conservation International Global Assessment Unit and BirdLife International were also exceptionally important.

The key data sources are summarised in Figure 3.

All data provided were managed via a Data Register and were stored within a Base Data Archive geodatabase. Data were reviewed for their suitability for use in the preparation of the derived layers. The data management process is summarised in Figure 4.

Figure 3 Summary of the key organisations that provided spatial data to the Project. Without the assistance of these organizations the Project would not have been possible.

Abu Dhabi

- Environment Agency-Abu Dhabi (EAD) Data:
  - Environmental Baseline Database
  - Coastal and Marine Resource Ecosystem Classification System (CMRECS)
  - EAD Soil Survey
  - EAD unpublished survey and monitoring data
- Department for Municipal Affairs (DMA)
- Abu Dhabi Urban Planning Council (UPC)
- Abu Dhabi City Municipality (ADM)
- Abu Dhabi National Oil Corporation (ADNOC)
- Abu Dhabi Company for Onshore Oil Operations (ADCO)
- Abu Dhabi Tourism and Culture Authority (ADTCA)
- Tourism Development & Investment Company (TDIC)

UAE

- Breeding Centre for Endangered Arabian Wildlife (BCEAW)
- Emirates Nuclear Energy Corporation (ENEC)
- Emirates Wildlife Society-Worldwide Fund for Nature (EWS-WWF)
- Environment and Protected Areas Authority-Sharjah (EPAA)
- Emirates Marine Environmental Group (EMEG)
- Ministry of Environment and Water (MoEW)
- Municipalities of Ajman, Dubai, Fujairah and Umm Al Quwain
- New York University-Abu Dhabi (NYUAD)
- University of Sharjah

Arabian Peninsula / Global

- Agricultural Research and Extension Authority (AREA), Taiz, Yemen
- BirdLife International
- Centre for Middle East Plants, Royal Botanic Garden Edinburgh, UK (CMEP)
- Conservation and Management Planning Workshops-Sharjah (CAMP)
- Environmental Monitoring Information System of Kuwait (eMISK)
- Foundation for the Protection of the Arabian Leopard in Yemen
- International Union for Conservation of Nature-Conservation International (IUCN-CI) Global Assessment Unit, Washington
- IUCN-Regional Office for West Asia (ROWA)
- Ministry of Environment (MoE), Jordan
- Ministry of Environment (MoE), Qatar
- Ministry of Water and Environment (MWE), Yemen
- Qatar Natural History Museum
- Saudi Wildlife Authority (SWA), Kingdom of Saudi Arabia
- Online GIS data sources (IUCN Red List, USGS, SRTM, GEBCO, WWF Marine Ecoregions)
- Public Commission for the Protection of Marine Resources, Environment and Wildlife (PCPMREW), Bahrain
- Royal Society for Conservation of Nature, Jordan (RSCN)
- Sana'a University, Yemen
- United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC)
- University of Jordan

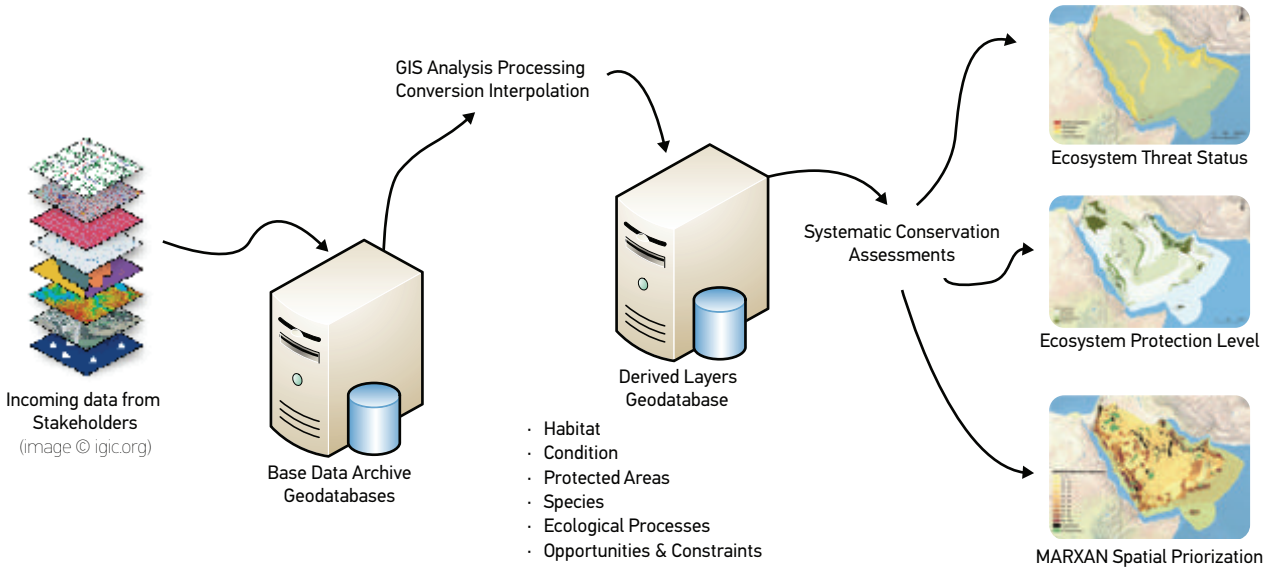


Figure 4 Project Data Management Process

Derived Layers

Data within the Base Data Archive were extracted to build the derived layers required for the SCP assessments. The best available data provided by the stakeholders were used to create the derived layers. Table 1 below demonstrates how each layer was used within each of assessments.

Table 1 Systematic Conservation Planning Assessments with corresponding derived layers used for analysis.

Derived Layer	Ecosystem Threat Status	Ecosystem Protection Level	MARXAN Spatial Prioritization
Habitats	X	X	X
Habitat Condition	X		X
Protected Areas		X	X
Species			X
Ecological Processes			X
Opportunities and Constraints			X

Habitats

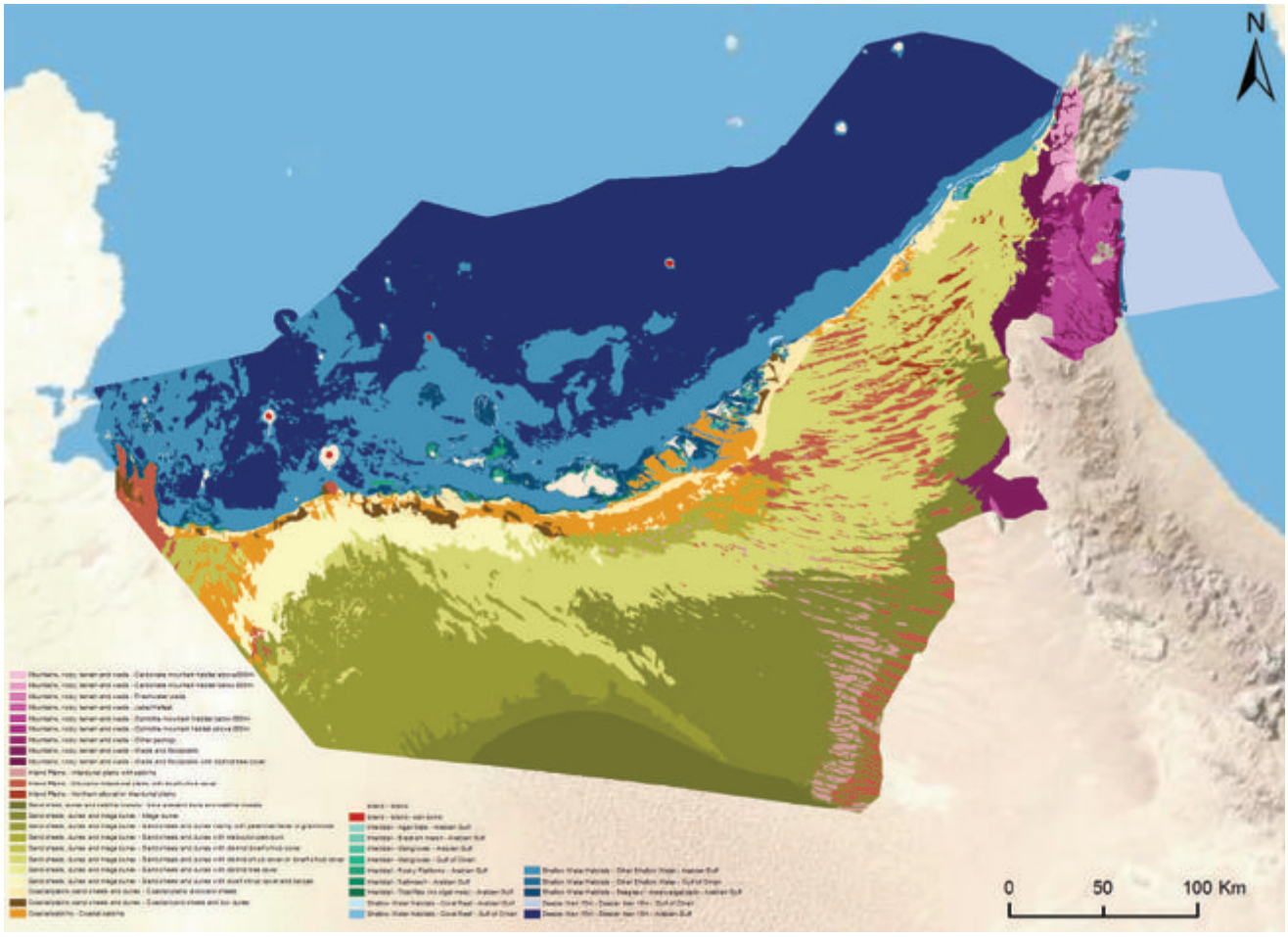
The ability to map and classify habitats into different ecosystem types is a key basis for SCP. As suitable habitat maps did not exist for either the UAE or the Arabian Peninsula, their development was a key activity for the Project. The Project developed integrated terrestrial and marine habitat maps for the UAE (Figure 5) and the Arabian Peninsula (Figure 6).

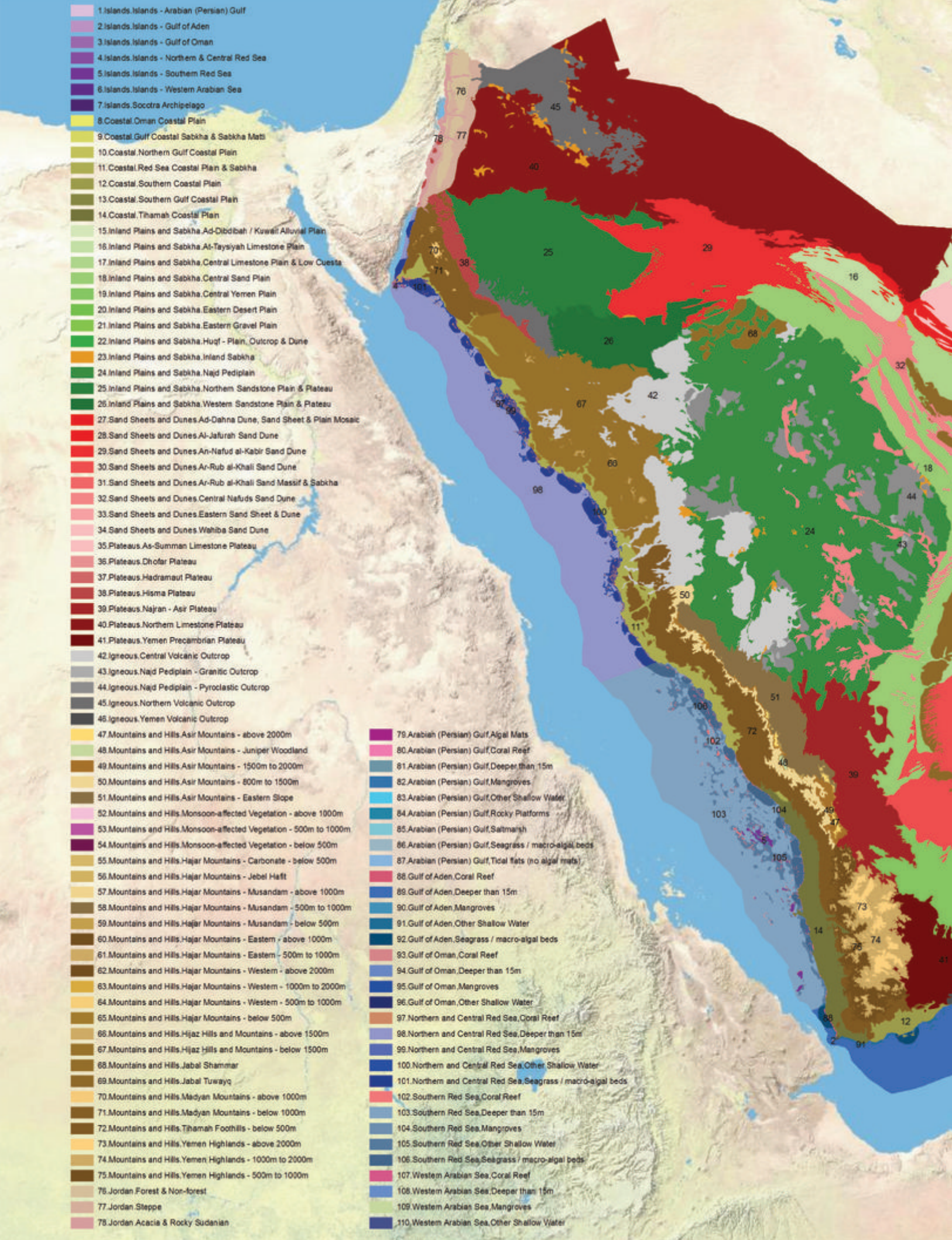
The Arabian Peninsula map was developed from existing habitat and bioregional classifications , most notably the draft bioregional classification developed by the Saudi Wildlife Authority (Llewellyn, 2011), together with global geology, bathymetry, WWF Marine Ecoregion and UNEP-WCMC marine GIS data.

The UAE habitat map was a refinement and combination of the Soil Survey for Abu Dhabi (2006-2009) and the Northern Emirates (2010-2012), geological maps from the National Atlas of the UAE and existing marine habitat classification for Abu Dhabi Coastal and Marine Resource Ecosystem Classification System (CMRECS).

In both cases the habitat maps were based on interpolation from existing spatial data (with their intrinsic accuracy limitations), and although they represent a significant advance in the understanding of patterns of biodiversity across the region, they are not a replacement for field-based maps. The habitat maps are a valuable product in their own right and have a wide array of other biodiversity uses.

Figure 5 Habitat map for the UAE.




1.Islands.Islands - Arabian (Persian) Gulf
2.Islands.Islands - Gulf of Aden
3.Islands.Islands - Gulf of Oman
4.Islands.Islands - Northern & Central Red Sea
5.Islands.Islands - Southern Red Sea
6.Islands.Islands - Western Arabian Sea
7.Islands.Socotra Archipelago
8.Coastal.Oman Coastal Plain
9.Coastal.Gulf Coastal Sabkha & Sabkha Matti
10.Coastal.Northern Gulf Coastal Plain
11.Coastal.Red Sea Coastal Plain & Sabkha
12.Coastal.Southern Coastal Plain
13.Coastal.Southern Gulf Coastal Plain
14.Coastal.Tihamah Coastal Plain
15.Inland Plains and Sabkha.Ad-Dibdibah / Kuwait Alluvial Plain
16.Inland Plains and Sabkha.At-Taysiyah Limestone Plain
17.Inland Plains and Sabkha.Central Limestone Plain & Low Cuesta
18.Inland Plains and Sabkha.Central Sand Plain
19.Inland Plains and Sabkha.Central Yemen Plain
20.Inland Plains and Sabkha.Eastern Desert Plain
21.Inland Plains and Sabkha.Eastern Gravel Plain
22.Inland Plains and Sabkha.Huqf - Plain, Outcrop & Dune
23.Inland Plains and Sabkha.Inland Sabkha
24.Inland Plains and Sabkha.Najd Pediplain
25.Inland Plains and Sabkha.Northern Sandstone Plain & Plateau
26.Inland Plains and Sabkha.Western Sandstone Plain & Plateau
27.Sand Sheets and Dunes.Ad-Dahna Dune, Sand Sheet & Plain Mosaic
28.Sand Sheets and Dunes.Al-Jafurah Sand Dune
29.Sand Sheets and Dunes.An-Nafud al-Kabir Sand Dune
30.Sand Sheets and Dunes.Ar-Rub al-Khali Sand Dune
31.Sand Sheets and Dunes.Ar-Rub al-Khali Sand Massif & Sabkha
32.Sand Sheets and Dunes.Central Nafuds Sand Dune
33.Sand Sheets and Dunes.Eastern Sand Sheet & Dune
34.Sand Sheets and Dunes.Wahiba Sand Dune
35.Plateaus.As-Summan Limestone Plateau
36.Plateaus.Dhofar Plateau
37.Plateaus.Hadramaut Plateau
38.Plateaus.Hisma Plateau
39.Plateaus.Najran - Asir Plateau
40.Plateaus.Northern Limestone Plateau
41.Plateaus.Yemen Precambrian Plateau
42.Igneous.Central Volcanic Outcrop
43.Igneous.Najd Pediplain - Granitic Outcrop
44.Igneous.Najd Pediplain - Pyroclastic Outcrop
45.Igneous.Northern Volcanic Outcrop
46.Igneous.Yemen Volcanic Outcrop
47.Mountains and Hills.Asir Mountains - above 2000m
48.Mountains and Hills.Asir Mountains - Juniper Woodland
49.Mountains and Hills.Asir Mountains - 1500m to 2000m
50.Mountains and Hills.Asir Mountains - 800m to 1500m
51.Mountains and Hills.Asir Mountains - Eastern Slope
52.Mountains and Hills.Monsoon-affected Vegetation - above 1000m
53.Mountains and Hills.Monsoon-affected Vegetation - 500m to 1000m
54.Mountains and Hills.Monsoon-affected Vegetation - below 500m
55.Mountains and Hills.Hajar Mountains - Carbonate - below 500m
56.Mountains and Hills.Hajar Mountains - Jebel Hafit
57.Mountains and Hills.Hajar Mountains - Musandam - above 1000m
58.Mountains and Hills.Hajar Mountains - Musandam - 500m to 1000m
59.Mountains and Hills.Hajar Mountains - Musandam - below 500m
60.Mountains and Hills.Hajar Mountains - Eastern - above 1000m
61.Mountains and Hills.Hajar Mountains - Eastern - 500m to 1000m
62.Mountains and Hills.Hajar Mountains - Western - above 2000m
63.Mountains and Hills.Hajar Mountains - Western - 1000m to 2000m
64.Mountains and Hills.Hajar Mountains - Western - 500m to 1000m
65.Mountains and Hills.Hajar Mountains - below 500m
66.Mountains and Hills.Hijaz Hills and Mountains - above 1500m
67.Mountains and Hills.Hijaz Hills and Mountains - below 1500m
68.Mountains and Hills.Jabal Shammar
69.Mountains and Hills.Jabal Tuwayq
70.Mountains and Hills.Madyan Mountains - above 1000m
71.Mountains and Hills.Madyan Mountains - below 1000m
72.Mountains and Hills.Tihamah Foothills - below 500m
73.Mountains and Hills.Yemen Highlands - above 2000m
74.Mountains and Hills.Yemen Highlands - 1000m to 2000m
75.Mountains and Hills.Yemen Highlands - 500m to 1000m
76.Jordan.Forest & Non-forest
77.Jordan.Steppe
78.Jordan.Acacia & Rocky Sudanian
79.Arabian (Persian) Gulf,Algal Mats
80.Arabian (Persian) Gulf,Coral Reef
81.Arabian (Persian) Gulf,Deeper than 15m
82.Arabian (Persian) Gulf,Mangroves
83.Arabian (Persian) Gulf,Other Shallow Water
84.Arabian (Persian) Gulf,Rocky Platforms
85.Arabian (Persian) Gulf,Saltmarsh
86.Arabian (Persian) Gulf,Seagrass / macro-algal beds
87.Arabian (Persian) Gulf,Tidal flats (no algal mats)
88.Gulf of Aden,Coral Reef
89.Gulf of Aden,Deeper than 15m
90.Gulf of Aden,Mangroves
91.Gulf of Aden,Other Shallow Water
92.Gulf of Aden,Seagrass / macro-algal beds
93.Gulf of Oman,Coral Reef
94.Gulf of Oman,Deeper than 15m
95.Gulf of Oman,Mangroves
96.Gulf of Oman,Other Shallow Water
97.Northern and Central Red Sea,Coral Reef
98.Northern and Central Red Sea,Deeper than 15m
99.Northern and Central Red Sea,Mangroves
100.Northern and Central Red Sea,Other Shallow Water
101.Northern and Central Red Sea,Seagrass / macro-algal beds
102.Southern Red Sea,Coral Reef
103.Southern Red Sea,Deeper than 15m
104.Southern Red Sea,Mangroves
105.Southern Red Sea,Other Shallow Water
106.Southern Red Sea,Seagrass / macro-algal beds
107.Western Arabian Sea,Coral Reef
108.Western Arabian Sea,Deeper than 15m
109.Western Arabian Sea,Mangroves
110.Western Arabian Sea,Other Shallow Water

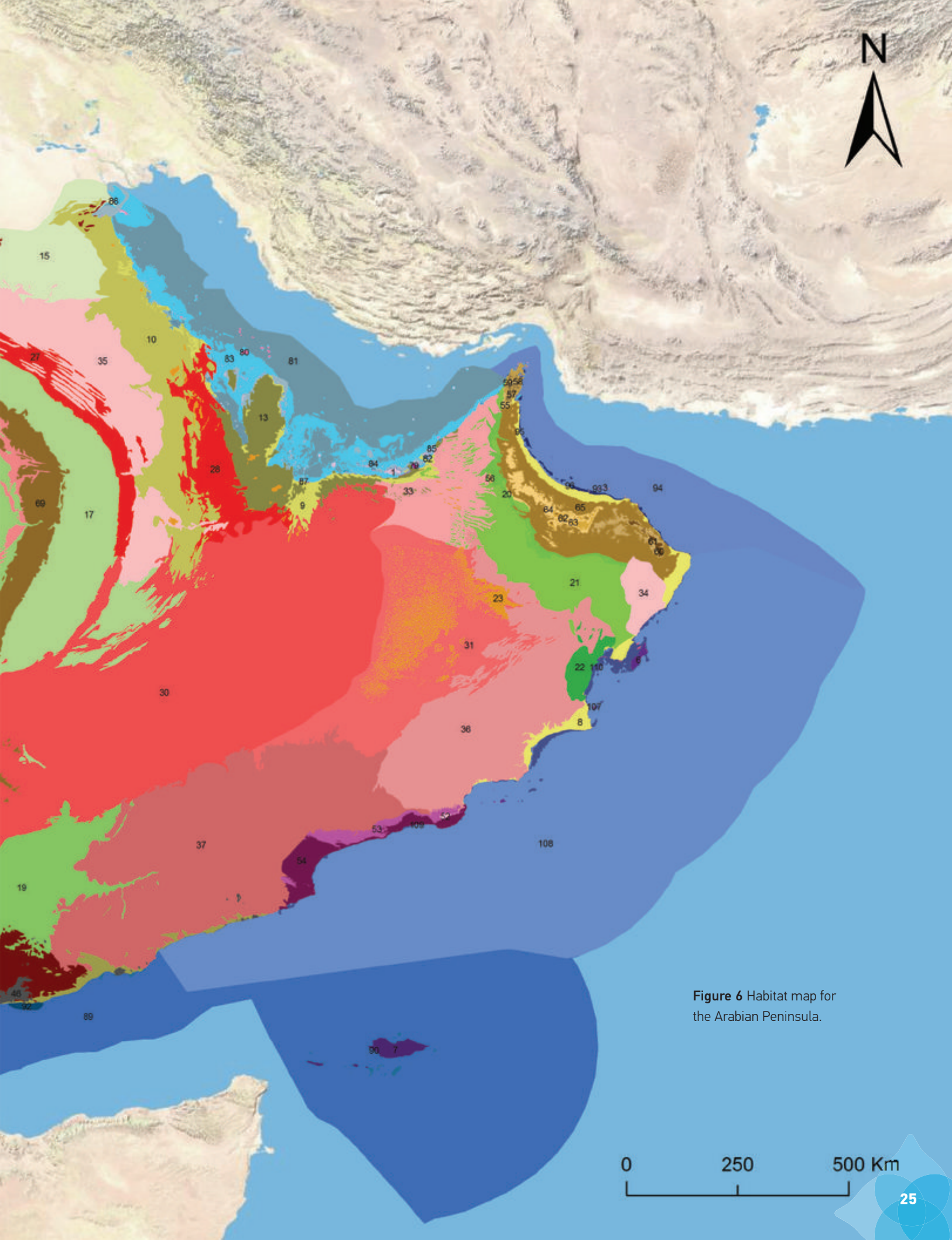


Figure 6 Habitat map for the Arabian Peninsula.

Natural

Areas which remain in their original state, with no permanent loss or conversion of habitat to some alternate state, and where there is no significant degradation of habitat. (Juniper woodland *Juniperus excelsa polycarpos* in the Hajar Mountains, Oman)

Habitat Condition

A key component of the SCP process is mapping the condition of each habitat. The approach to mapping the condition of habitats was to develop maps of individual pressures (e.g. areas with urban development, overgrazing, high fishing intensity or with coastal development), and from these develop a proxy or surrogate for ecological condition.

Ecological condition was not measured directly in most cases, and was inferred from spatial data on a range of pressures in the marine and terrestrial environments. Ecological condition can range from natural or near-natural through to extremely modified.

For the purposes of the Project, condition has been summarised into three comparable categories for both terrestrial and marine habitats, namely natural, degraded or transformed for terrestrial, and good, fair or poor for marine.

The terrestrial condition assessment was relatively straightforward using land use and land cover data to identify transformed habitats. Degradation data, especially from camel and goat overgrazing, were very difficult to obtain and map accurately; this is a key gap for future SCP projects to address.

Degraded

Habitat impacted by human activities, but not permanently converted from a natural state, and where there is potential for rehabilitation. Includes areas which are overgrazed, trampled or vehicle damaged, alien vegetation infested or accessible and in close proximity to houses, factories, roads and other infrastructure. (Shepherd and flock close to Al Zubara in north-western Qatar)


© Steve Parr

Transformed

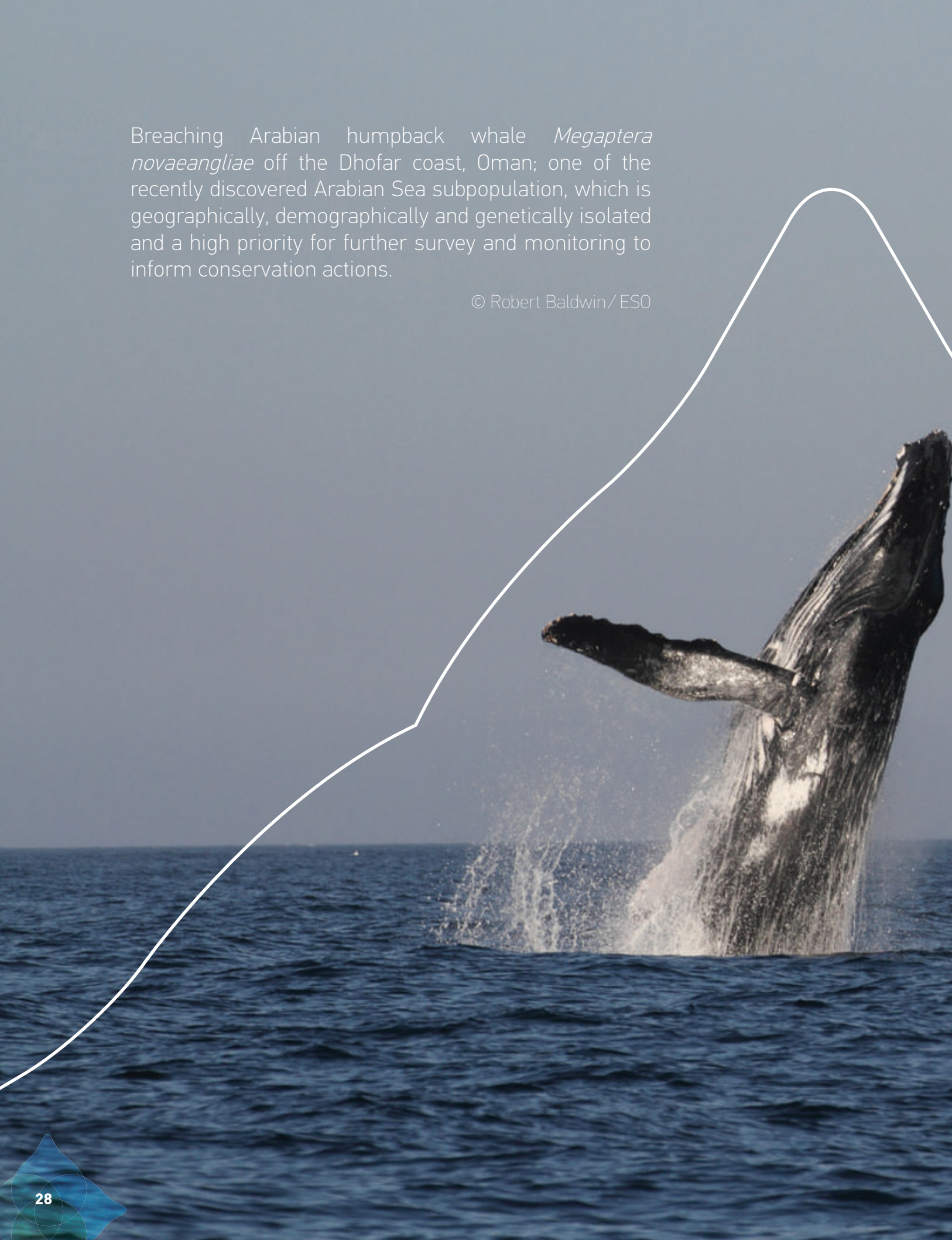
Areas of permanent loss or conversion of original habitat to some alternate state where there is no realistic prospect of rehabilitation to a natural state. This includes built up areas, developed plots, farms, plantations, roads, car parks, pavements, runways, utility areas, factories waste sites and power stations. (Abu Dhabi corniche)

Marine pressure data presented a real challenge since impacts were often difficult to map accurately. The process for measuring marine condition is summarised in Figure 7 and was in essence a cumulative scoring process.

This assessment therefore also established a basis for determining areas of low conservation opportunity and high conflict with other land use activities. In some cases (e.g. planted forests), a transformed habitat may be prioritized because of its importance for species or ecological processes. In other cases, transformed or degraded areas may be important for ecological linkages and corridors.

The final integrated Habitat Condition map for the Arabian Peninsula is provided in Figure 8.


© Benno Böer and Chanthy Huot



Breaching Arabian humpback whale *Megaptera novaeangliae* off the Dhofar coast, Oman; one of the recently discovered Arabian Sea subpopulation, which is geographically, demographically and genetically isolated and a high priority for further survey and monitoring to inform conservation actions.

© Robert Baldwin / ESO

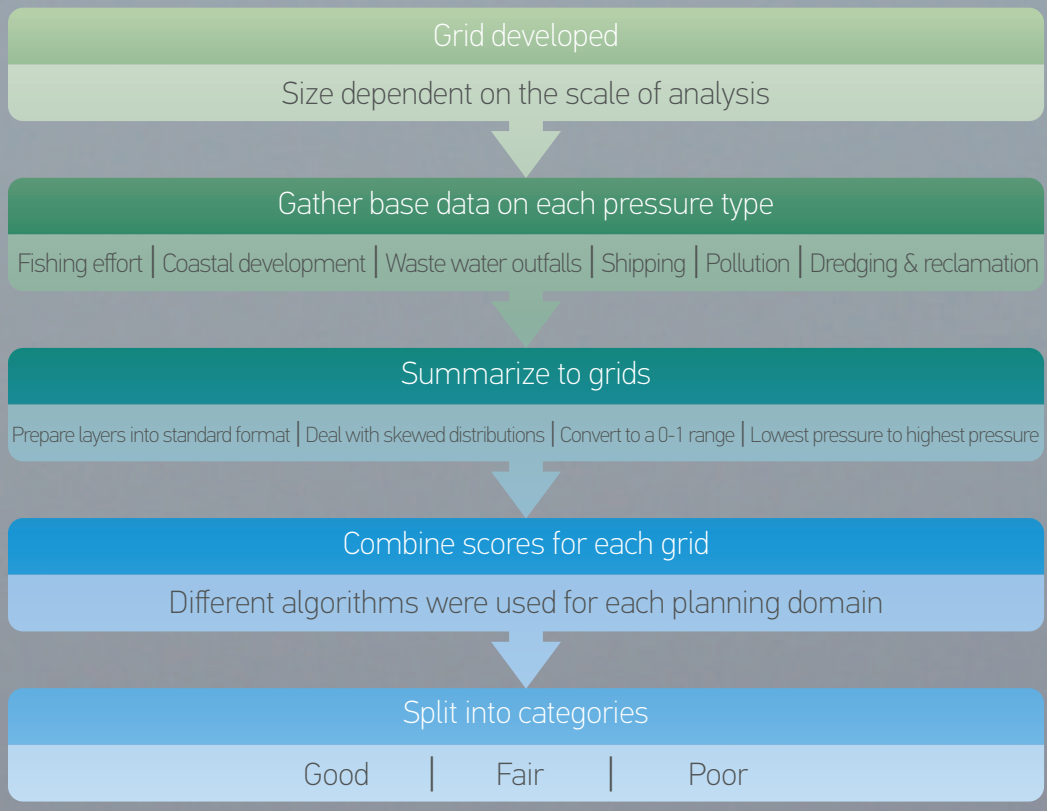
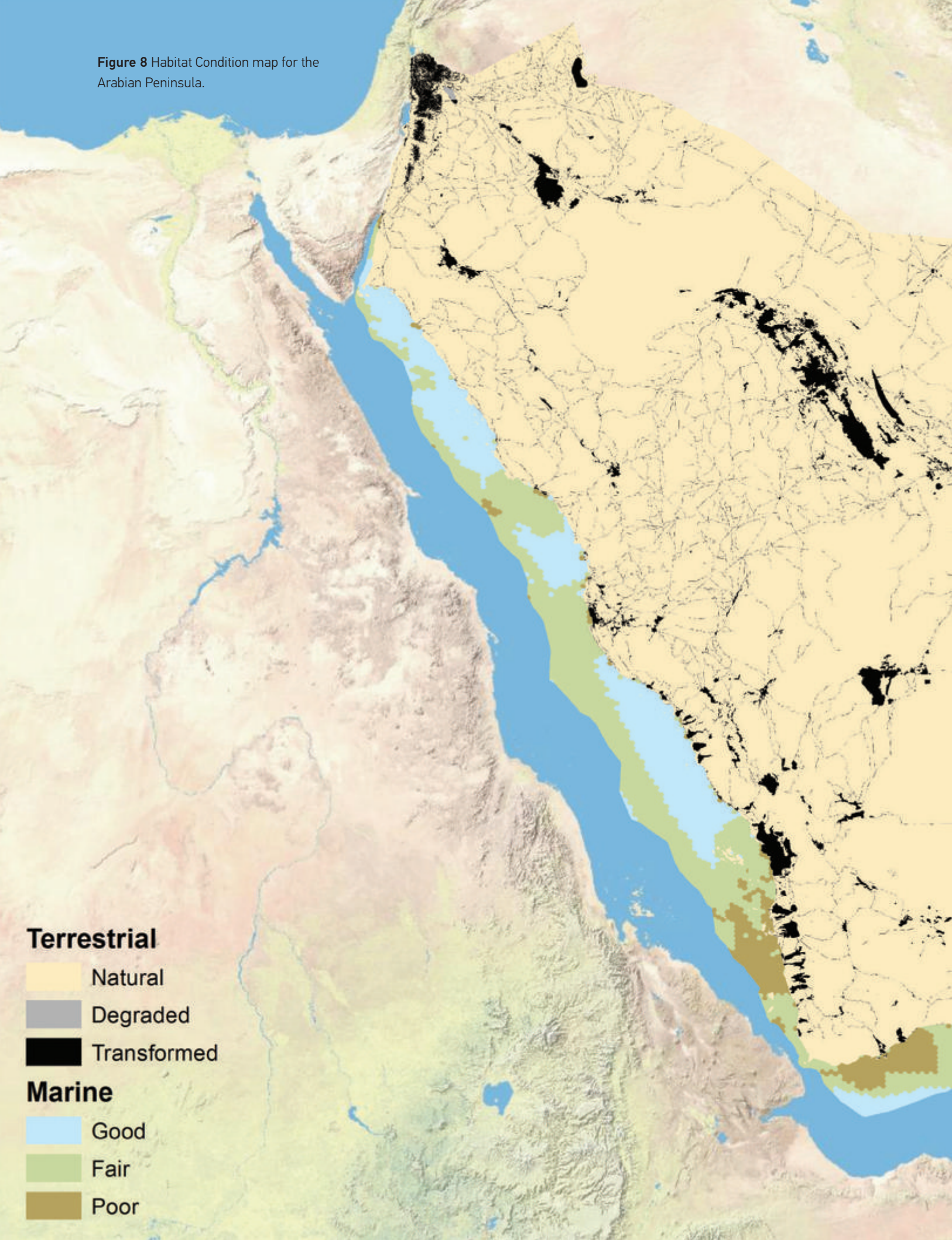
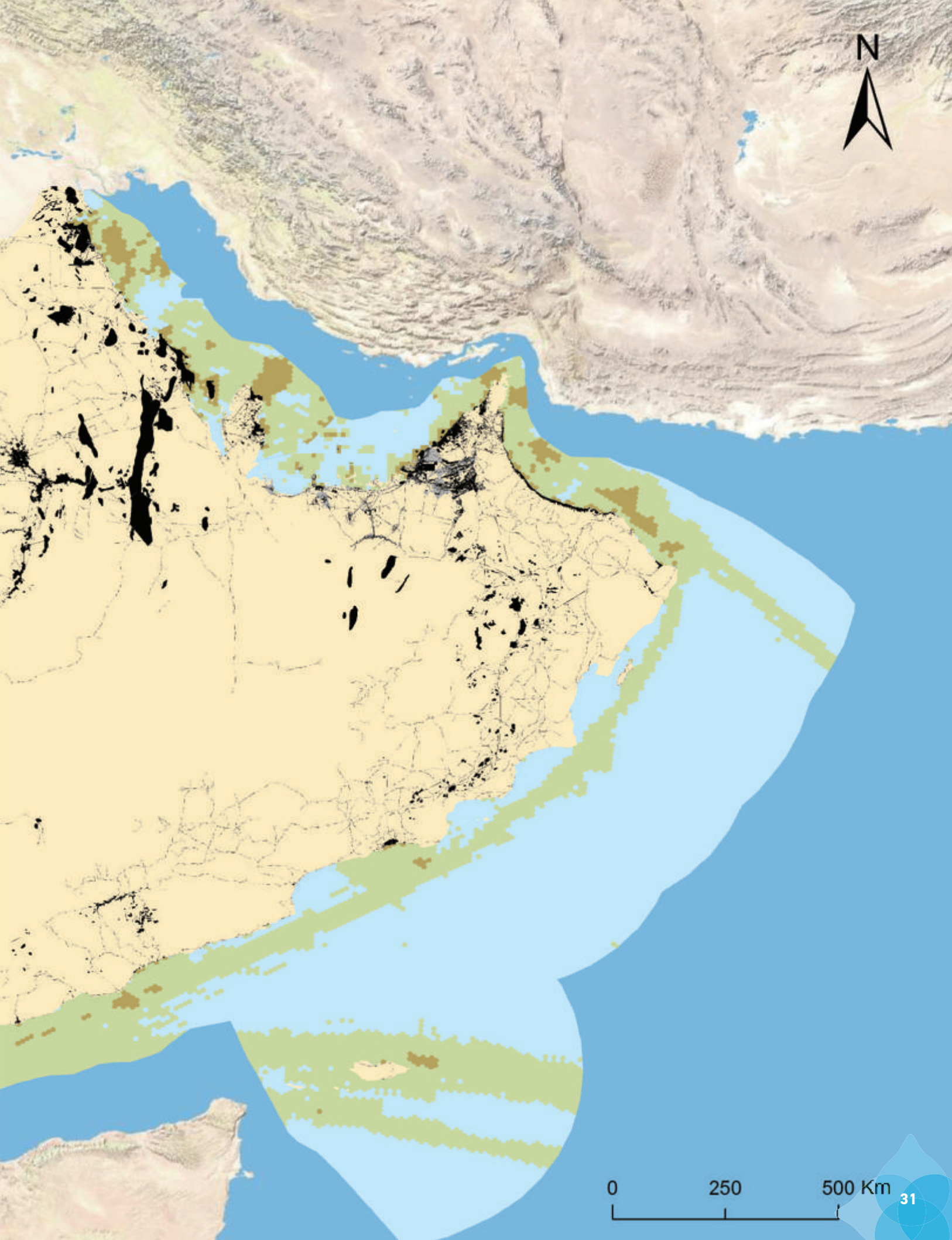


Figure 7 Generic summary of process for preparing marine condition map. Note that the specific pressure layers listed are examples, and the actual layers used differed for each assessment.

Figure 8 Habitat Condition map for the Arabian Peninsula.




N
0
250
500 Km

Protected Areas

Protected Areas are the foundation for conservation efforts across the world. Their key role is reflected within the Convention on Biological Diversity (CBD) which sets explicit targets, part of the so-called 'Aichi' targets, that 'at least 17% of terrestrial and inland water areas, and 10% of coastal and marine areas, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of Protected Areas and other effective area-based conservation measures'.

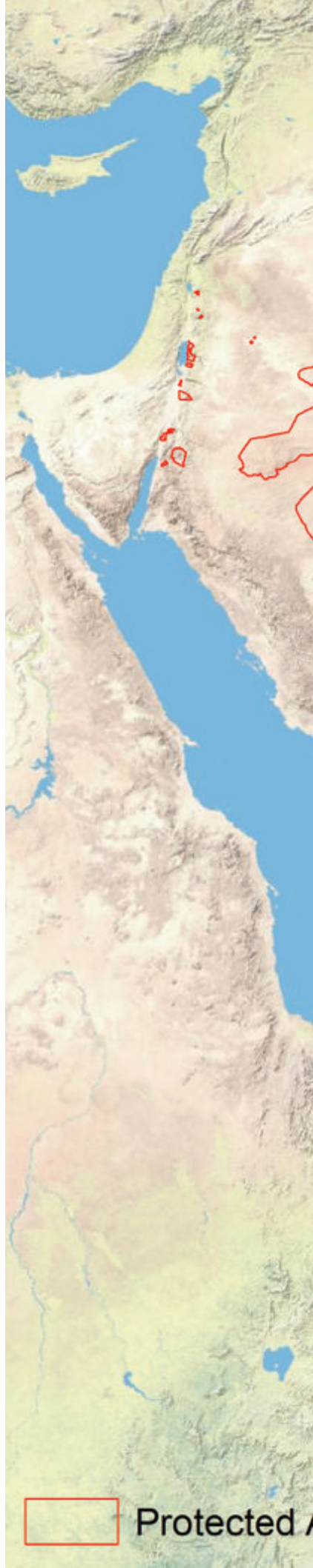
Accurate Protected Areas data are necessary for the assessment of Ecosystem Protection Level ("gap analysis") and the Spatial Prioritization.

Only formally designated Protected Areas were included within the Protected Areas Derived Layer for Abu Dhabi, UAE and Arabian Peninsula. All Protected Areas for the Arabian Peninsula are shown in Figure 9.

The SCP process is sensitive to changes in the Protected Area network. Hence when there have been expansions in the network, or less commonly where sections or entire Protected Areas are removed or reclassified because of competing and unsympathetic land uses, then the Protected Areas layer needs to be updated and SCP re-assessments undertaken.

This analysis did not seek to assess the quality of management of each Protected Area and its constituent habitats and focal species. It was a critical assumption of the Project that Protected Areas were being managed in a way that ensures the persistence of the biodiversity features found in the reserve. Confirming that Protected Areas are meeting this objective, is an additional and critical area of work, however it was beyond the scope of this Project.

Overgrazing, especially from rapidly increasing camel and other livestock numbers, is a key pressure on terrestrial habitats throughout the Arabian Peninsula. Here a remnant area of desert vegetation has been protected from decades of grazing at Khor Al Udayd, Qatar.



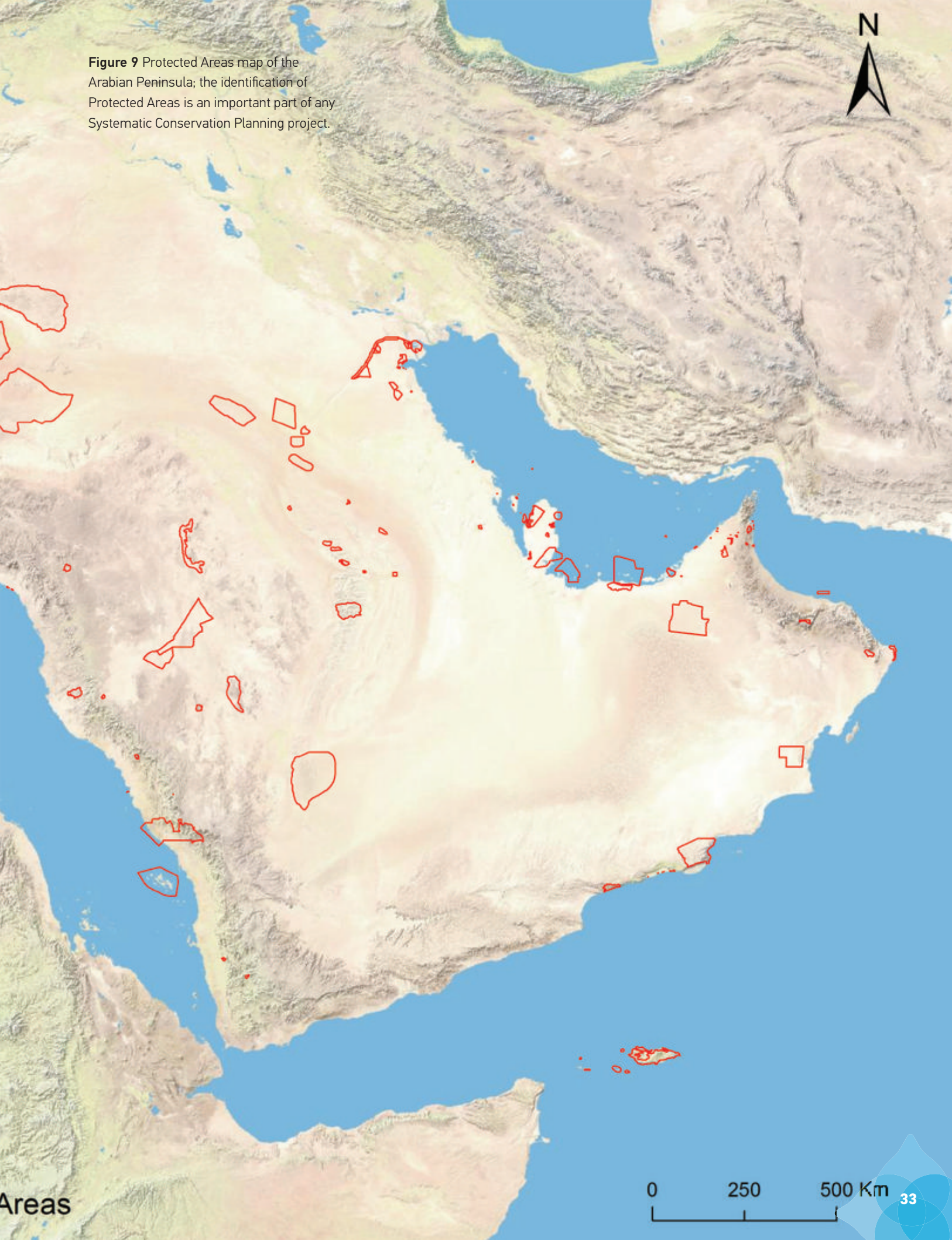
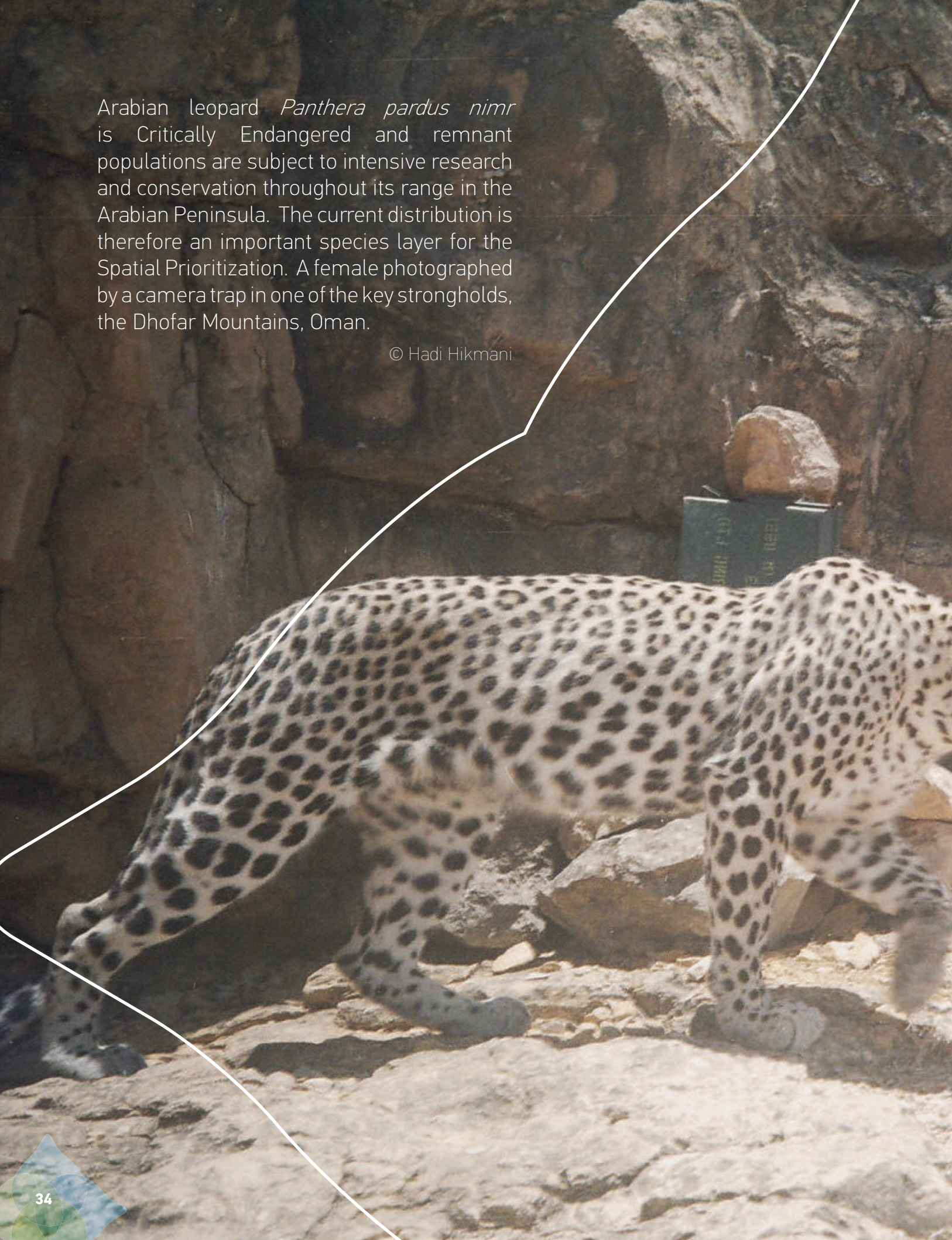


Figure 9 Protected Areas map of the Arabian Peninsula; the identification of Protected Areas is an important part of any Systematic Conservation Planning project.



Arabian leopard *Panthera pardus nimr* is Critically Endangered and remnant populations are subject to intensive research and conservation throughout its range in the Arabian Peninsula. The current distribution is therefore an important species layer for the Spatial Prioritization. A female photographed by a camera trap in one of the key strongholds, the Dhofar Mountains, Oman.

© Hadi Hikmani

Species

Although the SCP process focussed on habitats for its headline indicators, identification of areas important for key species was critical to the Project. Species distribution data provide an important means of refining the Spatial Prioritization by identifying key areas within habitats where species are confined and reliant for their long term survival.

139 rare, threatened and range-restricted species distributions were collated and included included in the Spatial Prioritization.

Verbascum akdarensis, endemic to the Hajar Mountains, Oman. Plant distributions are relatively well documented but not well mapped especially in upland hotspots such as the Asir Highlands, Yemen Highlands and Oman Mountains.

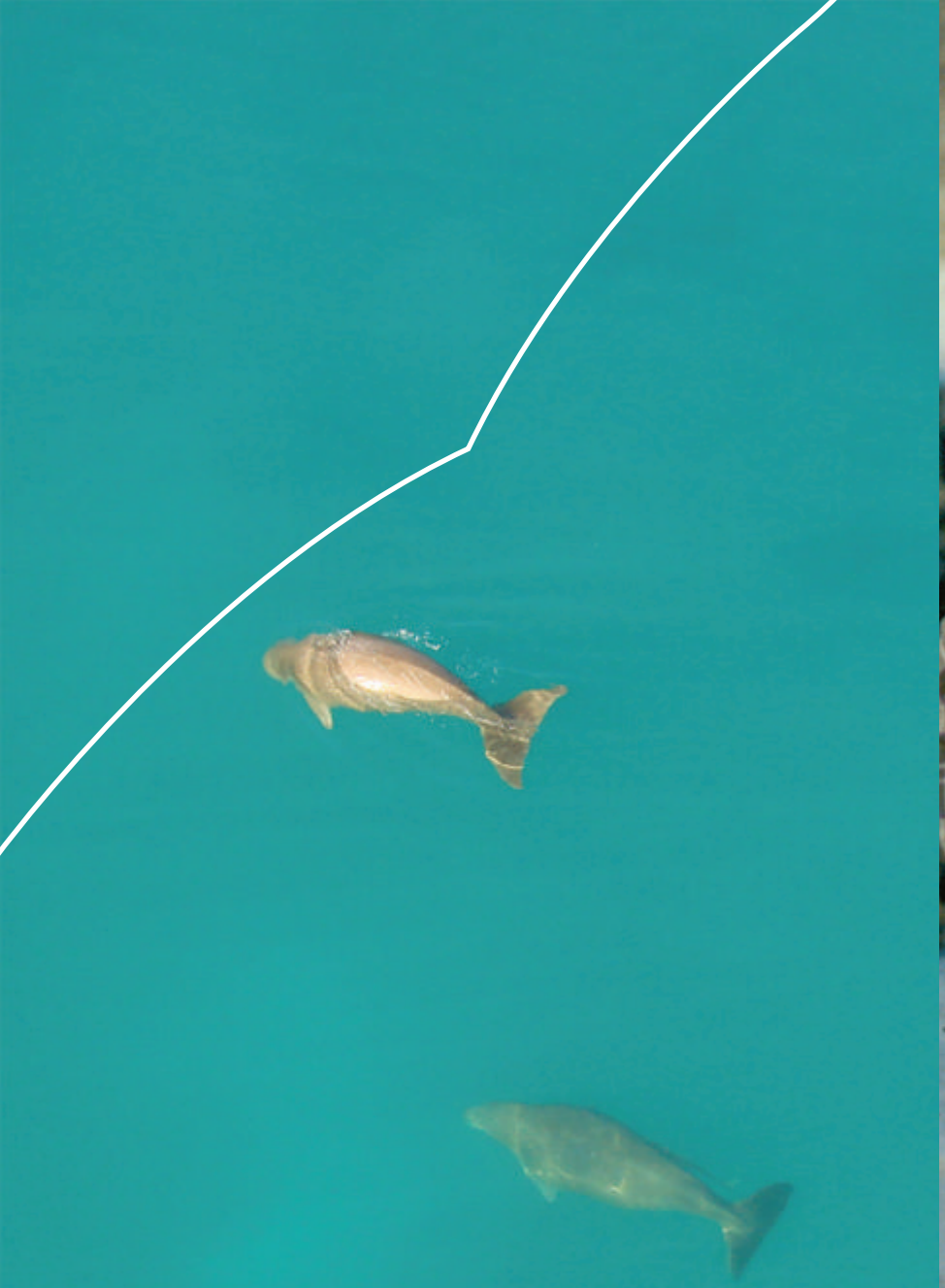
© Shahina Ghazanfar

Asaccus gallagheri is endemic to Musandam and the Hajar Mountains, Oman. Reptiles and amphibians are well mapped through a recent IUCN Arabian Peninsula assessment (Cox, Mallon, Bowles, Els, & Tognelli, 2012) but only at a fine scale in parts of the Arabian Peninsula, such as the uplands within UAE and Oman.

© Drew Gardner

Breeding birds have been subject to a recent comprehensive, regional atlas project (Jennings, 2010) and distributions are well mapped at a broad scale. Individual species such as Arabian collared kingfisher *Todirhamphus chloris kalbaensis* are covered by a number of national monitoring schemes, often involving partnerships of professional scientists and skilled amateurs, but there is limited regional coverage and coordination.

© John Pereira



Dugong *Dugong dugon* is perhaps the best monitored species within the Arabian Peninsula with comprehensive data from the globally important Arabian Gulf population collected annually by both boat and helicopter surveys.

Abu Dhabi, Qatar and Bahrain hold the second largest Dugong population in the world, of which 30% occur in the shallow waters or shoals surrounding the island of Bu Tinah. The population is dependent on extensive seagrass meadows and negligible human disturbance.

© Sheikh Ahmed bin Hamdan al Nayhan

Whales, dolphins and sharks are subject to limited monitoring and methods do not provide accurate population estimates and therefore trends are not possible to detect. Many shark species are subject to uncontrolled hunting for their fins and killed as gillnet by-catch. Most shark fins, like these being removed on a Socotra beach, are most likely destined for Eastern Asia.

© Fareed Krupp

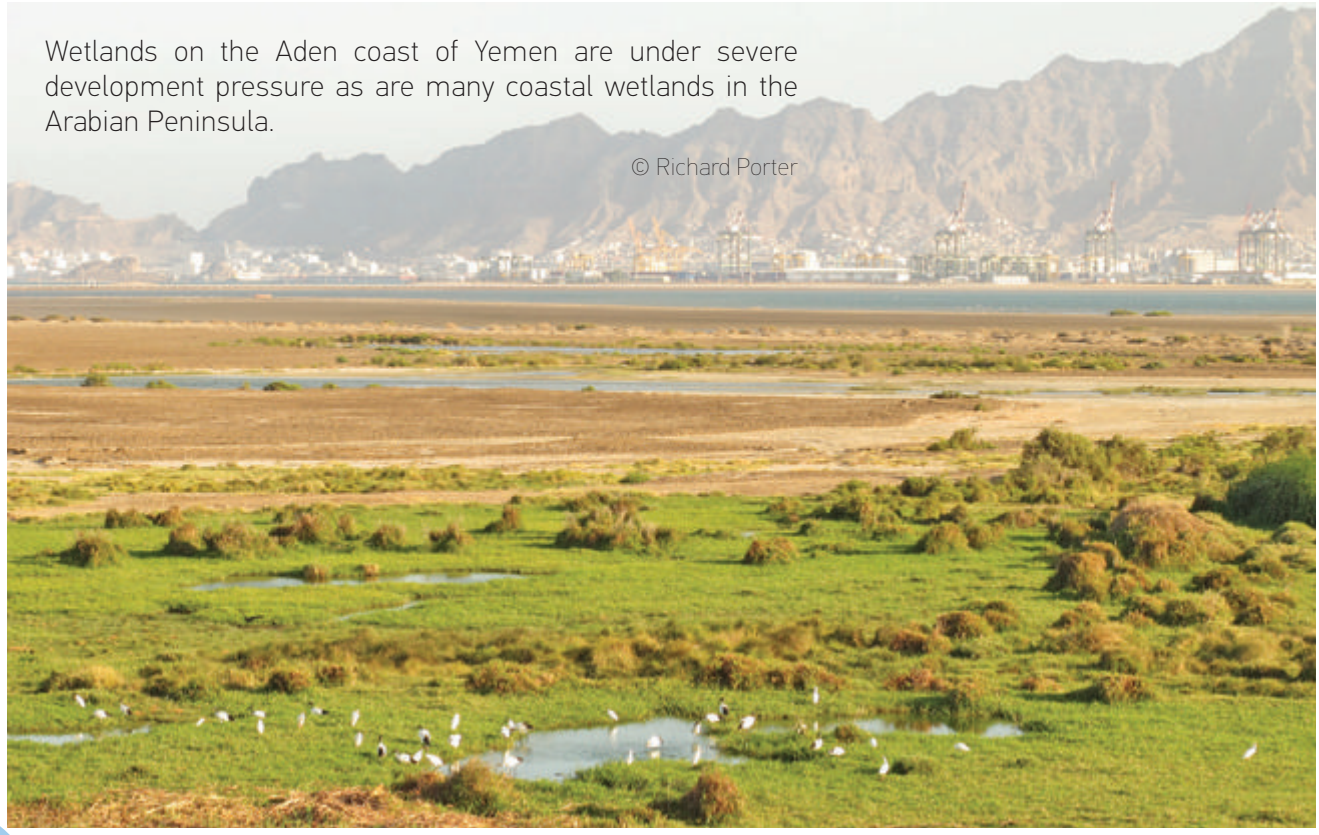
Many commercial fish species are subject to sophisticated monitoring schemes primarily designed to manage harvesting rates. Non-commercial marine fish and other species such as these cuttlefish *Sepia pharoensis* are not subject to similar survey or monitoring schemes therefore there is limited spatial data to guide conservation efforts.

© Keith Wilson

Ecological Processes

Identification and protection of habitats and species areas is not in itself sufficient to ensure the long term persistence of biodiversity. A variety of ecological processes, which operate at a range of geographic scales (e.g. from international migration routes for key species through to local level pollination processes) and time scales (e.g. from short term season movements of species through to long term processes linked to groundwater infiltration and movement), are responsible for ensuring the long term persistence of biodiversity. These process areas are particularly important in the context of changing environments, especially through global climate change.

Identification of areas important for supporting ecological processes was a key activity for SCP project. However, data scoping revealed that little or no direct data on ecological processes existed for the region. The Project therefore focussed on filling this gap in spatial knowledge, and accommodated ecological processes in the planning process through inclusion of ecological requirements for a range of keystone species; inclusion of breeding and foraging sites for birds (often identified as Important Bird Areas); inclusion of important plant areas; and inclusion of proxy species for ecological processes. For example, Arabian Tahr *Arabitragus jayakari* and Arabian Leopard *Panthera pardus nimr* served as proxies for a range of ecological processes in mountain areas which require extensive linked and intact habitat. Further, ecological process considerations were built into the SCP process to ensure that best available areas of habitat were chosen and that connected landscapes were favoured, as both of these considerations will help support key ecological processes and persistence of habitats and species in the long term. Despite this effort, data on ecological processes for the region remained sparse and this is a key area for future targeted data collection.



Wetlands on the Aden coast of Yemen are under severe development pressure as are many coastal wetlands in the Arabian Peninsula.

Opportunities & Constraints

SCP not only considers biodiversity elements in the Spatial Prioritization but also opportunities and constraints on conservation implementation. The first purpose of this layer is to identify areas which are sympathetic to conservation action, and where it would be relatively easy to implement area based conservation actions such as expanding Protected Areas. These would be identified as opportunity areas. Opportunities may include areas such as existing conservation initiatives, identified but not protected priority areas such as Important Bird Areas and areas that are protected for other reasons (e.g. World Heritage Sites, other cultural sites and security sites).

In contrast, the second purpose is to identify the locations where activities, land use and plans are in conflict with conservation and such locations would be identified as constraints. Constraints may include areas planned for large scale development (e.g. planned new cities and port projects), areas within urban edges, or areas where development approval have been received. Examples of both Opportunities and Constraints data obtained are shown in Figure 10.

In order to remain systematic, an area was never included in the Project because it was an opportunity if there were no other reasons for selection, and likewise an area was never excluded because it was an area which could be difficult to implement if that habitat was necessary for meeting targets for biodiversity features and there were no alternatives (i.e. the site was irreplaceable).

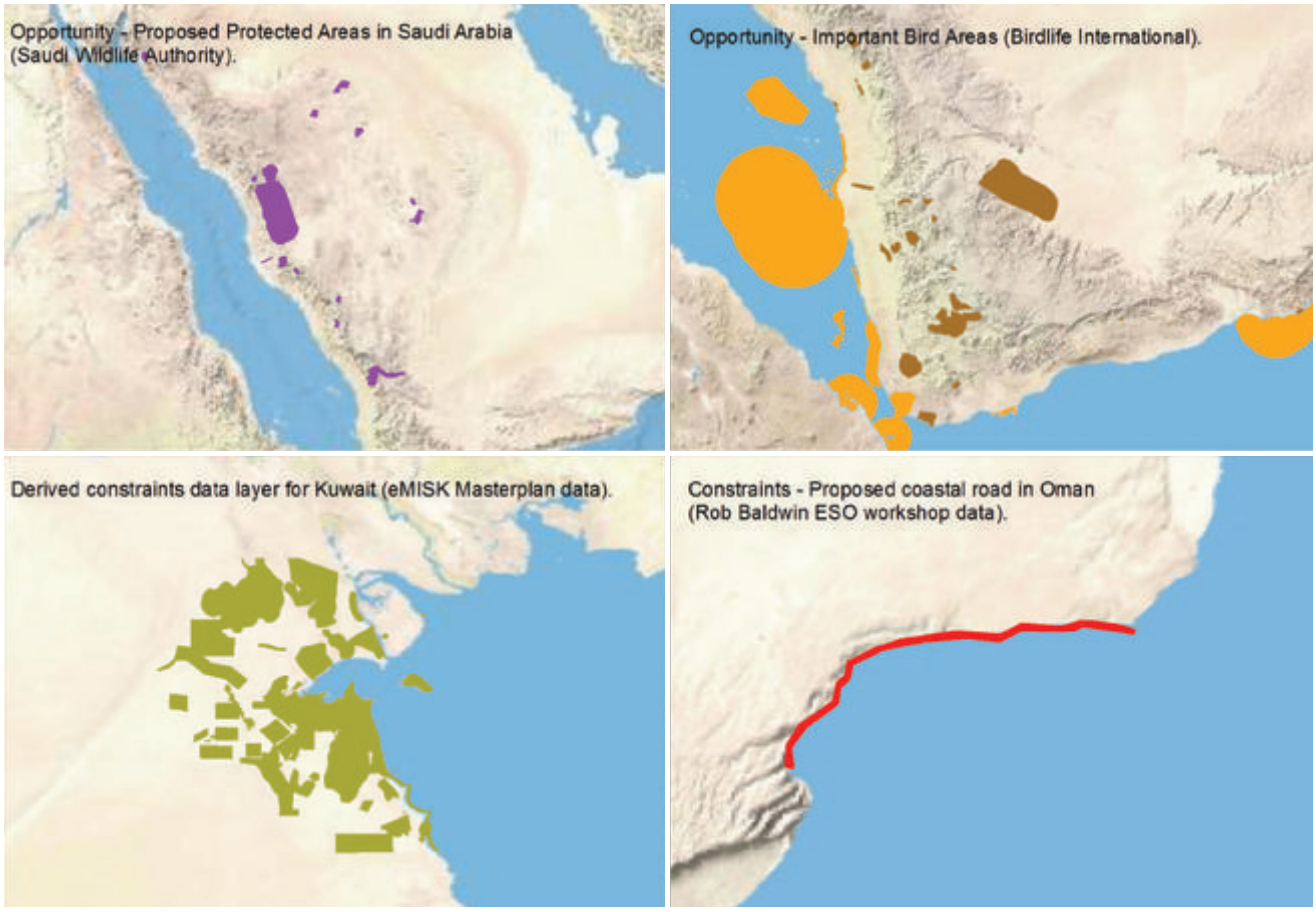


Figure 10 Examples of Opportunities and Constraints data used for the Arabian Peninsula Spatial Prioritization

Expert Workshops

Expert workshops were undertaken to review, verify and refine the derived layers especially the Habitat map, Habitat Condition map, Protected Areas map, Species distribution data and Opportunities and Constraints data.

The workshops also helped to fill data gaps identified during the base data archiving exercise, which was particularly important for the Species and Opportunities and Constraints data. They also acted as a review of assessment outputs and an important means of knowledge transfer.

Abu Dhabi & UAE

- Marine and Terrestrial Habitats
- Species, Processes and Opportunities & Constraints
- Initial Conservation Assessment
- Spatial Prioritization

Arabian Peninsula

- Six Derived Layers
- Spatial Prioritization at the 14th Conservation Workshops, Sharjah

Monsoon-affected vegetation in the Dhofar mountains, Oman; the habitat is rich in endemic flora and fauna with strong Afro-montane affinities.

©Shahina Ghazanfar

Analyses and Outputs

Red Lists for Species are well established but not so for ecosystems or habitats. This is still an emerging process and progress towards developing standard criteria by IUCN and partners is ongoing (Rodríguez et al., 2011). This Project is at the forefront of this type of habitat analysis.

This section sets out the results of the Ecosystem Threat Status and Protection Level assessments. Both are important ecosystem headline indicators. Finally, the results of the Spatial Prioritization analyses have produced a set of Priority Focus Areas. These are areas in which Protected Area expansion will most efficiently meet targets for habitat representativeness and species persistence.

Jabal Shada al-A'la is a granite massif and an outlier of the Sarawat Escarpment in the Tihamah foothills, Saudi Arabia. Its location to the west of the 'Asir escarpment ensures high rainfall and, coupled with its wide altitudinal range and diversity of micro-climates, thus supports an exceptionally rich flora as well as important bird and mammal species.

Ecosystem Threat Status

Ecosystem Threat Status provides a measure of the integrity of each ecosystem or habitat type. It represents the degree to which ecosystems are still intact, or alternatively losing vital aspects of their structure, function or composition, on which their ability to provide ecosystem services ultimately depends.

Threat status has traditionally been assessed for species, in the form of national or global Red Lists that draw attention to species threatened with extinction (IUCN Standards And Petitions Subcommittee, 2010). Measuring the threat status of ecosystems and habitats has not been undertaken in the same standardised way globally, though this is now emerging as a process (Rodríguez et al., 2011).

The main steps in assessing the Ecosystem Threat Status are presented in Figure 11.

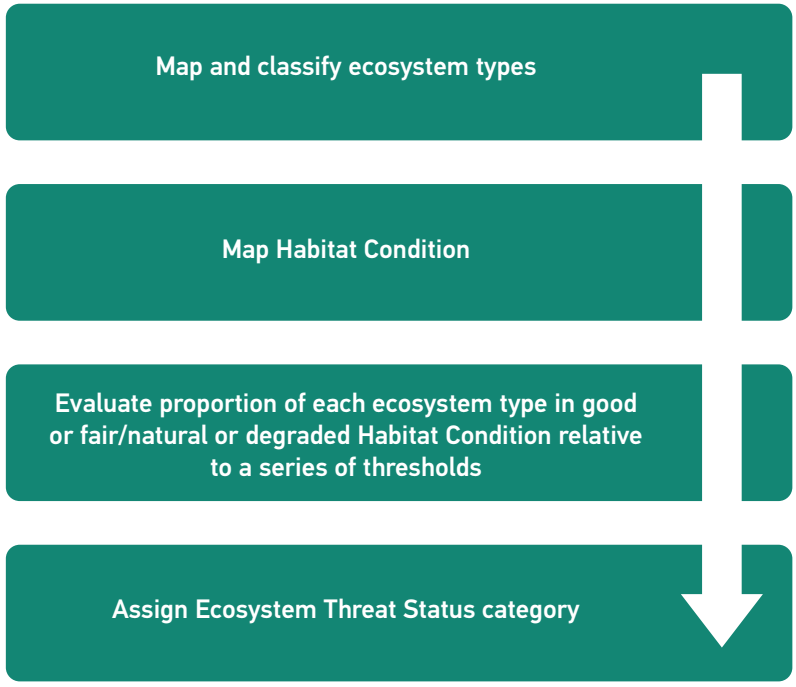


Figure 11 Principal Steps in Assessing Ecosystem Threat Status.

Figure 12 Ecosystem Threat Level Assessment for the Arabian Peninsula.

Mahazat as-Sayd is a Protected Area that is representative of the western edge of the Najd Pediplain in central Saudi Arabia, in an area known to have once supported various gazelle species. Mahazat as-Sayd is one of the world's largest fenced protected areas.

Assessments of Ecosystem Threat Status require biodiversity targets to be set for ecosystem types. Biodiversity targets should ideally be based on the ecological characteristics of the ecosystem concerned, and ideally, the biodiversity target is calculated based on a detailed knowledge of species richness, diversity and ecosystem function. However, these data do not yet exist for the UAE and the Arabian Peninsula. Therefore a flat target of 25% of the original extent of each ecosystem type was set based on the mid-points of target ranges used for similar assessments elsewhere in the world.

The baseline target was used to develop a series of thresholds (Table 2), which allowed habitats to be classified into particular Ecosystem Threat Statuses. For example, if less than the target of 25% of the original habitat remained in a good/natural state then a habitat was classified as (CE) and if less than 45% Endangered (EN). In addition to examining remaining amount of good/natural condition habitat, the process also examined remaining functional habitat (which includes both Good/Natural and Fair/Degraded habitat), with these values being used to define whether a habitat was Vulnerable (VU) or Least Threatened (LT).

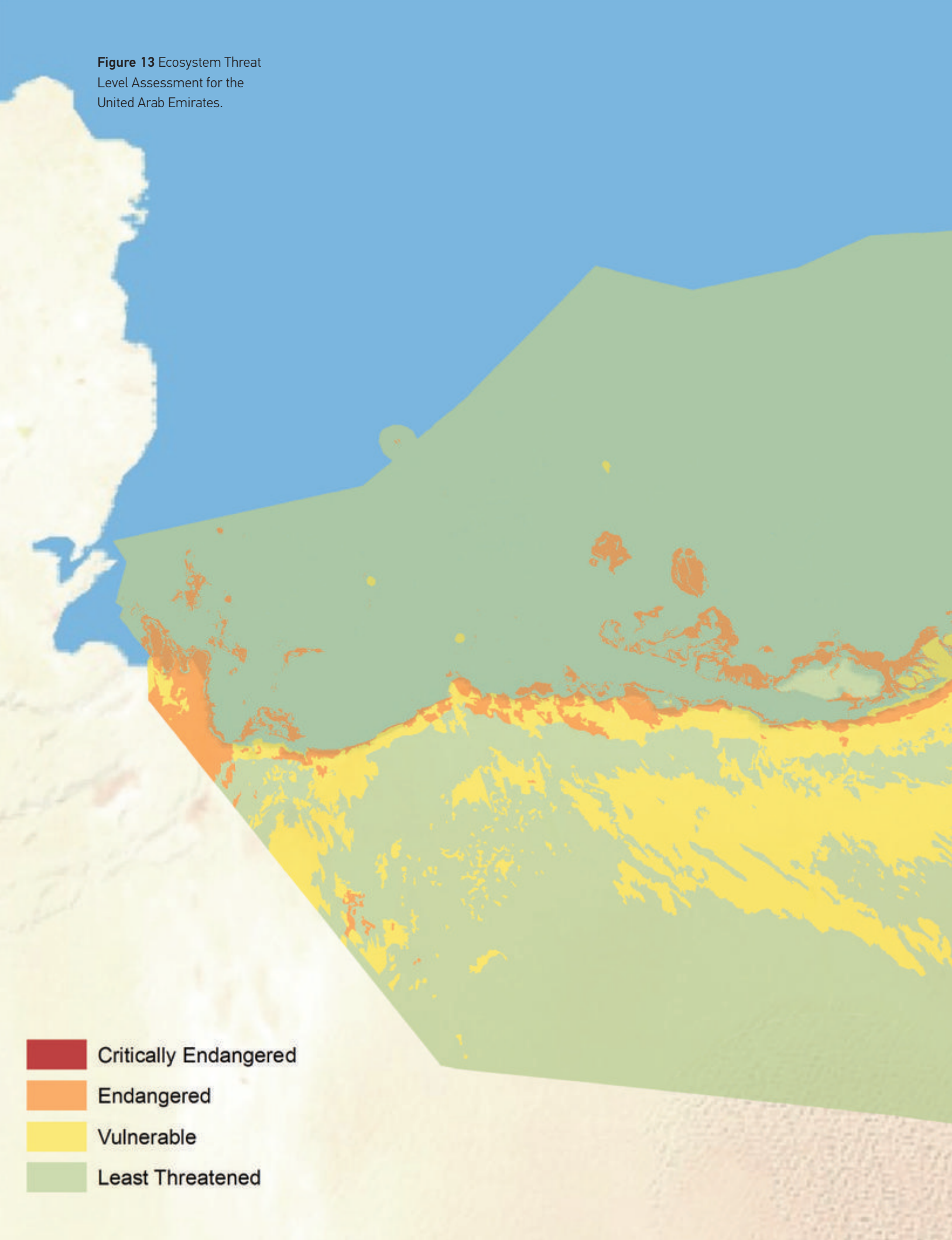
The results of the analysis for the Arabian Peninsula in Figure 12 and for the UAE are shown in Figure 13.

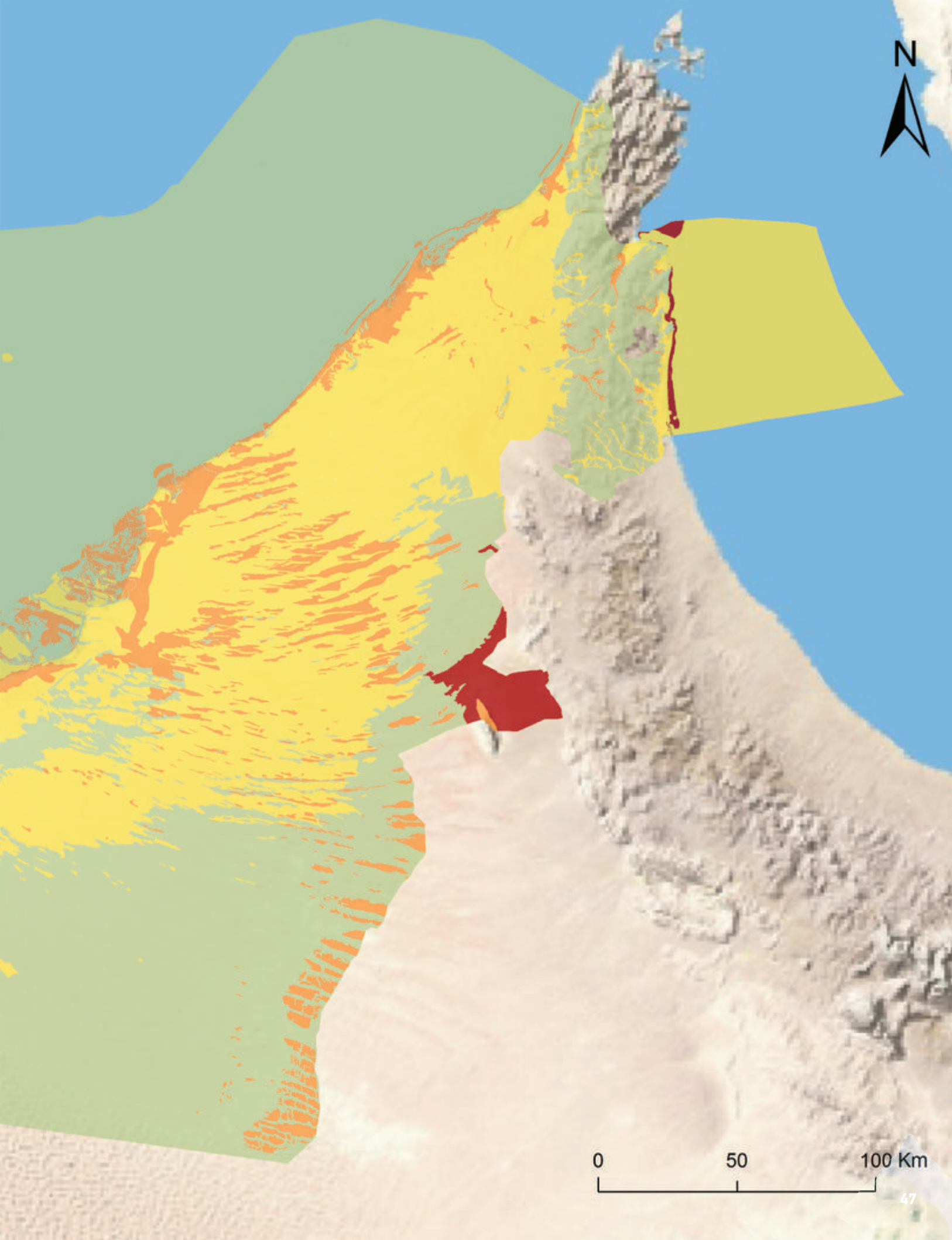
Table 2 Criteria for defining Ecosystem Threat Status.

Ecosystem Threat Status	Critically Endangered	Endangered	Vulnerable	Least Threatened
Description	Less than the target of 25% of the original habitat remains in a Good/Natural state.	Less than 45% of the original habitat remains in a Good/Natural state.	Less than 80%* of habitat remains in a functional state (Good/Natural or Fair/Degraded).	More than 80% of habitat remains in a functional state (Good/Natural or Fair/Degraded)

*Note that for the Arabian Peninsula assessment the Project used a 90% cut-off for Least Threatened category. This was necessary as the mapping of degradation (especially due to overgrazing) was more comprehensive in Abu Dhabi and the UAE than elsewhere in the Arabian Peninsula. The threshold adjustment was necessary to ensure consistency of assessment results.

Figure 13 Ecosystem Threat Level Assessment for the United Arab Emirates.

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Ecosystem Protection Level

Ecosystem Protection Level assessed whether ecosystems are adequately protected or under-protected. This relates to the key SCP principle of representativeness.

In the past, the extent of protection was reported on by giving the overall proportion of land or sea protected. However, these figures do not provide any information about which specific ecosystems are well protected and which are poorly protected. The main steps in assessing Ecosystem Protection Level in marine and terrestrial environments are shown in Figure 14.

The Ecosystem Protection targets that were used are summarised and were based on:

- The internationally accepted Protected Area targets of the CBD Strategic Goal C Target 11 (the CBD has been ratified by all countries in the Arabian Peninsula), which specifies 17% of terrestrial habitat types and 10% of marine habitat types. Unlike previous CBD targets which were for aggregated national Protected Area networks, these are representative targets, i.e. these portions are required of each habitat type to ensure a representative reserve network.

  Based on Project workshop feedback on the importance of different habitat types, intertidal habitat types have been placed with terrestrial rather than marine habitats, in order to use the more appropriate higher target percentage.

- Higher targets were set for key habitats such as mangroves, coral reef, sea-grass, and salt marsh. These targets were based on expert workshop reviews and policy established, especially in the UAE. Targets for these rare and species-rich coastal habitats were set at 80%. Because of the relatively large extent of seagrass habitats, lower targets of 34% were set for the Arabian Peninsula assessment.

- For the UAE extremely rare habitats (i.e. less than 1km^2 in extent), a 100% target was set. For the Arabian Peninsula assessment a 100% target was used for habitats under 10km^2 and 80% for habitats under 20km^2 of the original extent.

The results produced a Protection Level assessment for the UAE (Figure 16) and Arabian Peninsula ecosystems (Figure 17).

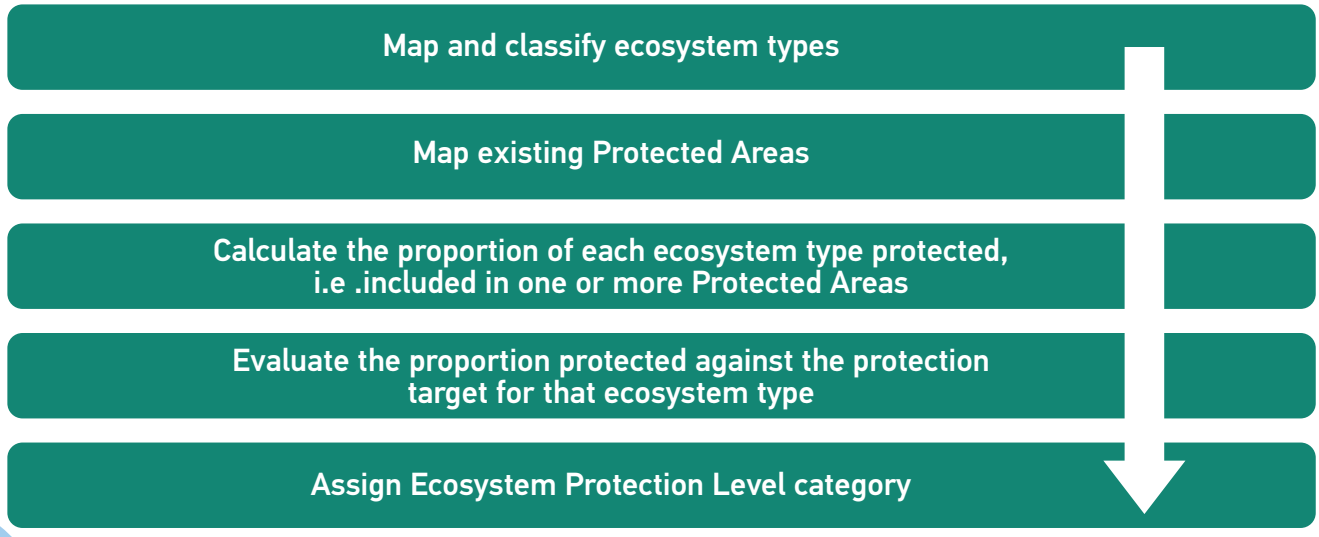
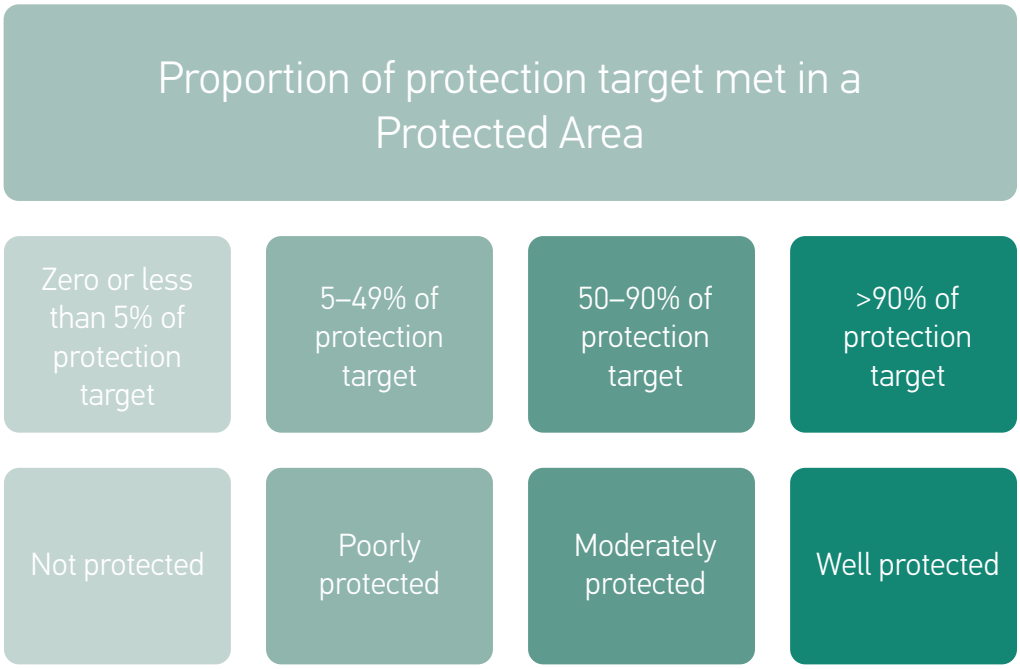


Figure 14 Principal Steps in Assessing Ecosystem Protection Level in Marine and Terrestrial Environments.

Figure 15 Categories used for the Protection Level assessments for Abu Dhabi, UAE and Arabian Peninsula.



Tarut Bay, Saudi Arabia is a proposed Protected Area, Important Bird Area and an important shrimp nursery.

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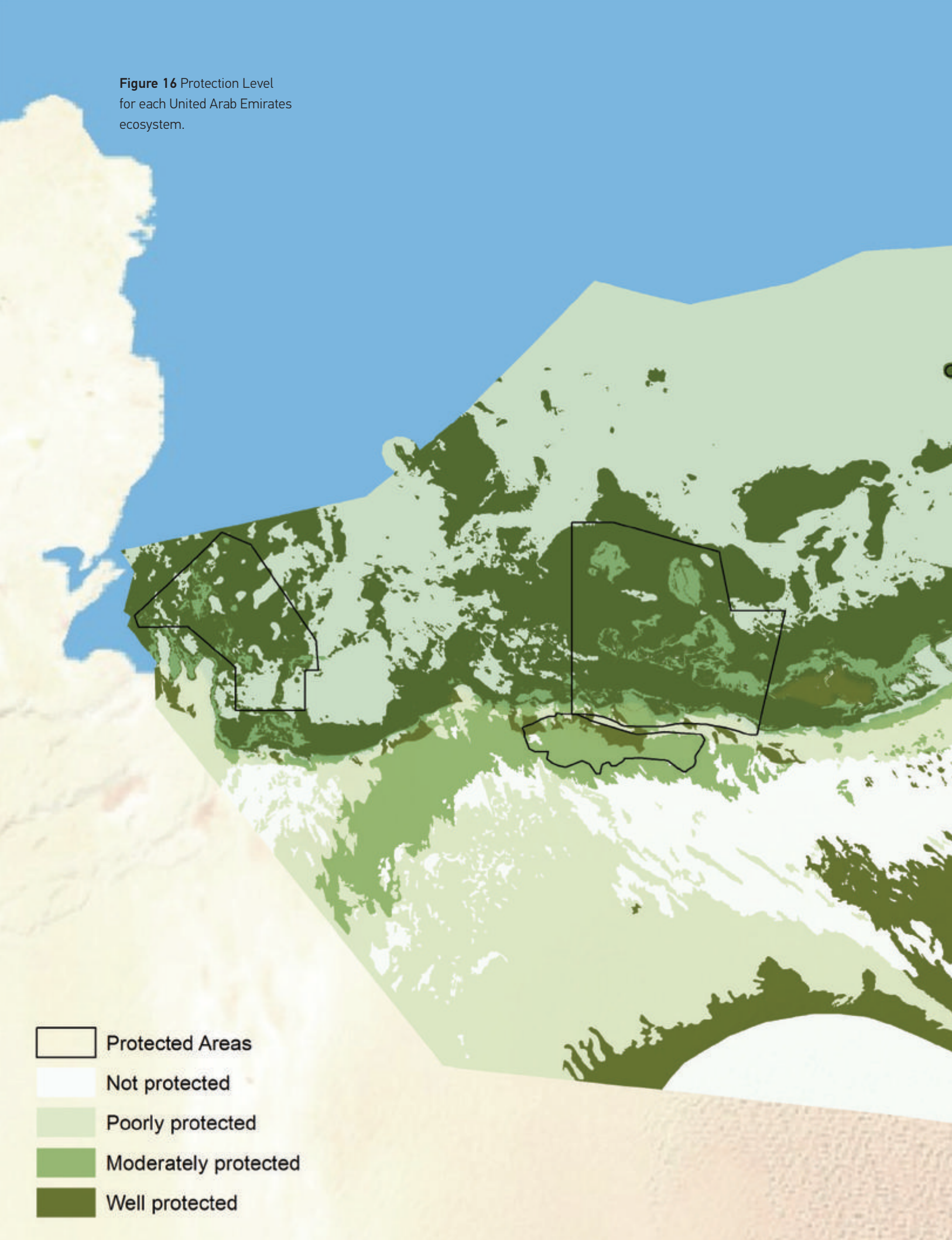
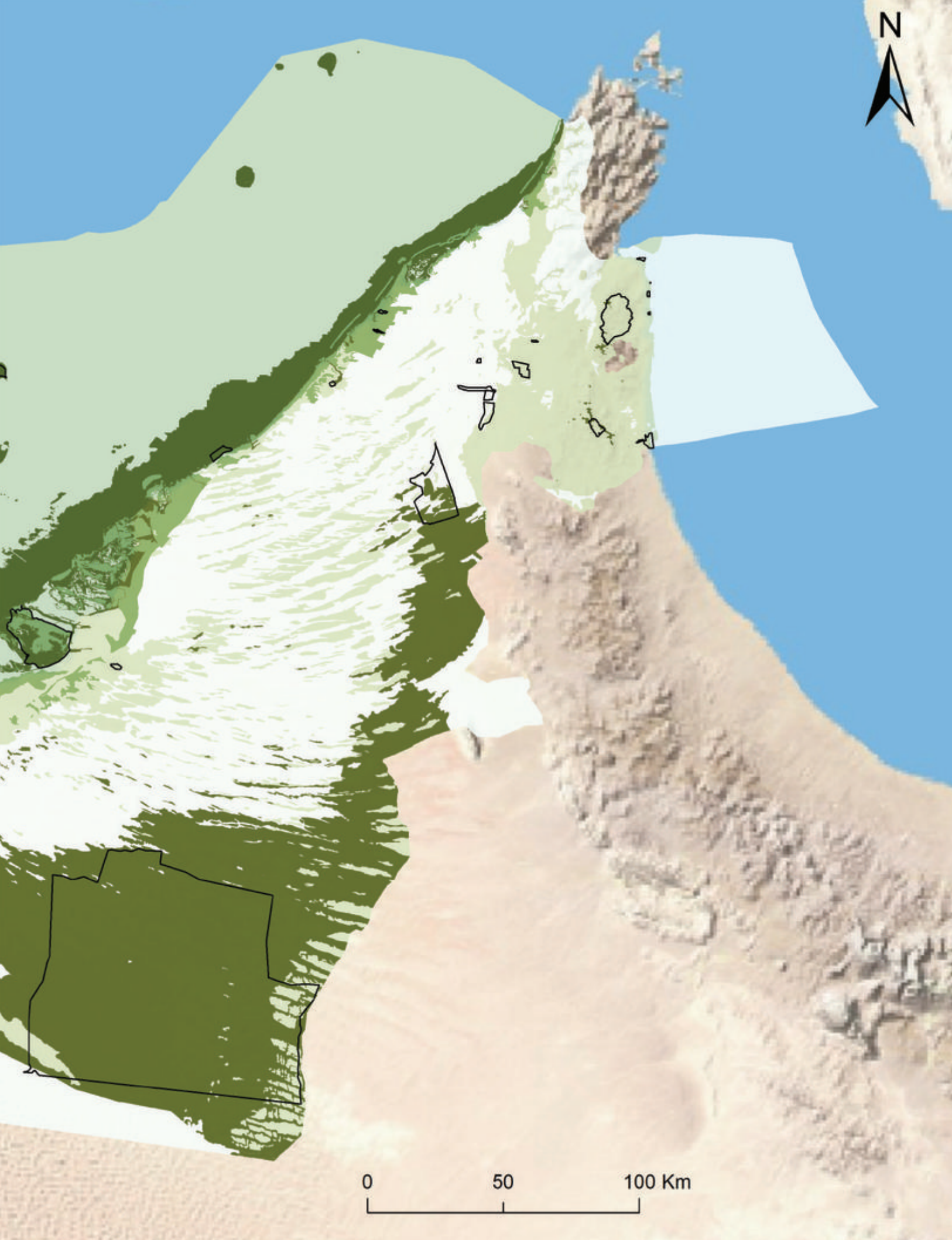
Figure 16 Protection Level for each United Arab Emirates ecosystem.




N
0
50
100 Km


Protected Areas
Not Protected
Poorly protected
Moderately protected
Well protected

Figure 17 Protection Level for each Arabian Peninsula ecosystem.

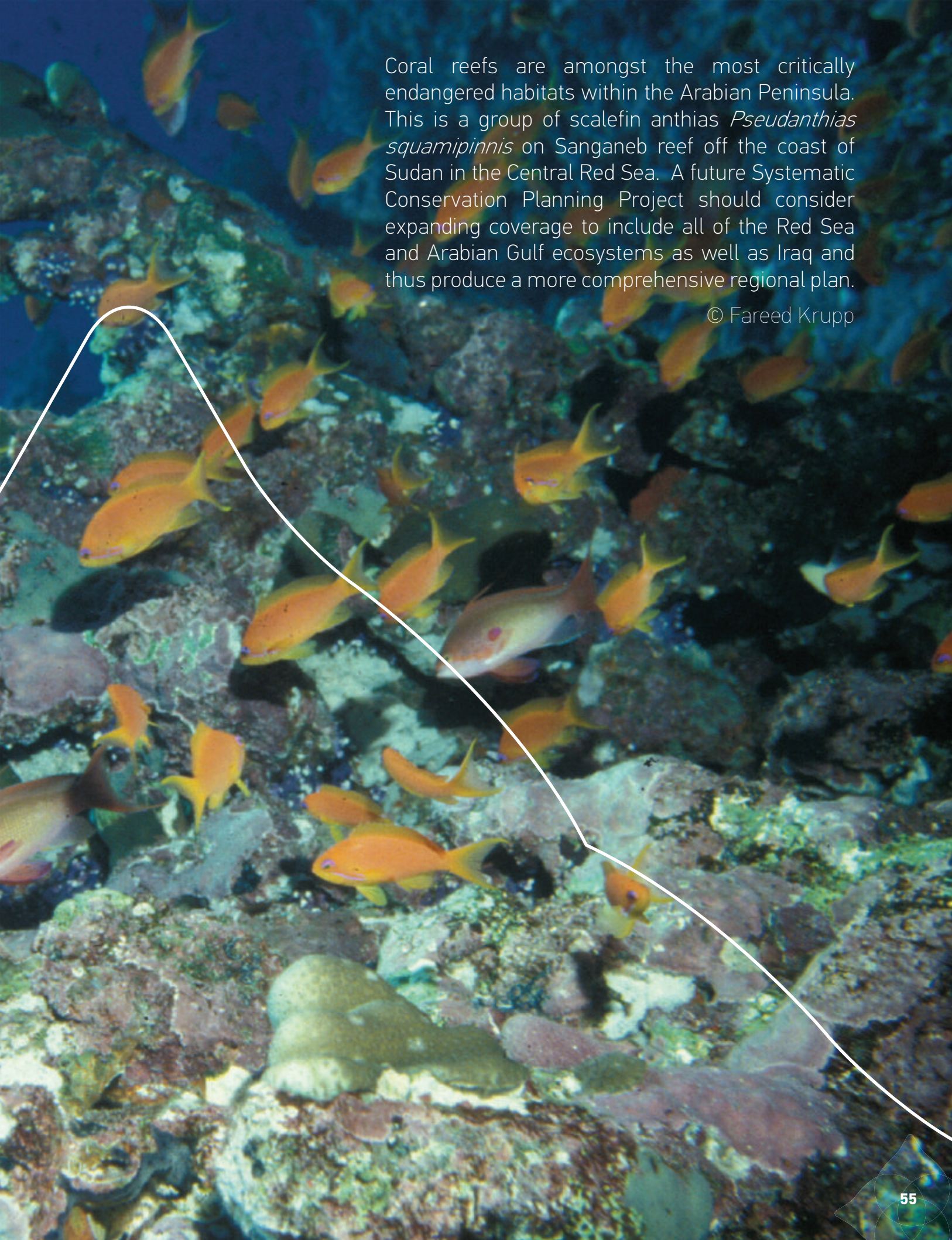
Headline Indicators

The combination of Protection Level and Ecosystem Threat Status for each ecosystem provides an important indicator of conservation priority.An analysis by ecoregion for the Arabian Peninsula is provided in Table 3.

Terrestrial ecosystems were largely classified as Least Threatened (LT); this was to be expected in arid environments. This includes most types within Lowland, Desert, Upland and Mountain Ecoregions. The principal exceptions were the three habitats types in West Jordan which were all Threatened. Most notably, the Forest and Non-Forest Mediterranean Ecosystem was both Endangered and Poorly Protected. Most coastal ecosystems were classified as Vulnerable (V) having lost significant portions of their original extent, and were also poorly represented in the Protected Area network.

Caution is required in the interpretation of Ecosystem Threat Status, as due to a lack of data, the Project heavily under-estimated the levels of degradation, principally from overgrazing. An enhanced spatial measure of grazing pressures across the region is a high priority for further work.

Marine ecosystems were, in comparison to terrestrial areas, much more threatened. Coral Reefs in the Arabian Gulf, Gulf of Aden, and Gulf of Oman were all Critically Endangered (CR). Mangroves and Seagrass/ Macro-algal Beds were similarly threatened. The shallow water habitats within the Red Sea and Western Arabian Sea were generally less threatened, as were the deeper water habitats in all Ecoregions. Protection Levels were mixed in all marine ecosystems; the most poorly protected and threatened marine ecosystems were within the Gulf of Aden, Arabian Gulf and Gulf of Oman.



Coral reefs are amongst the most critically endangered habitats within the Arabian Peninsula. This is a group of scalefin anthias *Pseudanthias squamipinnis* on Sanganeb reef off the coast of Sudan in the Central Red Sea. A future Systematic Conservation Planning Project should consider expanding coverage to include all of the Red Sea and Arabian Gulf ecosystems as well as Iraq and thus produce a more comprehensive regional plan.

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Table 3 Protection Level and Ecosystem Threat Status by Ecoregion for Arabian Peninsula Ecosystems.

Ecoregion	Habitat Name	Protection Level	Ecosystem Threat Status
Islands	Islands - Gulf of Aden	Not Protected	Least Threatened
	Islands - Northern and Central Red Sea	Not Protected	Least Threatened
	Islands - Western Arabian Sea	Not Protected	Least Threatened
	Islands - Arabian (Persian) Gulf	Well protected	Vulnerable
	Islands - Gulf of Oman	Well protected	Least Threatened
	Islands - Southern Red Sea	Well protected	Least Threatened
	Socotra Archipelago	Well protected	Least Threatened
Coastal	Northern Gulf Coastal Plain	Not Protected	Vulnerable
	Red Sea Coastal Plain and Sabkha	Not Protected	Vulnerable
	Tihamah Coastal Plain	Not Protected	Vulnerable
	Southern Coastal Plain	Not Protected	Least Threatened
	Gulf Coastal Sabkha and Sabkha Matti	Poorly protected	Vulnerable
	Oman Coastal Plain	Poorly protected	Vulnerable
	Southern Gulf Coastal Plain	Moderately protected	Least Threatened
Lowlands	Eastern Desert Plain	Not Protected	Vulnerable
	Central Limestone Plain and Low Cuesta	Not Protected	Least Threatened
	Central Yemen Plain	Not Protected	Least Threatened
	Eastern Gravel Plain	Not Protected	Least Threatened
	Western Sandstone Plain and Plateau	Not Protected	Least Threatened
	Central Sand Plain	Poorly protected	Vulnerable
	Ad-Dibdibah / Kuwait Alluvial Plain	Poorly protected	Least Threatened
	Inland Sabkha	Poorly protected	Least Threatened
	Najd Pediplain	Poorly protected	Least Threatened
	At-Taysiyah Limestone Plain	Well protected	Least Threatened
	Huqf - Plain, Outcrop and Dune	Well protected	Least Threatened
	Northern Sandstone Plain and Plateau	Well protected	Least Threatened
Deserts	Al-Jafurah Sand Dune	Not Protected	Least Threatened
	Ar-Rub al-Khali Sand Massif and Sabkha	Not Protected	Least Threatened
	Wahiba Sand Dune	Not Protected	Least Threatened
	Ad-Dahna Dune, Sand Sheet and Plain Mosaic	Poorly protected	Least Threatened
	An-Nafud al-Kabir Sand Dune	Poorly protected	Least Threatened
	Ar-Rub al-Khali Sand Dune	Poorly protected	Least Threatened
	Central Nafuds Sand Dune	Poorly protected	Least Threatened
	Eastern Sand Sheet and Dune	Well protected	Vulnerable
Uplands	As-Summan Limestone Plateau	Not Protected	Least Threatened
	Central Volcanic Outcrop	Not Protected	Least Threatened
	Hadramaut Plateau	Not Protected	Least Threatened
	Najd Pediplain - Granitic Outcrop	Not Protected	Least Threatened
	Najran - Asir Plateau	Not Protected	Least Threatened
	Yemen Precambrian Plateau	Not Protected	Least Threatened
	Yemen Volcanic Outcrop	Not Protected	Least Threatened
	Dhofar Plateau	Poorly protected	Least Threatened
	Hisma Plateau	Poorly protected	Least Threatened
	Najd Pediplain - Pyroclastic Outcrop	Poorly protected	Least Threatened
	Northern Limestone Plateau	Poorly protected	Least Threatened
	Northern Volcanic Outcrop	Well protected	Least Threatened

Al-Jahra Pool Nature Reserve, Kuwait is the only significant freshwater wetland in the country but entirely created by run-off from a nearby sewage farm; it is designated as an Important Bird Area. Artificial wetland, plantation and agricultural habitats have importance for a wide range of species in the Arabian Peninsula.

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Ecoregion	Habitat Name	Protection Level	Ecosystem Threat Status
Mountains	Asir Mountains - 1500m to 2000m	Poorly protected	Least Threatened
	Asir Mountains - 800m to 1500m	Moderately protected	Least Threatened
	Asir Mountains - above 2000m	Not Protected	Least Threatened
	Asir Mountains - Eastern Slope	Not Protected	Least Threatened
	Asir Mountains - Juniper Woodland	Well protected	Least Threatened
	Hajar Mountains - below 500m	Poorly protected	Least Threatened
	Hajar Mountains - Carbonate - below 500m	Not Protected	Vulnerable
	Hajar Mountains - Eastern - 500m to 1000m	Not Protected	Least Threatened
	Hajar Mountains - Eastern - above 1000m	Not Protected	Least Threatened
	Hajar Mountains - Jebel Hafit	Not Protected	Vulnerable
	Hajar Mountains - Musandam - 500m to 1000m	Not Protected	Least Threatened
	Hajar Mountains - Musandam - above 1000m	Not Protected	Least Threatened
	Hajar Mountains - Musandam - below 500m	Not Protected	Least Threatened
	Hajar Mountains - Western - 1000m to 2000m	Poorly protected	Least Threatened
	Hajar Mountains - Western - 500m to 1000m	Not Protected	Least Threatened
	Hajar Mountains - Western - above 2000m	Not Protected	Least Threatened
	Hijaz Hills and Mountains - above 1500m	Not Protected	Least Threatened
	Hijaz Hills and Mountains - below 1500m	Not Protected	Least Threatened
	Jabal Shammar	Not Protected	Least Threatened
	Jabal Tuwayq	Moderately protected	Least Threatened
	Madyan Mountains - above 1000m	Not Protected	Least Threatened
	Madyan Mountains - below 1000m	Poorly protected	Least Threatened
	Monsoon-affected Vegetation - 500m to 1000m	Moderately protected	Least Threatened
	Monsoon-affected Vegetation - above 1000m	Well protected	Least Threatened
	Monsoon-affected Vegetation - below 500m	Poorly protected	Least Threatened
	Tihamah Foothills - below 500m	Moderately protected	Least Threatened
	Yemen Highlands - 1000m to 2000m	Not Protected	Least Threatened
	Yemen Highlands - 500m to 1000m	Not Protected	Least Threatened
	Yemen Highlands - above 2000m	Not Protected	Least Threatened
Jordan	Forest and Non-forest	Poorly protected	Endangered
	Steppe	Poorly protected	Vulnerable
	Acacia and Rocky Sudanian	Moderately protected	Vulnerable
Arabian (Persian) Gulf	Algal Mats	Moderately protected	Least Threatened
	Mangroves	Poorly protected	Endangered
	Rocky Platforms	Well protected	Least Threatened
	Saltmarsh	Poorly protected	Vulnerable
	Tidal flats (no algal mats)	Well protected	Least Threatened
	Coral Reef	Poorly protected	Critically Endangered
	Other Shallow Water	Well protected	Vulnerable
	Seagrass / macro-algal beds	Poorly protected	Endangered
	Deeper than 15m	Poorly protected	Vulnerable
Gulf of Aden	Mangroves	Poorly protected	Critically Endangered
	Coral Reef	Not Protected	Critically Endangered
	Other Shallow Water	Poorly protected	Critically Endangered
	Seagrass / macro-algal beds	Not Protected	Critically Endangered
	Deeper than 15m	Not Protected	Least Threatened
Gulf of Oman	Mangroves	Poorly protected	Endangered
	Coral Reef	Moderately protected	Critically Endangered
	Other Shallow Water	Poorly protected	Critically Endangered
	Deeper than 15m	Not Protected	Vulnerable
Northern and Central Red Sea	Mangroves	Poorly protected	Vulnerable
	Coral Reef	Not Protected	Least Threatened
	Other Shallow Water	Not Protected	Least Threatened
	Seagrass / macro-algal beds	Not Protected	Least Threatened
	Deeper than 15m	Not Protected	Vulnerable
Southern Red Sea	Mangroves	Poorly protected	Endangered
	Coral Reef	Poorly protected	Vulnerable
	Other Shallow Water	Well protected	Vulnerable
	Seagrass / macro-algal beds	Not Protected	Vulnerable
	Deeper than 15m	Poorly protected	Vulnerable
Western Arabian Sea	Mangroves	Moderately protected	Vulnerable
	Coral Reef	Not Protected	Least Threatened
	Other Shallow Water	Poorly protected	Least Threatened
	Deeper than 15m	Not Protected	Least Threatened

Spatial Prioritization using MARXAN

The Spatial Prioritization identifies where conservation actions (including all place-based conservation activities, but particularly focussed on Protected Area expansion) should be prioritized in order to maximize gains and minimize potential future loss of biodiversity, while at the same time minimizing socio-economic impacts and conflict with other land uses.

The MARXAN decision support tool developed by Ian Ball and Hugh Possingham was utilised for the Spatial Prioritization analysis. This is the most widely adopted site selection tool used by conservation groups globally, having been applied to local and regional planning efforts in over 60 countries around the world (Ball *et al.,* 2009). MARXAN is designed to provide an objective approach to site prioritization which is adaptable and repeatable based on an algorithm that evaluates very large numbers of possible alternatives and retains the most efficient solutions given a specific set of criteria. It is a stand-alone software program that provides decision support to conservation planners to help identify efficient areas that combine to satisfy ecological, social and economic objectives. It utilises data on species, habitats, ecosystems and other biodiversity features; combined with data on planning unit costs; to identify sets of sites which meet all biodiversity representation goals, while minimizing the total cost of the solution and hence ensuring a spatially optimal configuration of sites.

The general approach and methodology to Spatial Prioritization used in this Project is illustrated in Figure 18.

All the derived layers (Habitat map, Habitat Condition map, Protected Areas map, Species data, Ecological Processes data, and Opportunity and Constraints data) were used to generate a Spatial Prioritization using MARXAN.

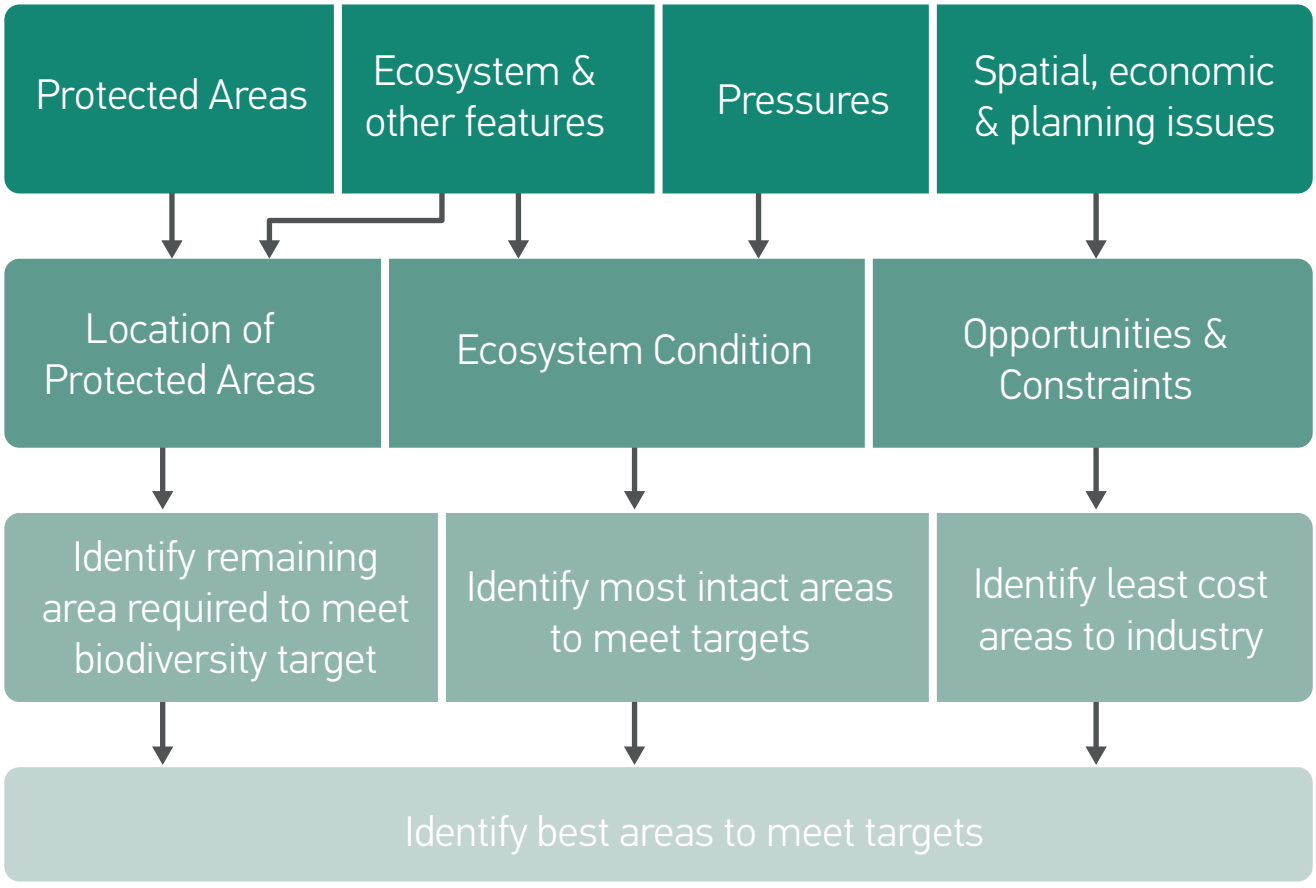


Figure 18 Overview of Spatial Prioritization Process.

Quantitative targets were set for all biodiversity features (e.g. Habitats, Species and Ecological Processes) for use in the MARXAN analysis. For Habitats, these targets were never less than the Protected Area targets. Low targets were used for widely distributed features, while features with a very limited distribution were incorporated using relatively high proportion targets.

Cost surfaces were used in the Spatial Prioritization process to help guide the MARXAN selection algorithm. The cost surface summarizing the cost of inclusion of additional areas into the Protected Area network was developed from the Habitat Condition and the Opportunities and Constraints layers. The data were used to identify the areas of least cost to existing land uses. These components were iteratively combined in MARXAN to identify the potential Priority Focus Areas for inclusion in the Protected Area network.

The primary output of the MARXAN-based process is a selection frequency map. This map gives a measure of how important each planning unit is for meeting targets, and summarizes the number of times (expressed as a percentage) that a planning unit is included in potential spatial configurations which meet the targets and minimize costs according to the parameters used in the MARXAN analyses. MARXAN Site Selection Frequency maps for the UAE and the Arabian Peninsula are provided in Figure 19 and Figure 20.

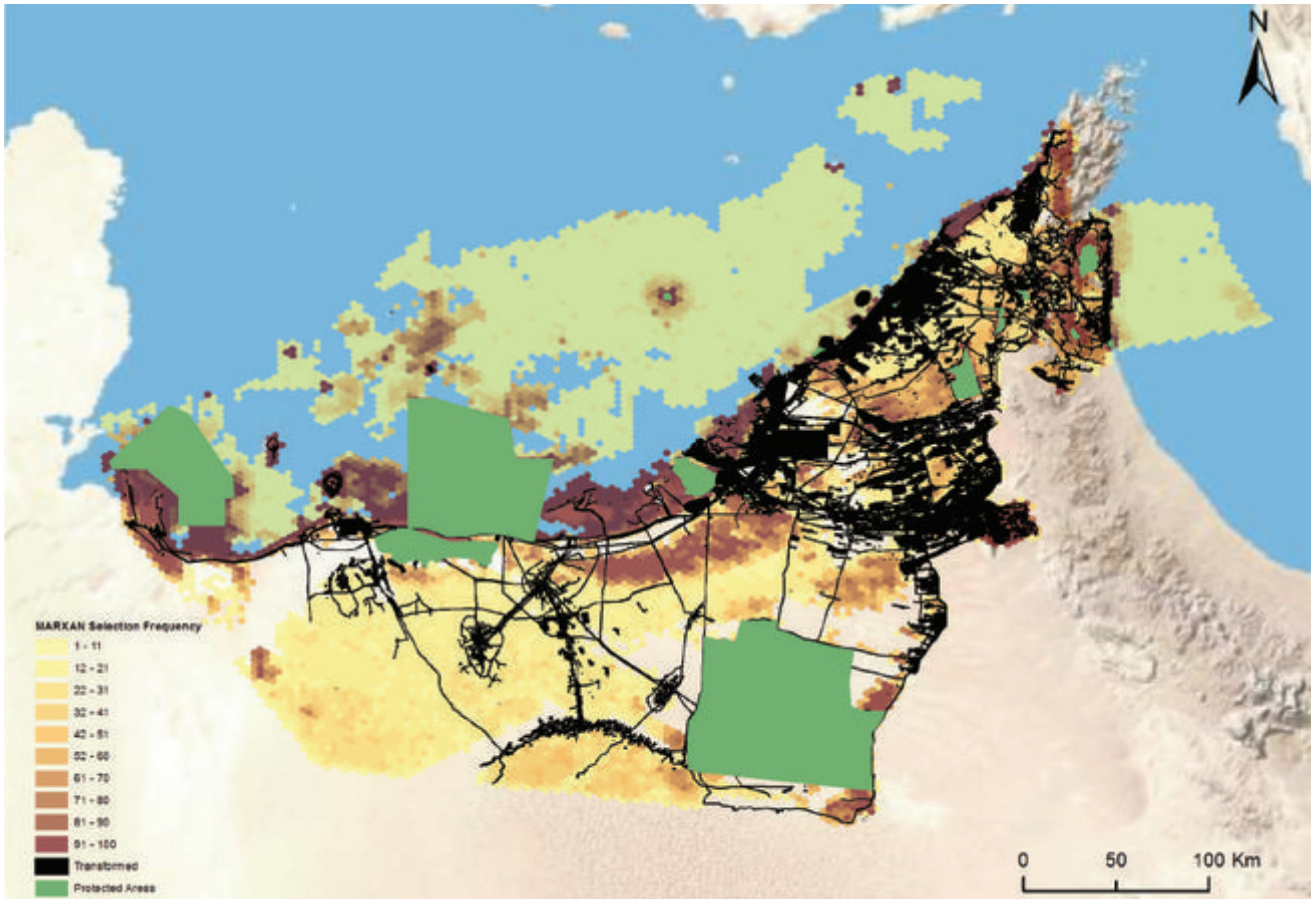


Figure 19 MARXAN Site Selection Frequency for the UAE. Darker brown areas are most frequently required to meet targets, while paler areas are less frequently required.

Priority Focus Areas

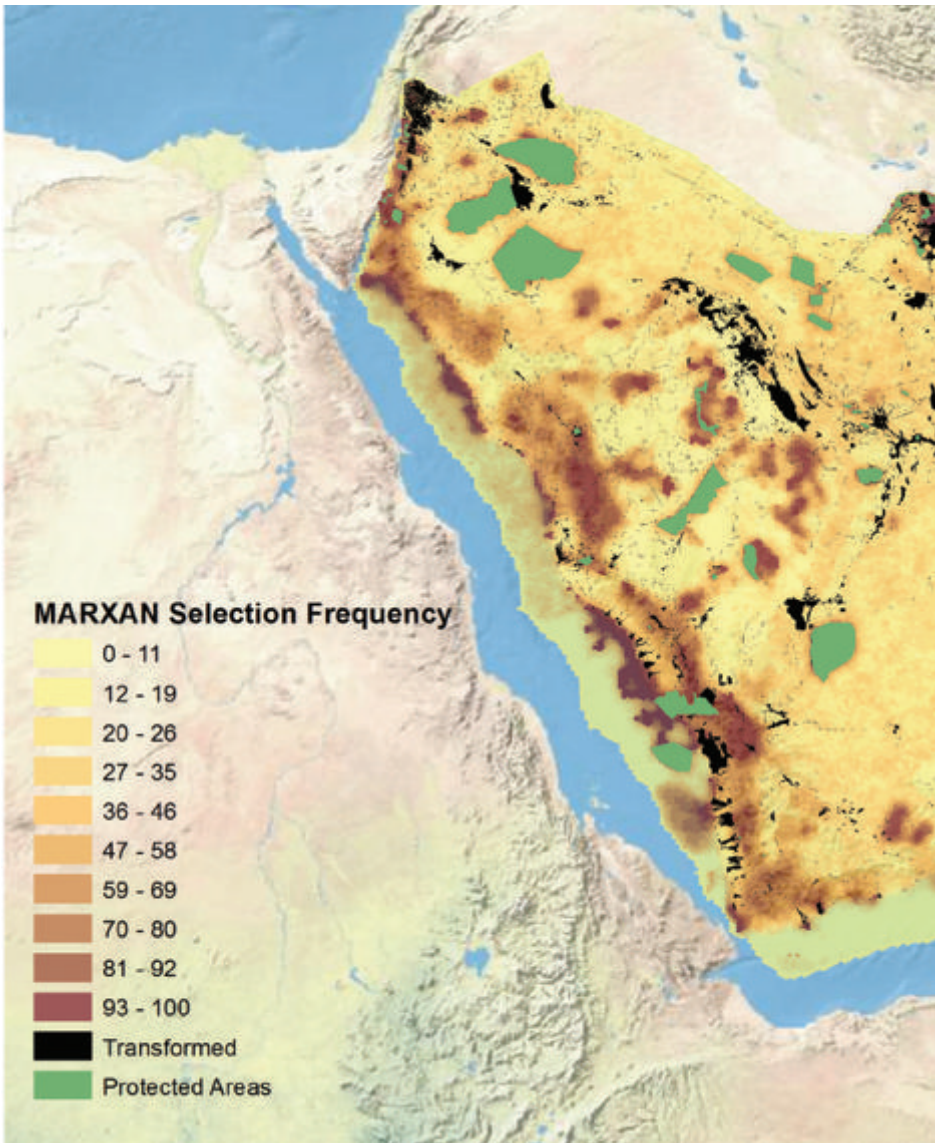
The MARXAN analysis helped identify Priority Focus Areas which are areas within which Protected Area expansion would most efficiently meet Protected Areas targets and hence improve the representativeness of the Protected Area network, while at the same time meeting targets for species.

Protection of ecosystems within the prioritized areas will:

- Improve Ecosystem Protection Level of habitats, and improve the representativeness of the reserve network;
- Reduce inefficiencies by avoiding unnecessary duplication of areas already sufficiently represented in the reserve network;
- Reduce the risk of worsening of Ecosystem Threat Status of habitat types; and
- Allow for the protection of areas required for the maintenance of ecological processes and persistence of threatened and keystone species.

Importantly, the Priority Focus Areas are not potential future Protected Area boundaries, rather they are areas within which area-based conservation actions may be prioritized to efficiently meet targets.

The Priority Focus Area selection process identified 22 Priority Focus Areas within the UAE covering an area of around 9.5% of the planning domain (Figure 21) and 35 in the Arabian Peninsula, covering approximately 12.7% or just over four times the current regional Protected Area network (Figure 22). These provide a focus for immediate conservation action and a basis for more detailed planning work to identify the optimal areas for consideration as Protected Areas or other forms of place-based conservation.



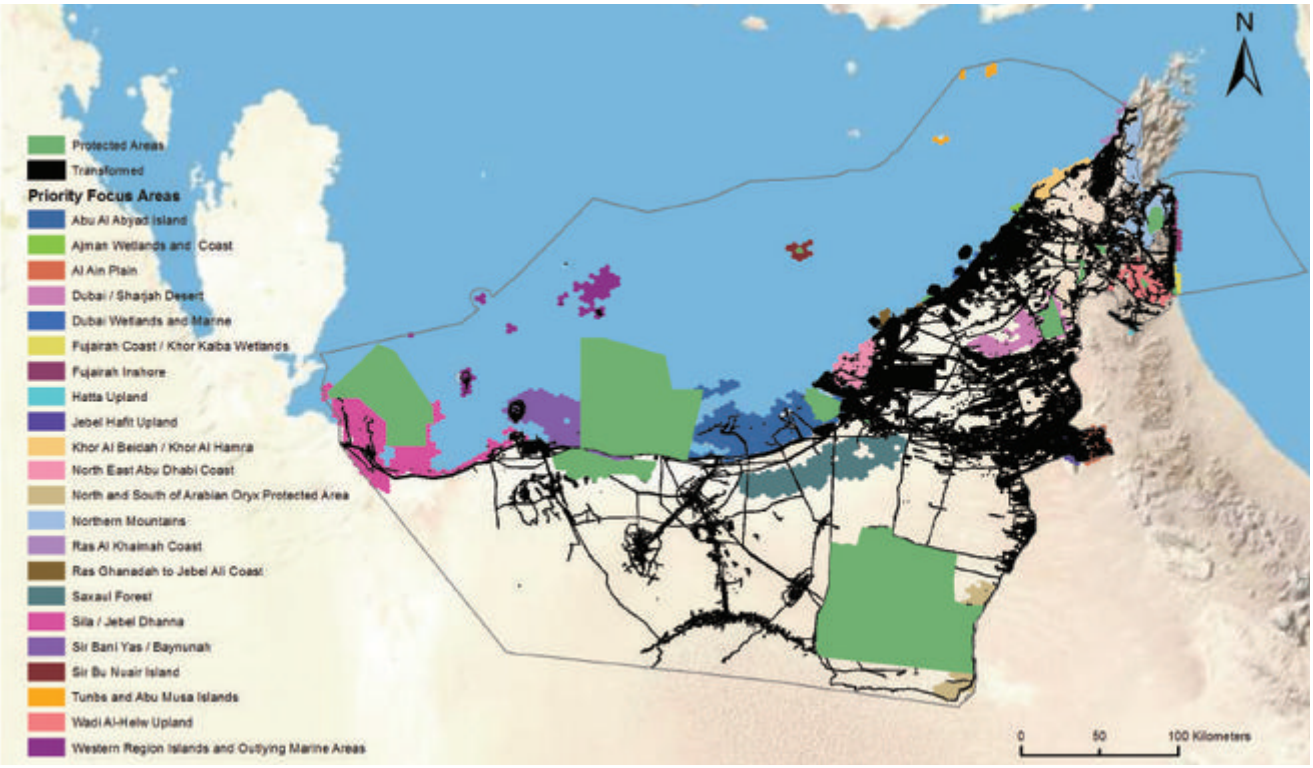


Figure 21 Priority Focus Areas for the UAE.

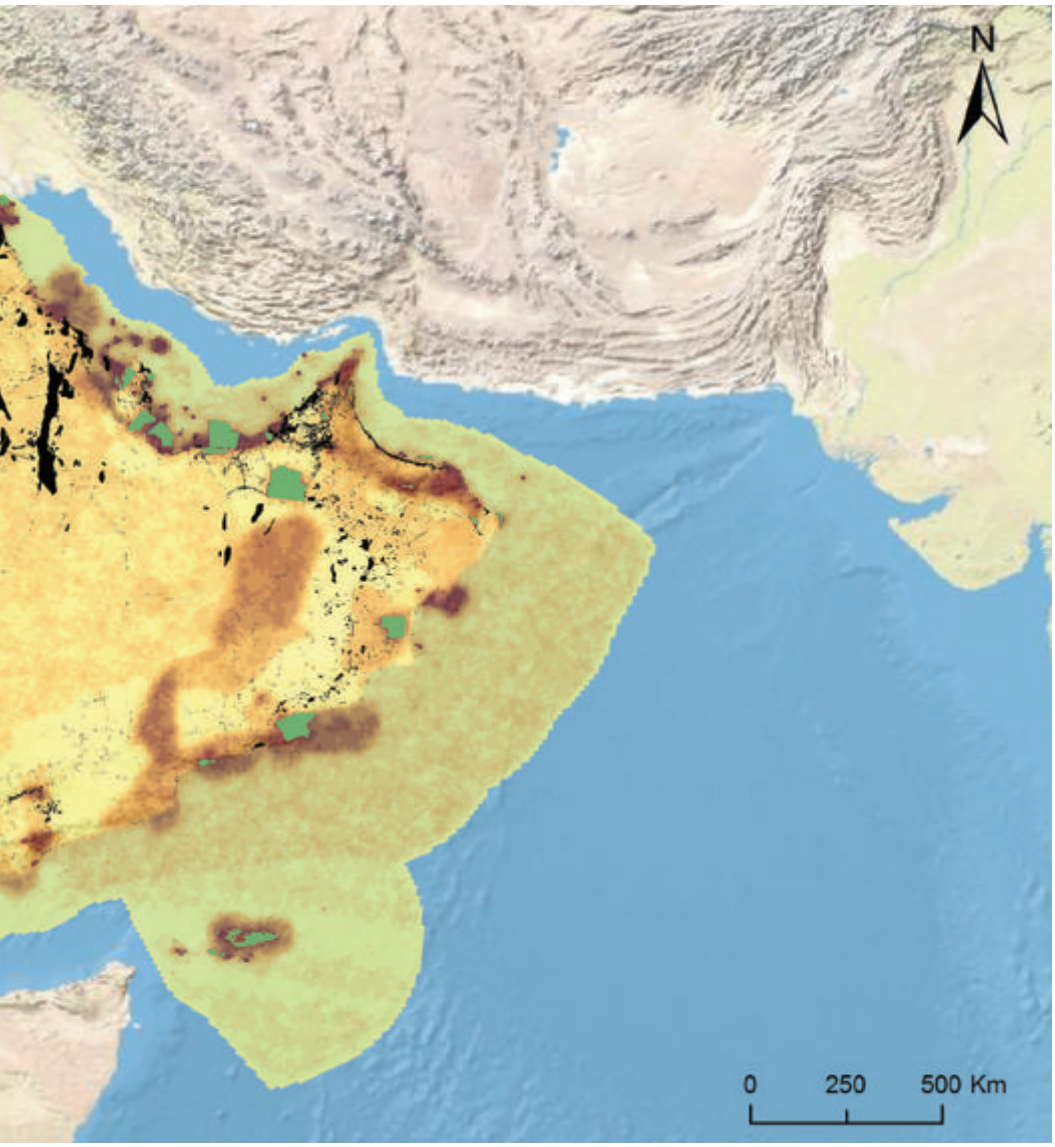
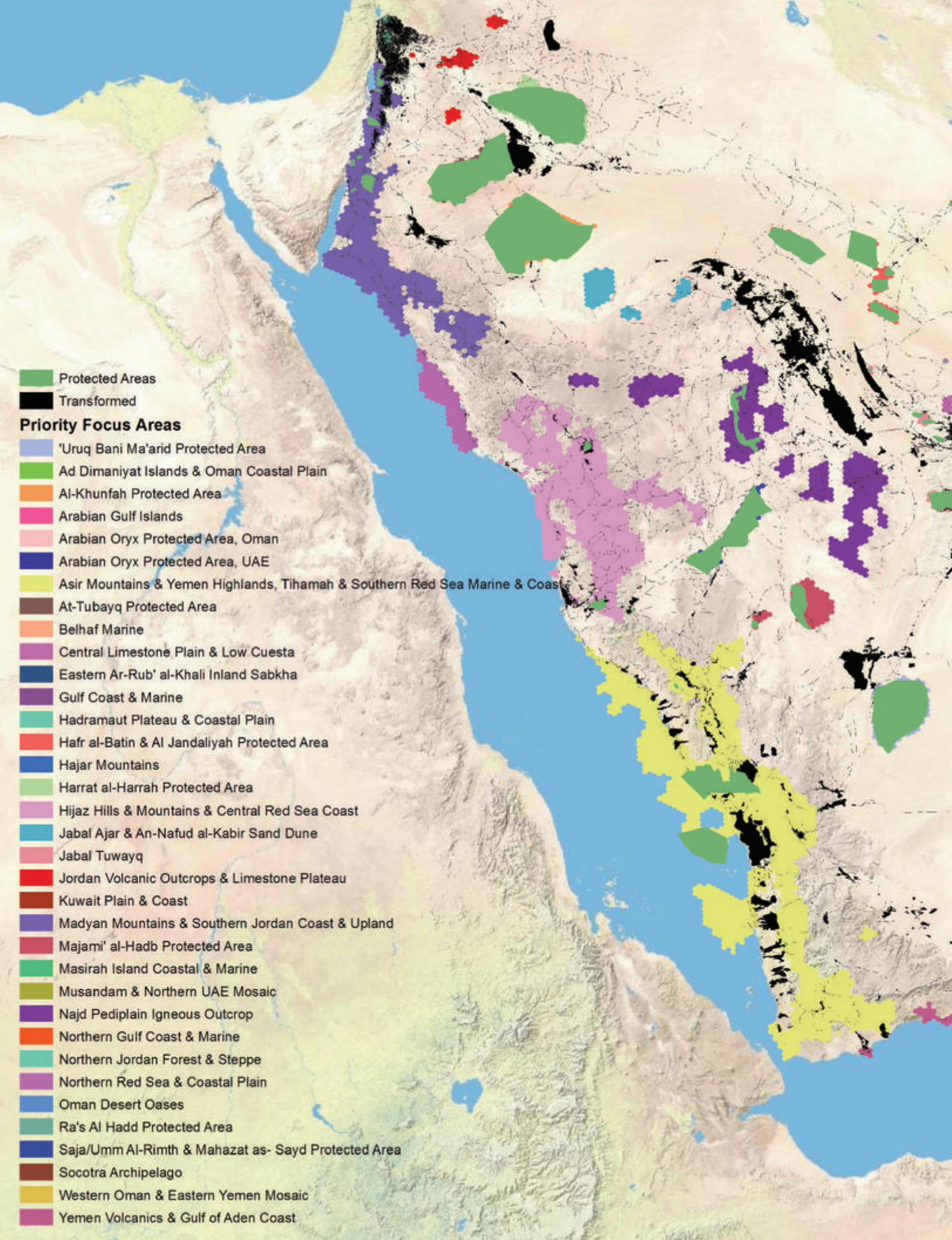


Figure 20 MARXAN Site Selection Frequency for Arabian Peninsula.


Protected Areas
Transformed
Priority Focus Areas
'Uruq Bani Ma'arid Protected Area
Ad Dimaniyat Islands & Oman Coastal Plain
Al-Khunfah Protected Area
Arabian Gulf Islands
Arabian Oryx Protected Area, Oman
Arabian Oryx Protected Area, UAE
Asir Mountains & Yemen Highlands, Tihamah & Southern Red Sea Marine & Coast
At-Tubayq Protected Area
Belhaf Marine
Central Limestone Plain & Low Cuesta
Eastern Ar-Rub' al-Khali Inland Sabkha
Gulf Coast & Marine
Hadramaut Plateau & Coastal Plain
Hafr al-Batin & Al Jandaliyah Protected Area
Hajar Mountains
Harrat al-Harrah Protected Area
Hijaz Hills & Mountains & Central Red Sea Coast
Jabal Ajar & An-Nafud al-Kabir Sand Dune
Jabal Tuwayq
Jordan Volcanic Outcrops & Limestone Plateau
Kuwait Plain & Coast
Madyan Mountains & Southern Jordan Coast & Upland
Majami' al-Hadb Protected Area
Masirah Island Coastal & Marine
Musandam & Northern UAE Mosaic
Najd Pediplain Igneous Outcrop
Northern Gulf Coast & Marine
Northern Jordan Forest & Steppe
Northern Red Sea & Coastal Plain
Oman Desert Oases
Ra's Al Hadd Protected Area
Saja/Umm Al-Rimth & Mahazat as- Sayd Protected Area
Socotra Archipelago
Western Oman & Eastern Yemen Mosaic
Yemen Volcanics & Gulf of Aden Coast

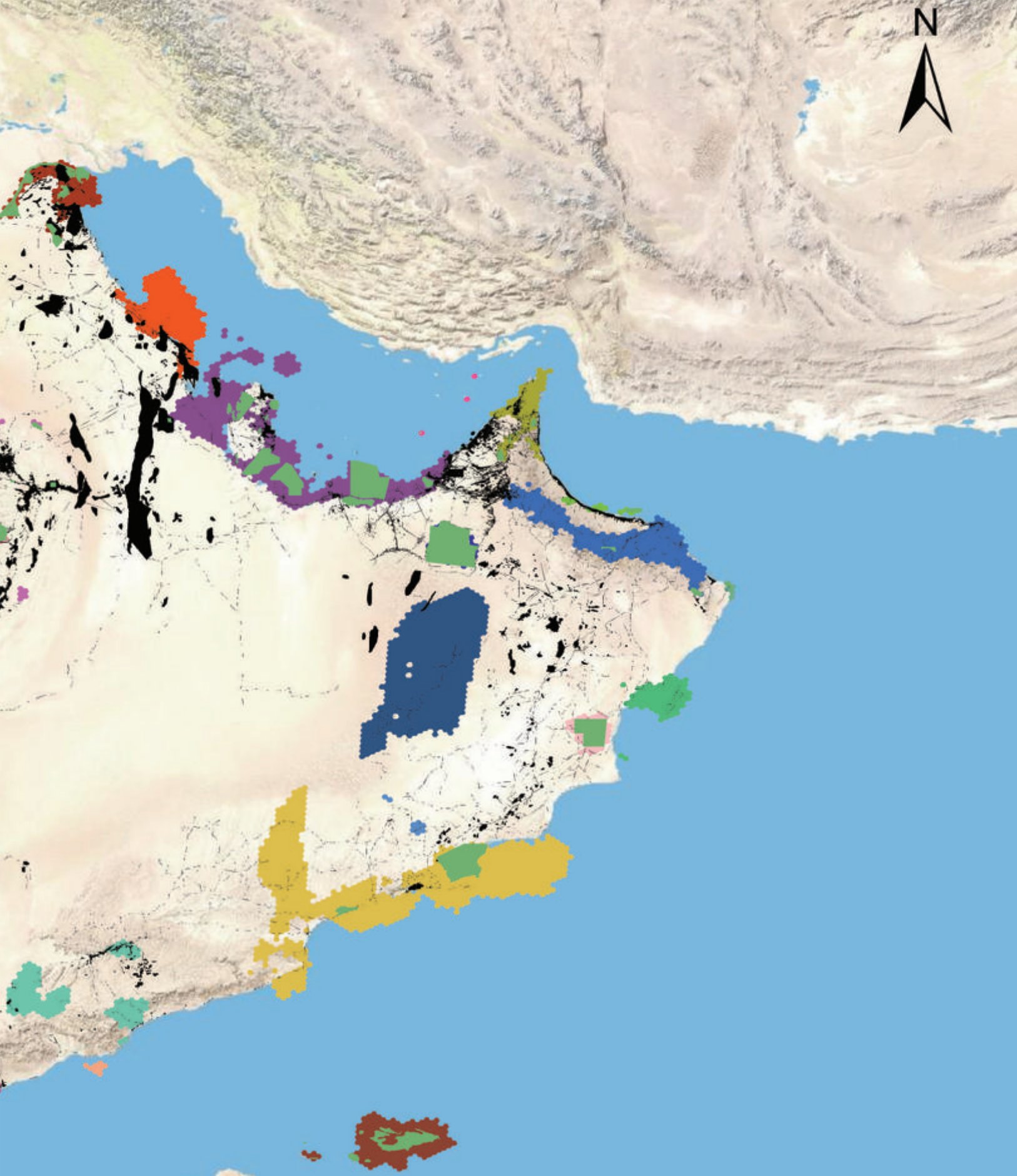


Figure 22 Priority Focus Areas for the Arabian Peninsula.

Expert Evaluations of Priority Focus Areas

Although some conservation activity is necessary in all Priority Focus Areas in order to meet targets, not all areas are of equal importance, urgency or as easy to implement. The Project undertook rapid prioritization exercises of both UAE and Arabian Peninsula Priority Focus Areas. These were both based on expert evaluations at workshops of: 'Biodiversity Value', 'Urgency of Implementation and, for the Arabian Peninsula only, 'Ease of Implementation.

Biodiversity Value scoring was based on the biodiversity importance, value and uniqueness; threatened and under protected habitats; and threatened, rare, endemic species. The scoring of Urgency of Implementation for each site was based on identifying where few options for conservation exist; where opportunities could be quickly lost; areas with current threats; and areas experiencing ongoing or increasing degradation. The scoring of Ease of Implementation was based on factors which aid implementation (e.g. proximity to an existing Protected Area or with existing conservation initiatives, and areas perceived to be a conservation priority at a political or decision-maker level) or alternatively areas without the above factors or where there are many competing activities and land uses which would make it harder to implement a Protected Area.

The evaluation was used to summarize the priority of each Priority Focus Area within the UAE (Table 4) and Arabian Peninsula (Table 5).

Table 4 Summary of Expert Evaluation of the UAE Priority Focus Areas. Those located either entirely or partly within Abu Dhabi are identified.

		Focus Area Value	
		Highest Value Sites	Other Valuable Sites
Urgency of implementation	Very Urgent	Jebel Hafit Upland (Abu Dhabi); Khor Al Beidah / Khor Al Hamra; North East Abu Dhabi Coast (Abu Dhabi); Ras Al Khaimah Coast; Sila / Jebel Dhanna (Abu Dhabi); Sir Bani Yas / Baynunah (Abu Dhabi)	Al Ain Plain (Abu Dhabi)
	Moderately Urgent	Western Region Islands and Outlying Marine Areas (Abu Dhabi) Fujairah Inshore; Ras Ghanadah to Jebel Ali Coast (part Abu Dhabi); Northern Mountains	Abu Al Abyad Island (Abu Dhabi); Ajman Wetlands and Coast; Fujairah Coast and Khor Kalba Wetlands
	Less Urgent	Sir Bu Nuair Island; Wadi Al-Helw Upland	Dubai / Sharjah Desert; Dubai Wetlands and Marine; Hatta Upland; North and South of Arabian Oryx Protected Area (Abu Dhabi) Saxaul Forest (Abu Dhabi); Tunbs and Abu Musa Islands

Table 5 Summary of Expert Evaluation of the Arabian Peninsula Priority Focus Areas.

High Priority	Medium Priority	Low Priority
Regional Trans-boundary		
Asir Mountains and Yemen Highlands, Tihamah and Southern Red Sea Marine and Coast; Gulf Coast and Marine; Hajar Mountains; Madyan Mountains and Southern Jordan Coast and Upland; Western Oman and Eastern Yemen Mosaic	Northern Gulf Coast and Marine	Eastern Ar-Rub' al-Khali Inland Sabkha
Regional Single Country		
Ad Dimaniyat Islands and Oman Coastal Plain; Hijaz Hills and Mountains and Central Red Sea Coast; Jabal Ajar and An-Nafud al-Kabir Sand Dune; Masirah Island Coastal and Marine; Northern Jordan Forest and Steppe; Northern Red Sea and Coastal Plain; Socotra Archipelago	Arabian Gulf Islands; Hadramaut Plateau and Coastal Plain; Kuwait Plain and Coast; Majami' al-Hadb Protected Area; Belhaf Marine; Musandam and Northern UAE Mosaic; Yemen Volcanics and Gulf of Aden Coast	Al-Khunfah Protected Area; Arabian Oryx Protected Area, Oman; Arabian Oryx Protected Area, UAE; At-Tubayq Protected Area; Central Limestone Plain and Low Cuesta; Hafr al-Batin and Al Jandaliyah Protected Area; Harrat al-Harrah Protected Area; Jabal Tuwayq; Jordan Volcanic Outcrops and Limestone Plateau; Najd Pediplain Igneous Outcrop; Oman Desert Oases; Ra's Al Hadd Protected Area; Saja/Umm Al-Rimth and Mahazat as- Sayd Protected Area: 'Uruq Bani Ma'arid Protected Area

The Mediterranean Forests in Jordan were all classified as Endangered and Poorly Protected in this ecosystem analysis, and fell within a high priority, Priority Focus Area. This is Aleppo Pine *Pinus halepensis* within Dibbeen Forest Reserve, Jordan.

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Conclusions

The following key outputs were produced for each of the three scales (Abu Dhabi, the UAE and Arabian Peninsula):

- A strong stakeholder and specialist expert database which will support future Systematic Conservation Planning projects as well as other biodiversity and land management projects in the region.
- A range of important derived layers including the first habitat map for the Arabian Peninsula which has significant value beyond the scope of this Project.
- The first objective measures of Ecosystem Threat Status and Ecosystem Protection Level providing valuable headline indicators of current state of biodiversity.
- The first Spatial Prioritization and map of Priority Focus Areas for Abu Dhabi, the UAE and the Arabian Peninsula.

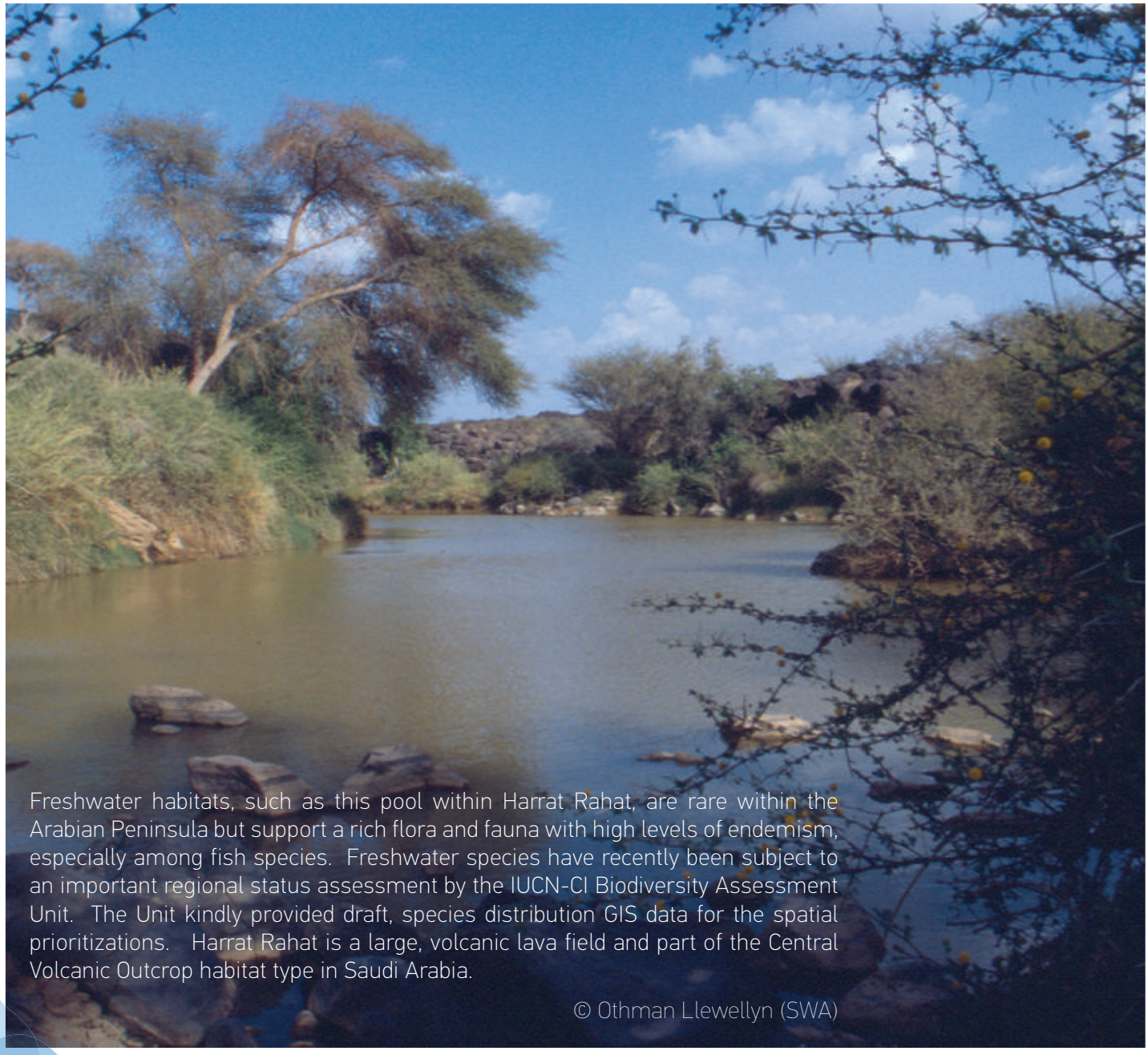
Socotra chameleon *Chamaeleo monachus* is one of a wide range of endemic and globally threatened species on the Socotra Archipelago. It is restricted to patches of dense woodland and bushland. These terrestrial habitats, although well protected, continue to be degraded by changes to traditional, rotational forms of livestock management leading to severe overgrazing.

Outcomes

The AGEDI Local, National and Regional Biodiversity Rapid Assessment Project produced peer-reviewed Systematic Conservation Plans for the Emirate of Abu Dhabi, the UAE, and the Arabian Peninsula.

These map-based outputs provide headline indicators of Ecosystem Threat Status and Ecosystem Protection Level, and identified Priority Focus Areas within which Protected Area expansion and other place-based conservation activities could be undertaken. Conservation activities within the Priority Focus Areas will improve representativeness of the reserve network and ensure the long term persistence of both ecosystems and their constituent species.

The outcomes of the SCP process provide an objective and repeatable method to evaluate the state of biodiversity and continually identify further protection priorities. In the longer term it is considered good practice that the Arabian Peninsula level SCP process is undertaken at least every five years.



Freshwater habitats, such as this pool within Harrat Rahat, are rare within the Arabian Peninsula but support a rich flora and fauna with high levels of endemism, especially among fish species. Freshwater species have recently been subject to an important regional status assessment by the IUCN-CI Biodiversity Assessment Unit. The Unit kindly provided draft, species distribution GIS data for the spatial prioritizations. Harrat Rahat is a large, volcanic lava field and part of the Central Volcanic Outcrop habitat type in Saudi Arabia.

Application of Project Outputs

Systematic Conservation Planning provides a framework for strategic conservation action and priority setting as follows:

Protected Area Development

The Project outputs provide a list of Priority Focus Areas within which Protected Areas should be investigated and implemented. These need to be investigated with relevant agencies to consider the many other factors such as socio-economic benefits, land ownership and local constraints and opportunities that influence Protected Area expansion.

Detailed fine scale conservation planning then needs to take place at the local scale to support each new Protected Area and Protected Area expansion activity. At this finer scale (i.e. beyond the scope of the current Project) when implementation of Priority Focus Areas is being planned in detail, a number of issues need to be considered to facilitate implementation:

- Implementation of transboundary Priority Focus Areas need to be addressed by appropriate formal and informal structures, in order to ensure that implementation is well coordinated. The annual Sharjah conservation workshops run by the Environment and Protected Areas Authority - Sharjah - Sharjah provide an excellent informal platform to initiate this work.
- The boundaries of Priority Focus Areas should be adjusted to take into account alignment with cultural and heritage issues.
- The Priority Focus Areas were identified through desk-based information and there is a need to ground truth these areas to confirm their habitats, extent of transformation and degradation and boundaries.

The Project results also provide a range of outputs that may be included within current Protected Area management plans.

Land Use Planning and Environmental Permitting

There is strong potential for inclusion of Systematic Conservation Planning outputs into transboundary and national level development planning and land use decision making and this should be explored. Such outputs have been successfully used elsewhere as the basis for local and district level strategic land use planning, for example in providing the basis for Strategic Environmental Assessments, Environmental Management Frameworks and inputs to zoning schemes. Systematic Conservation Planning also assists in site option appraisals, Environmental Impact Assessments and would enable lists of potential damaging operations to be developed for each habitat type.

Biodiversity Action Plans

The outputs from Systematic Conservation Planning may be used to assist with meeting CBD targets. In particular the Ecosystem Threat Status assessment may be used as the basis for biodiversity action planning. Action plans for the most threatened habitats may be developed to aid recovery and allow progress reporting towards the reduction of biodiversity loss called for by the CBD. Ecosystem Protection Levels may be used to report against CBD Protected Area targets.

The headline indicators of Ecosystem Threat Status and Protection Level may form the cornerstone of State of Environment (SoE) reporting.

GIS data and maps for Habitat, Habitat Condition and Protected Areas together with the outputs from the spatial assessments are available on the AGEDI website www.agedi.ae.

Future Work

The next steps to include:

- Collation of further data which was not possible within the Project timeframes to improve the derived layers and future SCP.
- Multi-sector finer scale systematic planning of spatial priorities within Priority Focus Areas.
- Building SCP headline indicators into national State of Environment reporting.
- Building the institutional basis for regional data sharing and to take SCP forward over the next 10 years and embed within national planning processes.

- Capacity building and the sharing of skills and data amongst stakeholders across each planning domain. Capacity building would be most valuable in relation to the collation and preparation of derived ecological, threat and opportunity layers, the Threat Status and Protection Level assessments and the Spatial Prioritization.

This young sooty falcon's *Falco concolor* breeding habitat on offshore islands around the Arabian Peninsula is threatened by development, disturbance and introduced predators. A sufficient proportion of this habitat type requires protection and sensitive management to safeguard this and many other rare and threatened species.

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Highland Terraces, Western Yemen - the breeding area of at least eight regionally endemic birds and many other endemic taxa - within the Asir Mountains and Yemen Highlands, Tihamah and Southern Red Sea Marine and Coast Priority Focus Area..

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Glossary

Adapted from (Driver *et al.*, 2011).

Aichi targets: The 20 Aichi Biodiversity Targets are the key elements of the CBD Strategic Plan for Biodiversity 2011-2020, which the 10th meeting of the Conference of the Parties to the CBD agreed on in October 2010 in Nagoya, Japan. The targets are organized under five strategic goals. Goals and targets comprise the aspirations for achievement at the global level, and a flexible framework for the establishment of national or regional targets.

Biodiversity target: the minimum proportion of each ecosystem type that needs to be kept in a natural or near-natural state in the long term in order to maintain viable representative samples of all ecosystem types and the majority of species associated with those ecosystem types.

Constraint area: an area where plans are for a land use that is not in sympathy with biodiversity conservation and therefore an area to be avoided in a spatial prioritization if at all possible.

Critically Endangered ecosystem: an ecosystem type that has very little of its original extent (measured as area, length or volume) left in natural or near-natural condition. Most of the ecosystem type has been severely or moderately modified from its natural state. The ecosystem type is likely to have lost much of its natural structure and functioning, and species associated with the ecosystem may have been lost.

Degraded area: an area of a terrestrial ecosystem that is significantly degraded from its natural state by impacts such as overgrazing. Such impacts lead to a loss of plant species richness and a consequent reduction of faunal richness. Such impacts are generally reversible through restoration projects and targeted management actions. See also transformed areas.

Derived Layer: six types of spatial data organised within a GIS geodatabase that form the basis for the SCP assessments. These include habitat, species, ecological processes, Protected Area, pressures and opportunity and constraints data.

Ecological processes: an area where the long term persistence of a species is enabled. Species are generally identified within discrete distributions but over time wider areas of habitat may be required for the persistence at times of extreme weather or longer term climate change impacts.

Ecoregion: An area comprising of a distinct set of ecosystems or habitats. Terrestrial ecoregions were identified and classified by this Project and, for marine, incorporated the WWF Marine Ecoregions.

Ecosystem: an ecological unit of wide extent, characterised by complexes of plant communities and associated animal communities and ecosystems, and determined mainly by altitude, climatic factors, soil types and geology. An ecosystem may extend over large, more or less continuous expanses or land surface, or may exist in small discontinuous patches.

Ecosystem Protection Level: one of two Headline Indicators; this is the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as well protected, moderately protected, poorly protected, or not protected, based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. Unprotected, poorly protected or moderately protected ecosystem types are collectively referred to as under-protected ecosystems.

Ecosystem services: a measure of the benefits that people obtain from ecosystems, including provisioning services (such as food and water), regulating services (such as flood control), cultural services (such as recreational benefits), and supporting services (such as nutrient cycling, carbon storage) that maintain the conditions for life on Earth. Ecosystem services are the flows of value to human society that result from a healthy stock of ecological infrastructure. If ecological infrastructure is degraded or lost, the flow of ecosystem services will diminish.

Ecosystem Threat Status: one of two Headline Indicators; this is an indicator of how threatened ecosystems are, in other words the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function or composition. Ecosystem types are categorised as critically endangered, endangered, vulnerable or least threatened, based on the proportion of the original extent of each ecosystem type that remains in good ecological condition relative to a series of biodiversity thresholds. Critically endangered, endangered and vulnerable ecosystems are collectively referred to as threatened ecosystems.

Ecosystem type: an ecosystem unit that has been identified and delineated as part of a hierarchical classification system, based on biotic and/or abiotic factors. Factors used to map and classify ecosystems differ in different environments. Ecosystem types can be defined as, for example, vegetation types or marine or coastal habitat types. Ecosystems of the same type are likely to share broadly similar ecological characteristics and functioning.

Endangered ecosystem: an ecosystem type that is close to becoming critically endangered.

Least Threatened ecosystem: an ecosystem type that has experienced little or no loss of natural habitat or deterioration in condition.

Ecosystem classification system: a hierarchical system for mapping and classifying ecosystem types in the terrestrial and marine environment. A national ecosystem classification system provides an essential scientific foundation for ecosystem-level assessment, planning, monitoring and management.

Geodatabase: a spatial database that is optimized to store and query data that is related to objects in space, including points, lines and polygons.

GIS: Geographical Information System software for storing and manipulating geographical information on a computer.

Habitat condition: marine habitats are impacted to various degrees by a wide range of human impacts and most are difficult to evaluate and many are cumulative. SCP adopts are 3-tier classification of 'good', 'fair' and 'poor' condition based on a quantitative assessment of impacts and based on a degree grid. Terrestrial habitats are impacted through a more discrete set of factors. Hence these habitats are classified as transformed, degraded or natural. See Transformed, Degraded and Natural area descriptions.

Natural area: an area of terrestrial ecosystem that is not classified as degraded or transformed and is thus classified as being in a natural state. This classification implies the area supports the community of species.

Opportunity area: an area managed in sympathy with biodiversity and therefore a priority to identify and include within the spatial prioritization.

Pressures: The spectrum of human impacts on terrestrial ecosystems normally classified as either degraded or transformed. See also habitat condition.

Acronyms

Priority Focus Areas: largest, intact and unfragmented areas of high biodiversity importance, suitable for the creation and expansion of large protected areas. They include features in the landscape or seascape that are important for conserving a representative sample of ecosystems and species, for maintaining ecological processes, or for the provision of ecosystem services.

Protected Area: an area of land or sea (normally a Marine Protected Area) that is legally protected through national legislation and hence formally announced and declared. Protection implies that there will be no significant transformation of habitats or deleterious impacts on species and any degradation or species impacts will be reversed by the implementation of a management plan.

Protected Area target: a quantitative goal for how much of an ecosystem type should be included in the protected area network by a certain date. Protected area targets should be revised every five years.

Systematic Conservation Planning (SCP): a scientific method for identifying geographic areas of biodiversity importance. It involves: mapping biodiversity features (such as ecosystems, species, spatial components of ecological processes); mapping a range of information related to these biodiversity features and their ecological condition; setting quantitative targets for biodiversity features; analysing the information using software linked to GIS; and developing maps that show spatial biodiversity priorities. The configuration of priority areas is designed to be spatially efficient (i.e. to meet biodiversity targets in the smallest area possible) and to avoid conflict with other land and water resource uses where possible.

Threatened ecosystem: an ecosystem that has been classified as critically endangered, endangered or vulnerable based on an analysis of ecosystem threat status. A threatened ecosystem has lost or is losing vital aspects of its structure, function or composition.

Threatened species: a species that has been classified as Critically Endangered, Endangered or Vulnerable, based on a conservation assessment (Red List), using a standard set of criteria developed by the IUCN for determining the likelihood of a species becoming extinct. A threatened species faces a high risk of extinction in the near future.

Transformed area: an area of terrestrial ecosystem that has been permanently and irreversibly transformed by human development or other human use such that it no longer supports any of the biodiversity features normally associated with the ecosystem.

Vulnerable ecosystem: an ecosystem type that still has the majority of its original extent (measured as area, length or volume) left in natural or near-natural condition, but has experienced some loss of habitat or deterioration in condition. The ecosystem type is likely to have lost some of its structure and functioning, and will be further compromised if it continues to lose natural habitat or deteriorate in condition

AGEDI	Abu Dhabi Global Environmental Data Initiative
CAMP	Conservation and Management Planning Workshops-Sharjah
CBD	Convention on Biological Diversity
CMRECS	Coastal and Marine Resource Ecosystem Classification System
CR	Critically Endangered
EEZ	Exclusive Economic Zone
EN	Endangered
GEBCO	General Bathymetric Chart of the Oceans
LT	Least Threatened
MARXAN	MARine, and SPEXAN, itself an acronym for SPatially EXplicit ANnealing
PFA	Priority Focus Area
SCP	Systematic Conservation Planning
SoE	State of Environment
SRTM	Shuttle Radar Topography Mission
UAE	United Arab Emirates
USGS	United States Geological Survey
VU	Vulnerable

The Shubak Mountains are a proposed Protected Area near Petra, Jordan; with a high habitat diversity reflecting the wide altitudinal range , and part of the Madyan Mountains and Southern Jordan Coast and Upland Priority Focus Area.

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About AGEDI

The Abu Dhabi Global Environmental Data Initiative (AGEDI) was launched under the guidance and patronage of His Highness Sheikh Khalifa bin Zayed Al Nahyan, President of the United Arab Emirates was formed United Nations World Summit for Sustainable Development in Johannesburg in 2002 to address the local, regional and global responses to the critical need for readily accessible, accurate environmental data and information for all those who need it. Supported by Environment Agency – Abu Dhabi (EAD) on a local level, and championed by United Nations Environment Programme (UNEP), regionally and internationally.

AGEDI works to bridge the environmental data and information gap between developed and developing countries. AGEDI works closely with international networks to facilitate and enhance information exchange enabling more effective, accurate environmental decision making. For more information, visit www.agedi.ae.

AGEDI's work encompasses the following:

- Monitoring and enabling environmental and societal data collection and assessment across global networking movements.
- Ensuring capability and capacity building to support 'best impact' and application of data and information for local, national, regional and global environmental decision making.
- Identifying needs and working with theme experts to ensure sustainable development planning is based on timely, useable, and updated data and information of high quality.
- Defining and delivering projects that address specific data access, acquisition and dissemination to boost the accessibility of data and information by all.
- Enabling and facilitating national and international information processing and exchange mechanisms.

Key maps are available for download at **AGEDI**.ae

About the Environment Agency–Abu Dhabi

The Environment Agency – Abu Dhabi (EAD) was established in 1996 to preserve Abu Dhabi's natural heritage, protect our future, and raise awareness about environmental issues. EAD is Abu Dhabi's environmental regulator and advises the government on environmental policy. It works to create sustainable communities, and protect and conserve wildlife and natural resources. EAD also works to ensure integrated and sustainable water resources management, to ensure clean air and minimise climate change and its impacts.

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Environment Agency - ABU DHABI

For more information, visit EAD.ae

About Hyder Consulting

Hyder Consulting is an international multi-national advisory and design consultancy and has been working with and providing solutions for public and private sector organisations in the Middle East for almost 50 years. By developing long-term relationships built on a high degree of trust it gains an excellent understanding of clients' aspirations in the environment, property, transport and utilities sectors.

Hyder

Hyder Consulting has been working with EAD and AGEDI for several years having previously delivered EAD's Environmental Baseline Database. Hyder Consulting's environmental team is therefore proud to have delivered this important regional initiative. It required a collaboration of expertise in ecology, environmental data management, stakeholder engagement, and GIS combined with a local knowledge gained from a longstanding presence in the region.

For further information about Hyder Consulting please visit www.hyderconsulting.com.

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