AGEDI
مبادرة أبوظبي العالمية للبيانات البيئية
Abu Dhabi Global Environmental Data Initiative

هيئة البيئة - أبوظبي
Environment Agency - ABU DHABI

Systematic Conservation Planning Assessments and Spatial Prioritizations

Supporting Technical Information for the Emirate of Abu Dhabi

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This report provides supporting technical information in relation to the Abu Dhabi track of the Local, National and Regional Biodiversity Assessment Project to that published within the AGEDI project e-booklet *Systematic Conservation Planning Assessments and Spatial Prioritizations for the Emirate of Abu Dhabi, the United Arab Emirates and the Arabian Peninsula*.

This report should be read in conjunction with supporting technical information for the United Arab Emirates (Report reference MU000945_F11_02_01) and the Arabian Peninsula (Report reference MU000945_F11_03_01)

Front cover: Dunes at Umm az-Zamool, UAE © Drew Gardner and Arabian humpback whale *Megaptera novaeangliae* © Robert Baldwin

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Abbreviations and Definitions

Abu Dhabi	Emirate of Abu Dhabi
ADATC	Abu Dhabi Authority for Tourism and Culture
ADCO	Abu Dhabi Company for Onshore Oil Operation
ADNOC	Abu Dhabi National Oil Company
AGEDI	Abu Dhabi Global Environmental Data Initiative
BLM	Boundary Length Modifier
CBA	Council of Boundary Affairs
CBD	Convention on Biological Diversity
CITES	Convention on Trade in Endangered Species
CLUZ	Conservation Land-Use Zoning
CMRECS	Abu Dhabi Coastal and Marine Resources and Ecosystem Classification System
CR	Critically Endangered – IUCN Red List Threat Status
DD	Data Deficient – IUCN Red List Threat Status
EAD	Environment Agency – Abu Dhabi
EBDB	EAD Environmental Baseline Database
EIA	Environmental Impact Assessment
EN	Endangered – IUCN Red List Threat Status
ESRI	Environmental Systems Research Institute
EWS-WWF	Emirates Wildlife Society - Worldwide Fund for Nature
GISDB	EAD GIS Database
IBA	Important Bird Area
ICBA	International Center for Biosaline Agriculture
IPA	Important Plant Area
IUCN	International Union for Conservation of Nature
LC	Least Concern – IUCN Red List Threat Status
LoN	Letter of Notification
LT	Least Threatened – IUCN Red List Threat Status
MARXAN	MARine, and SPEXAN, itself an acronym for SPatially EXplicit ANnealing
NGO	Non-Government Organisations
NT	Near Threatened – IUCN Red List Threat Status
PFA	Priority Focus Area
Project	Local, National and Regional Biodiversity Assessment Project
RFI	Request for Information
SCP	Systematic Conservation Planning
SI	Special Initiatives
SPF	Species Penalty Factor
TDIC	Tourism Development & Investment Company
UAE	United Arab Emirates
UNEP	United Nations Environment Programme

UNEP-WCMC	UNEP-World Conservation Monitoring
UPC	Abu Dhabi Urban Planning Council
USDA-NRCS	United States Department of Agriculture Natural Resources Conservation Service
VLIZ	Flanders Marine Institute
VU	Vulnerable – IUCN Red List Threat Status

1 Introduction

1.1 Background

A systematic biodiversity assessment for the region was first proposed at the 11th Conservation Workshop for the Fauna of Arabia in Sharjah in 2010. A workshop produced a first rapid biodiversity assessment for the Arabian Peninsula (Holness, Knight, Sorensen, & Othman, 2011) and demonstrated that the approach could be applied to the region. At the plenary session of the subsequent First Conference on Biodiversity Conservation in the Arabian Peninsula 2010, it was recognized that there was a need to:

- Produce a habitat map for the Arabian Peninsula.
- Collate information on the distribution of species across the Arabian Peninsula.
- Use the habitat map and the species distribution maps to conduct a systematic conservation assessment for the Arabian Peninsula.
- On the basis of this conservation assessment, work towards a Regional Conservation Strategy that may include:
  - The restoration of traditional forms of resource management (e.g. hema).
  - The development of Trans-Boundary Conservation Areas.

The EAD accepted the mandate from this international meeting and made a commitment at the Conference to support a systematic conservation assessment for Arabia, and the Project is one of the results of that commitment. This Abu Dhabi Global Environmental Data Initiative (AGEDI) Local, National and Regional Biodiversity Assessment Project (Project) is one of the results of that commitment. The Project is focused on the following three tracks:

- Track 1: Local - The Emirate of Abu Dhabi (Abu Dhabi).
- Track 2: National - The United Arab Emirates (UAE).
- Track 3: Regional - The Arabian Peninsula comprising Bahrain, Jordan Kuwait, Oman, Qatar, Saudi Arabia, UAE and Yemen.

This report provides supporting technical information in relation to the Abu Dhabi track of the Local, National and Regional Biodiversity Assessment Project to that published within the AGEDI project e-booklet *Systematic Conservation Planning Assessments and Spatial Prioritizations for the Emirate of Abu Dhabi, the United Arab Emirates and the Arabian Peninsula*.

1.2 Systematic Conservation Planning Concept

The Project is based on the Systematic Conservation Planning (SCP) concept. This is the process of deciding where, when and how to allocate limited biodiversity conservation resources to minimize the loss of biodiversity, ecosystem services and other valuable aspects of the natural environment. The benefits of such a robust evidence-based, conservation planning approach have been demonstrated in a wide

variety of marine and terrestrial environments and scales, from regions to reserves, across the globe.

Since it emerged in the 1990s (Margules & Pressey, 2000) and coupled with decision-support software such as the MARXAN (Ball, Possingham, & Watts, 2009), GIS-based SCP has rapidly become an important tool for planning biodiversity conservation at various scales. MARXAN is freely available from the University of Queensland (http://www.uq.edu.au/MARXAN/) and the MARXAN process is reviewed in the Conservation Land-Use Zoning (CLUZ) website (http://www.kent.ac.uk/dice/cluz/index.html). The principal reason for this widespread take-up is that SCP provides efficient spatial solutions to the sensitive, resource allocation problems required to identify ecologically representative and well-connected systems of Protected Areas and other effective area-based conservation measures. SCP is also cost efficient and reduces conflicts by minimizing spatial competition with other land use activities.

The planning process is essentially a sequential, data integration method that builds on the input of the best available data. This can add value to existing datasets. It is also highly dependent, especially in data-deficient areas, on the input of expert knowledge at workshops. The SCP process can be broken down into a series of inter-linked activities, which are summarised in Figure 1-1 below. Each individual activity can consist of a number of iterative steps and required adaptive feedback loops.

Figure 1-1: Systematic Conservation Planning Process Summary

1.3 Emirate of Abu Dhabi Planning Domain

The planning domain is defined as the area of coverage and interest of the Project. The planning domain boundary for Abu Dhabi was initially derived from the Abu Dhabi soil survey data received from the EAD. The following three datasets were also employed to improve the Emirate of Abu Dhabi's boundary: (1) Flanders Marine Institute (VLIZ) maritime boundaries 2011 for the marine UAE boundary, (2) Abu Dhabi Coastal and Marine Resources and Ecosystem Classification System or CMRECS (EAD, 2010) for the Emirate of Abu Dhabi marine boundary, and (3) EAD Geographical Information System Database Spatial Database Engine (EAD GISDB) Abu Dhabi Emirate boundary 2010 for the terrestrial part of the Emirate of Abu Dhabi.

A GIS format UAE boundary was requested from the Council of Boundary Affairs (CBA) and a low resolution PDF version of the UAE boundaries was supplied by AGEDI. This PDF version was used to further refine the planning domain boundary.

As the Project did not receive the full Emirate of Abu Dhabi boundary in GIS format, the Project made use of the best available complete boundary set at the time of closure of the Project Base Data Archive. Therefore, the boundaries illustrated in this report should only be viewed and used as a planning domain boundary for the purpose of the Project and should not be used for any other purpose.

The planning domain for Abu Dhabi used for the Project is illustrated in Figure 1-2.

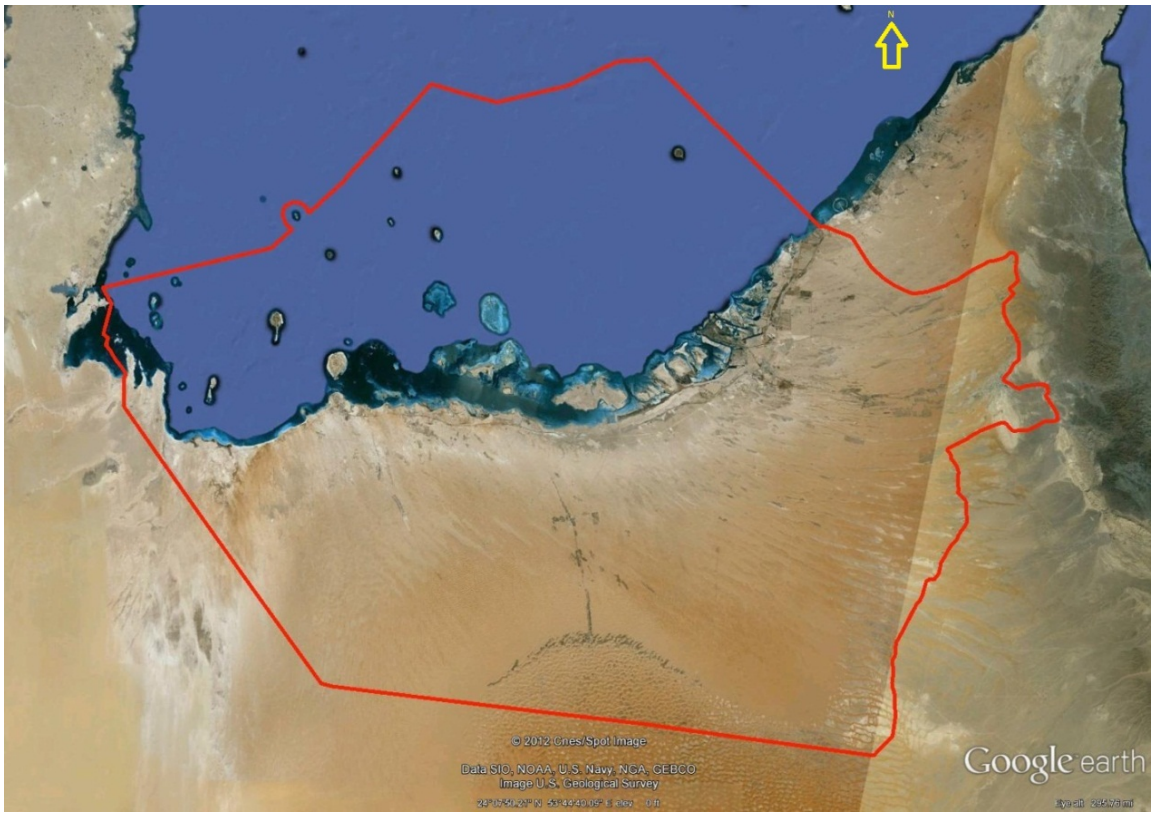


Figure 1-2: Abu Dhabi Planning Domain used for the Project

2 Data Acquisition and Stakeholder Engagement Methodology

2.1 Introduction

A key component of the Project was the acquisition of existing data to be used to derive the ecological, threat and opportunity layers that are the input layers for the spatial prioritization. This involved identifying relevant stakeholder entities, scoping the required data, stakeholder engagement, conducting expert workshops, reviewing data received and incorporating relevant data into the Base Data Archive.

Following completion of the stakeholder engagement and data acquisition period for the local track, an Abu Dhabi Base Data Archive Report was prepared which set out a detailed description of the methodology through which relevant Abu Dhabi data was acquired for the Project and how the data was managed and reviewed for its suitability for inclusion in the Project. It also detailed the data sources and the final Abu Dhabi component of the Base Data Archive.

2.2 Stakeholder Engagement Planning

A Stakeholder Liaison Plan was prepared prior to the initiation of local, national and regional stakeholder engagement. This report initially identified a total of 227 stakeholder individuals who comprised of 102 stakeholder entities, 57 at the local and national scales and 45 at the regional scale. Through the stakeholder engagement process additional organisations were identified that were not originally identified in the Stakeholder Liaison Plan. At the conclusion of the stakeholder engagement process, the total number of stakeholders was 343 and comprised a total of 142 stakeholder entities with 67 at the local and national scales and 76 at the regional scale. At the national level, 12 additional entities were identified during the data collection process.

Using a variety of sources, the Stakeholder Liaison Plan identified:

- Data focal points - These were leaders within overseas, regional, national or local organisations with which the Project may establish agreements and expedite and facilitate cooperation and involvement by a wider group of dependent data providers and experts (both defined below). Two groups of data focal points were identified: priority and general.

- Data providers - Data providers were technical specialists, that collated, collected or managed important biodiversity or related datasets or whose experience provided them with specialist knowledge. Two groups of data providers were identified: those that were ‘independent’ and with whom contact was made directly and ‘dependent’ who were known staff within organisations but where permissions were required from the data focal point to make contact.

- Experts - Experts were a subgroup of data providers with the greatest depth of knowledge in their specialist area. Again there were independent and dependent experts.

A Stakeholder Tracker was used to manage stakeholder engagement. This documented all stakeholders and all correspondence between them throughout the Project.

2.3 Stakeholder Engagement

Once stakeholders were identified, Letter of Notification (LoN) packages were prepared and issued. The LoN packages introduced the Project to the stakeholders and requested the nomination and contact details of a focal point. The stakeholder engagement process for the local scale was undertaken between April 18th 2012 and August 9th 2012.

Following the issue of the LoN packages and, once a nominee name was received, Request for Information (RFI) packages were issued. This commenced on May 9th 2012; each RFI package consisted of a detailed list of data required along with details of the appropriate format for data submission.

2.4 Stakeholder Meetings

Meetings were arranged with priority national organisations that were considered to be the most likely to contribute relevant data to the Project. At the Abu Dhabi level, 15 meetings were conducted with external stakeholders to introduce the Project and the team, and to discuss data availability.

2.5 Expert Workshops

Expert workshops were undertaken to review and verify data uploaded into the base data archive and incorporated into the derived layers. The workshops also helped fill data gaps identified during the base data archiving exercise. Two separate 'Abu Dhabi and UAE Terrestrial and Marine Habitat' workshops were undertaken with a total of 32 experts on June 27th and 28th 2012 and a subsequent 'Abu Dhabi and UAE Species and Ecological Processes' workshop was conducted on October 3rd 2012 with 58 attendees. Initial conservation assessment outputs were also subject to review at a workshop on 7th October 2012. Final conservation assessment outputs were presented at a workshop on 28th February 2013. This also included a ranking of the PFAs by the attendees. This also acted as a capacity building workshop. A summary of the workshops held for the Abu Dhabi Track is provided in Table 2-1.

Table 2-1: Summary of Workshops

No	Workshop	No. of Attendees	Workshop Purpose	Workshop Outputs
1	Abu Dhabi and UAE Terrestrial Habitat Workshop	16	To conduct habitat classification and map reviews with invited external experts in the fields of terrestrial and marine habitat in the UAE.	• Abu Dhabi and UAE Proxy Integrated Habitat Map • Habitat Classification Description
2	Abu Dhabi and UAE Marine Habitat Workshop	16		
3	Abu Dhabi and UAE Species and Ecological Processes Workshop	27	To identify important areas for key species	• Maps showing important species areas • Species/Ecological Processes workshop metadata forms
4	Abu Dhabi and UAE Initial	29	To review initial threat status and protection	• Review initial threat status and protection

No	Workshop	No. of Attendees	Workshop Purpose	Workshop Outputs
	Conservation Assessment Review Meeting		level assessment layers for the UAE	level assessment layers for the UAE
5	Abu Dhabi and UAE Spatial Prioritization Review Workshop	28	Information transfer and capacity building. Review and ranking of PFA.	• PFA evaluation and ranking.

2.6 Data Scoping

2.6.1 Data Scoping Methodology

The SCP process required well organised, spatial data on biodiversity and related pressures/constraints and opportunities features. Prior to issuing requests to identify stakeholders for collaboration through the provision of data, a scoping exercise was undertaken to help define the types of data and sources that would be required for each of the derived layers. The results were compiled within the Abu Dhabi Data Scoping Report.

The EAD's Environmental Baseline Database (EBDB) provided the principal sources of data for the Abu Dhabi Emirate and hence was reviewed in detail as well as being used as the basis for discussions with EAD stakeholders in order to determine the range of data available especially for habitats and species. Following an initial review of the data held within the EAD EBDB, a meeting was held with EAD stakeholders on 21st March 2012. This meeting identified that additional data was held locally by various EAD experts and would be made available to the Project. A further series of one to one meetings with key experts assisted in identifying which data was of potential value to the Project.

2.6.2 Data Criteria

The criteria described in the subsequent sections were a key consideration for the selection of relevant datasets for the Project:

2.3.2.1 Geospatial Data

A fundamental requirement in SCP assessments is that all data used must be spatial. As the principal outputs are spatial analysis and viewed on a map, the data used must have geographical context. Hence, if biodiversity or other land-use data do not have geospatial information associated with them, then these cannot be used for SCP.

2.3.2.2 Comprehensive Coverage

Completeness of the data is important for SCP and data supplied should preferably cover the entire planning area. In some cases it was necessary to interpolate or extrapolate the data to create comprehensive data distributions.

2.3.2.3 Data Scale

The scale or resolution of the feature data sets needs to be appropriate for the area of interest or planning domain. MARXAN requires that the planning domain is divided into

equal area planning units so that quantitative targets for each feature may be applied. The Abu Dhabi assessments are worked on hexagons with 2km sides (10.4km^2).

2.3.2.4 *Equal Coverage across Taxa*

Ideally, equal coverage for all selected taxa should be available for the planning domain. In practice this is unlikely to be the case, so there is a need to fill the gaps with expert inputs. SCP also makes use of proxies for missing data and poorly known taxa.

2.3.2.5 *Original Habitat Extent and Current Distributions*

There is a requirement to have at least an estimate of original extent of habitats. This is because within SCP, targets for habitats are set against original extent.

2.3.2.6 *Density vs. Presence / Absence*

The outputs of the SCP process are most useful if they incorporate issues such as high density or core areas for species. Hence detailed distribution density data are useful for key species such as that generated from atlas fieldwork which employ timed counts within randomly selected, grid squares. However, this data is not a necessity.

2.3.2.7 *Justification for Feature Inclusion*

There is a need for clearly documented justification for inclusion (or exclusion) of each feature based on the above criteria.

2.6.3 Data Types

The principal types of data required for SCP can be broken down into three biodiversity features and three other types of features. These are shown in Figure 2-3.

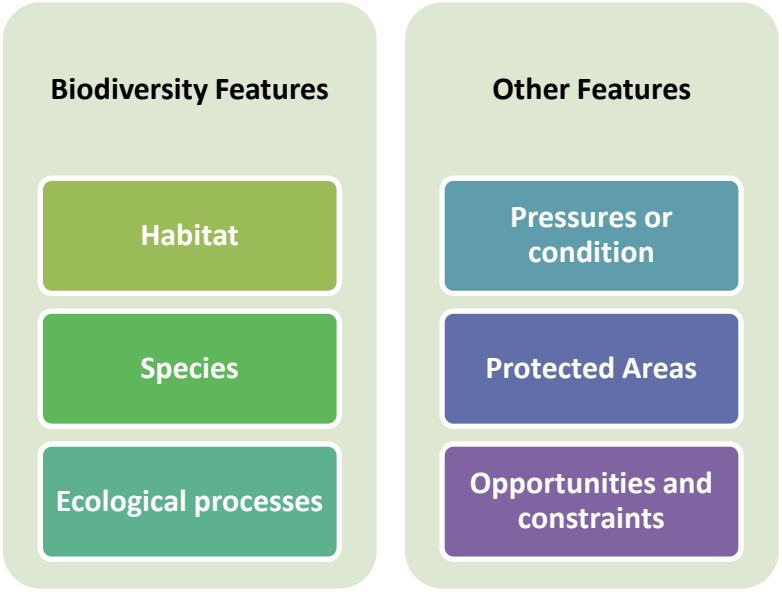


Figure 2-3: Summary of Principal Data Types Required for Systematic Conservation Planning

2.3.3.1 Habitat Data

Habitat data was used to produce an integrated habitat map. This habitat map was the basis for all subsequent analyses. Conservation targets were set against the original extent of each habitat type. The level of current ecosystem threat status was evaluated for these habitat types, as is the level of protection of each of these types ('gap analysis'). Conceptually, the baseline was the extent of habitat before significant anthropogenic impact on the planning domain.

The ideal dataset would be an integrated, hierarchically nested, high resolution, marine and terrestrial habitat map. The habitat classification may be based on maps produced for vegetation, bioregional classification and land cover. The lack of a refined and high resolution vegetation maps is common in many planning areas and the use of habitat proxy maps is thus well founded. The creation of a habitat proxy map which is sufficient for SCP does not remove the need for appropriate field or remote sensing-based mapping in the longer term. There is often the need to 'edge map' or create a seamless boundary between the separate marine and terrestrial classifications basing the edge on the higher resolution map and extending the land cover to the original habitat type to fill any gaps.

2.3.3.2 Condition Data

The second key set of data required for SCP is data on the current remaining extent or condition of habitats or other biodiversity features. In the terrestrial context this is typically represented in a land cover or land use map, while in a marine environment this typically takes the form of a map of the major pressures on marine ecosystems (e.g. fishing effort and pollution) but can also include areas with direct transformation of marine habitats (e.g. harbour and oil infrastructure). There is generally a strong inverse relationship between levels of transformation in a landscape and biodiversity intactness (Scholes & Biggs, 2005) and these layers provide a key insight into remaining areas of high biodiversity value. Current and historical data are valuable to assess the state of transformation and loss of habitats.

Land Use (Terrestrial Condition)

Land uses are classified in two categories: transformed and degraded land uses. Transformed land uses include urban and industrial land uses which include structures such as buildings, roads, pipelines, power lines, and waste sites, and arable agriculture (e.g. planted fields and plantations).

Degraded habitats include overgrazed areas with high densities of camel and goats, and areas with significant groundwater impacts, and areas in close proximity to infrastructure where some level of degradation can be expected.

Condition (Marine)

Typical marine pressures data include:

- Areas of high fishing effort or catch.
- Marine pollution.
- Landing site.
- Aquaculture.
- Marine structures (e.g. oil rigs).

- Coast development impacts on adjacent marine biodiversity.

2.3.3.3 Protected Area Data

There are a range of Protected Area designations. All included in this category are formally announced or declared areas. All others are regarded as informally protected and placed within the Opportunities derived layer. Hence Protected Areas included:

- Declared and Announced Terrestrial Protected Areas including Reserves and Sanctuaries.
- Declared and Announced Marine Protected Areas.

2.3.3.4 Species Data

Species data is used to enhance the spatial prioritization and hence the Project sought distribution data for species with restricted ranges or with particular habitat requirements. Widely distributed species distributions were not included as these are catered for by the habitat targets. There was a need to prioritise species for inclusion into the assessment. The principal priorities were the IUCN Red List Species together with local and national assessments of threat together with culturally significant species.

The key datasets for SCP included:

- Species distribution
- Species breeding areas.
- Spawning sites.
- Migration stopovers.
- Over-wintering and specific foraging areas especially for mobile species such as marine fish, reptiles and mammals and flying species such as bats and birds.

2.3.3.5 Ecological Processes Data

The presence of species, and even habitats, is not sufficient to ensure long term persistence of biodiversity. Therefore the important ecological processes on which the persistence of biodiversity pattern depends has to be deliberately included. The identification of areas important for supporting ecological processes is a key activity for any conservation planning project, and this Project is no exception. However, data scoping revealed that little or no direct data on ecological processes exists for the region and other methods were used to fill this gap as detailed in Section 3.6.

2.3.3.6 Opportunities and Constraints Data

Opportunities

Opportunity areas are all areas which are not formally protected but for one or a number of reasons offer the potential for enhancement of the Protected Area network due to sympathetic land use or land management. These are thus very important to identify for the spatial prioritization.

The primary opportunity areas are areas that receive a level of habitat or species protection but which are not formally (legally) recognised such as:

- Fisheries Reserve.

- Private Protected Areas.
- Marine and Terrestrial Stewardship Areas.
- Traditional management areas (e.g. hema).

There are also areas under biodiversity-compatible land use controls. These areas form the basis for future expansion of conservation areas and include:

- Fishing areas, where low intensity traditional methods are used.
- Existing conservation initiatives.
- Important Bird Areas (IBA) and Important Plant Areas (IPA).
- Expert identified areas of conservation opportunity or low cost for conservation.
- Areas under control of organizations such as Abu Dhabi National Oil Company (ADNOC) or the military, which although not primarily (or even deliberately) managed for biodiversity conservation, may have a biodiversity benefit due to the exclusion of activities such as grazing or off-road vehicle access.
- Sites protected for cultural reasons – e.g. natural areas of World Heritage Sites and their buffers.
- Sites of cultural importance, which have high touristic / cultural / traditional value to the local, national or global population, and where synergies may exist between conserving landscapes for cultural and biodiversity objectives.

Constraints

These areas provide the basis for identifying areas that are likely to be transformed in the future, that have been earmarked for development, where development has already been approved, or where other factors reduce potential for effective conservation actions. These include:

- Land use and development plans including urban edges.
- Development and infrastructure projects.
- Areas with low conservation opportunity.
- Expert identified areas of high conservation cost.

2.6.4 Data Formats

A fundamental requirement of the SCP is that all data used must be spatial as the principal outputs are spatial analysis and will be viewed on a map. Thus, the data format used must have had a geographical context.

The appropriate data formats requested of contributors, detailed in the Abu Dhabi Data Scoping Report, include the following:

- Environmental Systems Research Institute (ESRI) geodatabase, including:
  - ESRI's Personal geodatabase (.mdb).
  - ESRI's File Based geodatabase (.gdb).
- ESRI Shapefile (.shp).
- ESRI ArcINFO export with no compression (.e00).
- Drawing Exchange Files (.dxf).
- Raster data.
- Geospatial PDF.

2.7 Data Review and Management

When data was received from a stakeholder, the following steps were undertaken:

- The data received from a stakeholder was recorded in the Incoming Data Register. This recorded the date of receipt, source and format.
- Data was then given an initial type and format review and only spatial data was loaded into the Base Data Archive geodatabase. This is discussed in further detail in Section 2.8.1.
- Once all data available had been received within the data collection period of the Project, a further comprehensive review (discussed further in Section 2.8.3) was undertaken to determine the suitability of the feature classes for the derived layers. If the data was considered suitable then it was loaded into the relevant derived layers feature class.

2.7.1 Data Review for Base Data Archive

To enable data to be loaded into the Base Data Archive geodatabase a format review was required against the data format criteria described in Section 2.3.4.

During the data collection phase, a number of stakeholders shared essential and up to date datasets which were geospatial, but not yet mapped. A review of these datasets was undertaken to check that first, the datasets could be reworked into a correct format within the Project timeframe and that second, if the data were to be reworked, that only the most appropriate and relevant spatial data was reworked and incorporated into the Base Data Archive.

Where the data was not in the correct format but was deemed essential and up to date for the Project, it was converted to the correct geospatial format. This was an iterative process and was undertaken as data was provided over the data collection period. Examples of the type of data provided by stakeholders and the type of geoprocessing undertaken to convert these to a more suitable format included:

- Word documents - Maps relevant to the Project provided in Word documents were digitised into new feature classes.
- Excel workbooks - Relevant data provided in excel format were converted into new point feature classes and then converted into correct coordinate system (defined in Section 3.4 of the Abu Dhabi Data Scoping Report to load into the geodatabase.
- PDFs - Selected PDF documents were used to verify data received from other stakeholders (e.g. Protected Areas in Abu Dhabi). With PDFs containing maps relevant to the Project, the selected maps were converted into .geotiff files. These were then geo-referenced and used to capture data (e.g. Dubai Major Projects Plan).
- Images - Selected Images (.jpeg and other files) were used to verify data received from other stakeholders (e.g. Protected Areas in Abu Dhabi).
- Shapefile - Shapefiles (.shp files) were converted into the correct coordinate system to load into the geodatabase.
- Geodatabases - Feature classes were converted into the correct coordinate system to load into the geodatabase.
- AutoCAD - Select AutoCAD files (.dwg and .dxf files) were converted into the correct coordinate system to load into the geodatabase.
- MapInfo - Select MapInfo files (.map and .tab files) were converted into the correct coordinate system to load into the geodatabase.
- Raster datasets - Select raster files (.grid and other files) were converted into the correct coordinate system to load into the geodatabase.
- Google Earth - Select Google Earth files (.kmz and kml files) were converted into the correct coordinate system to load into the geodatabase.

Once the files were successfully converted, an assessment was employed to identify any invalid or topologically incorrect geometries. If any were found, the geometry of concern was corrected.

2.7.2 Base Data Archive Geodatabase

The Base Data Archive is an ESRI File Geodatabase (Version 10.0) into which data was categorised by six data types (referred to in the database as feature dataset – i.e. a collection of related Feature Classes that share a common coordinate system). These six types are listed below along with ‘Other Layers’ which is a feature dataset that holds data relevant to the Project but that did not fit within the other six data types (e.g. the local planning domain boundary).

The seven feature datasest are as follows:

- Ecological Processes.

- Habitat.
- Opportunities and Constraints.
- Pressures and Conditions.
- Protected Areas.
- Species.
- Other Layers.

It should also be noted that any raster data received could not be held within the feature datasets due to their format and thus had to be saved separately but within the same geodatabase.

The feature classes (homogeneous collections of common features, each having the same spatial representation, such as points, lines, or polygons, and a common set of attribute columns) associated with the feature datasets have the following naming convention:

Geographical area of data_ Source of data_ Name of original feature class (e.g. UAE_GISDB_Habitats)

As the three planning domains are nested (i.e. Abu Dhabi is part of the UAE which in turn is part of the Arabian Peninsula), only one Base Data Archive geodatabase was created for all three scales. This allowed easier management of the geodatabase and for single datasets to be used at one or more planning domains.

Appendix A provides a summarised list of all the feature classes relevant to the Abu Dhabi planning domain that are in the Base Data Archive. The Base Data Archive is a holding geodatabase of all potentially relevant spatial data but it should be noted that not all data loaded into the Base Data Archive was used to subsequently create the derived layers. Each feature class was subject to further checks as detailed in Section 2.8.3 prior to their use within the derived layers.

2.7.3 Data Review for Derived Layers

A review process was undertaken for each feature class to determine its inclusion or exclusion within each of the derived layers of the Derived Layers geodatabase. For each feature class to be loaded into the derived layer geodatabase the following checks were applied:

- Temporal review - review of the temporal extent of the data to determine whether it is reflection of what currently exists or is out of date.
- Quality review - review of the quality of the datasets against the criteria set out in Section 2.3.2 and determining whether it was fit for the Project's purpose.

Certain feature classes within the Base Data Archive were not incorporated into the derived layers because often, more comprehensive, more up to date or more complete feature classes were received and were integrated instead.

2.7.4 Derived Layers Geodatabase

Similar to the Base Data Archive geodatabase, one Derived Layers geodatabase was created to collect the derived layers. Within this geodatabase, each of the feature classes within the Base Data Archive were reviewed and only those deemed complete and relevant were loaded into the Derived Layers geodatabase. This activity converted a selection of Base Data Archive feature classes into one feature class in the Derived Layers geodatabase.

Additional fields were created for some feature classes to log the data sources, dates the data were loaded into the Derived Layers geodatabase and to record the geoprocessing the data had undergone to allow uploading into the geodatabase.

Metadata of the feature classes was then created for each feature class within the geodatabase. The metadata created followed the template described in ISO 19139:2007 ‘Geographic information Metadata XML schema implementation’ (Lee & Percivall, 2008).

3 Data Inputs into Systematic Conservation Planning

3.1 Introduction

The Project's approach was based on the systematic conservation planning concept, which represented the best practice in this field. The approach is an evidence based method for identifying geographic areas of biodiversity importance, which 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.
- Developing maps that provide headline indicators of the current status of ecosystems (namely the ecosystem threat status and ecosystem protection level assessments).
- Identification of spatial biodiversity priorities.

Systematic conservation planning is dependent on spatial data, which may be obtained from existing spatial datasets, derived spatial datasets or through expert driven workshop processes. The key categories of spatial data are summarized in Table 3-2.

Table 3-2: Summary of Major Categories of Data Included in each of the Three Primary Analyses

	Ecosystem threat status	Ecosystem protection level	MARXAN spatial prioritization
Habitat	x	x	x
Condition	x		x
Protected Areas		x	x
Species			x
Ecological processes			x
Opportunities and constraints			x

3.2 Mapping and Classifying Habitats

The ability to map and classify habitats into different ecosystem types is a key bed for systematic conservation planning. The integrated habitat map for Abu Dhabi served as:

- Basis for setting targets for a representative set of ecologically distinct areas.

- Basis for identifying original extent of habitats.
- Broad proxy for other associated fauna and flora.

The integrated habitat map is comprised of a terrestrial and each a marine portion. Both components were derived from existing geospatial data (with its intrinsic accuracy limitations), and used as a proxy for biodiversity planning for Abu Dhabi. The habitat map is not a detailed and definitive habitat map but has been derived for the purposes of this Project. It should not be regarded as a replacement for a detailed field-based survey.

3.2.1 Data Sources Used

The terrestrial component of the map was derived using the following data sources:

- Soil Survey of Abu Dhabi Emirate (2006-2009) geospatial layers from EAD Geographical Information System Database Spatial Database Engine (EAD GISDB). The EAD undertook the Soil Survey of Abu Dhabi Emirate in partnership with the International Center for Biosaline Agriculture (ICBA) and the survey was based on the standards of the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS), modified to fit the UAE conditions. The outputs of the soil survey also included vegetation maps which were used for the habitat map. The layers were available at a scale of 1:500,000.
- Soil Survey of Abu Dhabi Emirate – Summary (EAD, 2009a).
- Satellite imagery from IKONOS and Google Earth.

The marine component of the map was derived using the following data sources:

- Abu Dhabi Coastal and Marine Resources and Ecosystem Classification System (CMRECS) (2010) was used to derive marine (and coastal) habitat types in Abu Dhabi (e.g. mangroves, coral reef). This database is part of the EBDB and was extracted for the Project's use.
- Island descriptions from the National Atlas of the UAE (UAE University, 1993).

3.2.2 Process

The soil survey contained 2,279 GIS polygons which were also assigned vegetation groups from the vegetation survey. Terrestrial habitat types were assigned to particular combinations of soil and vegetation group types based on the Natural Habitat Types of Abu Dhabi Emirate (Brown & Böer, 2004). In this way each soil survey GIS polygon was allocated a habitat type. Some polygons from the soil survey had either not been assigned a soil type or a vegetation group or both. In these cases, satellite imagery, along with local field knowledge, was used to allocate a habitat type to the polygons. Satellite imagery and the use of experts with local field knowledge were also used to check the allocated terrestrial habitat types.

GIS polygons from CMRECS zones, geoforms and macro-habitats were selected to define intertidal and shallow marine habitats in Abu Dhabi. CMRECS depth zones were used to define deeper marine water habitats (i.e. deeper than 15m). Satellite imagery and the use of experts with local field knowledge were also used to spot check the allocated coastal and marine habitat types.

The terrestrial and marine habitat maps were presented at expert Abu Dhabi and UAE Terrestrial and Marine Habitat workshops on 27th and 28th June 2012. The main issues/gaps which were discussed are presented below:

- Habitat classification for islands.
- Mapping of barquas (mesas, jebels).
- Mapping of interdunal plains in Liwa Crescent.
- Distinction between coastal and inland sabkhas.
- Distinction between shallow and deep marine habitats.
- Inclusion of oyster beds and fan clam habitats.
- Coral reef distribution.
- Mapping of macro-algal beds.
- Distinction between natural and planted mangroves.
- Distribution of salt marsh.
- Coastline boundary.

The outcomes of the workshop discussions (for Abu Dhabi and UAE) were documented in decision tables. These are presented in Appendix B.1. Following the workshops the habitat classification was finalised and a total of 39 habitat types were defined. This classification scheme is presented in Table 3-3 below.

Table 3-3: Abu Dhabi and UAE Habitat Classification Table

ID	Habitat Group	Habitat Type	Description	Reference
1	Mountains, rocky terrain and wadis	Carbonate (limestone and dolomite) mountain habitat above 800m	Regionally unique area of high Musandam characterized by the appearance and dominance of species such as *Convolvulus acanthocladus, Artemesia sieberi, Prunus arabica, Ephedra pachyclada, Centaurea wendelboi, Phagnalon schweinfurthii* and *Moraea sisyrinchium* generally above 900m. The classification is based on an elevation greater than 800m since this provides a 100m buffer and hence takes account of the poor resolution of the contour data.	Feulner and workshop advice and geology map of UAE
2		Carbonate (limestone and dolomite) mountain habitat below 800m	Carbonate (limestone and dolomite) with an elevation less than 800m. Common lower elevations species include *Euphorbia larica, Tephrosia apollinea, Acacia tortilis, Fagonia indica* and *Moringa peregrina*.	Feulner and workshop advice and geology map of UAE
3		Freshwater wadis	Wadis with the presence water all year round with freshwater fish.	Feulner (1998)
4		Jebel Hafit	Mountain slopes and scree with low vegetation cover, but often surprisingly species-rich. Trees (e.g. *Acacia tortilis*), stem succulents (e.g. *Euphorbia larica*), shrubs, dwarf shrubs and perennial grasses are characteristic elements of the flora.	Brown and Böer (2004) and workshop advice
5		Ophiolite (gabbros and ultrabasics) mountain habitat above 800m	Summit region above 900m with a distinctive flora not otherwise found in the UAE, consisting of several hundred wild olive trees plus the large shrub *Ehretia obtusifolia* and the low perennial *Melhania muricata* (sole UAE site), plus high elevation species like *Convolvulus acanthocladus*, *Ephedra pachyclada* and *Phagnalon schweinfurthii*. The classification is based on an elevation greater than 800m since this provides a 100m buffer and hence takes account of the poor resolution of the contour data.	Feulner and workshop advice and geology map of UAE
6		Ophiolite (gabbros and ultrabasics) mountain habitat below 800m	Ophiolite (gabbros and ultrabasics) with an elevation less than 800m.	Feulner workshop advice and geology map of UAE
7		Other geology (metamorphic and chert/limestone facies)	Metamorphic and chert/limestone facies.	Feulner and workshop advice and geology map of UAE
8		Wadis and floodplains	Wadis and floodplains exclusively with temporary water flow, seasonal pools and very few permanent pools. Often species rich.	Feulner and workshop advice
9		Wadis and floodplains with distinct tree cover	Wadis and floodplains exclusively with temporary water flow, seasonal pools, very few permanent pools and distinct tree cover.	Feulner, Hornby and workshop advice

ID	Habitat Group	Habitat Type	Description	Reference
10	Inland plains	Interdunal plains with sabkha	Interdunal plains on which sabkha is developed. Due to the high salinity of the substrate, these areas will be largely devoid of vegetation, although *Zygophyllum qatarense* often predominates towards the margins. Locally with Seidlitzia rosmarinus.	Brown and Böer (2004) and workshop advice
11		Alluvial or interdunal plains with dwarf shrub cover	Gravel or interdunal plain, where the substrate may vary from sand to gravel. Dominant plant species within alluvial plains may be *Haloxylon salicornicum* and *Rhazya stricta*, while within interdunal plains the dominant floral species may be *Haloxylon salicornicum* or *Zygophyllum qatarense*.	Brown and Böer (2004) and workshop advice
12		Northern alluvial or interdunal plains	Gravel or interdunal plains dominated by *Acacia tortilis* and/or *Acacia ehrenbergiana*, while *Prosopis cineraria* may also be present.	Brown and Böer (2004) and workshop advice
13	Sand sheets, dunes and mega-dunes	Liwa crescent dune and sabkha mosaic	Mega dunes (dunes taller than 20m) and inland sabkha within the Liwa crescent. Characteristic flora species include *Seidlitzia rosmarinus* and *Calligonum crinitum* ssp. *arabicum*.	Brown and Böer (2004) and workshop advice
14		Mega-dunes	Mega-dunes (i.e. dunes taller than 20m) with sparse vegetation cover in which the dwarf shrubs / shrubs *Cornulaca arabica* or *Calligonum crinitum* are present, often accompanied by *Cyperus conglomeratus*.	Brown and Böer (2004)
15		Sand sheets and dunes mainly with perennial herbs or graminoids	Sand sheets and dunes with *Tribulus arabicus* dominant (often with *Cyperus conglomeratus* and *Cornulaca arabica*) where vegetation cover can be quite dense locally (up to 10 %), but species-poor or sand sheets and dunes in which graminoids (grasses or sedges) are present.	Brown and Böer (2004)
16		Sand sheets and dunes with distinct dwarf shrub cover	Sand sheets and dunes in which dwarf shrubs (i.e. woody perennials less than 1m, usually less than 50cm) are conspicuous elements of the vegetation: with *Haloxylon salicornicum* and/or *Cornulaca monacantha* with Cyperus conglomeratus often co-dominant; with *Rhanterium epapposum*; and with *Zygophyllum qatarense* (with varying amounts of *Cyperus conglomeratus*).	Brown and Böer (2004)
17		Sand sheets and dunes with distinct shrub or dwarf shrub cover	Sand sheets and dunes in which shrubs (i.e. woody plants taller than ca. 1m) are physiognomically conspicuous elements of the vegetation including with *Calotropis procera* and *Leptadenia pyrotechnica,* both of which are indicators of degradation. Also, sand sheets and dunes in which dwarf shrubs (i.e. woody perennials less than 1m, usually less than 50cm) are conspicuous elements of the vegetation: with *Haloxylon salicornicum* and/or *Cornulaca monacantha* with *Cyperus conglomeratus* often co-dominant; with *Rhanterium epapposum*; and with *Zygophyllum qatarense* (with varying amounts of *Cyperus conglomeratus*).	Brown and Böer (2004)
18		Sand sheets and dunes with distinct tree cover	Sand sheets, dunes and dune fields with natural groves of Prosopis cineraria ('ghaf').	Brown and Böer (2004)
19		Sand sheets and dunes with dwarf shrubs and barqas	Sand sheets and dunes and mega-dunes with inselberg-like rocky exposures at least 2m high. Dependent on the extent to which finer-grained substrate has developed, these exposures can be nearly barren to well-vegetated, with halophytic and non-halophytic vegetation. Typical plant species include *Cornulaca monacantha*, *Salsola drummondii* and *Salsola imbricata*.	Brown and Böer (2004) and Hornby workshop advice

ID	Habitat Group	Habitat Type	Description	Reference
20		Sand sheets and dunes with Haloxylon persicum	Sand sheets and dunes in which shrubs (i.e. woody plants taller than ca. 1m) are physiognomically conspicuous elements of the vegetation including *Haloxylon persicum* and often co-dominant with *Cyperus conglomeratus*, *Haloxylon salicornicum* or *Zygophyllum qatarense.*	Brown and Böer (2004)
21	Coastal plains, sand sheets and dunes	Coastal plains and sand sheets	Coastal plains and sand sheets dominated by chenopods, *Cyperus arenarius*, *Zygophyllum qatarense*; the influence of extreme halophytes such as *Halopeplis perfoliata*, and *Limonium axillare* is restricted mainly to depressions.	Brown and Böer (2004)
22		Coastal sand sheets and low dunes	Coastal white (coralline) sands with a relative profusion of perennial plant species and dense vegetation cover (up to ca. 15 %). Perennial grasses and dwarf shrubs are the most prominent elements of the flora.	Brown and Böer (2004)
23	Coastal sabkha	Coastal sabkha	Salt-encrusted desert close to the coast covering wide expanses. Coastal sabkha is devoid of vegetation due to the salinity of the substrate, although halophytes may occur where there is a thin carpeting of sand on the surface.	Brown and Böer (2004)
24	Islands	Island	Sand-dominated island habitats.	Workshop advice and National Atlas of the UAE 1993
25		Island - salt dome	Salt domes located on islands.	Workshop advice and National Atlas of the UAE 1993
26	Intertidal	Algal mats Arabian Gulf	Sheltered low-angle intertidal areas typically composed of unconsolidated sediments (sand or mud) with extensive cover of algal or microbial mats.	CMRECS (2010)
27		Brackish marsh	Coastal marsh receiving water from mountains with *Juncus rigidus* and *Cyperus laevigatus*.	Hornby (workshop advice)
28		Mangroves Arabian Gulf	Intertidal areas dominated by true mangroves and associates.	CMRECS (2010), UNEP-WCMC and workshop advice
29		Mangroves Gulf of Oman	Intertidal areas dominated by true mangroves and associates.	CMRECS (2010), UNEP-WCMC and workshop advice
30		Rocky platforms	Exposed low-angle intertidal shoreline terrace characterised by bedrock or boulders which singly or in combination have an aerial cover of 75% or more.	CMRECS (2010)
31		Saltmarsh Arabian Gulf	Intertidal areas dominated by emergent halophytic herbaceous vegetation and shrubs.	CMRECS (2010)

ID	Habitat Group	Habitat Type	Description	Reference
32		Tidal flats (no algal mats) Arabian Gulf	Exposed intertidal substrates having greater than 25% cover of particles smaller than gravel.	CMRECS (2010)
33	Shallow marine water habitats	Coral Reef Arabian Gulf	Areas characterized by a substrate or environmental setting largely constructed by the reef-building activities of corals and associated organisms. Live corals may or may not be present.	CMRECS (2010), UNEP-WCMC and John Burt
34		Coral Reef Gulf of Oman	Areas characterized by a substrate or environmental setting largely constructed by the reef-building activities of corals and associated organisms. Live corals may or may not be present.	CMRECS (2010) and UNEP-WCMC and John Burt
35		Other shallow water Arabian Gulf	Areas with a permanent overlaying water column less than 15m in depth.	CMRECS (2010) and GEBCO
36		Other shallow water Gulf of Oman	Areas with a permanent overlaying water column less than 15m in depth.	CMRECS (2010) and GEBCO
37		Seagrass/Macro-algal beds Arabian Gulf	Subtidal benthic substrates, generally composed of unconsolidated sediments, and characterised by greater than 10% cover of rooted vascular seagrass species.	CMRECS (2010), UNEP-WCMC and workshop advice
38	Marine water deeper than 15m	Deeper than 15m Arabian Gulf	Areas with a permanent overlaying water column greater than 15m in depth.	CMRECS (2010) and GEBCO
39		Deeper than 15m Gulf of Oman	Areas with a permanent overlaying water column greater than 15m in depth.	CMRECS (2010) and GEBCO

3.2.3 Outputs

The terrestrial and marine habitats components were combined into one integrated habitat map which is presented in Figure 3-4. the associated habitat legend is provided in Figure 3-5 and in large format in Appendix B.1. This is the habitat map that was then used for the threat status and protection level assessments, and the spatial prioritization.

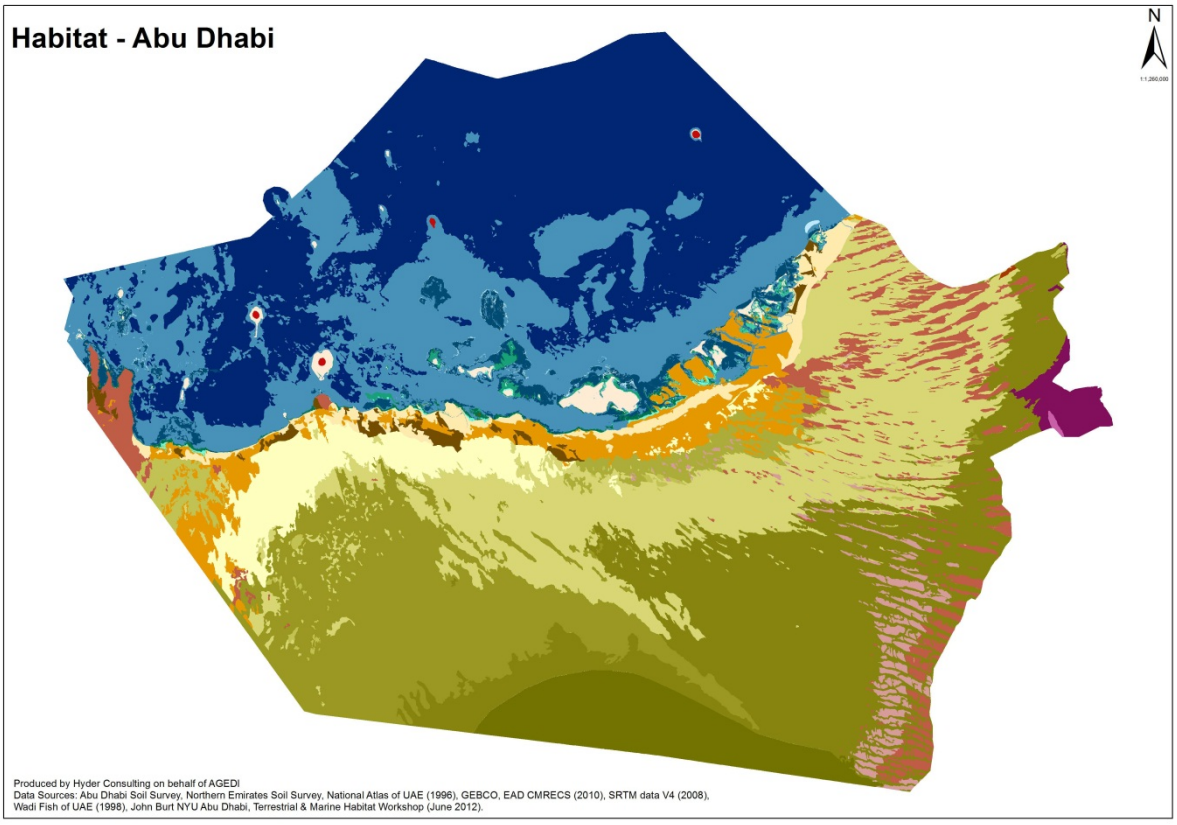


Figure 3-4: Integrated Terrestrial and Marine Habitat Map for the Emirate of Abu Dhabi (Note: Map legend provided in Figure 3-5)

Figure 3-5: Legend of Abu Dhabi Habitat Map as shown in Figure 3-4

3.3 Mapping Ecosystem Condition

There was a need to map the condition or ecological integrity of ecosystems, including where ecosystems have been lost or degraded. Changes in the condition of ecosystems are caused by multiple interacting drivers of change, such as land cover change through urbanization or agriculture, over-grazing or over-harvesting of resources, and pollution of aquatic environments. The major drivers of change or pressures on ecosystems differ in terrestrial and marine environments, and their relative importance varies considerably amongst ecosystem types. Measuring and mapping ecological condition is complex, and requires different approaches in terrestrial and marine environments.

3.3.1 Data Sources Used

The following sources of data were used to create the Habitat Condition derived layer:

- Abu Dhabi Company for Onshore Oil Operation (ADCO) – Island Roads (Zirku), Oil and Gas Pipelines, Plantations (Dates, Fruits, Tree), Infrastructure, Oil Tanks, Island Temporary Buildings and Island Runway.
- EBDB – Powerlines, Permanent Made Surfaces, Roads, Power stations, Waste Sites, Wastewater sites.
- Plot data from the Department of Municipal Affairs.
- EAD Fisheries Database – Fishing Ground Grid and Landing Sites; some data also regularly published in Statistical Bulletins (EAD, 2009b).
- International data on shipping intensity (Halpern et al., 2008).
- International data on gas flares (Halpern et al., 2008).
- Data capture exercise undertaken by the Project team using satellite imagery from Google Earth.

3.3.2 Process

The LNR Biodiversity Assessment Project's approach to mapping the condition of habitats was to develop maps of individual pressures (e.g. areas with 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 conditions 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 each for terrestrial and marine habitats; namely natural, degraded or transformed for terrestrial habitats, and good, fair or poor for marine habitats. These data provided the key measures of transformed habitats and 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 linkages and corridors, and hence may be targeted for corridor restoration projects.

3.3.2.1 *Mapping Terrestrial Habitat Condition*

A proxy map of ecosystem condition for terrestrial areas was developed as little direct mapping of ecosystem condition was available for Abu Dhabi. This process followed the following stages (based on Driver et al., 2011):

- Available data on land use, land cover, infrastructure, agricultural practices (e.g. grazing intensities for camels and goats) were collated as part of the Base Data Archive. Much of this data was already part of the EBDB. The data was supplemented by additional manual mapping. The data incorporation process is summarised below:
    - *Land use and landcover classification:* The existing land use and landcover datasets were used. Transformed areas included any area that could never be returned to a natural state such as built up areas, farms, plantations, roads, car parks, pavements, runways, utility areas, waste sites and power stations. Degraded areas included all land that could be rehabilitated to its natural state and includes buffers around transformed areas, overgrazed areas and 'Not Constructed Areas' as defined by the Department of Municipal Affairs' land use database.
    - *Grazing linked degradation mapping:* Areas where land has suffered degradation due to overgrazing by camels and goats are also important examples of terrestrial pressures. Point feature classes were provided by EAD identifying goat and camel locations across the Emirate of Abu Dhabi, and these were converted into a raster layer of the highest grazing intensity. Of these layers, only those with values greater than 1000 were classified as intensive camel / goat grazing areas. This raster image was then converted to a polygon feature class.
    - *Buffering:* Although all land use pressures are present across an area, in many GIS datasets these pressures are represented by lines or points. Hence to represent such features it was necessary to buffer these features to enable them to be incorporated into the derived layer. The following buffers were applied to the relevant pressure feature classes:
        - Roads – Two stage buffer, 100m transformed and a further degraded. Those roads that were either classified as track or unpaved were excluded.
        - Waste Sites – 500m buffer for transformed.
        - Power stations – 500m buffer for transformed.
        - Poultry Locations – 500m buffer for transformed.
        - Power lines – Two stage buffer, 100m transformed and a further 150m.
        - Gas and Oil Pipelines – Two stage buffer, 100m transformed and a further 150m degraded.
    - Additional data capture mapping using satellite imagery: The available data were supplemented by additional manual mapping of land use and infrastructure where there were gaps in the data (e.g. where recent developments were not reflected in municipality datasets).
- All the feature classes described above were then loaded into one derived layer with transformed polygons having precedence over degraded and all overlapping polygons then removed. It was then assumed that all the areas of land which were

not classified as transformed or degraded were classified as natural. This ensured that the final derived layer had comprehensive coverage of the planning domain.

- The available data were then classified into categories based on the severity and permanence of impacts on natural ecosystems as follows :
  - Transformed Areas: Any area of land that could never be returned to its natural state and includes built up areas, farms, plantations, roads, car parks, pavements, runways, utility areas, waste sites and power stations. In some cases, individual data points and lines were buffered by set distances based on an expert analysis of likely extent of impact area.
  - Degraded Areas: Any area of land that could return to its natural state, but via remediation management and includes overgrazed areas and areas with high level of human disturbance such as dune bashing. Expert judgement was used to assess the likely extent of habitat degradation found around features associated with habitat transformation e.g. it was assumed that areas within 250m of major roads are degraded.
  - Natural Areas: These were all terrestrial areas which were not natural or degraded.

3.3.2.2 *Mapping Marine Habitat Condition*

Development of a marine ecosystem condition map was more of a challenge than the terrestrial one due to:

- Significant gaps in marine data.
- Marine pressures very seldom result in complete destruction of a marine habitat in the same way that an urban area impacts on a terrestrial habitat.
- Marine pressures are often cumulative (i.e. habitat degradation may be the result of a number of different contributory factors).
- Marine impacts are not necessarily felt at the same site as the source of impact (e.g. waste water treatment outfalls may impact a wide area).
- The data are often fairly broad (e.g. fisheries data are typically collected on a grid basis).

A proxy map of ecosystem condition for marine areas was developed using different methods to those used in the terrestrial environment. In order to differentiate these results from those used in the terrestrial assessment different categories were used, namely good, fair and poor. A method successfully utilized for South Africa's marine assessment (Sink et al., 2012) was used which was in turn developed from a method used to first map marine pressures internationally (Halpern et al., 2008). This process followed the following stages (summarised in Figure 3-6):

- Data Gathering: Existing data from CMRECS (2010), the EAD EBDB, the EAD Fisheries Database and various other infrastructure datasets (e.g. from ADCO) were collated.
- Filling data gaps: During the data collation data gaps in the pressure layer became evident, and hence a desktop data capture exercise was undertaken using Google Earth to capture the following structures:

- Marinas and ports, breakwaters, landing sites, dredged channels, reclaimed land, outfall points and desalination plants.

- A five minute grid (approximately 8km x 8km) was created for the marine area. This grid was used as the basis for summarising each of the individual pressure layers.

- Pressure layers were developed in a standard format (with values ranging from 0 for no pressure to 1 for the highest levels of pressure) for each of the major types of impact on marine habitats. The following pressure layers were developed:

  - Coastal Development: The proportion of transformed terrestrial area in the coastal grid squares was calculated. The proportion developed was normalized to a 0-1 range.

  - Structural Impacts: The proportion of each grid square that had been dredged or reclaimed was calculated. These proportions were converted to a 0-1 ratio using the formula n/n90 where n is the actual value for a grid and n90 is the 90th percentile value. Values above 1 were then reclassified to 1. This approach normalized distributions which would otherwise have their values distorted by skewed distributions and a few high values.

  - Wastewater Outfalls: Grid squares with waste water treatment sites, desalination plants and ocean outfalls were all scored as 1s. Other grids had a 0 value. This approach was necessary since there was no data on the magnitude and type of waste discharge.

  - Shipping Intensity: International data on shipping intensity from Halpern 2008 were used to calculate average shipping intensity values per grid square. These values were converted to a 0-1 ratio using the formula n/n90 where n is the actual value for a grid and n90 is the 90th percentile value. Values above 1 were then reclassified to 1. This approach normalized distributions which would otherwise have their values distorted by skewed distributions and a few high values.

  - Coastal Infrastructure: Harbours, petroleum ports and additional coastal infrastructure were buffered by 1km. jetties, breakwaters and land sites were buffered by 500m. The proportion of each grid square was calculated that fell within these buffers. These proportions were converted to a 0-1 ratio using the formula n/n90 where n is the actual value for a grid and n90 is the 90th percentile value. Values above 1 were then reclassified to 1. This approach normalized distributions which would otherwise have their values distorted by skewed distributions and a few high values.

  - Oil and Gas Pipelines: Oil and gas pipelines were buffered by 100m, and then the proportion of each grid square impacted by oil infrastructure was calculated using n/nmax, where n is the grid value and nmax is the highest value for a grid square. This gives a 0-1 range.

  - Oil and Gas Wells: Oil and gas wells identified in a global analysis (Halpern et al., 2008) were used based on gas flares, since no detailed data on well locations was available. The portion of each grid cell which fell within the identified oil and gas wells dataset was calculated. Values were converted to a 0-1 range using the n/nmax method.

  - Fishing effort: For Abu Dhabi total fishing effort (using total duration in days) per fisheries grid cell was derived from the Abu Dhabi fisheries database. A distance weighted mean was used to interpolate these values. All values were converted

to a 0-1 ratio using the formula n/n90 where n is the actual value for a grid and n90 is the 90th percentile value. Values above 1 were then reclassified to 1. This approach normalized distributions which would otherwise have their values distorted by skewed distributions and a few high values.

- o Proximity to landing sites: A straight line distance to fishing landing sites was calculated, based on the assumption that impacts were likely to be highest near the landing sites. This distance was inverted. The average distance to land sites for each grid square were calculated. A value for the grid was calculated using n/nmax, where n is the grid value and nmax is the highest value for a grid square. This gives a 0-1 range.

- Cumulative pressure values for each grid square were calculated. The formula used was Nmean*Nmax. Where Nmean was the average value for the grid square and Nmax was the highest individual score for each grid square based on the nine individual pressure layers. This value was then used as a derived total marine pressures proxy score.

- The marine pressures proxy scores were then divided into three categories based on natural breaks in the value distributions. The group with the highest values was considered to be under highest pressure and was classed as 'poor', the middle group as 'fair' and the group with the lowest pressure values as 'good'.

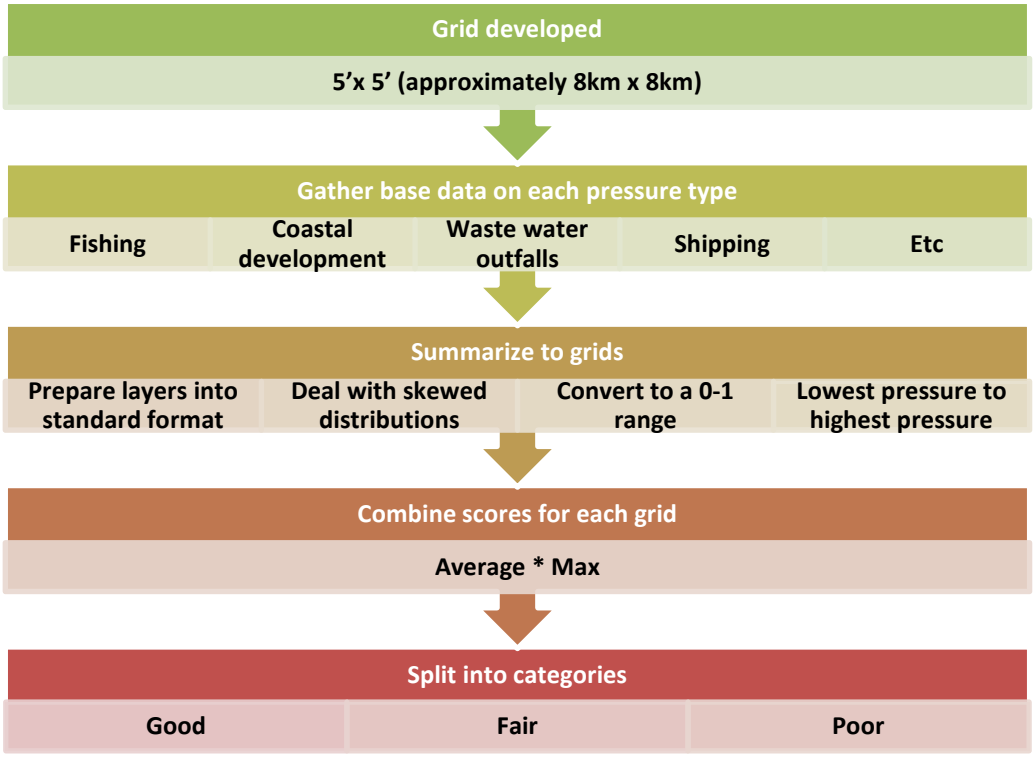


Figure 3-6: Marine Habitat Condition Methodology

3.3.3 Outputs

After both the terrestrial and marine components of the layer were derived they were then integrated to create a 'Habitat Condition' layer which provided complete coverage of the planning domain. For intertidal coastal habitats (e.g. mangroves and salt marshes) a precautionary approach to mapping habitat condition was applied using a composite of the terrestrial and marine values. Transformed and degraded values from the terrestrial layers always took precedence. But where the marine pressures mapped an area as 'poor' and the terrestrial mapped an area as 'natural', this was reclassified to 'degraded'. Marine 'fair' areas did not result in a reclassification of terrestrial 'natural' areas.

The Habitat Condition map is presented in Figure 3-7, and in large format in Appendix B.2. The Habitat Condition map was then used for the threat status assessment and in the spatial prioritization.

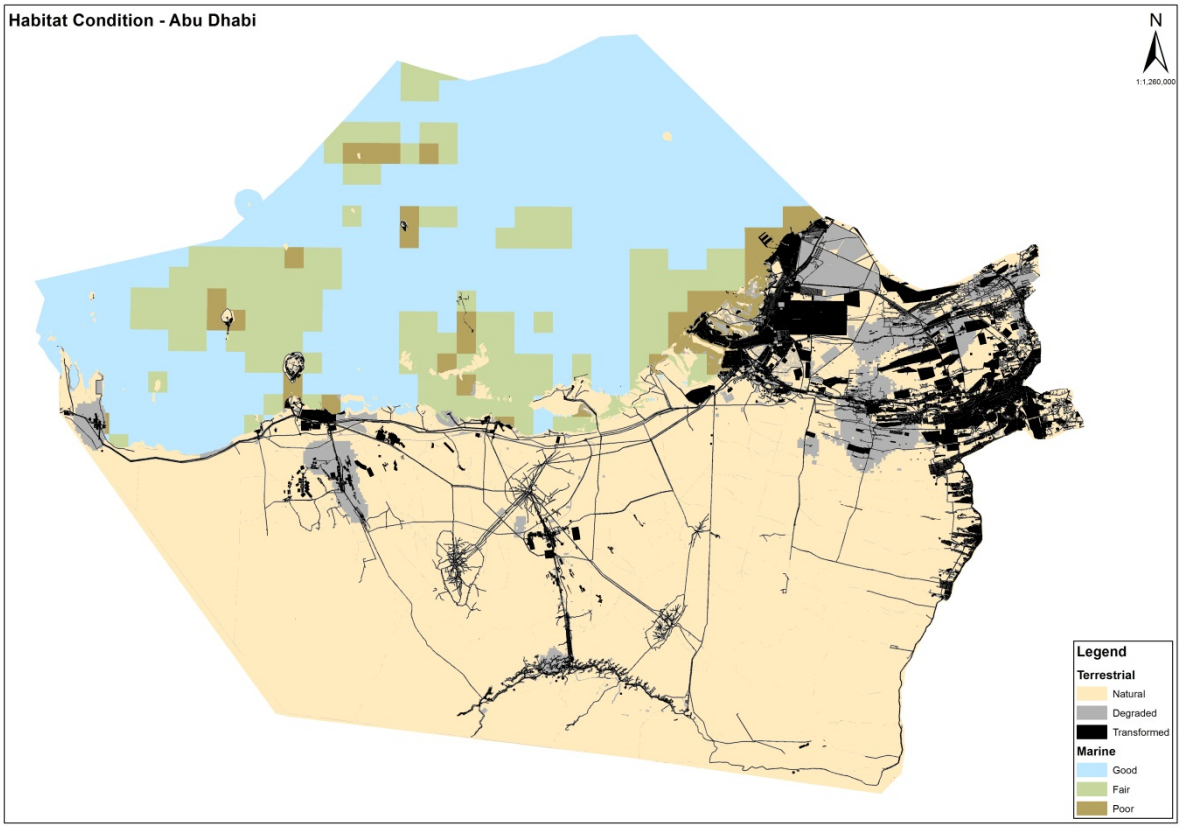


Figure 3-7: Abu Dhabi Habitat Condition used in the LNR Project

3.4 Mapping Protected Areas

The Protected Area layer is used in the assessment of ecosystem protection level and in the spatial prioritization process.

3.4.1 Data Sources Used

The Protected Area GIS boundaries in Abu Dhabi were obtained from the following sources:

- EBDB contained Abu Dhabi's Protected Area boundaries.
- CMRECS (2010) provided marine Protected Area boundaries.

3.4.2 Process

Only formally designated Protected Areas in Abu Dhabi were included in the Protected Areas Layer. These were checked with EAD's Protected Area specialist. There are six formal Protected Areas (three marine and three terrestrial) in Abu Dhabi as follows:

- Al Marawah Marine Biosphere Reserve - Declared by Amiri Decree 18/2001 and joined UNESCO Biosphere Reserve Network in 2007.
- Al Yasat Marine Protected Area - Declared by Amiri Decree 33/2005 and amended by Amiri Decree 12/2009.
- Bul Syayeef Marine Protected Area – announced in 2007.
- Houbara (Baynunah Forest) Protected Area – announced in 2008.
- Al Wathba Wetland Reserve - announced in 1998.
- Arabian Oryx Reserve – announced in 2008.

During the Abu Dhabi and UAE Initial Conservation Assessment Review Workshop, held on 7th October 2012, it was noted that the boundaries of the Arabian Oryx Reserve within the Emirate of Abu Dhabi had been amended and the southern section of the Protected Area had been removed. While no formal boundary amendments were received, the coordinates of two fence posts were provided by EAD which enabled cutting of the section from the concerned Protected Area polygon.

3.4.3 Outputs

The Protected Area map is presented in Figure 3-8, and in large format in Appendix B.3. The Protected Area map was then used for the protection level assessment and in the spatial prioritization.

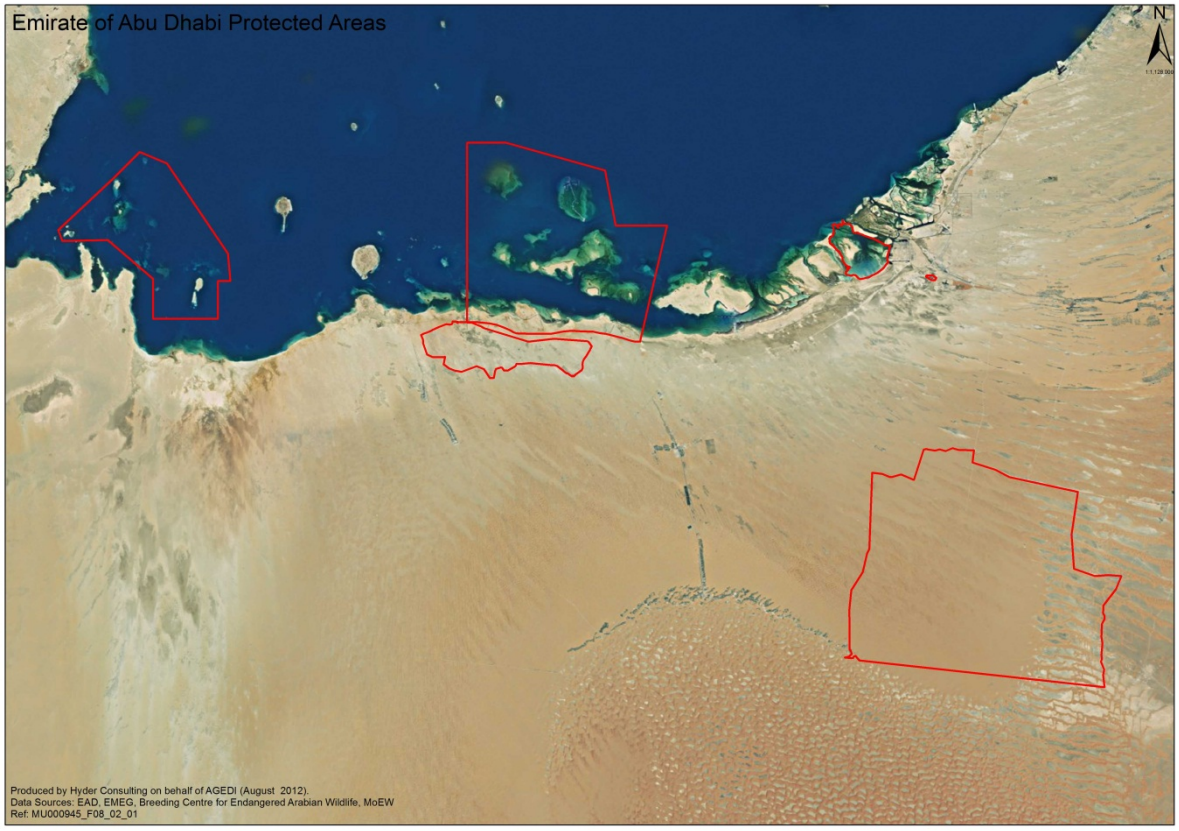


Figure 3-8: Abu Dhabi Protected Area Map used in the LNR Project

3.5 Mapping Species

Species distribution data provide an important means of refining the spatial prioritization by identifying discrete areas within habitats where species are confined and reliant for their long term survival. These areas are hence included and weighted to ensure that relevant species ranges are wholly or partially incorporated within the final spatial prioritization.

3.5.1 Data Sources Used

The following data were used to prepare the species maps:

- Locally available spatial data primarily collected and held by EAD and ADCO biodiversity specialists and a number of other experts. These data sources are listed below in Table 3-4.

Table 3-4: Summary of Species Data Inputted to the Spatial Prioritization

Source	Feature	Total Record Count	No of Taxa	Notes
ADCO	Ecology Wildlife Locations	1973	335	Records 1997-2011
ADCO	Mammals	295	15	Records 1997-2011
ADCO	Reptiles	1519	50	Records 1997-2011
ADCO	Turtles	303	1	-
ADCO	Bird Nesting Sites Zirku	120	2	-
ADCO	Turtle Nesting Sites Zirku	71	1	-
EAD EBDB	Breeding Area	1	1	-
EAD EBDB	Breeding Site	1809	1	-
EAD EBDB	Species Distribution	1106	501	-
EAD EBDB	Species Observation	19648	956	-
EAD GISDB	Marine Survey 2010	458	8	-
EAD GISDB	Species Richness	6164	31	-
EAD GISDB	Turtle Nests	424	1	-
Tourism Development & Investment Company (TDIC)	Turtle Track Activity Saadiyat	38	1	-
EAD	Threatened Species Distribution Plants	32	11	-
D. Gardner	UAE and Oman reptile records	5617	101	Note includes Oman records which were excluded
Abu Dhabi Urban Planning Council (UPC)	Wildflower distribution	68	68	Data extracted from (Jongbloed, Feulner, Böer, & Western, 2003)

Spatial data generated by the Abu Dhabi and UAE Species and Ecological Processes Workshop. The material from the workshop is summarised in Table 3-5 (data not sorted by Emirate) providing a summary of the features mapped and the number of mapped areas. At the workshop specialists groups reviewed data for marine species, terrestrial mammals, birds, reptiles and plants. The outputs were series of mapped areas either of species features or combination of species. A total of 128 areas were mapped throughout UAE.

Table 3-5: Summary of Workshop Species Outputs Inputted to Spatial Prioritization

Summary of mapped data generated from Abu Dhabi and UAE Species and Ecological Processes Workshop		
Type	**Feature**	**Mapped Areas**
Marine	Coral Reef / Mangroves	4
	Corals and sea horses.	1

Summary of mapped data generated from Abu Dhabi and UAE Species and Ecological Processes Workshop		
Type	**Feature**	**Mapped Areas**
	Dolphins	6
	Dugongs	5
	Dugongs/Dolphin/Sea turtle	2
	Hawksbill Turtle	1
	Marine birds	1
	Sea snakes	5
	Sea turtle	3
	Sea turtle/Dolphin/Dugong/Unknown	1
	Turtle nesting	1
	Marine Total	**30**
Mammals	*Arabitragus jayakari*	4
	Gazella gazella cora	2
	Gazella subgutturosa	1
	Gordon's Wild cat	1
	Important Mammal Areas	7
	Mountain Fauna Distribution	2
	Ruppells Fox	1
	Sand Gazelle	2
	White-tailed Mongoose	1
	Mammals Total	**21**
Birds	Desert	9
	Marine bird areas	23
	Mountains and Wadis	9
	Species Records	2
	Birds Total	**43**
Reptiles	*Acanthodactylus blandfordii*	1
	Arabian and Dhofar Toad	1
	Arabian Cat Snake	2
	Asaccus gallagheri	1
	Carter's Semaphore Gecko	1
	Desert Monitor	1
	Echis omanensis / Bunopus spatalurus	1
	Important Reptile Areas	7
	Mesalina brevirostris	1
	Psammophis schokari / Lytorhynchus diadema	1
	Spalerosphis diadema cliffordi	1
	Stenodactylus lepto-comsymbotes	1

Summary of mapped data generated from Abu Dhabi and UAE Species and Ecological Processes Workshop		
Type	**Feature**	**Mapped Areas**
	Uromastyx aegyptius microlepis	1
	Uromastyx aegyptius microlepis/leptieni	1
	Reptiles Total	**21**
Plants	Bab Al Shams	1
	Emirate Dubai	1
	High plant species diversity	1
	Jebel Hafit & Wadi Tarabat	3
	Important plant area	2
	Restricted distribution of Dew Forest	2
	Rus Al Jibal - important tree species	1
	Wadi Hilo - high diversity of plant species	1
	Plants Total	**13**
Grand Total		**128**

- Species for which there were a good number of presence records but no mapped ranges were subject to habitat suitability modelling within the UAE, using MaxEnt by H. Al Alqamy (EAD) to create potential distribution ranges. El Alqamy et al., 2010 and Elith & Leathwick, 2009 provide detailed background to the modelling methods. The species records details are provided in Table 3-6.

Table 3-6: Summary of Modelled Species Distributions Inputted to Spatial Prioritization

Source	Feature	Total Record Count	No of Taxa
D. Gardner/EAD	*Acanthodactylus pannonicus*	1672	1
D. Gardner/EAD	*Acanthodactylus gongrorhynchatus*	2806	1
D. Gardner/EAD	*Acanthodactylus opheodurus*	338	1
D. Gardner/EAD	*Asaccus gallagheri*	248	1
D. Gardner/EAD	*Bunopus spatalurus hajarensis*	403	1
EAD	*Canis lupus*	5	1
EAD	*Dugong dugon*	138	1
D. Gardner/EAD	*Hemidactylus persicus*	143	1
EAD	*Hyaena sultana*	4	1
D. Gardner/EAD	*Mesalina brevirostris*	624	1
D. Gardner/EAD	*Omanosaura cyanurus*	207	1
D. Gardner/EAD	*Omanosaura jayakari*	244	1
D. Gardner/EAD	*Platyceps ventromaculatus*	85	1
D. Gardner/EAD	*Pristurus celerrimus*	193	1
D. Gardner/EAD	*Pristurus minimus*	893	1
D. Gardner/EAD	*Stenodactylus lepto-cosymbotes*	1930	1
EAD	*Hawksbill turtle predicted range*	123	1
D. Gardner/EAD	*Uromastyx aegyptia leptieni*	645	1
D. Gardner/EAD	*Uromastyx aegyptia microlepis*	1672	1
EAD	*Vulpes cana*	4	1
EAD	*Vulpes rupellii*	4	1

A wide range of other data was reviewed especially from the published literature. This included atlases for species groups such as birds (Jennings, 2010; R. Porter & Aspinall, 2010) and wildflowers (Jongbloed et al., 2003) but the scale of mapping was in all cases too coarse to be usefully incorporated.

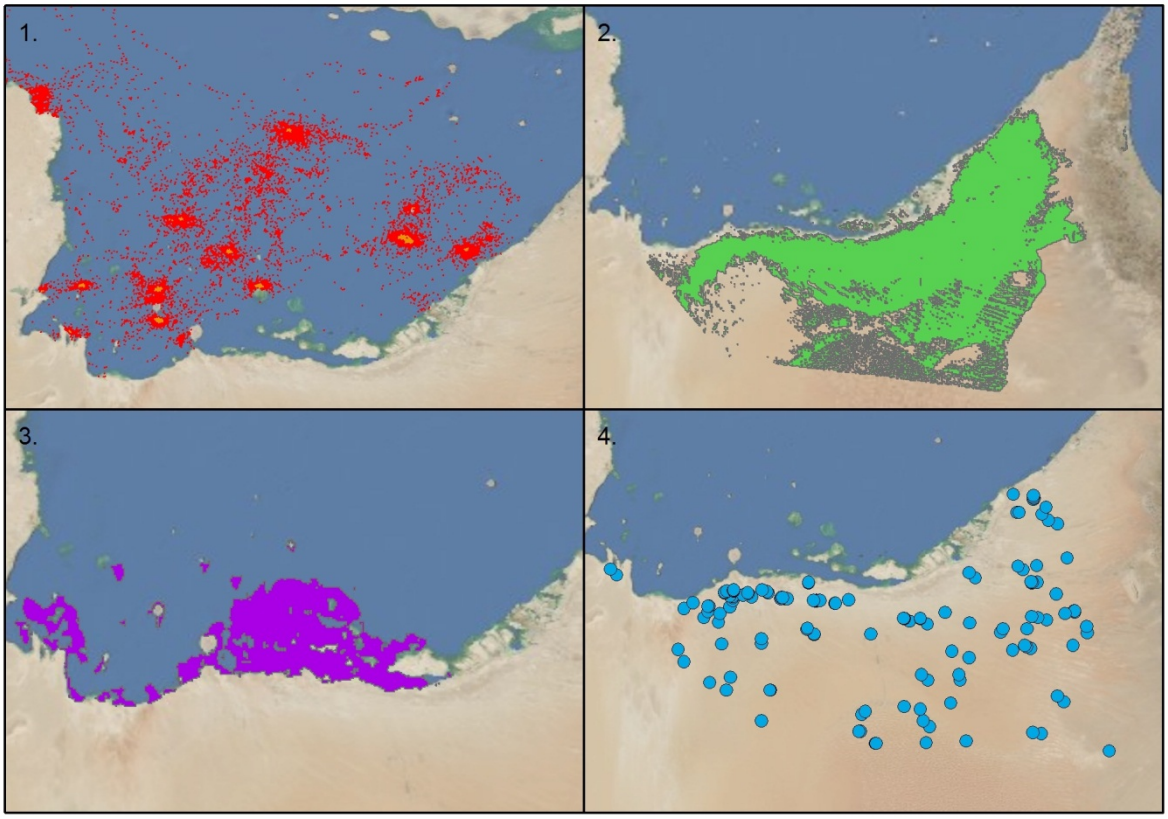
Globally available species distribution data sets such as the IUCN Red List maps from IUCN (downloaded from www.iucnredlist.org) and BirdLife International (http://www.birdlife.org/action/science/species/global_species_programme/) were reviewed but again were in all cases too coarse to be useful.

The online bird records from the Emirates Bird Records Committee (http://ebird.org/) were reviewed but were heavily biased towards particular sites or locations and so their modelling potential was limited and hence this dataset was excluded.

Examples of Abu Dhabi species distribution inputs to the spatial prioritization are provided in Figure 3-9.

Terrestrial invertebrate taxa were not prioritised principally because the quality of data for invertebrate taxa with occasional exceptions was assessed as being insufficient to map ranges with sufficient confidence and these were thus excluded.

Some marine invertebrate taxa, such as corals, were best dealt with by habitat mapping and also by experts identifying important assemblage areas.



1. EWS in association with WWF, Marine Research Foundation et al. Marine Turtle Conservation Project - Preliminary analysis by H.El Alkamy (EAD) on foraging grounds and migratory trajectories from satellite tracking of post-nesting hawksbill turtles in the Gulf region.
2. Acanthodactylus gongrorhynchatus supplied by D. Gardner/ EAD and modeled by H. El Alkamy (EAD)
3. Dugong Distribution supplied by EAD modeled by H. El Alkamy (EAD)
4. Lepus capensis records supplied by ADCO (1992 to 2004)

Figure 3-9: Examples of Key Species Distributions within Abu Dhabi

3.5.2 Process

The species range data was managed in a two-stage process. First vertebrate taxa were prioritised at the UAE level to identify the key species and to use this to also justify a weighting to reflect the priority in the spatial prioritization. This was achieved through circulation of species lists based on priorities taken from key references (Table 3-7) to experts attending the Abu Dhabi and UAE Species and Ecological Processes Workshop. The lists were then amended and agreed at the workshop. Priority lists for UAE were prepared for terrestrial mammals, birds, and reptiles and amphibians and marine taxa (mammals, reptiles and fish species). These lists are provided in Appendix B.4.

Table 3-7: Key References Used For Species Prioritization Prior to the Abu Dhabi and UAE Species and Ecological Processes Workshop

Taxa	Key References
Mammals	(Hornby, 1996a), (Tourenq & Drew, 2005)
Birds	(Hornby & Aspinall, 1996), (Javed, 2008)
Reptiles & Amphibians	(Hornby, 1996b), (Soorae, Al Quarqaz, & Gardner, 2009)
Freshwater fish	(Feulner, 1998)
Marine fish	EWS-WWF 'choose wisely' consumer guide 'red list' http://www.choosewisely.ae/

Having identified the priority species within the Abu Dhabi planning domain the distribution data was reviewed to check the following:

- If priority species had discrete and useful ranges, and
- If the range data was of sufficient quality to be used with confidence.

If species ranges were large and occupied areas that were already covered by one or more habitat types then these distributions would not improve the spatial prioritization (no matter how high the priority of the species). Hence these species data were discarded.

This species review was initially carried out by the Project team and then by the Abu Dhabi and UAE Species and Ecological Process Workshop attendees. The workshop also led to the creation of a number of mapped important species or assemblage areas, most of which were valid for inclusion within the prioritization because these were discrete and mapped with sufficient accuracy.

Species ranges used in the spatial prioritization were scored using a simple 1-4 scale; with '1' representing lowest priority and '4' highest priority. Species that were on the IUCN Red List as Critically Endangered or Endangered were all scored as 4, Vulnerable 3, Data Deficient and Near Threatened 2, and Locally Threatened (from AD or UAE Red Data Lists) 4. Species ranges where data accuracy or usefulness was poor or the records were not usable were scored as '0'.

3.5.3 Outputs

Species, like ecological processes are embedded within the spatial prioritization process and therefore it is not useful to produce a separate species layer.

3.6 Mapping 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 variety 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 is a key activity for any SCP project. However, data scoping revealed that little of no direct data on ecological processes exists for the region. The Project therefore focussed on filling this gap in spatial knowledge, and accommodated ecological processes in the conservation planning process.

3.6.1 Data Sources Used

Direct spatial data sources on ecological processes were largely unavailable. As spatial data sources on ecological process were largely unavailable, various proxies for ecological processes were developed as described in Section 3.6.2.

- The integrated habitat map. See Section 3.2.
- The ecosystem condition map was used to identify largest, most connected and least impacted fragments. See Section 3.3.
- The derived species datasets were used to identify high diversity areas. See Section 3.5.
- Certain process elements, such as groundwater recharge areas, were identified in the EBDB.
- Experts identified process areas from the Abu Dhabi and UAE Species and Ecological Processes Workshop.

3.6.2 Process

Processes were incorporated into the conservation planning process by:

- The Abu Dhabi and UAE Species and Ecological Processes Workshop was heavily focussed on the aspects needed to ensure long term ecological sustainability of species. These areas include key aspects like major feeding, breeding and resting grounds for migratory birds; and areas of particularly high numbers or dense concentrations of keystone species as opposed to just the general distributions of these species. For example, all Important Bird Areas were included.
- Data on habitat and process requirements for key species (e.g. breeding beaches for turtles and dugong foraging areas) were refined during the species and process workshops. This data was supplemented by MaxEnt modelling by H. Al Alqamy (EAD) in order to identify core habitat areas important for long term persistence of these species.
- The workshops were also used to identify linkages and connectivity important for species, as well as key remaining contiguous intact habitat (e.g. linkages for dugong between the major marine Protected Areas).
- The outputs from the initial conservation assessments (particularly of ecosystem threat status) were processed to identify which were the critical remaining fragments of threatened habitat types. The largest, most connected and least impacted fragments for these key habitat types were identified, and these areas were then included as an additional feature in the conservation planning prioritization to ensure that these areas which are likely to be most important for supporting ecological processes are included.
- Specific habitat types that are important for ecological processes were targeted which have higher protection targets (e.g. 80% for mangroves, seagrass, corals and saltmarshes).
- Hydrological process areas (such as freshwater wadis) were included with higher targets than other terrestrial habitat types. In addition, identified key groundwater recharge areas were included.

- The most connected and important areas in terms of linkages are deliberately identified in the conservation planning process. MARXAN was optimized to help design ecologically coherent landscapes, by identifying which areas were best linked into the remainder of the landscape.

- The conservation planning process deliberately dealt with marine and terrestrial areas at the same time in the spatial prioritization to ensure that the two were effectively linked. It would have been easier to do them separately, but bringing them together ensured key connectivity of coastal habitats.

3.6.3 Outputs

Ecological processes are largely embedded in the spatial prioritization process (and in various layers which have previously been presented such as areas important for various species), and therefore it is not useful (and in most cases possible) to produce a separate ecological process layer.

3.7 Mapping Opportunities and Constraints

SCP not only considers biodiversity elements in the spatial prioritization but also opportunities and constraints. In order to remain systematic an area is never included just because it is an opportunity and an area is never excluded just because it is difficult if that area is necessary for targets and there is no alternative (i.e. irreplaceable). Opportunities can include areas such as existing conservation initiatives, identified but not protected priority areas and areas that are protected for other reasons (e.g. cultural sites, security sites). Constraints can include areas flagged for development.

3.7.1 Data Sources Used

The opportunities and constraints GIS layer was derived using data from the following sources:

- EAD - CMRECS archaeological sites, CMRECS fishing right boundaries, EBDB important bird areas, bird wetland areas, EBDB Buhoor areas, EBDB environmental permit applications for developments, EBDB development sites where EIAs have been received by EAD, EAD GISDB archaeological important sites in Abu Dhabi, oilfields in the UAE, pearl diving sites (i.e. oyster beds) in UAE.

- UPC datasets – Plan Abu Dhabi 2030 and Plan Al Gharbia 2030, UPC proposed coastal conservation zones in Abu Dhabi, UPC proposed coastal park in Abu Dhabi, UPC proposed coastal stewardship zone in Abu Dhabi, development sites applications in Abu Dhabi which have been submitted to UPC, proposed nature reserves in Abu Dhabi, proposed Protected Areas in the Abu Dhabi.

- Abu Dhabi Authority for Tourism and Culture (ADATC) datasets – Al Ain World Heritage Site and buffer zone boundaries, archaeological important sites in Abu Dhabi, archaeological important sites on Al Marawah Island, archaeological structures of importance in Liwa, Plan Al Ain 2030 future development boundaries.

- ADCO datasets – archaeological buffer zones, concession area boundaries, land oil fields.

- Department of Municipal Affairs datasets – planned development plots.

- Tourism Development & Investment Company (TDIC) – one dune protection zone on Saadiyat Island in Abu Dhabi.

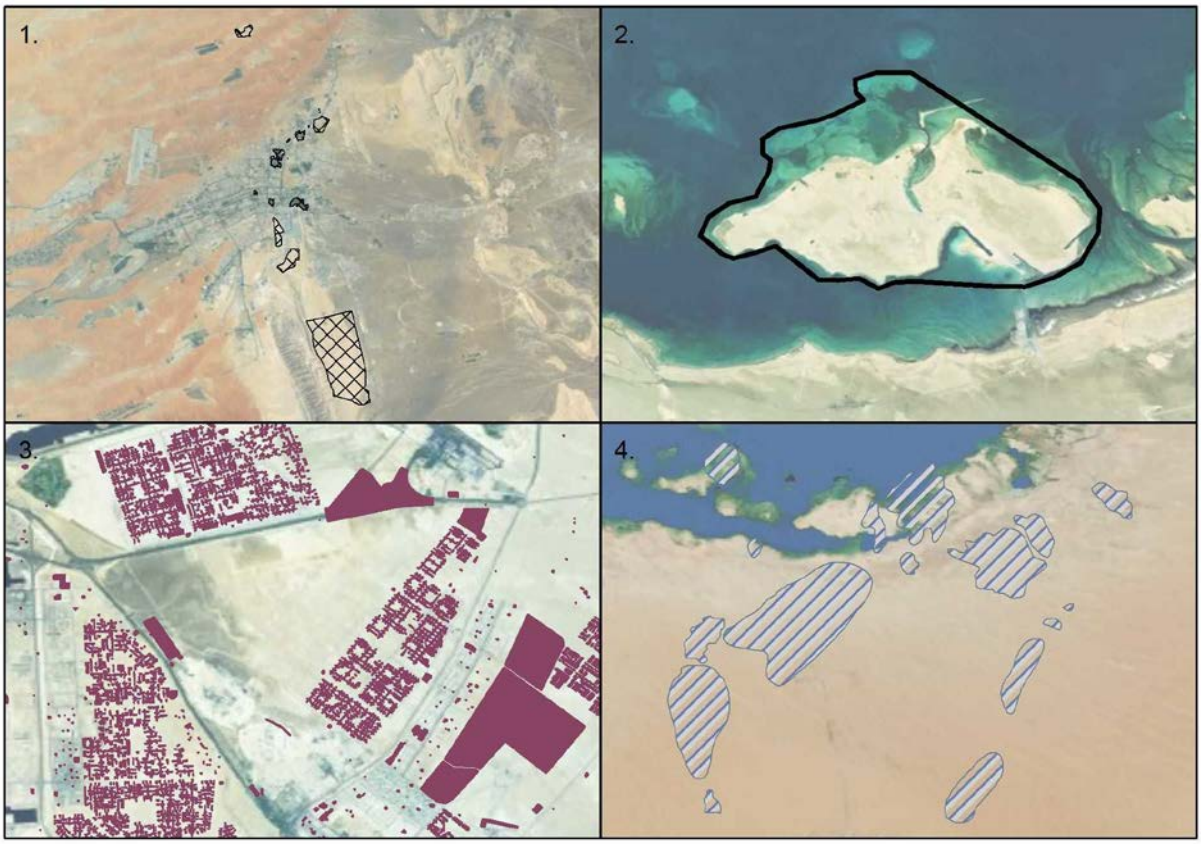
3.7.2 Process

A number of data sources were reviewed for their applicability as an opportunity or constraint. Those which were deemed appropriate were allocated a value as follows:

- 3: strong opportunity.
- 2: moderate opportunity.
- 1: slight opportunity.
- -1: slight constraint.
- -2: moderate constraint.
- -3: strong constraint

It should be noted that unlike the habitat and pressures layers the opportunities and constraints layer did not require complete coverage of the planning domain. It is also acceptable within this layer to have overlapping polygons.

The summary of opportunities and constraints used for the Abu Dhabi spatial prioritization is shown in Appendix B.5. Examples of opportunity and constraints inputs into the opportunity and constraints layer are presented in Figure 3-10.



1. Opportunity - Al Ain World Heritage Site Boundary supplied by ADACH
2. Opportunity - Important Bird Area (Abu al Abyadh island) supplied by Birdlife International
3. Constraints - Planned Developments in Abu Dhabi supplied by DMA
4. Constraints - Oilfields supplied by ADCO

Figure 3-10: Examples of Opportunity and Constraints within Abu Dhabi

3.8 Development of Cost Surfaces

Cost surfaces are used in the spatial prioritization process to help guide the MARXAN selection algorithm.

3.8.1 Data Sources Used

The cost surface was developed from the following layers:

- The Habitat Condition map was used to identify 'Natural'/'Good' areas, 'Degraded'/'Fair' areas, and 'Transformed'/'Poor' areas. (Section 3.3).
- The opportunities and constraints layer was used. See Section 3.7.

3.8.2 Process

A cost surface summarizing the cost of inclusion of additional areas into the Protected Area network was developed based on habitat condition, and the opportunities and constraints data:

Habitat condition: Habitat condition was the primary input into the cost surface. The objective was to strongly favour the selection of intact areas, to slightly avoid selection of degraded areas and strongly avoid selection of transformed areas. This was achieved by:

- Coding the Habitat Condition map with Natural/Good areas = 0.1, Degraded/Fair areas = 1, and Transformed/Poor areas = 10.
- The resultant layer was converted to a 200m raster grid.
- Zonal statistic were used to calculate average condition scores per planning unit, with 10 being the score for a completely transformed area and 0.1 the score for a completely natural planning unit.

Opportunities: Areas representing good opportunities for conservation actions (Section 3.7) were included at lower cost in the analysis. This was achieved by:

- Identifying all units with opportunities, and scoring these as per Section 3.7.2.
- Clipping the full extent of the opportunity areas (which were often broadly identified) to the remaining Natural/Good extent in order to ensure that only intact areas were prioritized.
- The resultant layer was converted to a 200m raster grid.
- Zonal statistic were used to calculate average opportunity scores per planning unit, with 0 being the score for a unit with no identified opportunities and 3 being the maximum possible score.

Constraints: Areas representing constraints to conservation actions (Section 3.7) were included at higher cost in the analysis. This was achieved by:

- Identifying all units with constraints, and scoring these as per Section 3.7.2.
- The resultant layer was converted to a 200m raster grid.

- Zonal statistics were used to calculate average constraint scores per planning unit.
- The values were linearly converted to a 0-10 range, with '0' being the planning units with no constraints, and '10' being planning units with the largest extent of strong constraints.

Creating the combined cost surface: The final cost surface was produced using the following formula:

- Total cost = Basic cost + Condition modifier + Constraints modifier – Opportunities modifier where:
    - 'Total cost' = Cost of included a planning unit in the MARXAN analysis.
        - 'Basic cost'= 3*Area(ha)
        - 'Condition modifier' = Area(ha)*Condition score
        - 'Constraints modifier' = Area(ha)*Constraints score
        - 'Opportunities modifier' = Area(ha)*Opportunities score

3.8.3 Outputs

The cost surface is shown in Figure 3-11 (and in large format in Appendix B.6), where highest cost values occur along the coast of Abu Dhabi, and in the Al Ain area due to the concentration of multiple pressures in these areas and the prevalence of constraints on conservation activity (e.g. areas identified for future development). Conversely lowest cost areas are found outside of the oil development and agricultural areas in the southern and western deserts of Abu Dhabi.

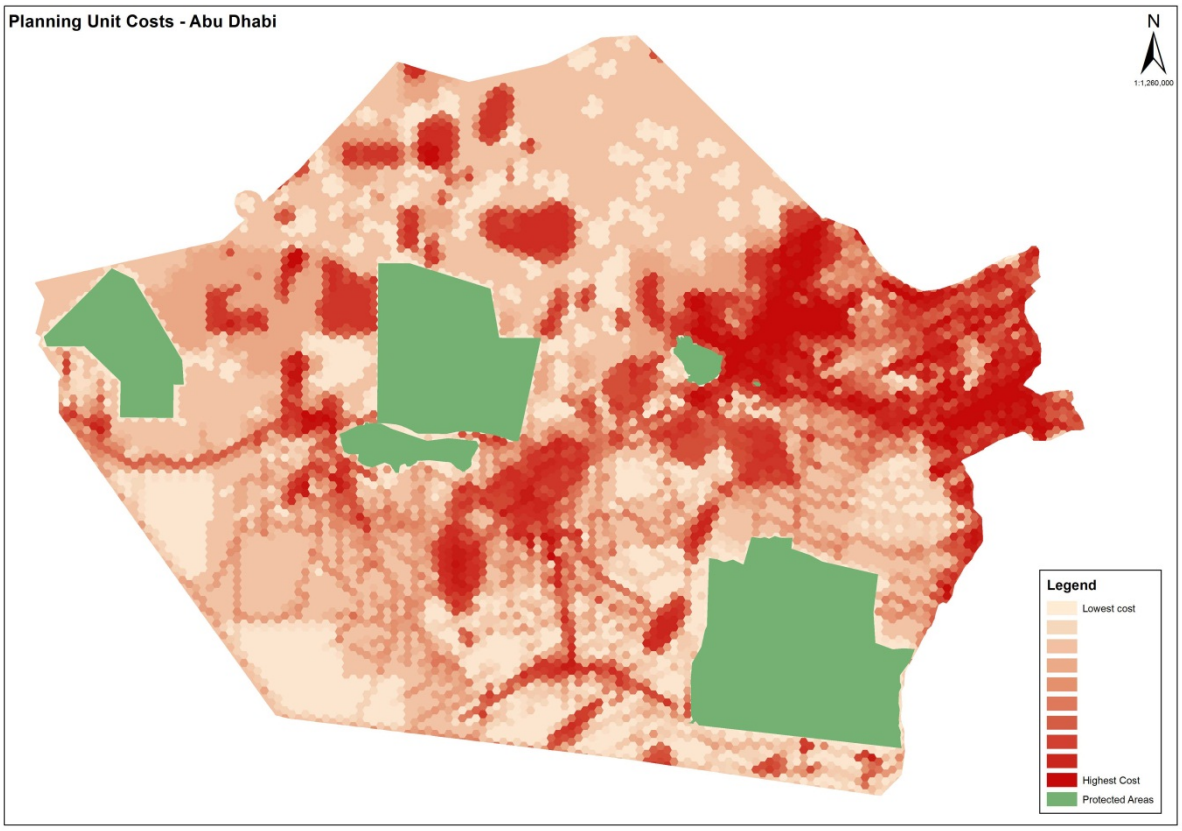


Figure 3-11: Planning Unit Costs Used in the Analyses

3.9 Data Limitations

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 permits and in all areas the data quality was adequate for the purposes of this SCP process. In some areas the data was of a much higher quality. As a result the maps and data are good for inspection and analysis at 1:100,000 but for more detailed analysis, for example at 1:25,000, then further survey and detailed data collection would be required.

4 Systematic Conservation Planning Process

The Project's approach is based on the SCP concept, which represents the best practice in this field. The systematic approach emphasizes the need to conserve a representative sample of ecosystems (where an integrated marine and terrestrial habitat classification is used as a proxy for ecosystems) and their species (the principle of representation). It also considers the ecological processes that allow these to persist over time (the principle of persistence). It sets quantitative biodiversity and protection targets that express how much of each biodiversity feature should be maintained in a natural or near-natural state, or should be included within Protected Areas. These principles of SCP are reflected in the headline indicators of the conservation assessments, namely the ecosystem threat status and ecosystem protection level, and in the process of identifying spatial priorities for conservation actions.

4.1 Introduction to the Headline Indicators

4.1.1 Ecosystem Threat Status

Ecosystem threat status 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. It is less usual for threat status to be assessed at the ecosystem or habitat level, though this is an emerging trend internationally (Rodríguez et al., 2011). .Assessing threat status and protection level at the ecosystem scale supports a landscape or seascape approach to managing and conserving biodiversity, and provides a robust basis for biodiversity monitoring and state of biodiversity or environment reporting. The main steps in assessing the ecosystem threat status are presented in Figure 4-12.

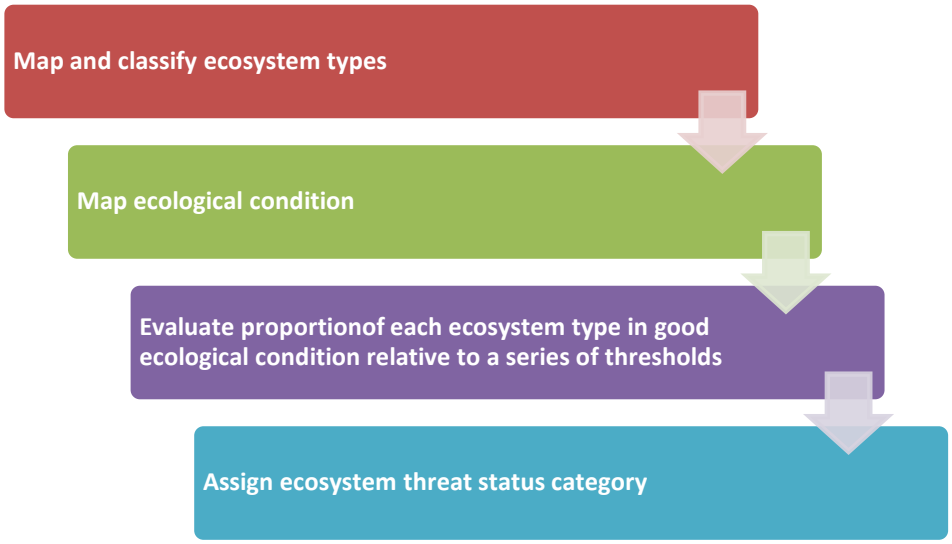


Figure 4-12: Principal Steps in Assessing Ecosystem Threat Status

4.1.2 Ecosystem Protection Level

Ecosystem protection level determines whether ecosystems are adequately protected or under-protected. Protected means included in a formally proclaimed or declared Protected Area such as a Nature Reserve, Protected Area or Marine Protected Area which has formal legal status. In the past, the extent of protection was usually reported on simply 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. Across the world, the location of Protected Areas has historically been driven by a range of factors, mostly unrelated to biodiversity importance, resulting in a Protected Area network that does not represent all ecosystem types and excludes key ecological processes. This means the Protected Area network is not as effective at protecting biodiversity and providing ecosystem services as it could be. Therefore it is important, as is done in this assessment, to examine the representiveness of the Protected Area network at an ecosystem level.

The main steps in assessing ecosystem protection level in marine and terrestrial environments are shown in Figure 4-13.

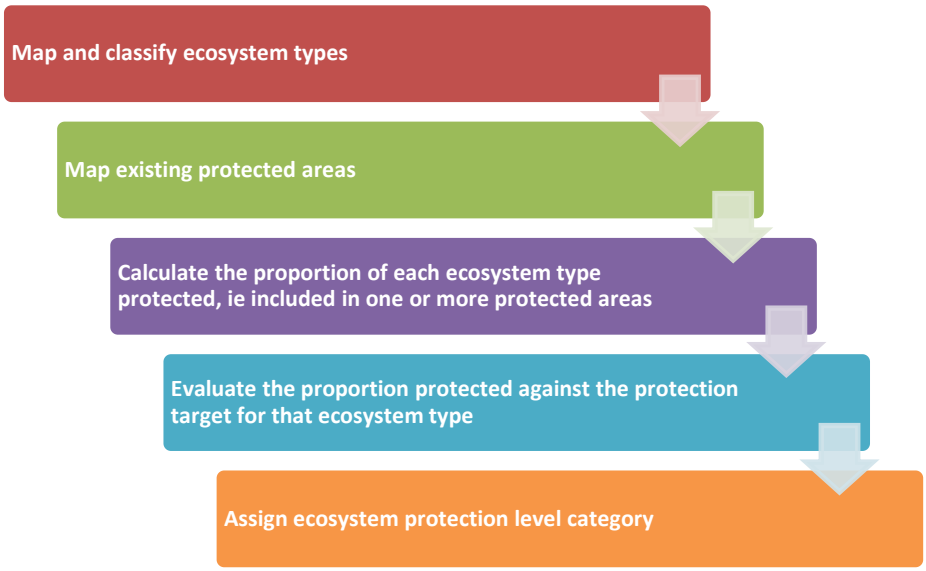


Figure 4-13: Principal Steps in Assessing Ecosystem Protection Level in Marine and Terrestrial Environments

Ecosystem threat status and ecosystem protection level are assessed independently of each other. The threat status cannot be inferred from protection level, or the other way around. While threat status and protection level co-vary for some ecosystems, this is not always the case, especially for aquatic ecosystems. For example, an ecosystem type may be least threatened and have no protection, or may be critically endangered and well protected, although this second example is less likely in practice.

4.2 Biodiversity and Ecosystem Protection Targets

A key characteristic of a SCP approach is the use of quantitative targets. For the current assessment biodiversity targets and protection targets, both of which are defined in terms of portions of the original extent of each habitat type have been used. Ideally one set of targets, which would be derived directly from ecological characteristics of the ecosystem concerned would be used. However two sets of targets have been used in this assessment to allow for the comparable evaluation of ecosystem threat status of all

habitat units, while still accommodating and reporting against the strategic objectives for Protected Area expansion (e.g. meeting international commitments such as CBD targets).

4.2.1 Biodiversity Targets

Assessments of ecosystem threat status require biodiversity targets to be set for ecosystem types. These targets are used to evaluate the current relative level of threat to each ecosystem. The biodiversity target is 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 ecosystems.

Biodiversity targets should preferably be based on the ecological characteristics of the ecosystem concerned, and ideally, the biodiversity target would be calculated based on a detailed knowledge of species richness, diversity and ecosystem function. However, a recent international review suggests that in most cases data do not exist to derive targets based on biodiversity characteristics, that the results obtained using assumed and flat-baseline targets produce comparable results in most planning environments, and that the time and effort invested in target formulation is better expended elsewhere in the conservation planning process (S. Porter, Sink, Holness, & Lombard, 2011). The data required to derive detailed species area curves do not exist for the region. Therefore a flat target of 25% of the original extent of each ecosystem type was set. This value was set by taking the mid-point of the targets used in the South African National Assessment (Driver et al., 2011), where the scientifically formulated species-area relationship was used to set biodiversity targets which vary between 16% and 36% of the original extent of each ecosystem type. Biodiversity targets may be refined over time as scientific knowledge and data improves. Importantly, they are the baseline against which the current relative level of threat to each ecosystem is assessed. Therefore although it is not ideal to use generalized targets, these still allow a good picture of the relative level of threat to each ecosystem to be developed. Biodiversity targets are given in Table 4-8.

4.2.2 Ecosystem Protection Targets

Ecosystem protection targets are quite different to biodiversity targets in that while they are also designed to allow relative evaluation of habitat types, they also reflect desired strategic or political objectives for Protected Area expansion which may differ between habitats or be independent of biodiversity criteria. The ecosystem protection targets used for this assessment were based on:

- The internationally accepted, and taken up in Abu Dhabi Environment Vision 2030, (EAD, 2012) Protected Area targets of the CBD Strategic Goal C Target 11 (the CBD has been ratified by the UAE), which specifies 17% of terrestrial habitat types and 10% of marine habitat types. Importantly, 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 the workshop feedback on the importance of different habitat types in Abu Dhabi, intertidal habitat types have been placed with terrestrial rather than marine habitats, in order to use the more appropriate higher target percentage.

- Higher targets for key habitats identified in Abu Dhabi Environment Vision 2030. These specify targets of 80% of area for certain habitats namely mangroves, coral reef, sea-grass, and salt marsh. Where these types are not directly comparable to those used in the habitat map, the habitat types which most closely match the descriptions in the Abu Dhabi Environment Vision 2030 were identified.

- For extremely rare habitat types, where the calculated target was less than 1km^2, the target has been specified as the full extent of the habitat type.

Ecosystem protection targets are given in Table 4-8.

Table 4-8: Biodiversity and Ecosystem Protection Targets for Abu Dhabi

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Protection Target %	Protection Target (km^2)	Biodiversity target %	Biodiversity target (km^2)
Coastal plains, sand sheets and dunes - Coastal plains and sand sheets	1,974.3	1,446.4	73.3	17.0	335.6	25.0	493.6
Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes	562.8	562.8	100.0	17.0	95.7	25.0	140.7
Coastal sabkha - Coastal sabkha	3,810.6	3,618.1	94.9	17.0	647.8	25.0	952.7
Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover	3,676.8	3,497.8	95.1	17.0	625.1	25.0	919.2
Inland Plains - Interdunal plains with sabkha	1,209.4	1,209.1	100.0	17.0	205.6	25.0	302.3
Inland Plains - Northern alluvial or interdunal plains	560.6	15.4	2.7	17.0	95.3	25.0	140.2
Island - Island	632.8	598.7	94.6	17.0	107.6	25.0	158.2
Island - Island - salt dome	33.5	33.5	100.0	17.0	5.7	25.0	8.4
Mountains, rocky terrain and wadis - Jebel Hafit	28.6	28.6	100.0	17.0	4.9	25.0	7.2
Mountains, rocky terrain and wadis - Wadis and floodplains	753.6	753.6	100.0	17.0	128.1	25.0	188.4
Sand sheet, dunes and sabkha mosaic - Liwa crescent dune and sabkha mosaic	3,795.6	3,795.6	100.0	17.0	645.2	25.0	948.9
Sand sheets, dunes and mega dunes - Mega-dunes	15,141.1	14,970.0	98.9	17.0	2,574.0	25.0	3,785.3
Sand sheets, dunes and mega dunes - Sand sheets and dunes mainly with perennial herbs or graminoids	10,425.4	10,425.4	100.0	17.0	1,772.3	25.0	2,606.4
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover	799.2	799.2	100.0	17.0	135.9	25.0	199.8

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Protection Target %	Protection Target (km^2)	Biodiversity target %	Biodiversity target (km^2)
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover	18,705.0	13,758.8	73.6	17.0	3,179.9	25.0	4,676.3
Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas	3,357.1	3,357.1	100.0	17.0	570.7	25.0	839.3
Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum	1,130.6	1,130.6	100.0	80.0	904.5	25.0	282.7
Deeper than 15m - Deeper than 15m - Arabian Gulf	33,722.2	21,222.3	62.9	10.0	3,372.2	25.0	8,430.5
Intertidal - Algal Mats - Arabian Gulf	107.9	107.9	100.0	17.0	18.3	25.0	27.0
Intertidal - Mangroves - Arabian Gulf	127.4	99.9	78.4	80.0	101.9	25.0	31.9
Intertidal - Rocky Platforms - Arabian Gulf	164.6	164.6	100.0	17.0	28.0	25.0	41.1
Intertidal - Saltmarsh - Arabian Gulf	48.3	48.3	100.0	80.0	38.6	25.0	12.1
Intertidal - Tidal flats (no algal mats) - Arabian Gulf	322.2	311.5	96.7	17.0	54.8	25.0	80.5
Shallow Water Habitats - Coral Reef - Arabian Gulf	172.9	123.6	71.5	80.0	138.3	25.0	43.2
Shallow Water Habitats - Other Shallow Water - Arabian Gulf	15,978.9	14,314.3	89.6	10.0	1,597.9	25.0	3,994.7
Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf	1,589.6	1,589.6	100.0	80.0	1,271.7	25.0	397.4

4.3 Ecosystem Threat Status Assessment

Ecosystem threat status evaluates 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 (CR), Endangered (EN), Vulnerable (VU) or Least Threatened (LT), based on the proportion of each ecosystem type that remains in good ecological condition relative to a series of thresholds. CR, EN and VU ecosystem types are collectively referred to as Threatened; the ecosystem equivalent of threatened species as defined by the IUCN 'Red List' process (IUCN Standard Working Group, 2008).

For definitions of the ecosystem threat status categories, see Figure 4-14.

- ***Critically Endangered ecosystems*** are ecosystem types that have very little of their original extent left in natural or near-natural condition. Most of the ecosystem type has been severely or moderately modified from its natural state. These ecosystem types are likely to have lost much of their natural structure and functioning, and species associated with the ecosystem may have been lost. Few natural or near-natural examples of these ecosystems remain. Any further loss of natural habitat or deterioration in condition of the remaining healthy examples of these ecosystem types must be avoided, and the remaining healthy examples should be the focus of urgent conservation action.

- ***Endangered ecosystems*** are ecosystem types that are close to becoming critically endangered. Any further loss of natural habitat or deterioration of condition in these ecosystem types should be avoided, and the remaining healthy examples should be the focus of conservation action.

- ***Vulnerable ecosystems*** are ecosystem types that still have the majority of their original extent left in natural or near-natural condition, but have experienced some loss of habitat or deterioration in condition. These ecosystem types are likely to have lost some of their structure and functioning, and will be further compromised if they continue to lose natural habitat or deteriorate in condition. Maps of biodiversity priority focus areas should guide planning, resource management and decision-making in these ecosystem types.

- ***Least Threatened ecosystems*** are ecosystem types that have experienced little or no loss of natural habitat or deterioration in condition. Maps of biodiversity priority focus areas should guide planning, resource management and decision-making in these ecosystem types.

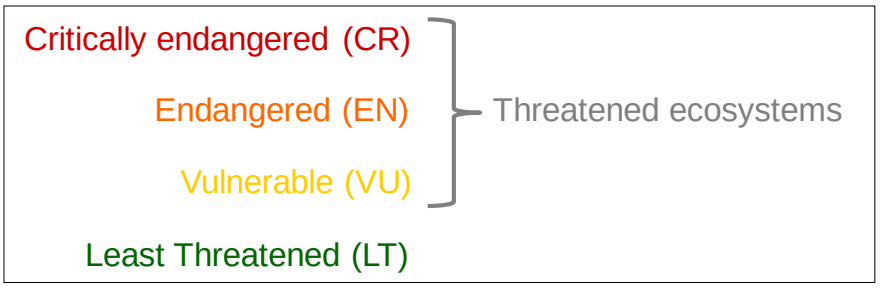


Figure 4-14: Ecosystem Threat Status Categories

In all environments, the proportion of each ecosystem type that remains in good (or natural) ecological condition (Section 3.3) was evaluated against a series of thresholds, as shown in Figure 4-15, to determine ecosystem threat status:

- The first of these thresholds (set at the biodiversity target of 25%) defines the cut-off for Critically Endangered ecosystems. The remaining portion of good/natural habitat against this threshold was evaluated. Ecosystem types that have less than this proportion of their original extent in good/natural ecological condition are likely to have lost much of their structure and functioning, and species associated with the ecosystem may have been lost.

- The second threshold (set at the biodiversity target plus 20%, i.e. 45% as the biodiversity target is 25%) defines the cut-off for endangered ecosystems, and indicates ecosystems that are close to becoming Critically Endangered. Again, the remaining portion of good/natural habitat against this threshold was evaluated.

- The third threshold (set at 80%) defines the cut-off point for Vulnerable ecosystems. Ecosystem types that have reached this point are likely to have lost some of their structure and functioning, and will be further compromised if they continue to lose natural habitat or deteriorate in condition. Unlike the previous two thresholds, both natural/good and degraded/fair areas were evaluated against this threshold.

- In addition to the above evaluations, minimum levels of complete habitat destruction that were necessary to confirm Critically Endangered or Endangered status were set. If a habitat type crossed the Critically Endangered threshold as it had little or no natural/good habitat remaining, but where less than 30% of the habitat type was completely transformed (i.e. in cases where there were large portions of degraded/fair habitat), these habitats were considered to be Endangered. Similarly, if a habitat type crossed the Endangered threshold as it had little natural/good habitat remaining, but where less than 5% of the habitat type was completely transformed (i.e. again in cases where there were large portions of degraded/fair habitat), these habitats were considered to be Vulnerable.

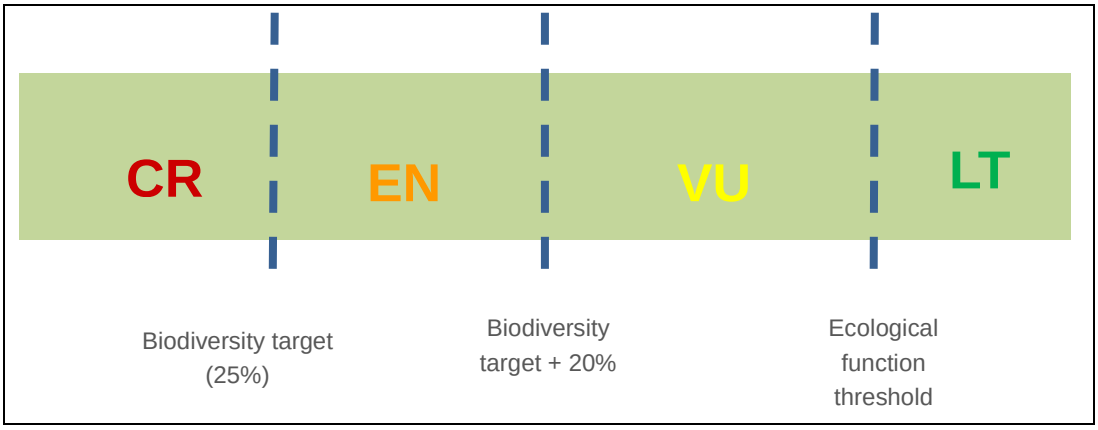


Figure 4-15: Thresholds used in Assessing Ecosystem Threat Status

4.4 Ecosystem Protection Level Assessment

Ecosystem protection level provides a measure of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types were categorised as well protected, moderately protected, poorly protected, or not protected. Moderately protected, poorly protected and unprotected ecosystem types are collectively referred to as under-protected ecosystems, as shown in Figure 4-16.

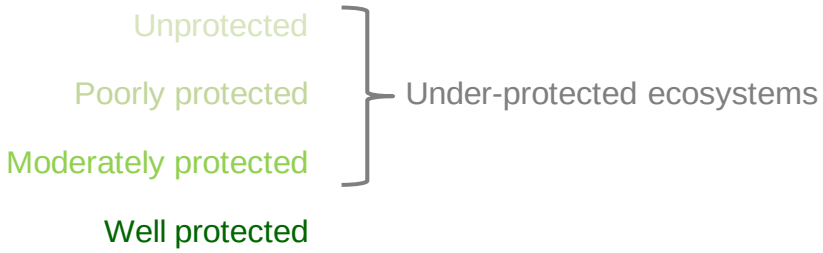


Figure 4-16: Ecosystem Protection Categories

Once ecosystem types were mapped and classified, the next step was to map existing Protected Areas. Protected Areas are areas of land or sea that are formally protected by law and managed mainly for biodiversity conservation. The proportion of each ecosystem type that falls within a Protected Area was calculated and compared with the protection target for that ecosystem type, to determine ecosystem protection level, as shown in Table 4-9. If more than 90% of the protection target had been met in a Protected Area, the ecosystem type was considered well protected. Conversely, if the ecosystem type did not occur in any Protected Area at all or if less than 5% of the protection target has been met in a Protected Area, the ecosystem was considered not protected. This category was deliberately not restricted to types with exactly 0 protection for two reasons: the first was that pragmatically GIS data and ecological mapping are never 100% correct, and hence small slivers or mis-mapped areas can result in an overly positive result being presented; the second was that even if some areas of a habitat type were included in a Protected Area, they were unlikely to be offering significant protection if the areas were very small or if the sections of habitat that were included were small or isolated.

Table 4-9: Ecosystem Protection Level Categories and Thresholds

Ecosystem Protection Categories	Proportion of Protection Target met in a Protected Area
Not Protected	Zero or less than 5% of protection target
Poorly Protected	5 - 49% of protection target
Moderately Protected	50 - 99% of protection target
Well Protected	≥90% of protection target

4.5 MARXAN Process for Spatial Prioritization

The MARXAN decision support tool developed by Ian Ball and Hugh Possingham was utilised for this Project. 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, Possingham, & Watts, 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 identifying 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 cost, 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.

Figure 4-17 summarizes the general approach and methodology to spatial prioritization used in this Project. The approach follows a number of steps. Firstly, key input data on biodiversity features were collated (Sections 3.2, 3.5 and 3.6), as were data on pressures and current condition of habitats (Sections 3.3 and 3.7), and the existing Protected Areas (Section 3.4). In addition, quantitative targets were set for how much of each of each biodiversity feature was required in the Protected Area network (Section 4.2). The initial data were used to identify the areas of least cost to existing land uses (Section 3.8). These components were iteratively combined in MARXAN to identify the potential priority focus areas for inclusion in the Protected Area network (examined in Section 5).

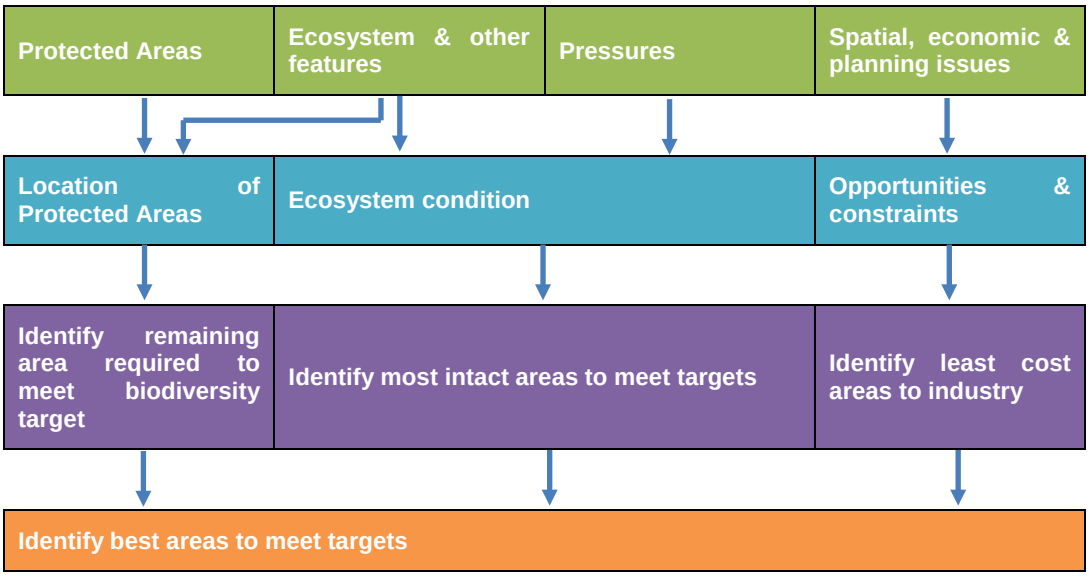


Figure 4-17: Overview of Spatial Prioritization Process

The SCP process implemented a number of design principles or rules during the spatial prioritization:

- The assessment intended to meet targets for all features while reducing conflict with other competing land uses. A cost surface approach was used to avoid transformed and degraded areas, to favour areas where opportunities existed for conservation activities or alternatively where costs for implementing conservation were lowest, while avoiding areas with known constraints for conservation activities or where costs for implementing conservation activities were highest.

- The assessment aimed to avoid fragmented landscapes as far as possible. Intact landscapes were favoured through the use of cost surfaces.

- The assessment aimed to meet all targets as far as possible but did not force the selection of transformed or poor condition areas. This balance was obtained by an iterative calibration of the MARXAN input variables.

- Natural/good condition areas were strongly favoured before degraded/fair condition areas, which in turn were favoured before transformed areas. This was undertaken both by using the cost surface and by utilizing 'dummy features', where two versions of the habitat map and duplicate biodiversity features were used. One habitat map was clipped to the remaining natural condition areas and one to the remaining natural and degraded areas. The consequence of this approach was that once the layers were combined, the selection algorithm ensured that targets were always first met in natural areas, as these would contribute to meeting targets for both the main and the dummy feature, and then if necessary find additional areas to meet targets in degraded areas. Transformed areas were not available for meeting habitat targets, as by definition these are areas where habitat has been lost.

- The inclusion of very under-protected types in close proximity to existing Protected Areas was prioritised. A 'dummy' biodiversity feature was created utilising all intact areas of unprotected and poorly protected habitat types within 10km of existing Protected Areas. This was used to ensure that where heavily under-protected habitats were present in close proximity to existing Protected Areas, that these would be favoured for selection to meet the primary planning targets.

- The inclusion of very threatened habitat types in close proximity to existing Protected Areas was prioritised. A 'dummy' biodiversity feature was created utilising all intact areas of Critically Endangered and Endangered habitat types within 10km of existing Protected Areas. This was used to ensure that these areas would be favoured for selection to meet the primary planning targets.

- Large intact areas of Critically Endangered and Endangered habitats were identified. The habitat condition data and the integrated habitat map were used to identify the areas of Endangered habitat that were over 500ha in extent, and areas of Critically Endangered habitat that were over 250ha in extent. High targets were used to force these areas into the analysis.

- High diversity areas were identified by examining all of the input data and identifying planning units where more than seven biodiversity features were found.

- Targets were set for areas with high conservation opportunity, in order to favour selection of these areas. Targets were set fairly low, in order to ensure that areas of conservation opportunity were only identified if they were required for meeting targets for biodiversity features and would not be selected if they were not useful for meeting biodiversity targets. See details below for additional targets used in the conservation planning process.

- An attempt was made to identify contiguous blocks of high priority focus areas rather than a scatter of priority sites. This was done through careful calibration of the boundary length modifier to ensure the production of an appropriately clumped output without becoming unnecessarily spatially inefficient.

- Setting quantitative targets for biodiversity features is central to the SCP methodology. The study utilized the protection targets for habitats detailed in Section 4.2. Targets were also set for the range of other biodiversity features used in the planning process (Table 4-10). These targets were set based on those used for

similar features in other conservation plans. In addition, a number of supplementary targets were used in the design phase of the conservation assessment.

Table 4-10: Summary of Targets for Biodiversity Features used in the Assessment

Targeted Feature	Target	Comments
Primary biodiversity features		
Terrestrial and marine habitats of the UAE (natural) Terrestrial & Coastal Marine Special types Extremely rare types (<1km^2)	 17% 10% 80% 100%	Targets were set against the full, original extent of each habitat type. For details see Table 4-8. Only natural areas were available to meet targets.
Terrestrial and marine habitats of the UAE (natural and degraded) Terrestrial & Coastal Marine Special types Extremely rare types (<1km^2)	 17% 10% 80% 100%	Targets were set against the full, original extent of each habitat type. For details see Table 4-8. Natural and degraded areas were available to meet targets. The objective of including two sets of similar set of habitat features (one just for natural areas, and one for natural and degraded areas), was that this ensured that natural areas were selected first, but that degraded areas were nevertheless available to meet targets if they could not be met in better condition sites.
Species <= 1000ha extent 1000 - <5000ha 5000 - < 25 000ha More than 25 000ha	 80% 60% 40% 30%	Individual targets were set for each species based on their extent. Targets were based on the remaining natural extent of each species range / key area.
Expert identified key sites for species ≤1000ha extent 1000 - <5000ha 5000 - < 25 000ha More than 25,000ha	 80% 60% 40% 30%	Individual targets were set for each species based on their extent. Targets were based on the remaining natural extent of each species range / key area.
Secondary planning targets		
Ecological process proxies Freshwater wadis Mountain process proxy Wetlands (priority) Core turtle foraging areas High diversity sites Important Bird Areas Turtle breeding beaches	 100% 60% 100% 30% 30% 100% 100%	Targets were set against remaining natural extent, i.e. these targets were never used to force inclusion of degraded or transformed sites.
Heavily under-protected habitats in close proximity to Protected Areas	60%	A 'dummy' biodiversity feature was created utilizing all intact unprotected and poorly protected habitat types within 10km of existing Protected Areas. This was used to ensure that where heavily under-protected habitats were present in close proximity to existing Protected Areas, that these would be favoured for selection to meet the primary planning targets.
Strongly threatened habitats in close proximity to Protected Areas	80%	A 'dummy' biodiversity feature was created utilizing all intact Critically Endangered and Endangered

Targeted Feature	Target	Comments
		habitat types within 10km of existing Protected Areas. This was used to ensure that these areas would be favoured for selection to meet the primary planning targets.
Identified opportunities Large sites (>10 000ha) Small sites (>10 000ha)	 20% 60%	Targets were set against remaining natural extent, i.e. these targets were never used to force inclusion of degraded or transformed sites.

The MARXAN analysis used the following approach:

- Data layers were prepared using ESRI ArcGIS 10.
- Planning units were developed using an iterative process to identify the most appropriate planning units in relation to the scale of the input data. Hexagonal units with a side length of 2km and an area of 1 000ha were found to be most appropriate. In addition, all Protected Areas were integrated into the planning unit layer.
- Boundary lengths between each planning unit were calculated in metres. These boundary lengths were used, in combination with the Boundary Length Modifier (BLM), to identify spatially efficient and connected combinations of planning units.
- Data, targets and cost surfaces were inputted into the MARXAN decision support tool using the CLUZ interface in ArcView 3.2 developed by Dr Bob Smith, Durrell Institute of Conservation and Ecology (http://www.kent.ac.uk/dice/cluz/).
- Data on 208 distinct biodiversity features were included into the analysis. These were used to develop a 'site by features matrix' which described how much of each habitat type was found within each planning unit.
- The analysis used MARXAN version 1.8.10.
- The analysis followed standard MARXAN processes as outlined in the MARXAN good practices handbook (Ardron, Possingham, & Klein, 2008).
- A cost surface was used to ensure preferential selection of least transformed, high opportunity and least conflict sites. This cost surface development is described in Section 3.8.
- An iterative approach was used to identify appropriate Species Penalty Factor (SPF) values and BLM. Satisfactory inclusion of biodiversity features in a spatially efficient and ecologically connected layout was obtained using an SPF value of 1,000,000,000 and a BLM of 0.8. These values were calibrated using an iterative manual calibration method compliant with the objectives outlined in the MARXAN good practices handbook (Ardron et al., 2008).
- A final MARXAN run was undertaken using a 100 runs of 1,000,000 iterations each. This was used to define site selection frequency for the spatial prioritization. The basic output of the MARXAN-based process described here is a selection frequency map. This map gives an idea of how important each planning unit is for meeting targets, and summarizing 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 analysis.

- Once a stable site selection frequency output from MARXAN was achieved, a set of summary PFAs for the Project required developing, as these aided the understanding of the spatial prioritization, are useful for describing selected areas, and are easier to include in implementation plans. To do this, the most frequently selected planning units (areas selected 100% of the time) were selected and dissolved into spatially contiguous units. Similarly, all planning units which were selected more than 60% of the time were dissolved into contiguous blocks. PFAs were then identified by selecting all of the 60% frequency contiguous areas which overlapped the 100% selection areas. These PFAs were then manually cleaned by removing large transformed areas from the planning units as well as any small isolated sections of planning units were the isolated section did not contain the key features which were responsible for the selection of the planning unit.

5 Systematic Conservation Planning Outputs

5.1 Introduction

As explained in Sections 3 and 4, the LNR Biodiversity Assessment Project's approach was based on the systematic conservation planning concept. The Project has produced three primary spatial planning outputs:

- **Ecosystem threat status** 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. This analysis utilized the habitat map, quantitative biodiversity targets for each habitat type, and then used the map of current condition to evaluate (against a series of thresholds) if sufficient areas remain in a natural or near-natural state.

- **Ecosystem protection level** describes whether ecosystems are adequately protected or under-protected. 'Protected' means included in a formally proclaimed or declared Protected Area such as a Nature Reserve, Protected Area or Marine Protected Area which has formal legal status. This analysis utilized the habitat map, quantitative Protection targets for each ecosystem type, and maps of Protected Areas to evaluate whether sufficient habitat of each type has been protected. Importantly, this move beyond reporting on the overall proportion of land or sea protected, but rather examined the representiveness of the Protected Area network at an ecosystem level.

- **MARXAN 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 analysis utilized the datasets used in the ecosystem threat status and protection level assessments (i.e. habitat, condition and Protected Areas maps), in addition to data on additional biodiversity features (including species and ecological processes), and opportunities and constraints on conservation. The data was derived from formal datasets and as well as from systematically gathered workshop/expert inputs.

Ecosystem threat status, protection level and the spatial priorities are key underlying requirements for a strategic approach to prioritizing conservation actions, efficiently using available resources and minimizing conflict between conservation and other activities or land uses.

This chapter summarizes spatially and in a tabular form the outputs of the assessments of ecosystem threat status and protection level for Abu Dhabi, as well as the spatial priorities identified in the MARXAN assessment. Each section also includes a narrative description of the important habitats or areas highlighted by the analysis.

5.2 Ecosystem Threat Status

The outputs of the assessment of ecosystem threat status for Abu Dhabi are shown in Figure 5-18 (and a larger version in Appendix C.1) and Table 5-11.

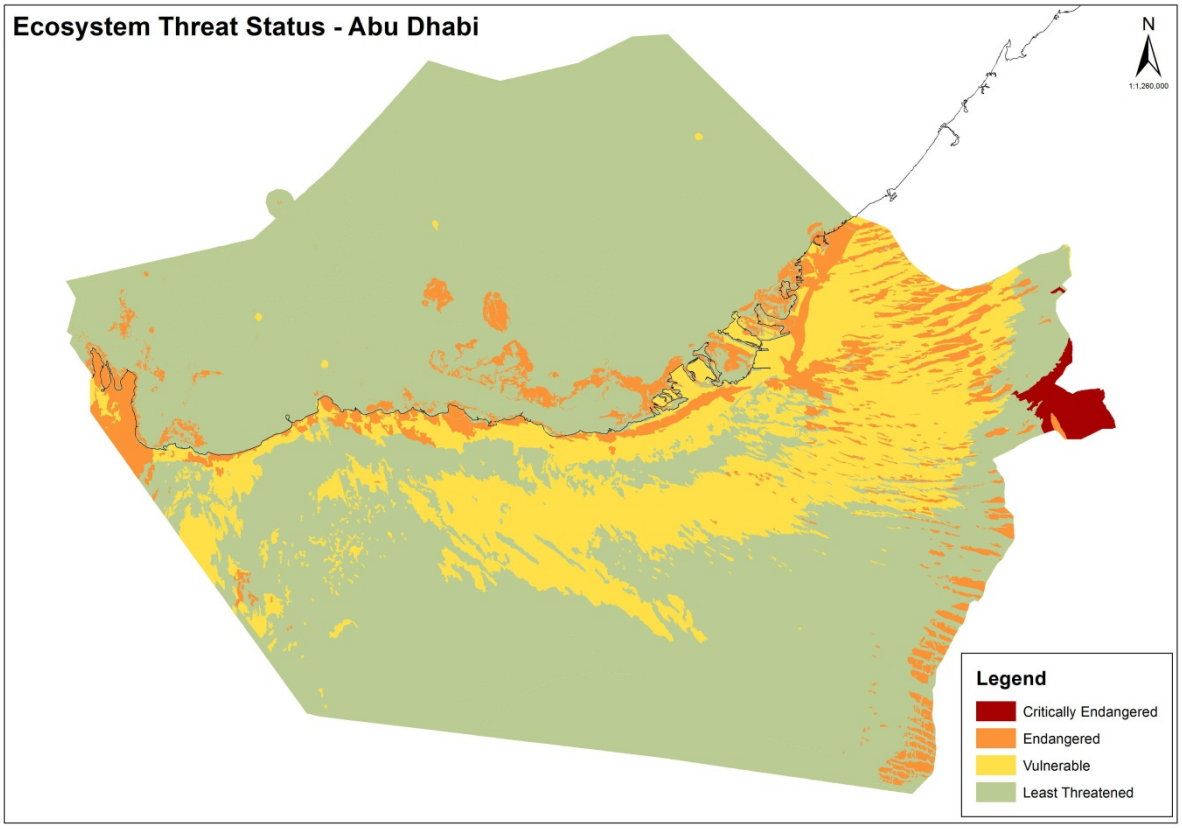


Figure 5-18: Ecosystem Threat Status for Abu Dhabi

Table 5-11: Ecosystem Threat Status for Abu Dhabi

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Biodiversity target %	Biodiversity target (km^2)	Area in a natural/good state (km^2)	Area in a degraded/fair state (km^2)	Area in a transformed/ poor state (km^2)	Ecosystem Threat Status
Coastal plains, sand sheets and dunes - Coastal plains and sand sheets	1,974.3	1,446.4	73.3	25.0	493.6	525.5	188.5	1,260.2	Endangered
Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes	562.8	562.8	100.0	25.0	140.7	313.0	79.1	170.7	Vulnerable
Coastal sabkha - Coastal sabkha	3,810.6	3,618.1	94.9	25.0	952.7	2,496.8	323.3	990.5	Vulnerable
Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover	3,676.8	3,497.8	95.1	25.0	919.2	1,638.2	799.8	1,238.8	Endangered
Inland Plains - Interdunal plains with sabkha	1,209.4	1,209.1	100.0	25.0	302.3	1,043.0	83.1	83.3	Least Threatened
Inland Plains - Northern alluvial or interdunal plains	560.6	15.4	2.7	25.0	140.2	354.9	35.1	170.6	Vulnerable
Island - Island	632.8	598.7	94.6	25.0	158.2	504.4	30.1	98.4	Least Threatened
Island - Island - salt dome	33.5	33.5	100.0	25.0	8.4	22.4	3.4	7.6	Vulnerable
Mountains, rocky terrain and wadis - Jebel Hafit	28.6	28.6	100.0	25.0	7.2	12.7	2.4	13.6	Endangered
Mountains, rocky terrain and wadis - Wadis and floodplains	753.6	753.6	100.0	25.0	188.4	141.1	90.6	521.9	Critically Endangered

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Biodiversity target %	Biodiversity target (km^2)	Area in a natural/good state (km^2)	Area in a degraded/fair state (km^2)	Area in a transformed/ poor state (km^2)	Ecosystem Threat Status
Sand sheet, dunes and sabkha mosaic - Liwa crescent dune and sabkha mosaic	3,795.6	3,795.6	100.0	25.0	948.9	3,321.4	237.3	236.9	Least Threatened
Sand sheets, dunes and mega dunes - Mega-dunes	15,141.1	14,970.0	98.9	25.0	3,785.3	12,085.3	1,188.0	1,867.9	Least Threatened
Sand sheets, dunes and mega dunes - Sand sheets and dunes mainly with perennial herbs or graminoids	10,425.4	10,425.4	100.0	25.0	2,606.4	9,277.1	648.7	499.6	Least Threatened
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover	799.2	799.2	100.0	25.0	199.8	751.1	20.5	27.7	Least Threatened
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover	18,705.0	13,758.8	73.6	25.0	4,676.3	10,823.8	2,971.2	4,910.0	Vulnerable
Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas	3,357.1	3,357.1	100.0	25.0	839.3	2,748.8	345.0	263.3	Least Threatened
Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum	1,130.6	1,130.6	100.0	25.0	282.7	1,028.2	48.5	53.9	Least Threatened
Deeper than 15m - Deeper than 15m - Arabian Gulf	33,722.2	21,222.3	62.9	25.0	8,430.5	22,210.4	10,733.8	778.0	Least Threatened

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Biodiversity target %	Biodiversity target (km^2)	Area in a natural/good state (km^2)	Area in a degraded/fair state (km^2)	Area in a transformed/ poor state (km^2)	Ecosystem Threat Status
Intertidal - Algal Mats - Arabian Gulf	107.9	107.9	100.0	25.0	27.0	81.2	22.0	4.7	Least Threatened
Intertidal - Mangroves - Arabian Gulf	127.4	99.9	78.4	25.0	31.9	48.0	54.6	24.8	Endangered
Intertidal - Rocky Platforms - Arabian Gulf	164.6	164.6	100.0	25.0	41.1	151.4	11.9	1.2	Least Threatened
Intertidal - Saltmarsh - Arabian Gulf	48.3	48.3	100.0	25.0	12.1	18.1	24.7	5.5	Endangered
Intertidal - Tidal flats (no algal mats) - Arabian Gulf	322.2	311.5	96.7	25.0	80.5	237.7	73.4	11.1	Least Threatened
Shallow Water Habitats - Coral Reef - Arabian Gulf	172.9	123.6	71.5	25.0	43.2	48.0	77.8	47.0	Endangered
Shallow Water Habitats - Other Shallow Water - Arabian Gulf	15,978.9	14,314.3	89.6	25.0	3,994.7	8,212.3	5,419.6	2,346.9	Least Threatened
Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf	1,589.6	1,589.6	100.0	25.0	397.4	593.3	573.0	423.3	Endangered

5.3 Description of Key Threatened Habitat Types

5.3.1 Critically Endangered Habitats

From the assessment of ecosystem threat status for Abu Dhabi, one habitat type has been identified as being Critically Endangered. These are the wadis and floodplains found around Jebel Hafit (not including Jebel Hafit) in Al Ain in the Eastern Region of Abu Dhabi Emirate.

- Wadis and Floodplains

This habitat consists of wadis and floodplains exclusively with temporary water flow, seasonal pools and very few permanent pools. Due to the periodic flooding or outwash of the area, this habitat tends to support a higher diversity of flora and fauna. Typical plant species recorded here include *Acacia tortilis*, *Aerva javanica, Rhazya stricta*, *Salsola imbricata* and *Pennisetum divisum*.

5.3.2 Endangered Habitats

From the assessment of ecosystem threat status for Abu Dhabi, eight habitat types have been identified as Endangered. These have been listed below along with a short description of each.

- Coastal Plains and Sand Sheets

  These coastal plains and sand sheets are dominated by chenopods, *Cyperus arenarius*, and *Zygophyllum qatarense*. There is some influence of extreme halophytes such as *Halopeplis perfoliata* and *Limonium axillare*, but these are mainly restricted to where there are depressions. This habitat type can be found as a strip, distributed along the coast from the western region near Sila to the Abu Dhabi / Dubai border.

- Alluvial or Interdunal Plains with Dwarf Shrub Cover

  This habitat consists of substrates varying from sand to gravel, resulting in gravel or interdunal plains. In alluvial plains of this habitat type, the dominant plant species tends to be *Haloxylon salicornicum* and *Rhazya stricta*. Within interdunal plains, the dominant floral species tend to be *Haloxylon salicornicum* or *Zygophyllum qatarense*. This habitat is distributed north of Abu Dhabi / Al Ain E22 highway to the Abu Dhabi / Dubai border. South of the Abu Dhabi / Al Ain E22 highway, the habitat is distributed to the south east, and can be found south of Al Ain, between the Abu Dhabi / Oman border and Abu Dhabi's most south easterly point. Small areas of this habitat are also found in the Western Region, towards the Saudi Arabia border.

- Jebel Hafit

  This habitat consists of mountain slopes and scree with low vegetation cover, but is often species-rich. The flora assemblage characteristically consists of trees (e.g. *Acacia tortilis*), stem succulents (e.g. *Euphorbia larica*), shrubs, dwarf shrubs and perennial grasses. This habitat type covers all of Jebel Hafit in Al Ain in the eastern region of Abu Dhabi Emirate.

- Intertidal Mangroves – Arabian Gulf

  This habitat consists of inter-tidal areas dominated by Grey Mangrove (*Avicennia marina*) and its associated species in the Arabian Gulf. Within Abu Dhabi Emirate, the distribution of this habitat type from east to west is from near Khalifa Port, with higher densities of this habitat around the islands to the east and west of Abu Dhabi Island. Mangrove habitats are also found along the coast heading westward, with a gradual decline in density. This habitat is also found in intertidal areas on islands such as Abu Al Abyadh, Marawah, Bu Tinah and Sir Bani Yas.

- Intertidal Saltmarsh – Arabian Gulf

  This habitat consists of intertidal areas dominated by emergent halophytic herbaceous vegetation and shrubs. This habitat type can be found in Abu Dhabi distributed east to west along the coast and islands from Khalifa Port to the Saudi Arabia border. There is a higher concentration of this habitat type around the islands to the east and west of Abu Dhabi Island.

- Intertidal Tidal Flats (no algal mats) – Arabian Gulf

  This habitat consists of exposed intertidal substrates having greater than 25% cover of particles smaller than gravel. This habitat type can be found in Abu Dhabi distributed east to west along the coast and islands from Khalifa Port to the Saudi Arabia border. There is a higher concentration of this habitat type around the islands to the east Abu Dhabi Island and around the coastal areas and islands found between Mussafah and Tarif.

- Coral Reef – Arabian Gulf

  This marine habitat consists of areas characterized by a substrate or is an environmental setting largely constructed by the reef-building activities of corals and associated organisms. This habitat type is mainly found in shallow water surrounding the islands of Abu Dhabi Emirate. One stand is found in the east at Khalifa Port, while larger areas of coral reef are found around the islands of the western region. This includes Abu Al Abyadh, Bu Tinah, Mubarraz, as well as the islands within the Al Yasat Marine Protected Area.

- Seagrass/ Macro-algal Beds – Arabian Gulf

  This marine habitat consists of subtidal benthic substrates, generally composed of unconsolidated sediments, and characterised by greater than 10% cover of rooted vascular seagrass species. Seagrass species in Abu Dhabi consist of *Halodule uninervis*, *Halophila stipulacea* and *Halophila ovalis*. In Abu Dhabi Emirate, this habitat type is distributed from west to east from the Saudi Arabia border to the Dubai border, along the coast line and around the islands.

5.3.3 Vulnerable Habitats

From the assessment of ecosystem threat status for Abu Dhabi, five habitat types have been identified as vulnerable. These have been listed below along with a short description of each:

- Coastal Sand Sheets and Low Dunes

  This habitat consists of coastal white (coralline) sands with a relative profusion of perennial plant species and dense vegetation cover (up to approximately 15 %). The most prominent flora elements in the habitat type are perennial grasses and dwarf shrubs. This habitat type has a patchy coastal distribution within Abu Dhabi Emirate. Main areas within which the habitat is found include near Ghweifat along the Abu Dhabi / Saudi Arabia border from which is sporadically distributed eastward to just east of Mirfa. It does not occur then between Mirfa and Abu Dhabi, but has an easterly fragmented distribution from Yas Island along the coast to Khalifa Port.

- Coastal Sabkha

  Costal sabkha is salt-encrusted desert close to the coast covering wide expanses. It is devoid of vegetation due to the high salinity of the substrate. Halophytes, however, may occur where there is a thin carpeting of sand on the surface. The distribution of this habitat type can be found from the Western Region with the border of Abu Dhabi and Saudi Arabia, where is follows the coast to the Abu Dhabi / Dubai border. The largest, most continuous area of this habitat is found from Abu Dhabi city mainland, to Khasifah, however, other large expanses of this habitat type can also be found in the far Western Region, near the Saudi Arabia border.

- Northern Alluvial or Interdunal Plains

  This habitat consists of substrates varying from sand to gravel, resulting in gravel or interdunal plains. These gravel or interdunal plains are dominated by *Acacia tortilis* and / or *Acacia ehrenbergiana*, while *Prosopis cineraria* may also be present. The main distribution of this habitat type is found within the Dubai Emirate, however a few areas of this habitat are found in north / north east of Abu Dhabi Emirate, just south of the Dubai border.

- Island – Salt Dome

  Salt domes are a particular habitat found only on islands with the exception of Jebel Dhana. Islands this habitat type is found on include Sir Bani Yas, Delma Island and Zirku Island.

- Sand Sheets and Dunes with Distinct Shrub Cover or Dwarf Shrub Cover

  This is often a mosaic of two habitat types. This can be sand sheets and dunes in which shrubs (i.e. woody plants taller than 1m) are physiognomically conspicuous elements of the vegetation including. This can include plant species such as *Calotropis procera* (which indicated a degraded stage of other communities) and with *Leptadenia pyrotechnica* (again a degradation stage). It can also be sand sheets and dunes in which dwarf shrubs (i.e. woody perennials less than 1m, usually less than 50cm) are conspicuous elements of the vegetation. This can include *Haloxylon salicornicum* and / or *Cornulaca monacantha* with *Cyperus conglomeratus* often co-dominant, or alternatively with *Rhanterium epapposum* as dominant species, or *Zygophyllum qatarense* as the dominant species (with varying amounts of *Cyperus conglomeratus*). This habitat type has a west to east distribution within larger expanses as the habitat moves westward within Abu Dhabi Emirate to the Dubai border.

5.4 Ecosystem Protection Level

The outputs of the initial assessments of ecosystem protection level for Abu Dhabi are shown in Figure 5-19 (and a large format version in Appendix C.2) and Table 5-12.

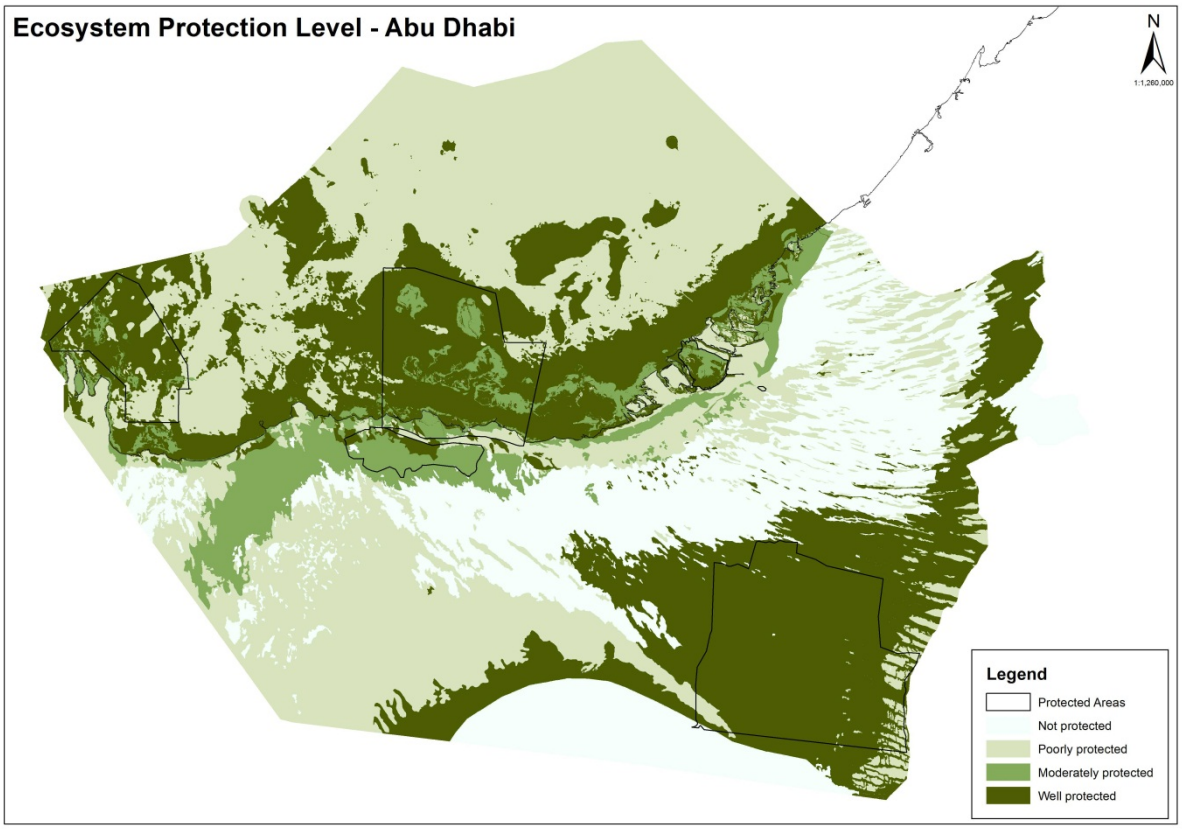


Figure 5-19: Ecosystem Protection Level for Abu Dhabi

Table 5-12: Ecosystem Protection Levels for Abu Dhabi

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level
Coastal plains, sand sheets and dunes - Coastal plains and sand sheets	1,974.3	1,446.4	73.3	17.0	335.6	283.0	84.3	Moderately protected
Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes	562.8	562.8	100.0	17.0	95.7	176.9	184.9	Well protected
Coastal sabkha - Coastal sabkha	3,810.6	3,618.1	94.9	17.0	647.8	162.1	25.0	Poorly protected
Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover	3,676.8	3,497.8	95.1	17.0	625.1	248.5	39.8	Poorly protected
Inland Plains - Interdunal plains with sabkha	1,209.4	1,209.1	100.0	17.0	205.6	533.4	259.4	Well protected
Inland Plains - Northern alluvial or interdunal plains	560.6	15.4	2.7	17.0	95.3	15.2	16.0	Poorly protected
Island - Island	632.8	598.7	94.6	17.0	107.6	107.8	100.2	Well protected
Island - Island - salt dome	33.5	33.5	100.0	17.0	5.7	9.1	159.4	Well protected

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level
Mountains, rocky terrain and wadis - Jebel Hafit	28.6	28.6	100.0	17.0	4.9	0.0	0.0	Not protected
Mountains, rocky terrain and wadis - Wadis and floodplains	753.6	753.6	100.0	17.0	128.1	0.0	0.0	Not protected
Sand sheet, dunes and sabkha mosaic - Liwa crescent dune and sabkha mosaic	3,795.6	3,795.6	100.0	17.0	645.2	9.0	1.4	Not protected
Sand sheets, dunes and mega dunes - Mega-dunes	15,141.1	14,970.0	98.9	17.0	2,574.0	5,801.7	225.4	Well protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes mainly with perennial herbs or graminoids	10,425.4	10,425.4	100.0	17.0	1,772.3	96.7	5.5	Poorly protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover	799.2	799.2	100.0	17.0	135.9	0.6	0.4	Not protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover	18,705.0	13,758.8	73.6	17.0	3,179.9	131.6	4.1	Not protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas	3,357.1	3,357.1	100.0	17.0	570.7	509.6	89.3	Moderately protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum	1,130.6	1,130.6	100.0	80.0	904.5	0.0	0.0	Not protected

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in Abu Dhabi	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level
Deeper than 15m - Deeper than 15m - Arabian Gulf	33,722.2	21,222.3	62.9	10.0	3,372.2	702.2	20.8	Poorly protected
Intertidal - Algal Mats - Arabian Gulf	107.9	107.9	100.0	17.0	18.3	24.6	134.0	Well protected
Intertidal - Mangroves - Arabian Gulf	127.4	99.9	78.4	80.0	101.9	9.9	9.7	Poorly protected
Intertidal - Rocky Platforms - Arabian Gulf	164.6	164.6	100.0	17.0	28.0	95.2	340.2	Well protected
Intertidal - Saltmarsh - Arabian Gulf	48.3	48.3	100.0	80.0	38.6	6.7	17.3	Moderately protected
Intertidal - Tidal flats (no algal mats) - Arabian Gulf	322.2	311.5	96.7	17.0	54.8	90.1	164.5	Well protected
Shallow Water Habitats - Coral Reef - Arabian Gulf	172.9	123.6	71.5	80.0	138.3	78.2	56.6	Moderately protected
Shallow Water Habitats - Other Shallow Water - Arabian Gulf	15,978.9	14,314.3	89.6	10.0	1,597.9	4,324.2	270.6	Well protected
Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf	1,589.6	1,589.6	100.0	80.0	1,271.7	795.6	62.6	Moderately protected

5.5 Description of Key Under-Protected Types

5.5.1 Not Protected

From the assessment of ecosystem protection level for Abu Dhabi, six habitat types were identified as not protected. These have been listed below along with a short description of each:

- Jebel Hafit

  See description in Section 5.3.

- Wadis and Floodplains

  See description in Section 5.3.

- Liwa Crescent Dunes and Sabkha Mosaic

  The habitat consists of a mosaic of mega dunes (dunes taller than 20m) and inland sabkha within the Liwa crescent in the western region of Abu Dhabi. Characteristic flora species include *Seidlitzia rosmarinus* and *Calligonum crinitum* ssp *arabicum.*

- Sand Sheets and Dunes with Distinct Dwarf Cover

  See description in Section 5.3.

- Sand Sheets and Dunes with Distinct Shrub Cover or Dwarf Shrub Cover

  This is often a mosaic of two habitat types. This can be sand sheets and dunes in which shrubs (i.e. woody plants taller than ca. 1m) are physiognomically conspicuous elements of the vegetation including. This can include plant species such as *Calotropis procera* (which indicated a degraded stage of other communities) and with *Leptadenia pyrotechnica* (again a degradation stage). It can also be sand sheets and dunes in which dwarf shrubs (i.e. woody perennials less than 1m, usually less than 50cm) are conspicuous elements of the vegetation. This can include *Haloxylon salicornicum* and / or *Cornulaca monacantha* with *Cyperus conglomeratus* often co-dominant, or alternatively with *Rhanterium epapposum* as dominant species, or *Zygophyllum qatarense* as the dominant species (with varying amounts of *Cyperus conglomeratus*). This habitat type has a west to east distribution within larger expanses as the habitat moves westward within Abu Dhabi Emirate to the Dubai Emirate border.

- Sand Sheets and Dunes with *Haloxylon persicum*

  This habitat consists of sand sheets and dunes in which shrubs (i.e. woody plants taller than ca. 1m) are physiognomically conspicuous elements of the vegetation including. Dominant plant species include *Haloxylon persicum*, often co-dominant with *Cyperus conglomeratus*, *Haloxylon salicornicum* or *Zygophyllum qatarense* This habitat, often referred to as ‘Dew Forest’, has a restricted range in Abu Dhabi running parallel to the coast from about 15 to 50km from the coast, between Madinat Zayed and Wathba. This is a zone in which there is sufficient dew (from fog)

(Aspinall, S; Hellyer, P, 2003) (Perry, 2008) to supply the water needs of the plant *Haloxylon persicum* (auto-watering mechanism) and the ground is not too saline.

5.5.2 Poorly Protected

From the assessment of ecosystem protection level for Abu Dhabi, six habitat types were identified as poorly protected. These have been listed below along with a short description of each:

- Coastal Sabkha

  See description in Section 5.3.

- Alluvial or Interdunal Plains with Dwarf Shrub Cover

  See description in Section 5.3.

- Northern Alluvial or Interdunal Plains

  See description in Section 5.3.

- Sand Sheets and Dunes mainly with Perennial Herbs or Graminoids

  This habitat consists of sand sheets and dunes with the dominant flora species *Tribulus arabicus* (often with *Cyperus conglomeratus* and *Cornulaca arabica*) where vegetation cover can be quite dense locally (up to 10 %). This habitat is however often species-poor or consists of sand sheets and dunes in which graminoids (grasses or sedges) are present. This habitat is largely found in the western region, to north and north-west of the Liwa crescent, stretching to just south west of the Baynunah Forest Protected Area. Another small patch of this habitat type can also be found just south west of Al Ain.

- Deeper than 15m – Arabian Gulf

  This consists of areas where there is a permanent overlaying water column greater than 15m in depth. This can be found offshore for the length of Abu Dhabi and is found on between 4km to 80km away from the coast.

- Intertidal Mangroves – Arabian Gulf

  See description in Section 5.3.

5.5.3 Moderately Protected

From the assessment of ecosystem protection level for Abu Dhabi, five habitat types were shown to be considered as moderately protected. These have been listed below along with a short description of each:

- Coastal Plains and Sand Sheets

  These coastal plains and sand sheets are dominated by chenopods, *Cyperus arenarius*, and *Zygophyllum qatarense*. There is some influence of extreme

halophytes such as *Halopeplis perfoliata* and *Limonium axillare*, but these are mainly restricted to where there are depressions. This habitat type can be found as a strip, distributed along the coast from the western region near Sila to the Abu Dhabi / Dubai border.

- Sand Sheets and Dunes with Dwarf Shrub Cover and Barqas

  This habitat consists of sand sheets, dunes and mega dunes interspersed with inselberg-like rocky exposures at least 2m in height. Dependent on the extent to which finer-grained substrate has developed, these exposures can be nearly barren to well vegetated, with halophytic and non-halophytic vegetation. Typical plant species include *Cornulaca monacantha*, *Salsola drummondii* and *Salsola imbricata*. These inselberg-like exposures provide shelter in an otherwise exposed environment, and are therefore considered valuable for birds, mammals and reptiles.

  This habitat type is distributed in the western region with small patches commencing around Al Dhafra and with larger expanses as you head westward, through Baynunah and continuing further west, south west towards the Abu Dhabi / Saudi Arabia border.

- Intertidal Saltmarsh – Arabian Gulf

  See description in Section 5.3.

- Coral Reef – Arabian Gulf

  See description in Section 5.3.

- Seagrass/ Macro-algal Beds – Arabian Gulf

  See description in Section 5.3.

5.6 Spatial Prioritization Results

5.6.1 MARXAN Selection Frequency

As described in Section 4, the primary output of the MARXAN-based process described here is a selection frequency map. This map provides 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 analysis. Figure 5-20 below (and a larger version in Appendix C.3) shows the site selection frequency map for Abu Dhabi.

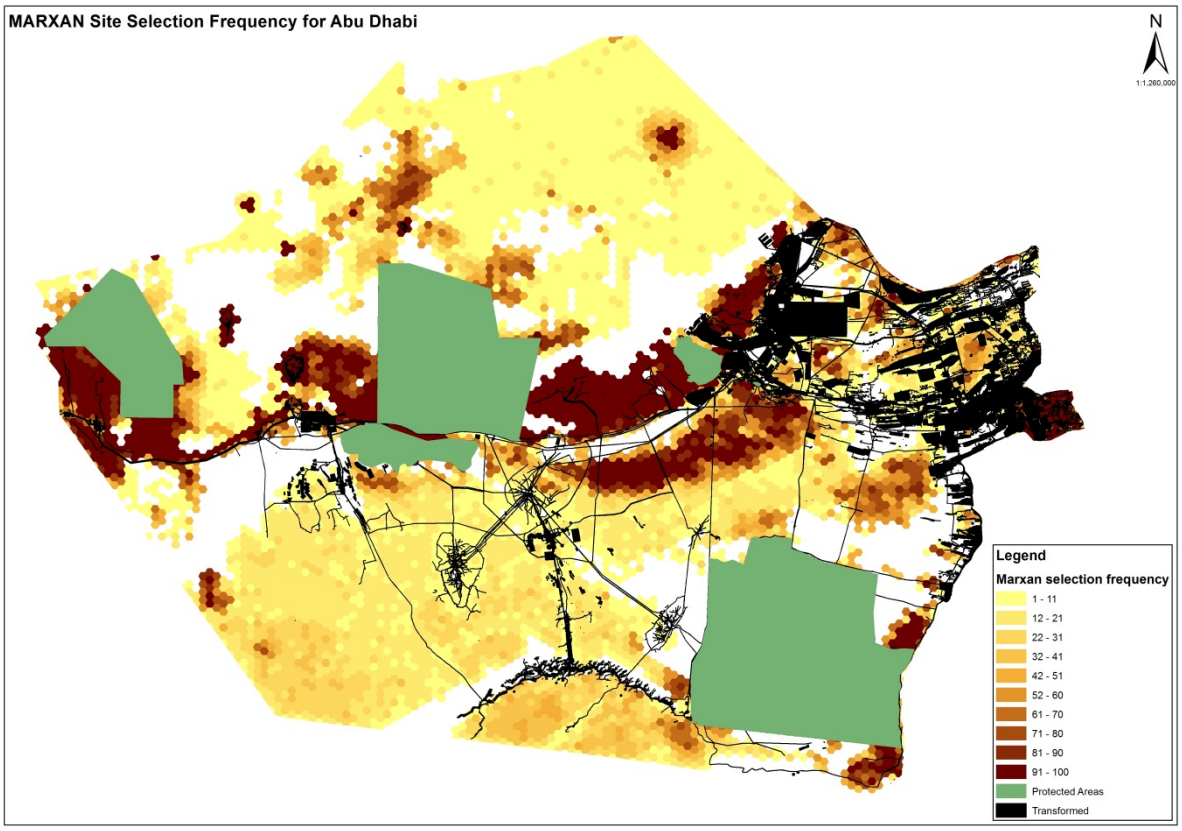


Figure 5-20: The MARXAN Site Selection Frequency for Abu Dhabi

5.6.2 Priority Focus Areas (PFAs)

Twenty two (22) PFAs were identified in total, of which 11 are in Abu Dhabi and 11 in other Emirates. The PFAs are shown in Figure 5-20 overlaid on the selection frequency, and in a simplified form in Figure 5-21.

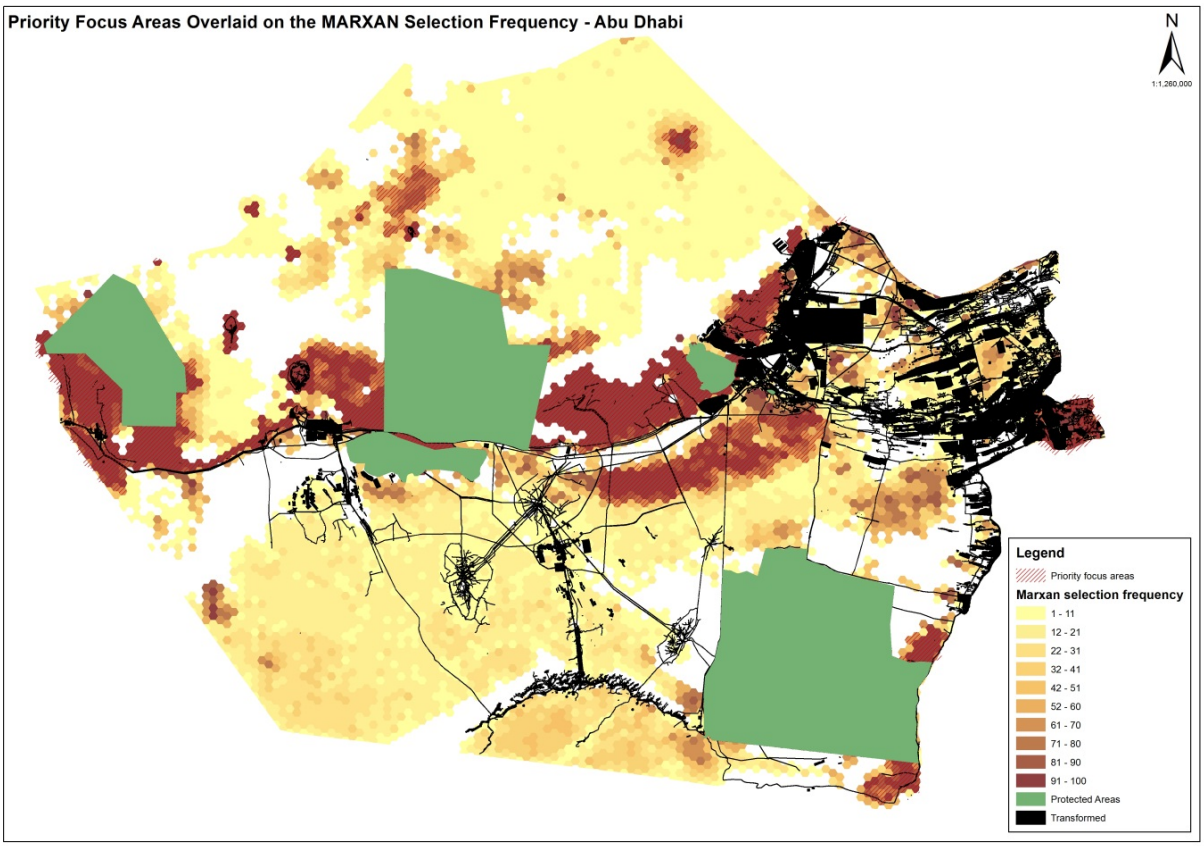


Figure 5-21: Priority Focus Areas Overlaid on the MARXAN Selection Frequency Map

The PFAs in Figure 5-22 (in large format in Appendix C.5) include all areas that are required in all iterations to meet targets combined with adjacent areas in other Emirates that are necessary at least 60% of the time. The PFAs were manually cleaned to remove major transformed areas and isolated sections.

The MARXAN spatial prioritization produced very stable results, and the same general areas were consistently identified irrespective of MARXAN variables. The spatial prioritization outputs hence produced one clear prioritization and whilst this required some iteration to stabilise there was no basis to generate a series of different scenarios since the data did not merit such an approach. Therefore, alternative scenarios are dependent solely on whether specific PFAs are implemented or not. Although, all the identified PFAs are necessary to meet targets, and it is the recommendation of this Project that some level of conservation action is necessary in each of the areas, there is the opportunity to review the identified PFAs and to indicate which are the most important to implement (or be included within an additional implementation scenario). This selected sub-set of PFAs would then be evaluated in addition to the current 'Status Quo' and 'Full Implementation' scenarios.

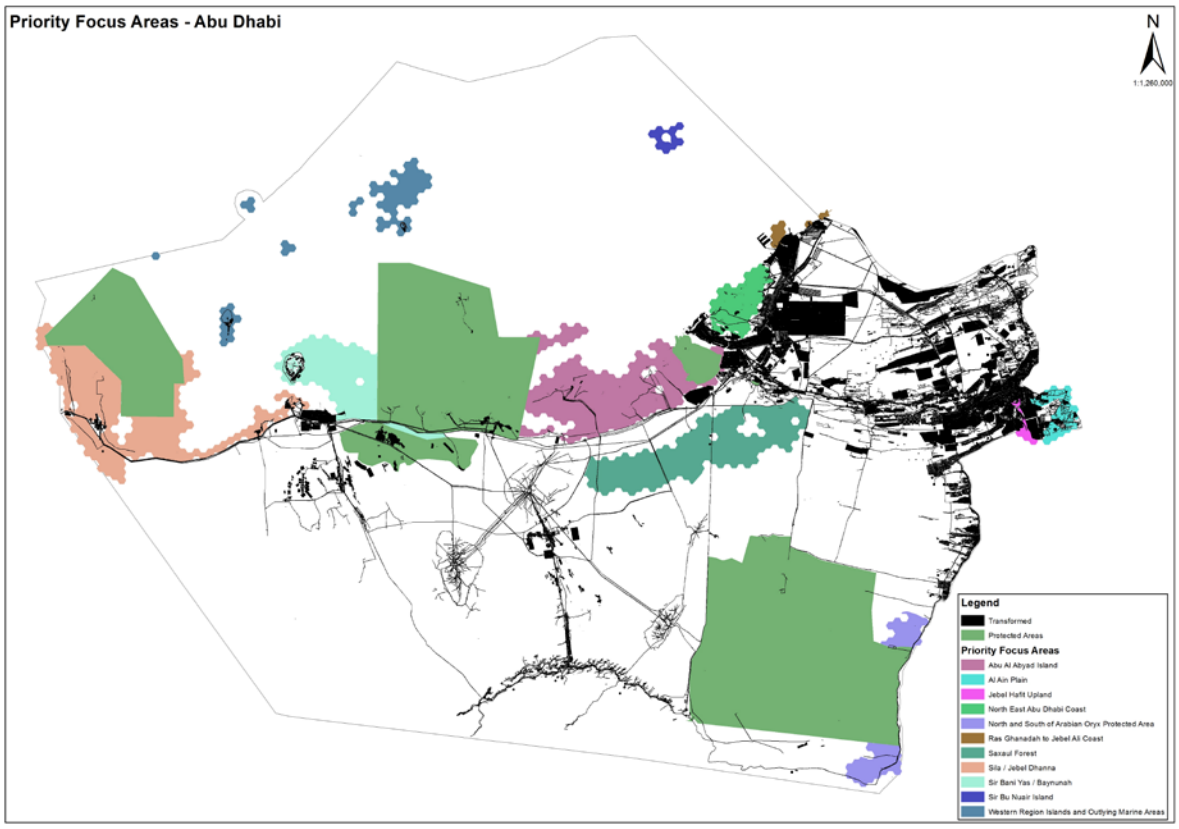


Figure 5-22: Identified Priority Focus Areas for Abu Dhabi

The PFAs cover an area of 896,216ha in Abu Dhabi and a total of 1,212,729ha across the UAE. For Abu Dhabi they represent an additional 9.2% of the land and sea area (or 64% of the current Protected Area network). These PFAs are:

- The areas within which Protected Area expansion would most efficiently meet Protected Areas targets (and hence improve the representiveness of the Protected Area network), while at the same time meeting targets for species. The 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. Protection of prioritized areas will improve:
    - Ecosystem protection level (in particular, representiveness of the reserve network).
    - Reduce inefficiencies (by avoiding unnecessary duplication of areas sufficiently represented in the reserve network).
    - Reduce the risk of worsening of ecosystem threat status of Abu Dhabi habitat types.
    - Efficiently prioritize areas required for the persistence of threatened and keystone species.

Importantly, the PFAs are not:

- Potential future Protected Area boundaries. Rather, they are areas within which can be efficiently met. In many cases, it is not necessary to protect the whole Priority Focus Area. Detailed site level Protected Area expansion planning is necessary to refine the potential boundaries of new or expanded Protected Areas. This planning should ideally incorporate finer level biodiversity data, as well as more detailed data on aspects such as socio-economic impacts and benefits.

- Designed to meet all targets for all habitat types. Note that the approach taken is to identify the highest PFAs where there is a combination of under-protected habitat and where areas are necessary for species or process conservation. The approach deliberately did not identify all areas necessary to meet habitat protection targets in areas with very high choice such as the area south of the Liwa Crescent and in the deserts. As shown in the MARXAN selection frequency map (Figure 5-20), some of these areas are required to meet targets, but in these areas where the whole of the habitat is available to meet targets and without additional biodiversity data, it is not useful to identify specific sites. As these areas generally are not subject to extensive transformation pressures, and hence consist of Least Threatened habitat types, Protected Area expansion is also far less urgent in these areas than elsewhere in the planning domain. Protected Area expansion in these habitats is necessary in the long term to ensure a fully representative Protected Area network, but should not be seen as part of the 'PFAs' where implementation actions should be focussed in the short term.

Table 5-13 details the habitat types and the ecosystem threat status of each habitat type found within each of the PFAs. The table shows how some PFAs (e.g. Abu Al Abyad Island) contain a wide range of habitat types, while others are focussed on one or two threatened habitat types (e.g. Al Ain Plains and Jebel Hafit Upland).

Table 5-14 provides a similar summary of the protection levels of the habitats found in each of the PFAs.

The key characteristics of the PFAs are summarized in Table 5-15 and Table 5-16. These tables are included to assist in understanding the value of each Priority Focus Area for inclusion within an expanded 'Protected' area network. Importantly, all of the areas are necessary and required to meet targets, all are of high priority, and each of the areas should be protected using appropriate conservation mechanisms. Table 5-15 is an unadjusted summary of the characteristics, Table 5-16 adjusts the values by area.

The indices used to summarize areas are:

- Total habitats: Number of different habitat types found in each focus area.

- Ecosystem threat status: This shows the number of habitats per ecosystem threat status, and summarizes against the total number of threatened habitats (Critically Endangered, Endangered and Vulnerable).

- Ecosystem protection level: This shows the number of habitats per ecosystem protection level, and summarizes against the total number of very under-protected types (not protected poorly protected and moderately protected).

- Biodiversity features – Number: This shows the total number of biodiversity features (e.g. a species) included within the conservation plan, that are found in each PFA.

- Biodiversity features - Number of features representing >10% of remaining target: The number of features found in a focus area where additional areas are required to

meet targets, and where the focus area contains sufficient quantity or area of the biodiversity feature to meet at least 10% of the remaining target.

- Biodiversity features - Summed contribution to unmet targets: This examines each biodiversity feature where additional areas are required to meet targets. The summed score is derived by adding the potential contribution (as a percentage, with a maximum per feature of 100%) to meeting targets for each biodiversity feature, that each PFA could contribute. For example, if an area could contribute 13% to the target for feature A and 110% of the requirement for Feature B both of which were currently below target, then the area would score 113.

Table 5-13: Detail of the Habitat Types and their Ecosystem Threat Status for each of the PFAs

	Priority Focus Area										
	Abu Al Abyad Island	Al Ain Plain	Western Region Islands and Outlying Marin	Ras Ghanadah to Jebel Ali Coast	Jebel Hafit Upland	North and South of Arabian Oryx Protected A	North East Abu Dhabi Coast	Saxaul Forest	Sila / Jebel Dhanna	Sir Bani Yas / Bayrunah	Sir Bu Nuair Island
Coastal plains, sand sheets and dunes - Coastal plains and sand sheets	EN			EN			EN		EN	EN	
Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes				VU			VU		VU	VU	
Coastal sabkha - Coastal sabkha	VU			VU			VU	VU	VU	VU	
Deeper than 15m - Deeper than 15m - Arabian Gulf	LT		LT						LT	LT	LT
Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover						EN		EN	EN		
Inland Plains - Interdunal plains with sabkha						LT		LT			
Intertidal - Algal Mats - Arabian Gulf	LT		LT				LT		LT	LT	
Intertidal - Mangroves - Arabian Gulf	EN		EN	EN			EN		EN	EN	
Intertidal - Rocky Platforms - Arabian Gulf	LT		LT						LT	LT	
Intertidal - Saltmarsh - Arabian Gulf	EN		EN	EN			EN		EN	EN	
Intertidal - Tidal flats (no algal mats) - Arabian Gulf	LT		LT				LT		LT	LT	
Island - Island	LT		LT				LT		LT	LT	LT
Island - Island - salt dome			VU							VU	
Mountains, rocky terrain and wadis - Jebel Hafeet					EN						
Mountains, rocky terrain and wadis - Wadis and floodplains		CR			CR						
Sand sheets, dunes and mega dunes - Mega-dunes						LT					
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover								LT	LT		
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover				VU				VU			
Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas								LT			
Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum								LT			
Shallow Water Habitats - Coral Reef - Arabian Gulf	EN		EN	EN					EN	EN	EN
Shallow Water Habitats - Other Shallow Water - Arabian Gulf	LT		LT	LT			LT		LT	LT	LT
Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf	EN		EN	EN			EN		EN	EN	EN
Critically Endangered (CR)	0	1	0	0	1	0	0	0	0	0	0
Endangered (EN)	5	0	4	5	1	1	4	1	6	5	2
Vulnerable (VU)	1	0	1	3	0	0	2	2	2	3	0
Least Threatened (LT)	6	0	6	1	0	2	4	4	7	6	3
Total types	12	1	11	9	2	3	10	7	15	14	5
Total threatened	6	1	5	8	2	1	6	3	8	8	2

Table 5-14: Detail of Habitat Types and their Protection Level for each of the PFAs

	Priority Focus Area										
	Abu Al Abyad Island	Al Ain Plain	Western Region Islands and Outlying Marine Areas	Ras Ghanadah to Jebel Ali Coast	Jebel Hafit Upland	North and South of Arabian Oryx Protected Area	North East Abu Dhabi Coast	Saxaul Forest	Sila / Jebel Dhanna	Sir Bani Yas / Baynunah	Sir Bu Nuair Island
Coastal plains, sand sheets and dunes - Coastal plains and sand sheets	MP			MP			MP		MP	MP	
Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes				WP			WP		WP	WP	
Coastal sabkha - Coastal sabkha	PP			PP			PP	PP	PP	PP	
Deeper than 15m - Deeper than 15m - Arabian Gulf	PP		PP						PP	PP	PP
Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover						PP		PP	PP		
Inland Plains - Interdunal plains with sabkha						WP		WP			
Intertidal - Algal Mats - Arabian Gulf	WP		WP				WP		WP	WP	
Intertidal - Mangroves - Arabian Gulf	PP		PP	PP			PP		PP	PP	
Intertidal - Rocky Platforms - Arabian Gulf	WP		WP						WP	WP	
Intertidal - Saltmarsh - Arabian Gulf	MP		MP	MP			MP		MP	MP	
Intertidal - Tidal flats (no algal mats) - Arabian Gulf	WP		WP				WP		WP	WP	
Island - Island	WP		WP				WP		WP	WP	WP
Island - Island - salt dome			WP							WP	
Mountains, rocky terrain and wadis - Jebel Hafeet					NP						
Mountains, rocky terrain and wadis - Wadis and floodplains		NP			NP						
Sand sheets, dunes and mega dunes - Mega-dunes						WP					
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover								NP	NP		
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover				NP				NP			
Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas								MP			
Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum								NP			
Shallow Water Habitats - Coral Reef - Arabian Gulf	MP		MP	MP					MP	MP	MP
Shallow Water Habitats - Other Shallow Water - Arabian Gulf	WP		WP	WP			WP		WP	WP	WP
Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf	MP		MP	MP			MP		MP	MP	MP
Not Protected (NP)	0	1	0	1	2	0	0	3	1	0	0
Poorly Protected(PP)	3	0	2	2	0	1	2	2	4	3	1
Moderately Protected (MP)	4	0	3	4	0	0	3	1	4	4	2
Well Protected(WP)	5	0	6	2	0	2	5	1	6	7	2
Total types	12	1	11	9	2	3	10	7	15	14	5
Total very under-protected	3	1	2	3	2	1	2	5	5	3	1

Table 5-15 and Table 5-16 highlight how different areas stand out for different reasons. For example:

- Sila / Jebel Dhana, Sir Bani Yas / Baynunah, Abu Al Abyad Island, Western Region Island and Outlying Marine Areas, and the North East Abu Dhabi Coast stand out in terms of total number of habitats. If one adjusts for area, however, then Ras Ghanadah to Jebel Ali Coast, Jebel Hafit Upland and Sir Bu Nuair Island stand out. There is a very similar pattern in terms of number of threatened habitat types.

- Saxaul Forest and Sila/Jebel Dhanna stand out in terms of the number of very under-protected habitat types present. However, if one adjusts for area, then the Jebel Hafit Upland and the Ras Ghanadah to Jebel Ali Coast contain a number of very under-protected types in a small area.

- Sila / Jebel Dhanna, Abu Al Abyad Island, Sir Bani Yas / Baynunah and Western Region Islands and Outlying Marine Areas are all extremely diverse in terms of the number of biodiversity features present. Jebel Hafit Upland and the Ras Ghanadah to Jebel Ali Coast have relatively large numbers of features given their size.

- Abu Al Abyad Island and Sila / Jebel Dhanna contain significant portions of area required to meet a number of remaining targets, whereas the Jebel Hafit Upland is very significant given its limited extent.

- In terms of summed contribution to unmet targets, Abu Al Abyad Island, Sila / Jebel Dhana and to a lesser extent Saxaul Forest and Sir Bani Yas/ Baynouna stand out, while the Jebel Hafit Upland contributes very significantly given its size.

Table 5-15: Summary of Key Characteristics of PFAs

		Habitat diversity	Ecosystem Threat Status					Ecosystem protection level					Biodiversity features		
Priority Focus Area	Area (ha)	Total habitats	Critically Endangered	Endangered	Vulnerable	Least Threatened	Total threatened habitats	Not protected	Poorly protected	Moderately protected	Well protected	Very underprotected types	Number of features	Number of features representing >10% of remaining target	Summed contribution to unmet targets
Abu Al Abyad Island	200822	12	0	5	1	6	11	0	3	4	5	3	33	30	1682
Al Ain Plain	16994	1	1	0	0	0	1	1	0	0	0	1	5	4	378
Western Region Islands and Outlying Marine Areas	63749	11	0	4	1	6	10	0	2	3	6	2	25	11	714
Ras Ghanadah to Jebel Ali Coast	7542	9	0	5	3	1	6	1	2	4	2	3	17	4	131
Jebel Hafit Upland	2718	2	1	1	0	0	2	2	0	0	0	2	11	7	541
North and South of Arabian Oryx Protected Area	48562	3	0	1	0	2	3	0	1	0	2	1	6	3	158
North East Abu Dhabi Coast	48788	10	0	4	2	4	8	0	2	3	5	2	21	10	585
Saxaul Forest	177675	7	0	1	2	4	5	3	2	1	1	5	21	18	898
Sila / Jebel Dhanna	198240	15	0	6	2	7	13	1	4	4	6	5	35	23	1241
Sir Bani Yas / Baynunah	106967	14	0	5	3	6	11	0	3	4	7	3	31	14	869
Sir Bu Nuair Island	11146	5	0	2	0	3	5	0	1	2	2	1	14	6	311

Notes: The values are the raw scores for each index. See text for details.

Table 5-16: Area Adjusted Summary of Key Characteristics of PFAs

		Habitat diversity	Ecosystem Threat Status	Ecosystem protection level	Biodiversity features		
Priority Focus Area	Area (ha)	Total habitats	Total threatened habitats	Very underprotected types	Number of features	Number of features representing >10% of remaining target	Summed contribution to unmet targets
Abu Al Abyad Island	200822	5.0	5.0	1.4	2.8	3.1	4.2
Al Ain Plain	16994	4.9	5.4	5.4	4.9	4.8	11.2
Western Region Islands and Outlying Marine Areas	63749	14.5	14.5	2.9	6.6	3.5	5.6
Ras Ghanadah to Jebel Ali Coast	7542	100.0	73.3	36.7	37.8	10.9	8.7
Jebel Hafit Upland	2718	61.7	67.8	67.8	67.8	52.8	100.0
North and South of Arabian Oryx Protected Area	48562	5.2	5.7	1.9	2.1	1.3	1.6
North East Abu Dhabi Coast	48788	17.2	15.1	3.8	7.2	4.2	6.0
Saxaul Forest	177675	3.3	2.6	2.6	2.0	2.1	2.5
Sila / Jebel Dhanna	198240	6.3	6.0	2.3	3.0	2.4	3.1
Sir Bani Yas / Baynunah	106967	11.0	9.5	2.6	4.9	2.7	4.1
Sir Bu Nuair Island	11146	37.6	41.3	8.3	21.0	11.0	14.0

Note: Scores were calculated by dividing the raw values by area. The scores normalized against the highest value to give a relative score ranging from 0 (lowest value) to a maximum of 100 (highest value). Reddest values highlight the top scores.

5.6.3 Expert Review of Priority Focus Areas

The identified PFAs were reviewed by experts from across Abu Dhabi and the UAE at the Abu Dhabi and UAE Spatial Prioritization Workshop on 28th February 2013. This involved:

- Preliminary review of each PFA in terms of their biodiversity features and current pressures as well as suggested amendments to PFA names and potential divisions. The results of this are presented in Table 5-17. In addition to this, an evaluation of PFAs both in terms of any significant missing priorities at a national scale, and also

whether any identified PFAs had been included which the experts did not considered to be important.

- Prioritization of implementation of the PFAs in terms of which areas are particularly valuable from a biodiversity perspective and which areas are most urgent in terms of risk of short term loss of biodiversity or reduction in opportunity to effectively conserve these areas in the short term.

5.6.3.1 *Evaluation of Priority Focus Areas*

The set of PFAs were positively received by the experts, and no significant errors or omission or unnecessary inclusion of areas was noted. However, at a finer scale (i.e. beyond the scope of the current Project) when implementation of Protected Areas is being planned in detail, a number of activities need to be considered to facilitate implementation. These are discussed in the recommendations in Section 6.

Table 5-17: Summary of Preliminary Review of Abu Dhabi Priority Focus Areas

PFA Name	Description comments
Ras Ghanadah to Jebel Ali Coast	Good example of intertidal ecosystem also includes the presidential palace. Much mangrove planting that has occupied inter-tidal habitats. The white coastal sand habitat was important and almost lost to the area from development. Extensive coral reef surveys by National Coral Reef Institute for large EIAs (held by Emirates Marine Environment Group in Dubai)
North East Abu Dhabi Coast	Proposed to become the Eastern Mangrove National Park. Signage present but no official designation. An important area for environmental awareness for Abu Dhabi. Adjacent at Umm al Nar is a World Heritage Site on the UNESCO tentative list. Important to try and combine these important cultural and biodiversity areas. The AGEDI Blue Carbon project may help aid implementation of this site. Military and oil refinery installations are being moved out of the area.
Abu Al Abyad Island	At Abu Al Abayd there is important breeding colony of crab plover as well as hawksbill turtle nesting sites. It is a private island so there is limited control over development on the island. Bul Syayeef Marine Protected Area to the east supports the largest flamingo breeding colony in the UAE but the protected area is being heavily degraded.
Saxaul Forest	Identified as a priority site by EAD in the Abu Dhabi Vision 2030 document. Although habitat is unique and currently the protected area network does not protect this type of habitat, it was felt that the site had limited other biodiversity value.
Sir Bani Yas / Baynunah	The Sir Bani Yas island itself is not important at all. Adjacent islands are very important for breeding sea birds, nesting hawksbill turtles. Noting though that all turtles in nearby islands are subject to poaching and action was urgently required.
Sila / Jebel Dhanna	Gaga Island had a new access road and Socotra cormorant was probably doomed. Important area of unique petrified forest. There was much habitat fragmentation and hence there was a need for fine scale analysis for planning purposes. Al Shuwiehat Island was very important and Jebel Danna has the only mainland salt dome.

PFA Name	Description comments
Western Region Islands and Outlying Marine Areas	Delma Island is still classified as an IBA but sooty falcon no longer breeds the IBA has now lost its principal features and the island should be excluded from the PFA. The outer islands are important breeding seabirds and nesting and foraging hawksbill turtles. It was proposed and accepted that Delma Island should be removed from the PFA (and the name changed) because it was now of little biodiversity value.
North and South of Arabian Oryx Protected Area	Both areas are of limited biodiversity value and heavily degraded. The northern section is heavily populated by camel farms. When camel farmers were evicted from Oman they were given these sections of land to try and control grazing. Hence it would be difficult to effect conservation in this area. Wadi Dank was important site for early human settlements.
Jebel Hafit Upland	Very important and biodiversity rich inselberg. A range of developments are pressuring this small isolated habitat and a priority for protection.
Al Ain Plain	The gravel plain forms part of a much larger habitat block that runs into Oman but within UAE it is heavily transformed by built development. There are a range of important small mammal and reptile species associated with the habitat but the fragments remaining are probably too small to be viable protected areas. Limited potential for a viable Protected Area. Conservation actions for this habitat type may be best implemented in Oman.
Sir Bu Nuair Island	Important island for breeding seabirds and nesting hawksbill turtle that is protected. The fringing coral reef is diverse and in largely pristine condition.

5.6.3.2 Prioritization of Implementation of the Priority Focus Areas

The assessment by the experts in the Abu Dhabi and UAE Spatial Prioritization Workshop was very useful in gaining an insight into the PFAs, however, it must be used in combination with the data driven approach to evaluating and summarizing the Priority Focus Areas given in Section 5.6.2.

The experts were divided into three groups (each with a project team facilitator) and they were asked to allocate a numerical score to each PFAs (1= High, 2 = Moderate, 3 = Low) for the Biodiversity Value and the Urgency of Implementation at each site.

Biodiversity scoring was based on:

- Importance/value of the biodiversity of each site.
- Uniqueness of biodiversity at each site.
- Threatened and under protected habitats.
- Threatened, rare, endemic species.
- Particularly good examples of functioning ecosystems.

Where a Priority Focus Area was associated with an existing Protected Area, the evaluation was of the additional contribution of the Priority Focus Area and excluded the existing Protected Area.

The scoring of the Urgency of Implementation of each site was based on:

- Number of remaining opportunities, i.e. where few options exists and where they could be quickly lost.
- Area with current or imminent development threat.
- Species/populations which are at short term risk.
- Areas which are currently fairly intact but are rapidly becoming fragmented and hence where opportunities to create a substantial Protected Area may disappear soon.
- Areas which are experiencing ongoing or increasing degradation, rather than areas where impacts have occurred already and the sites are relatively stable.

The resulting score for each Priority Focus Area was derived from the average of the total of these three criteria for each of the PFAs. The detailed scoring by each group as well as a summary of biodiversity value and implementation urgency is given in Table 9-20 in Appendix D.

The base values were then categorised; two categories were used for biodiversity importance, namely 'Highest value sites' and 'Other valuable sites', while three categories were used for urgency of implementation, namely 'Very Urgent', 'Moderately Urgent' and 'Less Urgent'. This evaluation is summarized in Table 5-18.

Table 5-18: Summary of Expert Evaluation of the PFAs

		Focus area value	
		Highest Value sites	**Other valuable Sites**
Urgency of Implementation	**Very Urgent**	Jebel Hafit Upland	Al Ain Plain
		North East Abu Dhabi Coast	
		Sila / Jebel Dhanna	
		Sir Bani Yas / Baynunah	
	Moderately Urgent	Western Region Islands and Outlying Marine Areas	Abu Al Abyad Island
		Ras Ghanadah to Jebel Ali Coast	
	Less Urgent	Sir Bu Nuair Island	North and South of Arabian Oryx Protected Area
			Saxaul Forest

Although all PFAs have significant biodiversity value and detailed conservation planning and implementation work is necessary in all of them, the expert review highlighted certain PFAs that were particularly valuable and urgently needed to be implemented.

The 'Very Urgent' and 'Highest Value Sites' included the Jebel Hafit Upland, North East Abu Dhabi Coast, Sila / Jebel Dhanna and Sir Bani Yas / Baynunah. Other 'Highest Value Sites' which were seen as 'Moderately Urgent' included Western Region Islands and Outlying Marine Areas and Ras Ghanadah to Jebel Ali Coast; while the remaining 'Highest Value Site' of Sir Bu Nuair Island was seen as 'Less Urgent' due to lack of immediate threat to this site.

The Al Ain Plain was seen as the only 'Other Valuable Site' which was 'Very Urgent', while Abu Al Abyad Island was 'Moderately Urgent', and the remaining sites North and South of Arabian Oryx Protected Area and Saxaul Forest were classed as 'Less Urgent'. It should also be noted that if implementation opportunities arise within the PFAs, these should be utilized, as all PFAs will need to have some form of conservation activity taking place within them, and any conservation action would in time enable Abu Dhabi to meet its overall conservation objectives and targets.

5.6.4 Protection Level Scenario Given Full Implementation of Priority Focus Areas

This section outlines the protection level scenario assuming that all PFAs (i.e. those in Abu Dhabi as well as the reminder of the UAE) are fully implemented. Table 5-19 details current and potential protection levels, while the current and post-implementation protection level maps are given in Figure 5-23 and Figure 5-24 and large format versions are provided in Appendix C.2 and C.6, respectively.

Table 5-19: Current and Potential Protection Levels of Ecosystems Assuming Full Implementation of PFAs

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in AD	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level	Potential: Protected Area (km^2)	Potential: Percentage of Protection target attained	Potential: Protection Level
Coastal plains, sand sheets and dunes - Coastal plains and sand sheets	1,974.3	1,446.4	73.3	17.0	335.6	283.0	84.3	Moderately protected	710.3	211.6	Well protected
Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes	562.8	562.8	100.0	17.0	95.7	176.9	184.9	Well protected	262.6	274.5	Well protected
Coastal sabkha - Coastal sabkha	3,810.6	3,618.1	94.9	17.0	647.8	162.1	25.0	Poorly protected	943.1	145.6	Well protected
Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover	3,676.8	3,497.8	95.1	17.0	625.1	248.5	39.8	Poorly protected	1,151.4	184.2	Well protected
Inland Plains - Interdunal plains with sabkha	1,209.4	1,209.1	100.0	17.0	205.6	533.4	259.4	Well protected	606.0	294.7	Well protected
Inland Plains - Northern alluvial or interdunal plains	560.6	15.4	2.7	17.0	95.3	15.2	16.0	Poorly protected	123.6	129.7	Well protected
Island - Island	632.8	598.7	94.6	17.0	107.6	107.8	100.2	Well protected	552.6	513.6	Well protected

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in AD	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level	Potential: Protected Area (km^2)	Potential: Percentage of Protection target attained	Potential: Protection Level
Island - Island - salt dome	33.5	33.5	100.0	17.0	5.7	9.1	159.4	Well protected	26.0	456.7	Well protected
Mountains, rocky terrain and wadis - Jebel Hafit	28.6	28.6	100.0	17.0	4.9	0.0	0.0	Not protected	15.1	309.3	Well protected
Mountains, rocky terrain and wadis - Wadis and floodplains	753.6	753.6	100.0	17.0	128.1	0.0	0.0	Not protected	182.1	142.1	Well protected
Sand sheet, dunes and sabkha mosaic - Liwa crescent dune and sabkha mosaic	3,795.6	3,795.6	100.0	17.0	645.2	9.0	1.4	Not protected	9.0	1.4	Not protected
Sand sheets, dunes and mega dunes - Mega-dunes	15,141.1	14,970.0	98.9	17.0	2,574.0	5,801.7	225.4	Well protected	6,063.9	235.6	Well protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes mainly with perennial herbs or graminoids	10,425.4	10,425.4	100.0	17.0	1,772.3	96.7	5.5	Poorly protected	96.7	5.5	Poorly protected

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in AD	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level	Potential: Protected Area (km^2)	Potential: Percentage of Protection target attained	Potential: Protection Level
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover	799.2	799.2	100.0	17.0	135.9	0.6	0.4	Not protected	71.4	52.6	Moderately protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover	18,705.0	13,758.8	73.6	17.0	3,179.9	131.6	4.1	Not protected	1,056.8	33.2	Poorly protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas	3,357.1	3,357.1	100.0	17.0	570.7	509.6	89.3	Moderately protected	532.2	93.3	Well protected
Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum	1,130.6	1,130.6	100.0	80.0	904.5	0.0	0.0	Not protected	896.3	99.1	Well protected
Deeper than 15m - Deeper than 15m - Arabian Gulf	33,722.2	21,222.3	62.9	10.0	3,372.2	702.2	20.8	Poorly protected	1,919.4	56.9	Moderately protected

Full habitat name	Original Extent (km^2)	Original Extent Abu Dhabi (km^2)	Percentage in AD	Protection Target %	Protection Target (km^2)	Protected Area (km^2)	Percentage of Protection target attained	Protection Level	Potential: Protected Area (km^2)	Potential: Percentage of Protection target attained	Potential: Protection Level
Intertidal - Algal Mats - Arabian Gulf	107.9	107.9	100.0	17.0	18.3	24.6	134.0	Well protected	105.6	575.8	Well protected
Intertidal - Mangroves - Arabian Gulf	127.4	99.9	78.4	80.0	101.9	9.9	9.7	Poorly protected	100.3	98.4	Well protected
Intertidal - Rocky Platforms - Arabian Gulf	164.6	164.6	100.0	17.0	28.0	95.2	340.2	Well protected	163.7	585.0	Well protected
Intertidal - Saltmarsh - Arabian Gulf	48.3	48.3	100.0	80.0	38.6	6.7	17.3	Moderately protected	43.8	113.5	Well protected
Intertidal - Tidal flats (no algal mats) - Arabian Gulf	322.2	311.5	96.7	17.0	54.8	90.1	164.5	Well protected	308.7	563.7	Well protected
Shallow Water Habitats - Coral Reef - Arabian Gulf	172.9	123.6	71.5	80.0	138.3	78.2	56.6	Moderately protected	149.1	107.8	Well protected
Shallow Water Habitats - Other Shallow Water - Arabian Gulf	15,978.9	14,314.3	89.6	10.0	1,597.9	4,324.2	270.6	Well protected	6,784.0	424.6	Well protected
Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf	1,589.6	1,589.6	100.0	80.0	1,271.7	795.6	62.6	Moderately protected	1,548.7	121.8	Well protected

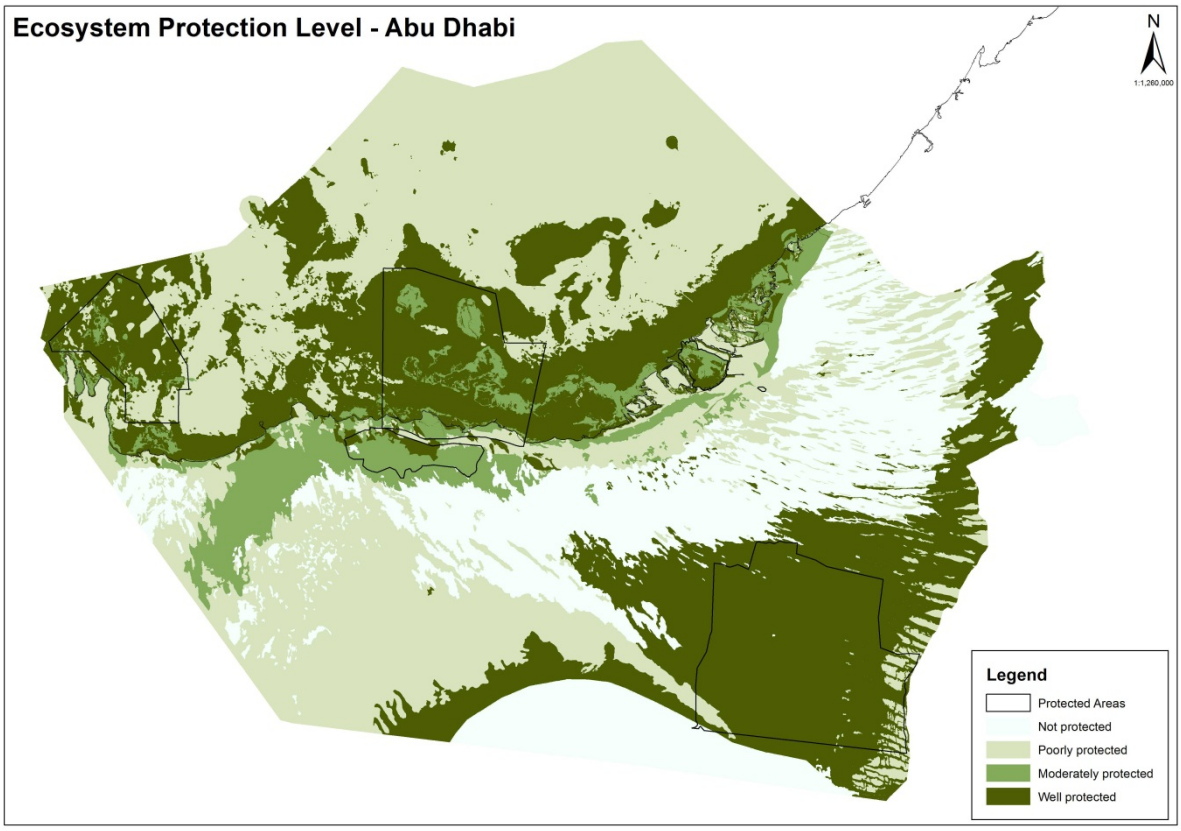


Figure 5-23: Current Ecosystem Protection Level for Abu Dhabi

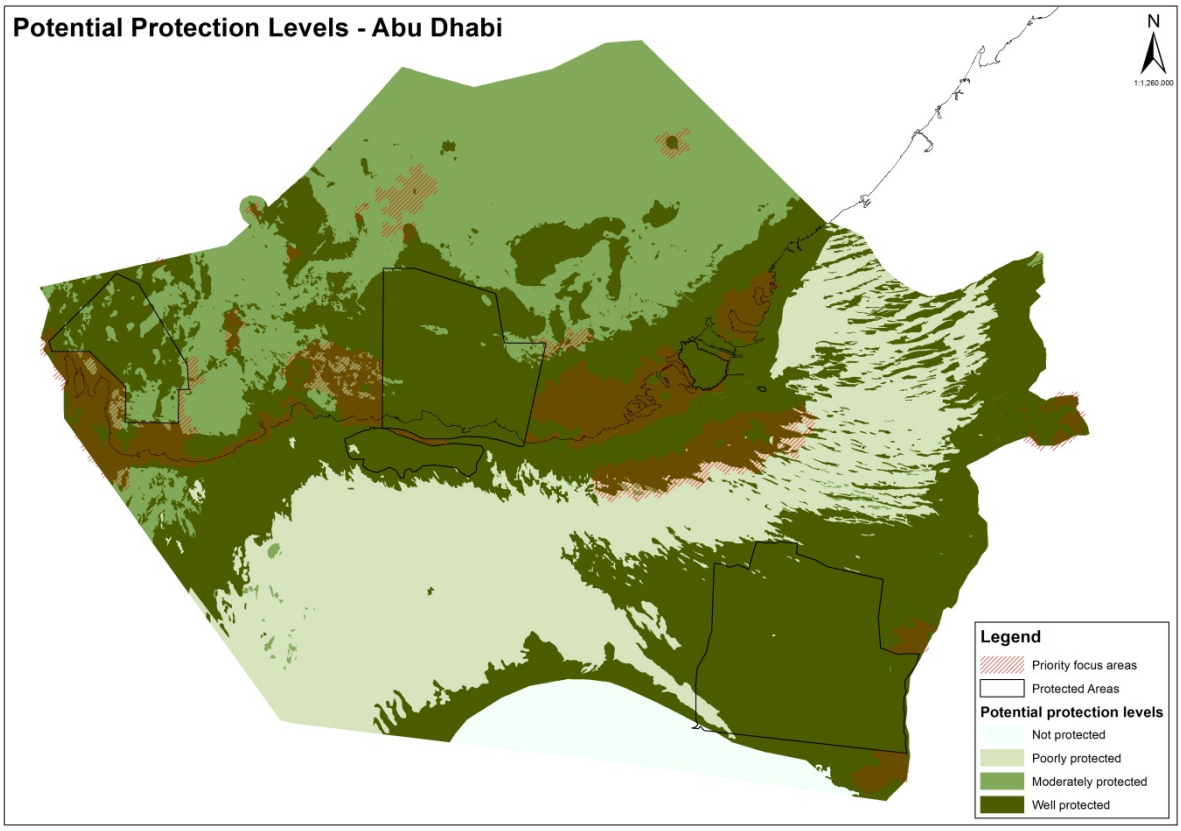


Figure 5-24: Potential Ecosystem Protection Level for Abu Dhabi Assuming Full Implementation of Protection Targets with all PFAs

6 Recommendations

This Project has resulted in a valuable set of products and strong foundation for SCP to become an integral part of EAD programmes. The following recommendations are provided which could be considered in future planning, initiatives and programmes.

6.1.1 Data Inputs

This Project has used existing data that was available in a manageable format within the schedule of the Project. The review of data received for the Project has highlighted areas where improvements could be made to existing datasets or where additional data could be provided to fill gaps in the datasets in Base Data Archive in the future, outside of this Project. These recommendations are provided in brief below:

- Updating of CMRECS (2010).
- Fill gaps in Abu Dhabi soils and vegetation survey data .
- Improve EAD Barqas dataset.
- Improve distinction between coastal sand sheets and inland sabkha – these habitats are hard to distinguish and it is recommended that if further habitat mapping is to be undertaken in the future that these habitats are better distinguished using remote sensing techniques coupled with ground truthing.
- Document planned conservation actions – it would be useful for future conservation planning that known proposed conservation actions are documented in a geospatial database so that they can be incorporated into the derived opportunities layer of the conservation assessment.
- Improve baseline data for species particularly in relation to deep marine species and terrestrial species.
- Data on climate change pressures were not available for the Project. These represent current and future pressures particularly on the marine environment which would assist in identifying habitat condition.

6.1.2 Mainstreaming SCP

SCP can provide a framework for strategic conservation and priority setting as follows:

6.1.3.1 Protected Area Development

The Project outputs provide a list of draft PFAs and which ones could be regarded as priority areas within which Protected Areas should be investigated and implemented. The next steps would be to investigate these areas further to consider the many other factors such as socio-economic benefits, land ownership and local opportunities that influence Protected Area expansion scheduling. This scheduling should be explored in an iterative way with the appropriate bodies such as UPC and ADM.

Detailed fine scale conservation planning then needs to take place 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 Protected Areas is being planned in detail, a number of items need to be considered to facilitate implementation:

- In most cases smaller areas within each Priority Focus Area should be identified for Protected Area expansion, land use controls or other conservation activity. This will aid implementation.
- The PFAs are areas within which targets for biodiversity features can be efficiently met. They are not designed to be used as Protected Area boundaries. In all cases it is recommended that detailed planning of Protected Areas takes place at a local scale.
- The boundaries of PFAs in sites with high levels of transformation (especially coastal areas) need to be particularly examined at a fine scale.
- The boundaries of PFAs should be adjusted to take into account alignment with cultural and heritage issues. For example, boundaries of PFAs could be aligned with protected oases and cultural sites on potential World Heritage Site lists to gain mutual benefit and ease implementation.
- Protected Area development should consider socio-economic costs and benefits as well as implementation opportunities and constraints at a fine scale
- The PFAs have been identified through desk based information and ground truthing these areas would also be necessary to confirm their habitats, extent of transformation and degradation and boundaries.

These results also provide a range of inputs that may be included within current Protected Area management plans.

The outcomes of the SCP process provide an objective and repeatable method to continually identify further protection priorities. In the longer term it is considered good practice that the Abu Dhabi level SCP process is undertaken every five years.

6.1.3.2 *Land Use Planning and Environmental Permitting*

There is strong potential for inclusion of SCP outputs into development planning and land use decision making and this should be explored. SCP outputs have been successfully used elsewhere in these contexts. Its use in South Africa is illustrated in Figure 6-25. SCP provides a robust informant to guide decisions on development. It could help in site option appraisals, EIAs and would enable lists of potential damaging operations to be developed depending on habitat types.

6.1.3.3 *Biodiversity Action Plans*

The outputs from SCP can be used to assist with the CBD's Aichi strategic goals and targets. In particular the ecosystem threat status assessment which identified the threat status of habitat types in Abu Dhabi and the UAE could be used as the basis for biodiversity action planning. Action plans for the most threatened habitats could be developed to aid recovery and allow progress reporting towards the reduction of biodiversity loss called for by the CBD.

6.1.3.4 *Biodiversity Surveying*

The SCP process can provide a structure to prioritize and guide field studies and surveys, as well as other data gathering exercises such as remote sensing of degradation. The habitat map can be used as a basis for a baseline survey sampling strategy.

6.1.3.5 *State of the Environment Reporting*

The headline indicators of Ecosystem Threat Status and Protection Level can form the cornerstone of State of Environment reporting.

6.1.3.6 *Alignment with other EA's EBDB and Environmental Atlas*

The Project's Base Data Archive is compatible with the EAD's EBDB which forms the platform for EADs Environmental Geoportal. The Project has used available data that was utilized for the Environmental Atlas of Abu Dhabi (2011) and outputs from this Project can be included in later versions of the Atlas.

6.1.3 Data Sharing

Currently data collected internally and externally for the Project has been collated into the Base Data Archive geodatabase. This includes data that was used to prepare the Derived Layers and data not used in the Derived Layers (Section 2.8.3). If EAD wish to circulate this data externally, they will need to seek permission from all the data providers (Section 3 of this report). However the Derived Layers geodatabase contains processed geospatial data derived from the original data. These data can therefore be made available to external parties preferably as shapefiles.

6.1.4 Capacity Building and Institutional Framework Strengthening

Many stakeholders showed enthusiasm for the Project and made informal requests for training and capacity building which should be considered in any future SCP initiatives in Abu Dhabi. In particular organisations would benefit from capacity building related to the use of GIS databases, baseline data collection and SCP at a more detailed level.

Given EAD and AGEDI's mandate within the Emirate and its current institutional relationships with external organisations, both are in a good position to promote and establish the process required to deliver SCP and implement its findings successfully in the Emirate. The key players have been identified as part of this Project as data focal points. Data sharing cooperation mechanisms such as Abu Dhabi Systems & Information Centre (ADSIC) already exist in Abu Dhabi which can be used for the data management related to SCP. The development of delivery mechanisms such as forums/working groups specifically designed for SCP would need to be formalised.

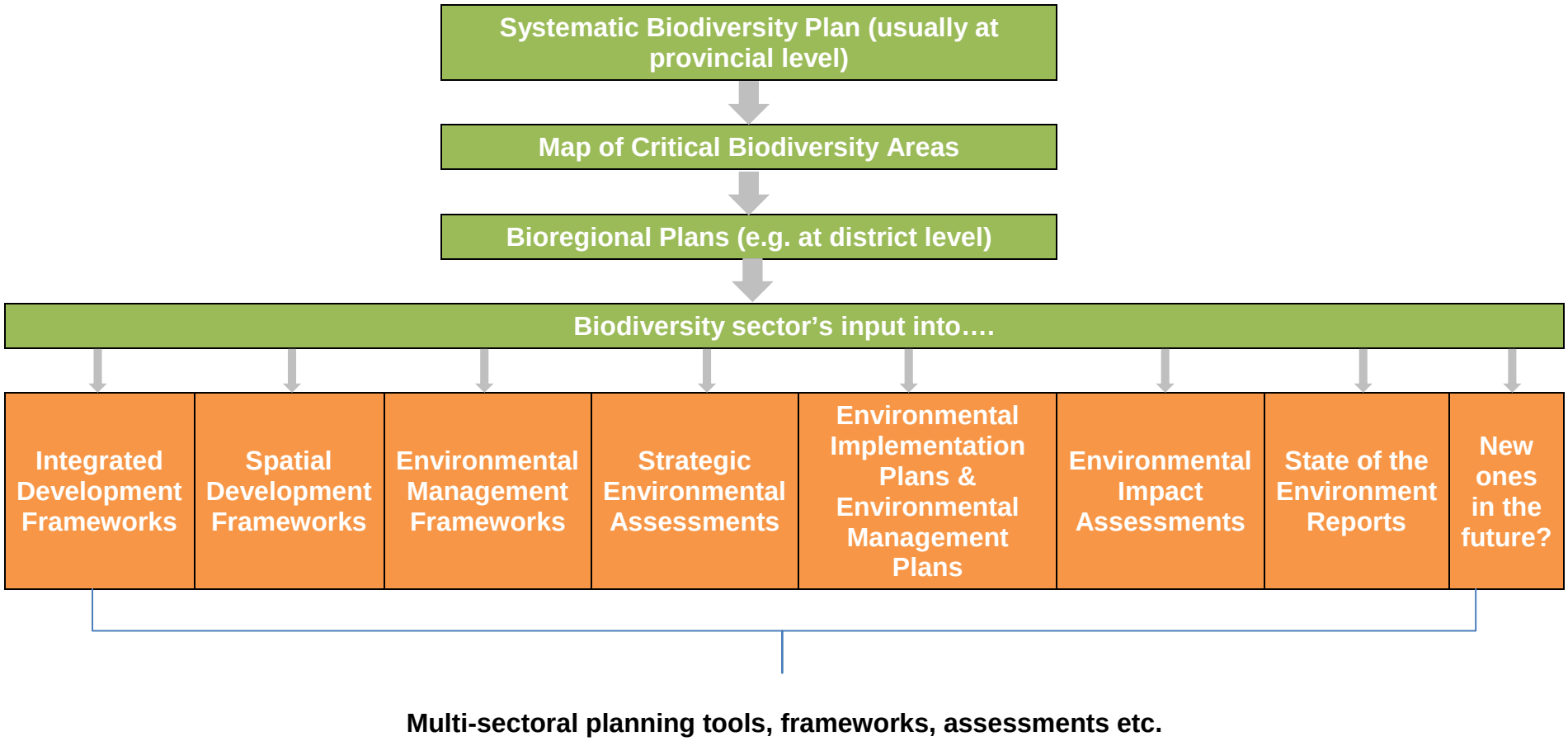


Figure 6-25: Uses of SCP in South Africa

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8 Glossary

Adapted from (Driver et al., 2011)

Biodiversity Action Plan: a plan aimed at ensuring the long-term survival in nature of an indigenous species, a migratory species or an ecosystem. Norms and standards to guide the development of Biodiversity Action Plans should be developed.

Biodiversity stewardship: a model for expanding the protected area network in which conservation authorities enter into contract agreements with private and communal landowners to place land that is of high biodiversity value under formal protection.

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 systematic conservation planning 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.

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: an indicator of 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: 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. Also see National ecosystem classification system.

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. Systematic conservation planning 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.

Offshore benthic: relating to the bottom of the ocean or the seabed.

Offshore pelagic: relating to the water column in the ocean.

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.

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: 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.

9 Technical Appendices

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Appendix D	**Summary of PFA Expert Evaluation**

Appendix A

Base Data Archive Summary

Feature Dataset	Source	Feature Class	Description
Habitat	EAD GISDB SDE database	UAE_GISDB_Habitats	Broad UAE habitat classification from Tatiana Atkinson.
	EAD GISDB SDE database	AD_GISDB_Beachline	General beachline within the Abu Dhabi Emirate.
	EAD GISDB SDE database	AD_GISDB_Coastline	General coastline within the Abu Dhabi Emirate.
	EAD GISDB SDE database	UAE_GISDB_Vegetation	Developed by MSD in 2002, classified into cropland, empty area, mangrove, orchard/plantation, trees, and orchard/palms.
	EAD CMRECS SDE database	AD_CMRECS_Shoreline	General shoreline position within the Abu Dhabi Emirate.
	EAD CMRECS SDE database	AD_CMRECS_Habitat	Fine scale land cover defined by geomorphology, substrate or sessile benthic community associations for the Emirate of Abu Dhabi.
	EAD CMRECS SDE database	AD_CMRECS_MacroHabitat	Moderate scale land cover defined by geomorphology, substrate or sessile benthic community associations for the Emirate of Abu Dhabi.
	EAD CMRECS SDE database	AD_CMRECS_Zone	Defines 6 marine zones (0-5,5-10,10-15,15-20 and >20) and intertidal zones.
	EAD CMRECS SDE database	AD_CMRECS_System	Defines the overall marine influence for the Emirate of Abu Dhabi such as terrestrial, transitional and marine.
	EAD CMRECS SDE database	AD_CMRECS_Land	Land areas within the Emirate of Abu Dhabi.
	GEBCO	AP_GEBCO_CMRECSZone	GEBCO bathymetric depth data to create polygon feature class indicating sea depth Classification the same as the CMRECS data.
	EAD EEBDB SDE database	AD_EEBDB_EcoRegion	Delineate EcoRegions across the Emirate of Abu Dhabi. The characterization features that inform the delineation of boundaries are mainly physical, above or below high water mark landform, elevation, soil characteristics, depth of water table, land use, salinity and marine water depth.
	EAD EEBDB SDE database	AD_EEBDB_EcoDistrict	Delineate EcoDistricts across the Emirate of Abu Dhabi. The characterization features that inform the delineation of boundaries are mainly physical, above or below high water mark landform, elevation, soil characteristics, depth of water table, land use, salinity and marine water depth.
	Tourism Development and Investment Company (TDIC)	AD_TDIC_MarineHabitats	Marine habitats of the following islands: Delma, Gasha, Jebel Dhanna, Kurkum Qasr Hamas Jabr, SBY islands.

Feature Dataset	Source	Feature Class	Description
	EAD CMRECS SDE database	AD_CMRECS_Geoform	Large to moderate scale geomorphological structures formed by solid substrates such as headlands, islands, beaches and lagoons.
	WWF	AP_WWF_meow_ecos	WWF marine ecoregions
	WWF	AP_WWF_terr_ecos	WWF terrestrial ecoregions
	WWF	AP_WWF_tnc_terr_ecoregions	WWF terrestrial ecoregions modified by The Nature Conservancy (TNC) to be used in its biodiversity planning (Ecoregional assessments).
	Environment Agency - Abu Dhabi	AD_EAD_Vegetation_AbuDhabi	Vegetation survey carried out at the same time as the Abu Dhabi Soil Survey.
	EAD GISDB SDE database	AD_GISDB_SoilMapUnitBoundaries500k	Soil survey carried out in the Emirate of Abu Dhabi.
	Abu Dhabi Urban Planning Council	AD_UPC_Habitat	Habitat data from UPC, localized only for Abu Dhabi Island and surrounding area.
	Derived Interim Layer	UAE_Terrestrial_Habitat	Terrestrial Habitat interim derived layer
	ADCO	AD_ADCO_EcologyHabitatClassification	Habitat classification for ADCO concession areas
Species	EAD GISDB SDE database	AD_GISDB_TurtleNests	Turtle nest information collected in 2001.
	EAD GISDB SDE database	AD_GISDB_SpeciesRichness	This derived dataset depicts the density and variety of wildlife species observations, according to a 5 km grid. This was developed by the AGEDI team in May 2008 based on data provided by EAD Departments by that date to provide a picture of where surveys were yielding the greatest density and variety of observations, as a proxy for biodiversity.
	EAD GISDB SDE database	AD_GISDB_MarineSurvey2010	Marine siting's from 2010 for the Emirate of Abu Dhabi.
	EAD EEBDB SDE database	AD_EEBDB_SpeciesObservation	Species observations across the Abu Dhabi Emirate.
	EAD EEBDB SDE database	AD_EEBDB_BreedingArea	Sailfish Breeding Area

Feature Dataset	Source	Feature Class	Description
	EAD EEBDB SDE database	AD_EEBDB_BreedingSite	Breeding sites of Hawksbill Turtle
	EAD EEBDB SDE database	AD_EEBDB_SpeciesDistribution	Species distribution across the Abu Dhabi Emirate.
	Atlas of the Breeding Birds of Arabia	AP_ABBA_BreedingBirdsArabia	Data Digitized using: M Jennings, Atlas of the breeding birds of Arabia, Vol 25, 2010 Scanned images from book were georeferenced and then digitized. Only observations from 1984 and onwards were captured Only those birds that were within the IUCN list and were breeding birds "2" were digitized The comment field uses the description in ABBA to describe the observation type.
	Tourism Development and Investment Company (TDIC)	AD_TDIC_TurtleTrackActivity	Turtle tracking from 2010 on Saadiyat island
	Birdlife International	AP_Birdlife_SpeciesDistribution	Bird species distribution across the Arabian Peninsula.
	Birdlife International	AP_Birdlife_ThreatenedSpecies	Threatened bird species across the Arabian Peninsula.
	IUCN	AP_IUCN_AMPHIBIANS	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Angelfish	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Butterflyfish	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Groupers	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Mammal	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Parrotfish	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Reptiles	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Wrasses	IUCN Red List of Threatened Species
	Abu Dhabi Urban Planning Council	UAE_UPC_FlowerIntersect	Geographic range of over 500 wild flower types within the UAE.
	Breeding Centre for Endangered	AP_BCEAW_HotspotsR	The biodiversity hotspots are regions known to hold especially high numbers of species

Feature Dataset	Source	Feature Class	Description
	Arabian Wildlife	evisited2004Lines	found nowhere else, yet their remaining habitat combined covers a little more than two percent of Earth's land surface. According to the criteria developed by Myers et al (2000)
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_HotspotsRevisted2004Polygons	The biodiversity hotspots are regions known to hold especially high numbers of species found nowhere else, yet their remaining habitat combined covers a little more than two percent of Earth's land surface. According to the criteria developed by Myers et al (2000)
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_AllGMACarnivora	Carnivore distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_ArabianOryx	Arabian Oryx distribution extent
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_ReptilesCompiled	Reptile information collected at Sharjah 2010 conference
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_SpeciesDataFromWorkshop	Species data collected from Sharjah 2010 conference
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_CarnivoresWgs84	Carnivore distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Felines	Feline distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Acanthobrama_hadiyahensis	Acanthobrama hadiyahensis distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Aphanius_sirhani	Aphanius sirhani distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Carasobarbus_exulatus	Carasobarbus exulatus distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Carasobarbus_exulatus_2	Carasobarbus exulatus_2 distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Garra_dunsirei	Garra dunsirei distribution

Feature Dataset	Source	Feature Class	Description
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Garra_ghorensis	Garra ghorensis distribution
	Breeding Centre for Endangered Arabian Wildlife	AP_BCEAW_Garra_longipinnis	Garra longipinnis distribution
	ADCO	AD_ADCO_Birds	Bird monitoring sites used for coastal sensitivity atlas 2000.
	ADCO	AD_ADCO_EcologyWildlifeLocations	Species observations across the Abu Dhabi Emirate.
	ADCO	AD_ADCO_Mammals	Represents the entire collection of mammal records held by ERWDA
	ADCO	AD_ADCO_Reptiles	Representss (X, Y) location and distribution of different types of reptile species throughout the Emirate.
	ADCO	AD_ADCO_Turtles	Sea turtle surveys conducted in Spring and Summer of 2004.
	ADCO	AD_ADCO_HailBirdAreas	Bird Areas relating to Hail
	ADCO	AD_ADCO_ZirkuBirdsNestingSites	Bird nesting sites relating to Zirku
	ADCO	AD_ADCO_ZirkuTurtleNestingSites	Turtle nesting sites relating to Zirku
Ecological Processes	EAD GISDB SDE database	AD_GISDB_Mangroves	This layer depicts the location and extent of significant mangrove habitat along the coast of Abu Dhabi. This information was collected in 2000 as part of the Abu Dhabi Coastal Sensitivity Atlas to support oil spill contingency planning and response The information was extracted from 2000 Landsat satellite data with limited ground truthing.
	EAD GISDB SDE database	AD_GISDB_Sabkha	This layer depicts the location and extent of significant sabkha habitat along the coast of Abu Dhabi. This information was collected in 2000 as part of the Abu Dhabi Coastal Sensitivity Atlas to support oil spill contingency planning and response.
	EAD GISDB SDE database	AD_GISDB_Saltmarsh	This layer depicts the location and extent of significant salt marsh habitat along the coast of Abu Dhabi. This information was collected in 2000 as part of the Abu Dhabi Coastal Sensitivity Atlas to support oil spill contingency planning and response. The information was

Feature Dataset	Source	Feature Class	Description
			extracted from 2000 Landsat satellite data with limited ground truthing.
	EAD GISDB SDE database	UAE_GISDB_Coral	This dataset depicts the location and extent of live and dead coral reefs covering the offshore islands and near shore areas of Abu Dhabi Emirate and eastern Qatar. This study, referred to as Coral Reef Investigations In Abu Dhabi and Eastern Qatar, was conducted from 2005-2007, was sponsored by Dolphin Energy, managed by the Emirates Wildlife Society, and implemented by the Environment Agency Abu Dhabi and the Supreme Council for the Environment and Natural Reserves, with technical and training support from the National Coral Reef Institute (Florida, USA).
	EAD GISDB SDE database	AD_GISDB_Seagrasses	This layer depicts the location and extent of significant seagrass habitat along the coast of Abu Dhabi. This information was collected in 2000 as part of the Abu Dhabi Oil Spill Protection Priorities Atlas 2000 to support oil spill contingency planning and response. The information was extracted from 2000 Landsat satellite data with limited ground truthing.
	EAD GISDB SDE database	AD_GISDB_CoastalSoils	Soil boundaries were delineated from 775 GPS-surveyed sample points with 15 to 20-meter accuracy in 2003/2004 undertaken by EAD for the coastal strip of Abu Dhabi emirate. This dataset will be supplemented with results from the on-going soil survey.
	EAD GISDB SDE database	AD_GISDB_Wetlands	The boundaries of the protected areas in Abu Dhabi are depicted in this layer. These areas were declared as protected areas in 2001 and are managed by EAD. The protected areas are classified into marine and terrestrial. There are other protected areas in the emirate of Abu Dhabi managed by other authorities such as Private Departments, Emirates Heritage Club, etc. and these are not included in this layer. The purpose of the data layer is to be able to manage and monitor the designated protected areas.
	EAD GISDB SDE database	UAE_GISDB_Wells	This map service includes the location and basic characteristics of over 42,000 water wells within Abu Dhabi Emirate.
	EAD GISDB SDE database	UAE_GISDB_WLDecline 2007	This data represents the amount of groundwater decline between (ADD YEAR/MONTH) and March 2007. Decline regimes (areas of average decline between isolines) are measured in meters. This information has been derived from data being collected by the EAD as part of a comprehensive groundwater monitoring program.
	EAD GISDB SDE database	AD_GISDB_WLDecline2 008	Very limited geographical extent of groundwater decline in 2008
	EAD EEBDB SDE database	AD_EEBDB_WaterBody	Water bodies across the Emirate of Abu Dhabi

Feature Dataset	Source	Feature Class	Description
	EAD EEBDB SDE database	AD_EEBDB_WellLocations	Well locations across the Emirate of Abu Dhabi
	UNEP-WCMS	AP_WCMS_Arabian_Peninsula_USGS_Mangroves	Mangrove data across the Arabian Peninsula, compiled using recently available Global Land Survey (GLS) data and the Landsat archive
	UNEP-WCMS	AP_WCMS_Mangrove1997	Mangrove data across the Arabian Peninsula
	UNEP-WCMS	AP_WCMS_seagrass05pt	Seagrass point data across the Arabian Peninsula
	UNEP-WCMS	AP_WCMS_seagrass05py	Seagrass polygon data across the Arabian Peninsula
	UNEP-WCMS	AP_WCMS_CoralReef2010	Coral reef across the Arabian Peninsula
	University of New York - Abu Dhabi	UAE_NYU_DenseCoralPolygons	Coral reef across the UAE provided by John Burt at NYU Abu Dhabi.
	IUCN	AP_IUCN_CORAL	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Mangroves	IUCN Red List of Threatened Species
	IUCN	AP_IUCN_Seagrasses	IUCN Red List of Threatened Species
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_Forest	Forests across the Emirate of Abu Dhabi
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_Oasis	Oasis across the Emirate of Abu Dhabi
	Abu Dhabi Authority for Tourism and Culture	AlAin_ADACH_Wadi	Wadis in the Al Ain Region
	Abu Dhabi Authority for Tourism and Culture	AlAin_ADACH_Slope20PercentorHigher	Slopes 20% or higher in the Al Ain Region

Feature Dataset	Source	Feature Class	Description
	ADM	AD_ADM_ForestPlots	Forest plots across the Emirate of Abu Dhabi
	ADM	AD_ADM_SurfaceWaterBodies	Surface water bodies across the Emirate of Abu Dhabi
	CGIAR CSI Consortium for Spatial Information	NASA Shuttle Radar Topographic Mission (SRTM) 90m v4	90m Digital elevation model (global coverage) - Within BDA only AP extent
	GEBCO	EP_GEBCO_Masked_AP	Bathymetric Raster Depth Data.
	Derived Layer	AP_GEBCO_Contour	Contour data derived from GEBCO data
	ADCO	UAE_ADCO_HighWaterLine	High water line for the UAE
	ADCO	UAE_ADCO_LoweWaterLine	Low water line for the UAE
Pressures / Condition	EAD GISDB SDE database	UAE_GISDB_Roads	Road Network of UAE
	EAD GISDB SDE database	AD_GISDB_PowerStations	Power station locations across the Emirate of Abu Dhabi (points)
	EAD GISDB SDE database	AD_GISDB_CamelDistribution	Camel Distribution across UAE
	EAD GISDB SDE database	AD_GISDB_DumpArea	Dump areas across Abu Dhabi
	EAD GISDB SDE database	AD_GISDB_Goats2008	Goat Distribution across UAE
	EAD GISDB SDE database	UAE_GISDB_PoultryLocations	Poultry locations across UAE
	EAD GISDB SDE database	AD_GISDB_ReclaimedAnalysis	This feature class represents the analysis for reclaimed lands in Abu Dhabi Island, from 1963 to 2008.
	EAD GISDB SDE database	UAE_GISDB_WasteClassification	Waste classification across UAE

Feature Dataset	Source	Feature Class	Description
	EAD GISDB SDE database	AD_GISDB_WasteSitings	Dump locations in Liwa and Western Region
	EAD GISDB SDE database	AD_GISDB_DredgingChannel	This map service depicts the location and extent of dredged channels along the coast of Abu Dhabi. This information was collected in 2000 as part of the Abu Dhabi Coastal Sensitivity Atlas to support oil spill contingency planning and response. The information was extracted from 2000 Landsat satellite data with limited ground truthing and reference to British Admiralty charts at various scales.
	EAD CMRECS SDE database	AD_CMRECS_Dredged Areas	This dataset describes dredged areas within the Abu Dhabi Emirate as part of the web-based Coastal Resources Atlas (CRA).
	EAD EEBDB SDE database	AD_EEBDB_LandCover	Land cover across Abu Dhabi Emirate
	EAD EEBDB SDE database	AD_EEBDB_Permanent MadeSurfaces	Permanent made surfaces across Abu Dhabi Emirate
	EAD EEBDB SDE database	AD_EEBDB_IndustrialFacilities	Incomplete dataset, industrial facilities across the Emirate of Abu Dhabi
	EAD EEBDB SDE database	AD_EEBDB_CommIndustFacility	Identical to Industrial facilities feature class. Incomplete dataset, industrial facilities across the Emirate of Abu Dhabi.
	EAD EEBDB SDE database	AD_EEBDB_WasteFacility	Waste facilities across Abu Dhabi Emirate (point)
	EAD EEBDB SDE database	AD_EEBDB_Powerlines	Powerline across Abu Dhabi Emirate
	EAD EEBDB SDE database	AD_EEBDB_RoadSegment	Road network across Abu Dhabi Emirate
	EAD EEBDB SDE database	AD_EEBDB_DesalPlant	Desalination plants across Abu Dhabi Emirate
	EAD EEBDB SDE database	AD_EEBDB_WasteWaterPlant	Waste water plants across Abu Dhabi Emirate
	National Oceanic and Atmospheric Administration	UAE_NOOA_GasFlares	Gas Flares across UAE
	EAD EEBDB SDE database	AD_EEBDB_OceanOutfa	Ocean outfall points across Abu Dhabi Emirate

Feature Dataset	Source	Feature Class	Description
		ll	
	EAD EEBDB SDE database	AD_EEBDB_LandUse	Land use across Abu Dhabi Emirate.
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_Roadcentreline	Road network for Abu Dhabi Emirate
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_RoadSurface	Road Surface across Abu Dhabi Emirate
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_Plots	Plot boundaries across Abu Dhabi Emirate (land use)
	ADM	AD_ADM_Buildings	Building boundaries across Abu Dhabi Emirate
	ADM	AD_ADM_Plots_LandUse	Plot boundaries across Abu Dhabi Emirate (land use)
	ADM	AD_ADM_RoadCentreLines	Road centreline across Abu Dhabi Emirate
	EAD EEBDB SDE database	AD_EEBDB_LandingSites	Landing Sites for the Emirate of Abu Dhabi
	ADCO	AD_ADCO_Farms	Represents Farming areas across the Emirate of Abu Dhabi
	ADCO	AD_ADCO_Infrastructure	Depicts the location and extent of coastal built-up areas along the coast of Abu Dhabi. This information was collected in 2000 as part of the Abu Dhabi Coastal Sensitivity Atlas to support oil spill contingency planning and response. The information was extracted from 2000 Landsat satellite data using general, visual interpretation with limited ground truthing.
	ADCO	AD_ADCO_MainGasLineDasIsland	Main gas line for Das Island
	ADCO	AD_ADCO_PetroleumPort	Petroleum port for the Emirate of Abu Dhabi
	ADCO	AD_ADCO_TankerRoute	Tanker route aross the Emirate of Abu Dhabi

Feature Dataset	Source	Feature Class	Description
	ADCO	UAE_ADCO_OilGasPipeline	Oil and gas pineline for the UAE
	ADCO	UAE_ADCO_PlantationDates	Date plantations across UAE
	ADCO	UAE_ADCO_PlantationFruits	Fruit plantations across UAE
	ADCO	UAE_ADCO_PlantationTree	Tree plantations across UAE
	ADCO	UAE_ADCO_TankOilGas	Tank location for Oil and gas across the UAE
	ADCO	AD_ADCO_ZikuOilTanks	Oil tank locations around Zirku
	ADCO	AD_ADCO_ZirkuRoads	Road network of Zirku
	ADCO	AD_ADCO_ZirkuRunway	Airport runway on Zirku
	ADCO	AD_ADCO_ZirkuTempBuildings	Temporary buildings on Zirku
	ADCO	AD_ADCO_MainOilLineDasIsland	Main oil line for Das Island
	ADCO	UAE_ADCO_Powerlines	Powerlines across the UAE
Protected Areas	EAD GISDB SDE database	AP_GISDB_ProtectedAreasArabPenuns	Protected areas across the Arabian Peninsula, Data collection from different sources on the Biodiversity conference Sharjah (2010).
	EAD CMRECS SDE database	AD_CMRECS_MarineProtectedAreas	Marine protected areas in Abu Dhabi (3)
	EAD EEBDB SDE database	AD_EEBDB_ProtectedArea	Various types of protected areas across the Emirate of Abu Dhabi.
	Abu Dhabi Urban Planning Council	AD_UPC_ProtectedAreas	Protected area from UPC

Feature Dataset	Source	Feature Class	Description
	Abu Dhabi Urban Planning Council	AD_UPC_NatureReserve	Nature Reserve from UPC
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_AlAinWHSBoundaries	World heritage site boundaries in Al Ain.
Opportunities / Constraints	EAD GISDB SDE database	UAE_GISDB_PearlDiving	The Pearl diving sites shown on this Dataset are based on the 'Map of Pearl Diving in the Arabian Gulf between the Arabic and the Iranian Coasts' by Sheikh Mani' Bin Sheikh Rashid Al Maktoum, which contains the following statement: this dataset has been compiled for the benefit of everyone working in the pearl business. The editor has compiled the map from old charts and from his own visits to the pearl diving sites between Ras Abu Ali (Saudi Arabia) and Ruus Al jibal (Mussandam Peninsula).
	EAD GISDB SDE database	AP_GISDB_CombinedImportantBirdArea	Data collection from different sources on the Biodiversity conference Sharjah. This dataset represents the distribution of different birds on the Arab Peninsula, classified by area name (290 areas).
	EAD GISDB SDE database	AD_GISDB_Bird	This map service illustrates the bird monitoring sites used for coastal sensitivity Atlas 2000. Of the 104 total documented sites, data has been collected at 85 sites. Monitoring began prior to 2000 and is on-going, however, monitoring occurs variably for each monitoring site, i.e. not all sites are monitored every month and the number of times a site gets monitored each month varies.
	EAD GISDB SDE database	UAE_GISDB_EIAFootprints	For new or pre-existing "Projects" or areas where new development is occurring or industrial facilities existed prior to EIA regulations, environmental impact assessments are conducted at some level. For each assessment, Project boundaries have been developed, as shown in this layer, which depicts location and extent of Projects. For each Project, there are various levels of environmental data available that can benefit baseline or monitoring data for various constituents.
	EAD GISDB SDE database	AD_GISDB_CoastalSensitiveAtlas	ADNOC approached EAD to participate in a major oil spill response exercise, Operation Ghazal, to be held in 1999. EAD was to provide timely environmental advice to the responding agencies on matters such as protection priorities and clean up. As such, EAD developed the Environmental Sensitivity Index (ESI) atlas for the coastline of Abu Dhabi in 2000.

Feature Dataset	Source	Feature Class	Description
	EAD GISDB SDE database	AD_GISDB_Archaeology	This layer depicts the location of archaeological, paleontological, and heritage points covering parts of Abu Dhabi Emirate, excluding Al Ain, as a density grid. The 5 km x 5 km grid protects the exact location of the archaeological sites, data originally collected by the Abu Dhabi Island Archaeological Survey (ADIAS) between the early '90's and the present, while demonstrating the distribution and density of these important, historic sites across the Emirate.
	EAD CMRECS SDE database	AD_CMRECS_Archaeology_Sites	This dataset describes coastal archaeology sites of the Abu Dhabi Emirate as part of the web-based Coastal Resources Atlas (CRA).
	EAD CMRECS SDE database	AD_CMRECS_FishingRightBoundaries	This dataset describes the boundaries of fishing rights areas within the Abu Dhabi Emirate as part of the web-based Coastal Resources Atlas (CRA).
	EAD EEBDB SDE database	AD_EEBDB_DevelopInfraProject	Development and infrastructure Project across the Emirate of Abu Dhabi.
	EAD EEBDB SDE database	AD_EEBDB_AvianArea	Avian areas across the Emirate of Abu Dhabi.
	EAD EEBDB SDE database	AD_EEBDB_BuhoorArea	Buhoor areas across the Emirate of Abu Dhabi.
	Environment Agency - Abu Dhabi	UAE_EAD_BirdWetlandLocations	Created from Salim Javed at EAD documents and coordinates to create wetland bird areas for UAE. Polygons need verifying as some of the coordinates did not appear to plot in the correct location. Only wetland sights with large bird populations were plotted.
	Umm Al Quwain Municipality	UQA_UQAM_PlannedDevelopment	Planned developments in Umm Al Quwain.
	Birdlife International	AP_BirdlifeInt_IBAPoly	Important bird area polygon
	Birdlife International	AP_BirdlifeInt_IBAPoint	Important bird area points
	Tourism Development and Investment Company (TDIC)	AD_TDIC_Saadiyat_Dune_Protection_Zone	Dune protection zone on Saadiyat Island, Abu Dhabi
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_PlanGreenArea	Planned green areas for Abu Dhabi
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_PlanPlots	Planned plots for Abu Dhabi

Feature Dataset	Source	Feature Class	Description
	Department of Municipal Affairs - Abu Dhabi	AD_DMA_Vegetation	Vegetated areas for Abu Dhabi
	Abu Dhabi Urban Planning Council	AD_UPC_DevProject	Development Project for Abu Dhabi
	Abu Dhabi Urban Planning Council	AD_UPC_CoastalStewartshipZone	Coastal Stewardship zone
	Abu Dhabi Urban Planning Council	AD_UPC_CoastalPark	Coastal park
	Abu Dhabi Urban Planning Council	AD_UPC_CoastalConservationZone	Coastal conservation zone
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_AlAinWHSBufferZones	Al Ain World heritage site buffer zones
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_Plan_AlAin2030_UrbanGrowthBoundary	Al Ain 2030 Urban growth boundary
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_CulturalFacilities	Cultural facilities across the Emirate of Abu Dhabi
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_archaeological_sites	Archaeological sites across the Emirate of Abu Dhabi
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_liwa_forts	Liwa fort locations
	Abu Dhabi Authority for Tourism and Culture	AD_ADACH_murawah	Murawah archaeological sites
	ADM	AD_ADM_GreenAreas	Green areas across Abu Dhabi
	ADCO	AD_ADCO_Archaeology_Buffer	Used for planning purposed Archaeology zoning
	ADCO	AD_ADCO_LandUseCon	ADCO Concession Area

Feature Dataset	Source	Feature Class	Description
		cessionArea	
	ADCO	AD_ADCO_LanUseOilfields	Oilfield locations across the Emirate of Abu Dhabi
	EAD GISDB SDE database	UAE_GISDB_Oilfields	This file depicts the locations of oil field locations as derived from the 1989 British Petroleum 1:500K topographic basemap.
Other Layers	Derived Layer	AD_Planning_Domain	Derived extent of planning units for Marxan analysis
	Derived Layer	UAE_Planning_Units	Derived extent of planning domain for Marxan analysis
	VLIZ Maritime Boundaries Geodatabase	AP_VLIZ_WorldEEZ_v6	Maritime boundaries of the world

Appendix B.1

Abu Dhabi and UAE Terrestrial and Marine Habitat Map & Workshop Decision Tables

Local, National Regional Biodiversity Assessment Project
Project Ref: PCD-NK/AGEDI/Biodiversity Assessment/82/11

Terrestrial Habitat Workshop – 27th June 2012
Decision Table

Ref: MU000945_F05_10_01

ID.	Issue	Summary Discussion During Workshop	Decision During Workshop	Post-Workshop Actions
1	Mountains – no habitat classification was assigned due to the soil survey not covering this area of the UAE.	Essentially everything north of the Dibba Zone is carbonate and to the south, almost everything is part of the ophiolite suite of rocks and essentially no limestone. Exceptions within the UAE are (1) Jebel Hafeet, (2) the outlying rocky hills west of the gravel plains, and (3) areas in the tectonically complex Dibba zone. Many mountain plant species cross this boundary, but some 30 common ophiolite species are absent or rare in the carbonate mountains to the north. Only a few species, however, are restricted to the carbonate and avoid the ophiolite zone. It was noted that that Jebel Hafeet has a different geology and associated flora more akin to the adjacent Hajar Mountains and is thus identified as a separate habitat unit.	Divide mountains geologically and into three categories: • Carbonate (both limestone and dolomite) • Ophiolite • Other geology It was also agreed that 'Other Rocky Habitats' would be absorbed into the 'Mountain' classification.	Workshop recommendations on the geology split and incorporation of "other rocky habitats" were implemented in full using UAEU (1993)[1] to divide mountain areas based on geology.
		For UAE purposes, 900m is a useful approximation of the level at which elements of the high elevation flora become prominent and elements of the lower elevation flora diminish significantly or disappear.	To further divide the carbonate and ophiolite mountain categories by altitude to reflect major plant community differences:	The resolution of contour data using Jarvis et al (2008)[2] data for altitude was of poor quality; hence the 800m contour was used to provide a 100m buffer and ensure that all high altitude habitats were sufficiently captured.

[1] United Arab Emirates University (1993). *The National Atlas of the United Arab Emirates*. United Arab Emirates: United Arab Emirates University in association with GEOprojects (U.K.) Ltd.
[2] Jarvis A., H.I. Reuter, A. Nelson, E. Guevara, 2008, *Hole-filled seamless SRTM data V4*, International Centre for Tropical Agriculture (CIAT), available from http://srtm.csi.cgiar.org

ID.	Issue	Summary Discussion During Workshop	Decision During Workshop	Post-Workshop Actions
			• below 900m • above 900m	
		Wadis - fresh water wadis are considered different from one another. Thus, classification should be divided into wadis and freshwater wadis and it was recommended to follow the information within Gary Feulner's paper on 'Wadi Fish of the UAE' published in 1998.	1) Divide wadis into: • Major freshwater wadi systems • Other wadis This provides a classification in the mountain areas: 1. Carbonate mountain habitat below 900m 2. Carbonate above 900m 3. Ophiolite below 900m 4. Ophiolite above 900m 5. Other geology below 900m 6. Other geology above 900m 7. Major freshwater wadis 8. Other wadis 9. Jebel Hafeet	The recommendation on wadis was implemented using Feulner (1998)[3] to identify freshwater wadis in the UAE. Therefore, the revised classification used for mountains areas is: • Carbonate mountain habitat below 800m • Carbonate above 800m • Ophiolite below 800m • Ophiolite above 800m • Other geology below 800m • Other geology above 800m • Major freshwater wadis • Other wadis • Jebel Hafeet
2	Barqas or Mesas – presently are undifferentiated in	It was discussed that Barqas were not particularly different botanically from their surrounding habitats, but they were found to	It was agreed to amend the description of dunes to 'Rolling Sand Dunes with	The EAD Barqas dataset was assessed and found that it was incomplete with many Barqas not being mapped, that it was a point map rather than a map of the actual

[3] Feulner, G.R. (1998). *Wadi Fish of the UAE*. Tribulus, Volume 8.2: 16-22.

ID.	Issue	Summary Discussion During Workshop	Decision During Workshop	Post-Workshop Actions
	dunes within the UAE's Western region.	shelter various important faunal species such as reptile, owl and cat species. It was noted that the EAD held a potentially relevant dataset within 'Place Names' that provided locations of Barqas.	Barqas'. Also, it was agreed to review EAD's 'Place Names' data to determine if these could be used to identify Barqas within the UAE.	habitat extent (and therefore would require very significant additional mapping to convert this to a habitat map), and that a high proportion of point locations were inaccurate. Therefore this dataset could not be used for the terrestrial habitat map. The description of dunes was amended to 'Rolling Sand Dunes with Barqas'. Not that as for the Liwa cresent, the habitat is in fact a mosaic, and hence ecologically is best dealt with as a single unit from a conservation planning perspective.
3	Saltmarsh	There was a discussion as to why saltmarshes were not identified in the terrestrial habitat map but it was clarified that these were covered under the marine habitat classification.	To be delineated within the marine habitat map.	None.
4	Islands – these are not classified and no soil survey undertaken at these locations.	It was agreed that islands are indeed significantly different from the mainland habitats and should have their own habitat classifications.	Classify islands as two habitats: • Island - salt dome; and • Island - other.	New classification created as set out. Habitat types were identified using UAEU (1993).

Terrestrial Habitat Workshop – 27th June 2012
Decision Table

Ref: MU000945_F05_10_01

ID.	Issue	Summary Discussion During Workshop	Decision During Workshop	Post-Workshop Actions
5	Interdunal plains / sabkhas	Liwa crescent: It was discussed that the gravel plains within the Liwa crescent were not individually identified at this scale by the soil survey map. Furthermore, the habitats are dynamic and form an ecologically integrated unit, and hence are best identified as a mosaic.	Liwa crescent: The Liwa crescent was identified as 'Liwa Crescent Dune and Sabkha Mosaic'.	New classification created: Liwa Crescent Dune and Sabkha Mosaic.
		Dubai interdunal / alluvial plains: It was noted that there were no sabkhas north of Jebel Hafeet. Due to the lack of soil survey data for the Emirate of Dubai, this area was not classified in detail prior to workshop. However, it was noted that these habitats were significantly different from Abu Dhabi's interdunals plains and should be classified separately.	Dubai interdunal / alluvial plains: These were classified as 'Northern Alluvial or Interdunal Plains'.	New classification created: Northern Alluvial or Interdunal Plains.
6	Coastal vs. Inland sabkhas	There was a discussion on how to distinguish between coastal and inland sabkhas. There was no significant difference noted between the coastal and near-coastal habitat types.	It was agreed to check all these to determine if they were sensibly classified.	A rapid assessment of the all sabkha polygons was undertaken and it was determined that they were indeed correctly classified.
7	Targets	There was a discussion on targets; it was noted that the original CBD target was 12% but this had been amended at the Aichi conference to	It was decided to use the CBD Aichi 17 % target for terrestrial habitats. For spatial	Target reallocation will be explored in the spatial prioritization stage.

ID.	Issue	Summary Discussion During Workshop	Decision During Workshop	Post-Workshop Actions
		17%. Under any target system, there is the possibility to reallocate areas from common habitats (such as desert types) to those that are most rare (such as coastal dune habitats) and hence seek to protect greater proportions of the most threatened habitats. There was a discussion on the quality of Protected Areas and it was noted that even if some are poorly performing this was beyond the scope of the project. However, prioritising additional areas would best achieved through the identification of important opportunity areas such as Important Bird Areas. There was broad agreement that the CBD Aichi target provided a politically acceptable and reasonable target for this project.	prioritization, targets may be adjusted to reallocate areas from common habitats to those that are rare.	
8	Comments of circulated draft map and classification	Dick Hornby 01/08/12 Map colours Distribution of trees in desert and plains does not stand out at all well. Specific comments on the mapped units: “Northern alluvial or interdunal plains” is very		The habitat map is a proxy input layer into Marxan for this project and therefore the colours are not significant. Although it is not relevant to the conservation planning process and its outcomes, it is the mapping issue is noted, and will ensure that these units do show up clearly. Response to specific comments on mapped units: The habitat classification and description have been

ID.	Issue	Summary Discussion During Workshop	Decision During Workshop	Post-Workshop Actions
		under-represented. The Acacia plain near madam is shown as "Wadis and floodplains". Do Northern plains have trees, by definition? Sabkha is shown in the middle of Jebel Dhana, which is 80m. high. It is a diapiric salt dome. "Rolling dunes with barqas" is not a good name, as most people don't know what barqas are. Also the barqas are confined to the north-west of the very large area covered by this habitat. Outlying patches of "rolling dunes with barqas" do not match up with Google Earth. I am sure there are not any barqas there! Query about the habitat east of Jebel Hafeet? Patches near Al Hayer look wrong.		amended to reflect comments. The habitat descriptions have been amended to more clearly describe tree cover, and the classification of incorrectly identified polygons has been corrected.

Local, National Regional Biodiversity Assessment Project
Project Ref: PCD-NK/AGEDI/Biodiversity Assessment/82/11

Marine Habitat Workshop – 28th June 2012
Decision Table

Ref: MU000945_F05_10_01

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
1	Oyster beds + Fan clam habitats	Discussion on the location of both oyster beds and fan clam habitats. But it was agreed that data on both were not comprehensive across the planning domain and the only mapping that exists is in the form of crude diagrammatic maps from the 1980s. Also EAD has some pearl diving information, which was displayed during the workshop, but it was decided the data was insufficient and not comprehensive.	Data is not comprehensive enough to be used and the available data could only be included in the species derived layers and thence, the spatial prioritization.	Improving spatial data on special and fine scale habitats will be flagged as a task for future research activity.
2	Water depth	It was discussed whether 15m was a sound division between the shallow and deep water habitats (this division is dependent on light penetration).	The decision, supported by the approach in the CMRECS analysis, was that the depth categories of 0-15m and 15m+ were the best to separate shallow (e.g. coral and seagrass habitats) and deep water habitats.	Already divided at 15m, no further action required.
3	Turtle nesting beaches and habitats	There was a discussion on why turtle nests or beach habitats were not identified on the marine habitat map. It was noted that good quality data existed for turtle nesting beaches, especially within Abu Dhabi, Sharjah and Dubai. It was explained that the turtle breeding beaches are not a specific habitat type, but rather represent the subset of the available beaches which the turtles use for breeding. Therefore these data are more appropriate for the spatial prioritization rather than the habitat mapping.	These data would be included in the derived species layers and the subsequent spatial prioritization. These will also be further discussed in the upcoming species workshop.	None.

Marine Habitat Workshop – 28th June 2012
Decision Table

Ref: MU000945_F05_10_01

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
4	Macro-algal beds	There was a discussion on the value of adding macro-algal beds, which were a widespread habitat type. It was noted that they were important spring habitats for young fish. It was also noted that algal beds were transient habitats and normally associated with hard surface substrates. The data for Abu Dhabi was not regarded as reliable. However, sub-tidal algal mat data (at 2-3m) was available for Dubai but as the sub-tidal algal mat data is not comprehensive, it could not be used to represent the UAE. Both seagrass and algal habitat datasets were extracted from remotely sensed data and were impossible to distinguish.	It was agreed that seagrass habitat type would be amended to 'Seagrass / Macro-algal Beds'.	Classification amended to 'Seagrass / Macro-algal Beds'.
5	Corals	1) It was noted that on the north east coast of UAE, the marine habitat map did not include any of the recorded coral distribution (including 10 sites near Fujairah and approximately 2km^2 near Khor Fakkan). 2) The value of artificial structures to support corals was discussed; these habitats were, in some cases, more species rich than natural sites. However, including artificial structures within a natural habitat classification was illogical. However, their value was important to capture within the overall spatial prioritization.	1) John Burt from NYU-AD offered his data to supplement the coral distribution gap within the marine habitat map. 2) It was agreed that coral habitats on artificial structures should be identified within the spatial prioritization.	1) John Burt data incorporated into the marine habitat map. 2) Will be included in the spatial prioritization.
6	Mangroves	1) There was a discussion on the identification of the original extent of mangroves especially around Abu Dhabi. There has been extensive and highly successful planting undertaken such that low density mangrove	1) It was agreed to acknowledge that the mangrove habitat distribution reflected	1) None.

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
		areas have been transformed into high density habitats as well as entirely new areas planted. It was noted that this planting had transformed natural intertidal habitats. The accurate mapping of the original mangrove habitat extent does not exist. However, it was noted that a report on the current distribution of mangroves within the UAE is available through Marine Resource Research Centre – Umm Al Quwain.	both natural and planted areas, and that the 2010 data was to be used as the baseline.	
		2) It was noted that Khor Kalba was missing from the marine habitat map. Khor Kalba was described as the largest mangrove habitat on the east or south coast of the Arabian Peninsula and it has the only or nearly the only UAE populations of several species of birds, lizards, crabs, gastropods and nudibranchs.	2) It was agreed to review the area of mangroves within Khor Kalba and add to the marine habitat map.	2) Area of Khor Kalba was reviewed and is included within the integrated habitat map.
7	RAMSAR	There was a discussion on the suitability of the RAMSAR habitat classification / definitions within the marine habitat map. The rationale was that this would provide a strong link to existing policies related to wetland conservation. However there was a discrepancy between the depth categories used by RAMSAR and the current classification, which were not easily resolved.	It was agreed that the RAMSAR marine classification could not be utilized within the marine classification.	None.

Marine Habitat Workshop – 28th June 2012
Decision Table

Ref: MU000945_F05_10_01

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
8	Islands	1) There was a discussion on whether Islands should be included within the marine or terrestrial classifications. 2) Furthermore, the breakdown of habitats on islands between beach or sand and salt dome was discussed.	1) It was agreed that islands are best dealt with within the terrestrial classification. 2) It was agreed that it was ecologically sensible to separate salt dome habitats from other island habitats.	New classification created: island – salt dome. These were identified from the National Atlas of UAE.
9	Targets	There was a discussion on targets; there was a difference between political and aspirational targets. It was noted that the ENV2030 plan did include targets but did not identify critical habitats. A UAE 2020 plan by the Prime Minister's office was under discussion (a draft would be available in three months) and biodiversity targets would be included, but had not yet been defined. A strategic plan for protected areas was being prepared and would be available by the end of the year and would take account of a recent CBD workshop. The CBD targets were generally regarded as low, but were available to be used.	It was decided to use the CBD Aichi 10 % target for marine habitats. A 17% target would be used for the coastal types (e.g. mangroves and saltmarshes) as this fitted within the CBD framework, but better reflected identified strategic priorities.	None.

Marine Habitat Workshop – 28th June 2012
Decision Table

Ref: MU000945_F05_10_01

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
10	Comments on circulated draft	Dick Hornby 01/08/12 Accuracy of mapping of coastal areas especially around Abu Dhabi does not reflect historical maps (e.g. 1950s). Including: • Abu Dhabi Island is shown as sabkha, but it shows the modern outline of Abu Dhabi. • Intertidal flats far more extensive in Bu Syayeef and around Dabbiyah. • Sammaliyah, Umm Lifaina and Umm al Nar Islands are shown as sabkha. It was probably continuous sabkha without dredged channels that now separate them. • Rocky platform should be more extensive, e.g. north of Futaisi, Schweihat. • Yas Island would have been sabkha on its western side, and probably rocky platform or tidal flat. • Sabkha was extensive at Taweelah and there was an important area of "coastal sand sheets and low dunes" between the desalination plant and Ras Ghanada. • Algal mat is shown as much larger than it really is, especially between Braka and Sila'a. Algal mat stands out as very black and the dark ground on the landward side would be wet sabkha. • Saltmarsh is too extensive between Abu Dhabi and Dabbiyah, and also between Ruwais and Sila'a. • Khor Muzahmi (RAK) has intertidal flats, saltmarsh		The project has no scope for producing new data, but rather has to compile the best available data for the assessment. Many of the errors pointed out are relatively finescale gaps in spatial knowledge or a product of the high levels of human physical alteration of the coastline. It is therefore important that the project flags these as known issues, but it is beyond the scope of the project to produce new field or historical based maps. Although not perfect (indeed all remote sensing based habitat maps include classification errors) the CMRECs map is both the best available and the most appropriate for the purposes of conservation planning. Importantly, an accurate picture of historical extent is only of concern in terms of setting targets and assessing amount of each habitat type which has been lost. The coastal areas of UAE are perhaps globally unique in terms of how much the shape of the coast has been altered. Therefore, in these completely altered areas, it is better from an implementation perspective for the map to more closely represent the shape of the current coastline. The CMRECS data reflects the habitat distribution as well as the modified coast from imagery obtained in 2010 (Report Ref: Applied Science Associates 2010 Coastal and Marine Resources and Ecosystem Habitat Classification System. Unpublished Report for

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
		and seagrass.		Environment Agency - Abu Dhabi). Hence although it is not the ideal baseline habitat map for setting targets (seeking to represent a pre-anthropogenic impacts 1950s coastline), it is an excellent representation of current habitats, is the only available spatial data set that is comprehensive, and hence is used here to derive this habitat proxy map. We propose to accommodate for under-representation of the original extent of certain habitats (e.g. coral reefs) by increasing the targets for these features to ensure that we capture sufficient of the remaining intact examples of these habitat types. Although the Oil Spill Contingency Plan map (ADNOC 2000) offered a potentially more accurate pre-development coastline, particularly around Abu Dhabi, as the coastline has been so heavily altered, it no longer represents a realistic and implementable view of the current land and seascape. Further, the mapping is more general than the CMRECs classification and contradicts it in many areas. As indicated above, it is more representative of current conditions and hence the implementation environment, to use a map which represents the current coastline and rather adjust targets for selected habitats where we know that they are incompletely mapped. The discrepancies in the coastline data will not significantly affect the conservation assessment because

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
				they are relatively small in relation to the full extent of each habitat type, and where habitats are known to be under-represented these will be accommodated for by adjusting the targets. For the Northern Emirates, the coral reef data set was updated because of comprehensive data from Dr John Burt, but no such similar data exists for seagrass and mangroves and hence this project is reliant solely on UNEP-WCMC data for these marine areas.
		• Coral reef is under-represented, e.g. around Dabbiyah and Hail Shoal, especially if it is meant to show how it was in the 1950s. There were extensive *Acropora* beds offshore from Abu Dhabi Island. • Umm Amim is a proper island. • Hail Island is the wrong shape and has little algal mat. • Coastline around Ghantoot is inaccurate. It shows deep water when it is mostly sabkha. • Saltmarsh is not shown in Khor Hulaylah. This is		This project is not able to amend the CMRECS data for Abu Dhabi but only recommend that CMRECS is updated. Habitat map amended. CMRECS data used to correctly identify Umm Amim Island. Habitat map amended. CMRECS data used to correctly identify Island. Algal mat is based on information from CMRECS and so cannot be amended. Habitat map amended. GEBCO data is prone to inaccuracies in complex areas of coastline. Habitat Map amended to include new habitat group

ID.	Issue	Summary Discussion during workshop	Decision during Workshop	Post -Workshop Actions
		unique in UAE – brackish marsh with freshwater input from mountains. Dominated by *Juncus rigidus* and *Cyperus laevigatus*.		'Brackish Marsh'.
		• Deep water is shown in Khor al Beidah (UAQ). It has extensive intertidal flats, algal mat and saltmarsh.		Habitat map amended. GEBCO data prone to inaccuracies in complex areas of coastline.
		• Khor Kalba is shown as having deep water.		Habitat map amended. GEBCO data prone to inaccuracies in complex areas of coastline.
		• Southern part of Futaisi Island is sabkha.		Islands are classified as Islands and Island-Salt dome. It was decided at the workshop to keep these habitat types separate.

Habitat - Abu Dhabi

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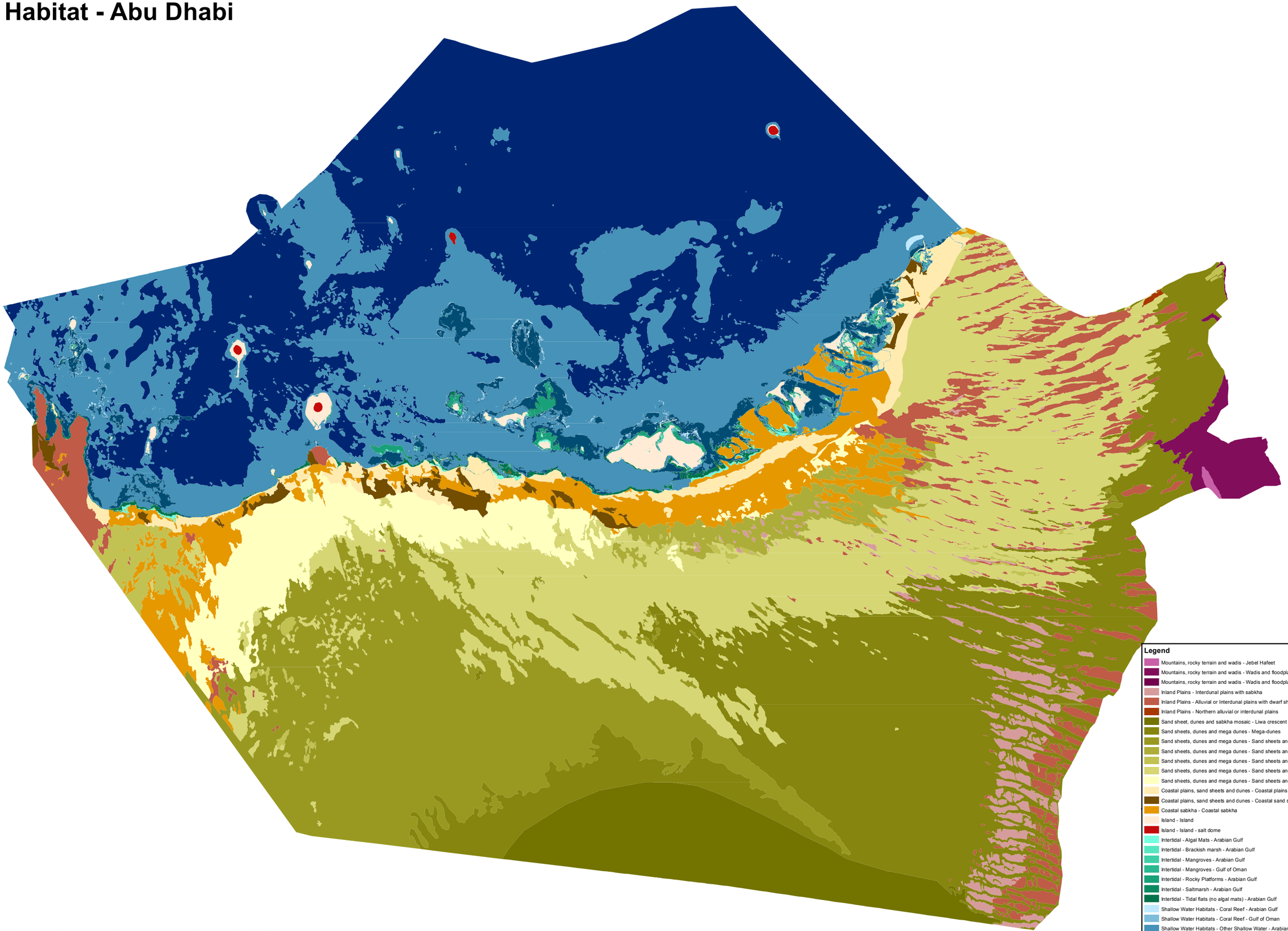

Legend

- Mountains, rocky terrain and wadis - Jebel Hafeet
- Mountains, rocky terrain and wadis - Wadis and floodplains
- Mountains, rocky terrain and wadis - Wadis and floodplains with distinct tree cover
- Inland Plains - Interdunal plains with sabkha
- Inland Plains - Alluvial or Interdunal plains with dwarf shrub cover
- Inland Plains - Northern alluvial or interdunal plains
- Sand sheet, dunes and sabkha mosaic - Liwa crescent dune and sabkha mosaic
- Sand sheets, dunes and mega dunes - Mega-dunes
- Sand sheets, dunes and mega dunes - Sand sheets and dunes mainly with perennial herbs or graminoids
- Sand sheets, dunes and mega dunes - Sand sheets and dunes with Haloxylon persicum
- Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct dwarf shrub cover
- Sand sheets, dunes and mega dunes - Sand sheets and dunes with distinct shrub cover or dwarf shrub cover
- Sand sheets, dunes and mega dunes - Sand sheets and dunes with dwarf shrub cover and barqas
- Coastal plains, sand sheets and dunes - Coastal plains and sand sheets
- Coastal plains, sand sheets and dunes - Coastal sand sheets and low dunes
- Coastal sabkha - Coastal sabkha
- Island - Island
- Island - Island - salt dome
- Intertidal - Algal Mats - Arabian Gulf
- Intertidal - Brackish marsh - Arabian Gulf
- Intertidal - Mangroves - Arabian Gulf
- Intertidal - Mangroves - Gulf of Oman
- Intertidal - Rocky Platforms - Arabian Gulf
- Intertidal - Saltmarsh - Arabian Gulf
- Intertidal - Tidal flats (no algal mats) - Arabian Gulf
- Shallow Water Habitats - Coral Reef - Arabian Gulf
- Shallow Water Habitats - Coral Reef - Gulf of Oman
- Shallow Water Habitats - Other Shallow Water - Arabian Gulf
- Shallow Water Habitats - Other Shallow Water - Gulf of Oman
- Shallow Water Habitats - Seagrass / macro-algal beds - Arabian Gulf
- Deeper than 15m - Deeper than 15m - Gulf of Oman
- Deeper than 15m - Deeper than 15m - Arabian Gulf

Produced by Hyder Consulting on behalf of AGEDI

Data Sources: Abu Dhabi Soil Survey, Northern Emirates Soil Survey, National Atlas of UAE (1996), GEBCO, EAD CMRECS (2010), SRTM data V4 (2008), Wadi Fish of UAE (1998), John Burt NYU Abu Dhabi, Terrestrial & Marine Habitat Workshop (June 2012).

Appendix B.2

Abu Dhabi Habitat Condition Map

Habitat Condition - Abu Dhabi

N

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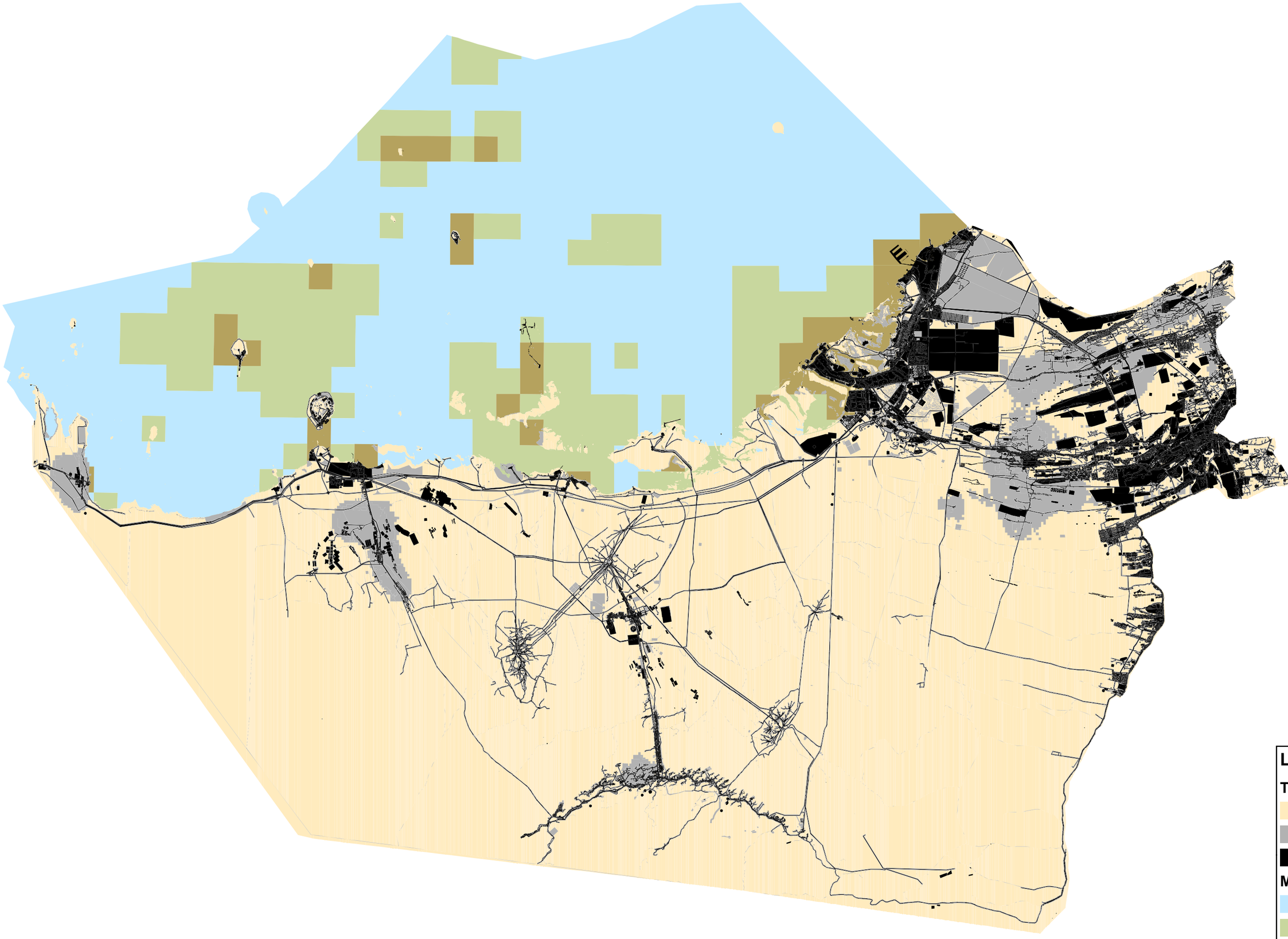

Legend

Terrestrial

- Natural
- Degraded
- Transformed

Marine

- Good
- Fair
- Poor

Appendix B.3

Abu Dhabi Protected Areas Map

Emirate of Abu Dhabi Protected Areas

N

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Produced by Hyder Consulting on behalf of AGEDI (August 2012).
Data Sources: EAD, EMEG, Breeding Centre for Endangered Arabian Wildlife, MoEW
Ref: MU000945_F08_02_01

Appendix B.4

Abu Dhabi Priority Species Lists

Abu Dhabi Species Priority List

Birds	Common Name	Scientific Name	IUCN Status	IUCN Year Published	IUCN Version	Hornby & Aspinall 1996 Status	Javed (2008) Status
	Sand Partridge	Ammoperdix heyi	Least Concern				Restricted Range
	Greater Flamingo	Phoenicopterus roseus	Least Concern				Regionally Important
	Persian Shearwater	Puffinus persicus	Near Threatened				Globally Threatened
	Red-billed Tropicbird	Phaethon aethereus	Least Concern			Small world range	Small world range
	Socotra Cormorant	Phalacrocorax nigrogularis	Vulnerable	2012	3.1	Globally Threatened or near threatened	Globally Threatened
	Indian Reef Heron	Egretta gularis schistacea	Least Concern				Regionally Important
	Osprey	Pandion haliaetus	Least Concern			Threatened in UAE	Threatened in UAE
	Egyptian Vulture	Neophron percnopterus	Endangered	2012	3.1	Threatened in Arabia	Regionally Threatened
	Lappet-faced Vulture	Torgos tracheliotos	Vulnerable	2012	3.1	Threatened in Arabia	Globally Threatened
	Long-legged Buzzard	Buteo rufinus	Least Concern			Rare Breeder	Rare UAE Breeder
	Greater Spotted Eagle	Aquila clanga	Vulnerable			Globally Threatened or near threatened	Globally Threatened
	Eastern Imperial Eagle	Aquila heliaca	Vulnerable			Not assessed	Globally Threatened
	Golden Eagle	Aquila chrysaetos					
	Bonelli's Eagle	Aquila fasciatus	Least Concern			Rare Breeder	Rare UAE Breeder
	Sooty Falcon	Falco concolor	Near Threatened	2012	3.1	Threatened in UAE	Threatened in UAE
	Barbary Falcon	Falco pelegrinoides	Least Concern			Rare Breeder	Rare UAE Breeder
	Macqueen's Bustard	Chlamydotis undulata	Vulnerable	2012	3.1	Threatened in Arabia	Globally Threatened
	Sociable Lapwing	Vanellus gregarius	Critically Endangered			Not assessed	
	Crab-plover	Dromas ardeola	Least Concern			Small world range	Small world range
	Black-tailed Godwit	Limosa limosa	Near Threatened				
	Great Knot	Calidris tenuirostris	Vulnerable			Important rare species within UAE	
	Broad-billed Sandpiper	Limicola falcinellus	Least Concern			Threatened in UAE	Threatened in UAE
	Cream-coloured Courser	Cursorius cursor	Least Concern			Threatened in UAE	Threatened in UAE
	Sooty Gull	Larus hemprichii	Least Concern			Small world range	Small world range
	Bridled Tern	Onychoprion anaethetus	Least Concern			Threatened in UAE	Threatened in UAE
	Saunders' Tern	Sternula saundersi	Least Concern			Small world range	Small world range
	Caspian Tern	Sterna caspia	Least Concern			Rare Breeder	Rare UAE Breeder
	White-cheeked Tern	Sterna repressa	Least Concern			Threatened in UAE	Threatened in UAE
	Swift Tern	Sterna bergii	Least Concern			Threatened in UAE	Threatened in UAE
	Lesser Crested Tern	Sterna bengalensis	Least Concern			Threatened in UAE	Threatened in UAE
	Chestnut-bellied Sandgrouse	Pterocles exustus	Least Concern			Threatened in UAE	Threatened in UAE
	Lichtenstein's Sandgrouse	Pterocles lichtensteinii					
	Pallid Scops Owl	Otus brucei	Least Concern			Rare Breeder	Rare UAE Breeder
	Pharaoh Eagle-Owl	Bubo ascalaphus	Least Concern			Threatened in UAE	Threatened in UAE
	Little Owl	Athene noctua					
	Arabian Collared Kingfisher	Todiramphus chloris kalbaensis	Least Concern			Small world range	Small world range
	Black-crowned Sparrow-Lark	Eremopterix nigriceps					
	Bar-tailed Lark	Ammomanes cinctura	Least Concern			Rare Breeder	Rare UAE Breeder
	Lesser Short-toed Lark	Calandrella rufescens	Least Concern			Threatened in UAE, Rare Breeder	Threatened in UAE
	Arabian Babbler	Turdoides squamiceps	Least Concern	2012	3.1	Small world range	Small world range
	Hooded Wheatear	Oenanthe monacha	Least Concern			Rare Breeder	Rare UAE Breeder
	Hume's Wheatear	Oenanthe albonigra	Least Concern				Restricted Range
	Garganey	Anas querquedula	Least Concern				Regionally Threatened
	Ferruginous Duck	Aythya nyroca	Near Threatened			Not assessed	Globally Threatened
	White Stork	Ciconia ciconia	Least Concern				Regionally Threatened
	Dalmatian Pelican	Pelecanus crispus	Vulnerable			Not assessed	
	Indian Pond Heron	Ardeola grayii	Least Concern			Important rare species within UAE	
	European Honey Buzzard	Pernis apivorus	Least Concern			Important rare species within UAE	Regionally Threatened
	Eurasian Griffon Vulture	Gyps fulvus	Least Concern			Important rare species within UAE	
	Pallid Harrier	Circus macrourus	Near Threatened				Globally Threatened
	Lesser Kestrel	Falco naumanni	Least Concern			Globally Threatened or near threatened	Globally Threatened
	Lanner Falcon	Falco biarmicus	Least Concern			Important rare species within UAE	Regionally Threatened
	Saker Falcon	Falco cherrug	Endangered			Important rare species within UAE	Globally Threatened
	Corncrake	Crex crex	Near Threatened				Globally Threatened
	Kentish Plover	Charadrius alexandrinus	Least Concern				Regionally Important
	Eurasian Curlew	Numenius arquata	Near Threatened				
	Great Snipe	Gallinago media	Near Threatened			Important rare species within UAE	Globally Threatened
	Eurasian Hoopoe	Upupa epops	Least Concern			Rare Breeder	Rare UAE Breeder
	White-spectacled Bulbul	Pycnonotus xanthopygos	Least Concern				Restricted Range
	Plain Leaf Warbler	Phylloscopus neglectus	Least Concern			Important rare species within UAE	Restricted Range
	White-throated Robin	Irania gutturalis	Least Concern			Important rare species within UAE	Restricted Range
	Hypocolius	Hypocolius ampelinus	Least Concern			Important rare species within UAE	Restricted Range
	Trumpeter Finch	Rhodopechys githaginea	Least Concern			Rare Breeder	Rare UAE Breeder
Mammals						**AD Red List 2005 Status**	**UAE Red List 2005 Status**
	Arabian Mountain Gazelle	Gazella gazella cora	Vulnerable	2008	3.1	Endangered	Vulnerable
	Arabian Tahr	Arabitragus jayakari	Endangered	2008	3.1	Critically Endangered	Critically Endangered
	Blanford's Fox	Vulpes cana	Least Concern	2008	3.1	Critically Endangered	Vulnerable
	Caracal Lynx	Caracal caracal schmitzi	Not Assessed			Critically Endangered	Vulnerable
	Honey Badger or Ratel	Mellivora capensis	Least Concern			Data Deficient	Critically Endangered
	Rüppell's Fox	Vulpes rüeppellii sabaea	Least Concern			Endangered	Vulnerable
	Sand Cat	Felis margarita	Near Threatened	2011	3.1	Endangered	Endangered
Amphibians						**UAE Category (2005 proposed)**	**Andrew Gardner Proposed UAE Category (19/09/2012)**
	Arabian Toad	Duttaphrynus arabicus					DD
	Dhofar Toad	Duttaphrynus dhufarensis					NT
Reptiles						**UAE Category (2005 proposed)**	**Andrew Gardner Proposed UAE Category (19/09/2012)**
	Bar-tailed Semaphore	Pristurus celerrimus					LC
	Blanford's Fringe-toed Lizard	Acanthodactylus blanfordii					CR B2ab
	Blue-tailed Oman lizard	Omanosaura cyanura					DD
	Carter's Semaphore Gecko	Pristurus carteri					CR B2ab
	Desert Monitor Lizard	Varanus griseus				DD	DD
	Persian Wonder Gecko	Teratoscincus keyserlingii				CR B1ab+E	EN A1ac
	Diadem Snake	Spalerosophis diadema cliffordi					DD
	East Sand Gecko	Stenodactylus leptocosymbotes				VU B1a+C	DD
	Egyptian spiny-tailed lizard	Uromastyx aegyptius microlepis				VU AB	VU A2ac
	Asian Snake-eyed Skink	Ablepharus pannonicus				VU B2ab	DD
	Persian Horned Viper	Pseudocerastes persicus persicus	Least Concern	2010	3.1	CR B1ab	CR B2ab
	Fan-footed Gecko	Ptyodactylus hasselquistii				VU B2ab	DD
	Gallagher's Leaf-toed Gecko	Asaccus gallagheri					NT
	Gray's racer	Platyceps ventromaculatus					Vu D 1,2
	Jayakar's Oman Lizard	Omanosaura jayakari					DD
	Least Semaphore Gecko	Pristurus minimus				CR B1ab	DD
	Leptien's spiny-tailed lizard	Uromastyx aegyptius leptieni				VU AB	Vu 2 ac
	Musandam Leaf-toed Gecko	Asaccus caudivolvulus					DD
	Persian leaf-toed gecko	Hemidactylus persicus					Vu D12
	Short-snouted Sand Lizard	Mesalina brevirostris	Least Concern	2010	3.1	VU B2ab	LC
	Sinai agama	Pseudotrapelus sinaltus				VU B2ab	DD
	Southern grass skink	Trachylepis septemtaeniata					VuD12
	Snake-tailed fringe-toed lizard	Acanthodactylus opheodurus				VU B2ab	DD
	Bosk's Fringe-toed Lizard	Acanthodactylus boskianus				DD	DD (Perhaps VuD12)
Marine						**EWS-WWF Status**	
		Aphanius dispar	Not Assessed				
		Cyprinion microphthalmum	Not Assessed				
	Orange-spotted Grouper	Epinephelus coioides	Near Threatened			Stock heavily overfished	
		Garra barreimiae	Vunerable	1996	2.3		
	Spangled Emperor	Lethrinus nebulosus	Not Assessed			Stock heavily overfished	
	Dugong	Dugong dugon	Vulnerable	2008	3.1		
	Hawksbill Turtle	Eretmochelys imbricata	Critically endangered	2008	3.1		

Appendix B.5

Abu Dhabi Opportunities and Constraints Summary

B.5 Summary of Abu Dhabi Opportunities and Constraints

Feature Class	Relevance	Type	Value	Description
AD_ADACH_Plan_AlAin2030_UrbanGrowthBoundary	Yes	Constraint	-3	Boundary of planned future development in Al Ain as specified in Al Ain 2030 Plan
AD_ADCO_LandUseConcessionArea	Yes	Constraint	-3	Boundary of ADCO's concession area (land only)
AD_EEBDB_DevelopInfraProject	Yes	Constraint	-3	Location of development sites in Abu Dhabi where environmental permit applications have been submitted to EAD - some are completed, some construction and some are proposed
AD_UPC_DevProject	Yes	Constraint	-3	Location of development sites in Abu Dhabi which have been submitted to UPC - some are completed, some construction and some are proposed
UAE_GISDB_EIAFootprints	Yes	Constraint	-3	Locations of development sites where EIAs have been received by EAD - includes Abu Dhabi and the Abu Dhabi to Fujairah pipeline
UAE_GISDB_Oilfields	Yes	Constraint	-3	Locations of oilfields in the UAE
Plan Abu Dhabi 2030	Yes	Constraint	-3	Boundary of planned future development in Abu Dhabi (city) as specified in Abu Dhabi 2030 Plan
Plan Al Gharbia 2030	Yes	Constraint	-3	Boundary of planned future development in Al Gharbia as provided by UPC
AD_ADCO_LanUseOilfields	Yes	Constraint	-3	Location of ADCO's oil fields (land)
AD_DMA_PlanPlots	Yes	Constraints	-3	Planned development plots within the Municipality of Abu Dhabi
AD_ADACH_AlAinWHSBoundaries	Yes	Opportunity	3	Location of World Heritage Sites in Al Ain
AD_ADACH_AlAinWHSBufferZones	Yes	Opportunity	3	Buffer zones around World Heritage Sites in Al Ain
AD_ADACH_archaeological_sites	Yes	Opportunity	2	Archaeological important sites in Abu Dhabi
AD_ADACH_liwa_forts	Yes	Opportunity	2	Archaeological structures of importance in Liwa in Abu Dhabi
AD_ADACH_murawah	Yes	Opportunity	2	Archaeological important sites on Marawah Island in Abu Dhabi
AD_ADCO_Archaeology_Buffer	Yes	Opportunity	2	Buffer zones around archaeological important sites within ADCO's concession area
AD_CMRECS_Archaeology_Sites	Yes	Opportunity	2	Location of archaeological important sites within the Emirate of Abu Dhabi
AD_CMRECS_FishingRightBoundaries	Yes	Opportunity	3	Location (polygons) of private traditional fishing areas i.e. where commercial fishing is not allowed (mainly around the Abu Dhabi islands)
AD_EEBDB_AvianArea	Yes	Opportunity	3	Important Bird Areas in the Emirate of Abu Dhabi
AD_EEBDB_BuhoorArea	Yes	Opportunity	3	Location (points) of private traditional fishing areas i.e. where commercial fishing is not allowed (mainly around the Abu Dhabi islands)
AD_GISDB_Archaeology	Yes	Opportunity	2	Location of archaeological important sites within the Emirate of Abu Dhabi
AD_GISDB_Bird	Yes	Opportunity	1	Location (points) of bird monitoring sites in Abu Dhabi
AD_TDIC_Saadiyat_Dune_Protection_Zone	Yes	Opportunity	3	Location of one dune protection zone on Saadiyat Island in Abu Dhabi
AD_UPC_CoastalConservationZone	Yes	Opportunity	3	Location of UPC proposed coastal conservation zones in Emirate of Abu Dhabi
AD_UPC_CoastalPark	Yes	Opportunity	3	Location of UPC proposed coastal park in Emirate of Abu Dhabi
AD_UPC_CoastalStewartshipZone	Yes	Opportunity	3	Location of UPC proposed coastal stewardship zone in Emirate of Abu Dhabi
UAE_EAD_BirdWetlandLocations	Yes	Opportunity	3	Locations of proposed bird wetland areas in the UAE
UAE_GISDB_PearlDiving	Yes	Opportunity	3	Locations of pearl diving sites (i.e. oyster beds) in UAE
AD_UPC_NatureReserve	Yes	Opportunity	3	Locations of proposed nature reserves in the Emirate of Abu Dhabi
AD_UPC_ProtectedAreas	Yes	Opportunity	3	Locations of proposed protected areas in the Emirate of Abu Dhabi

The value of the opportunity or constraints is categorized as follows:

3	**Strong opportunity**
2	**Moderate opportunity**
1	**Slight opportunity**
-1	**Slight constraint**
-2	**Moderate constraint**
-3	**Strong constraint**

Appendix B.6

Abu Dhabi Cost Surfaces Map

Planning Unit Costs - Abu Dhabi

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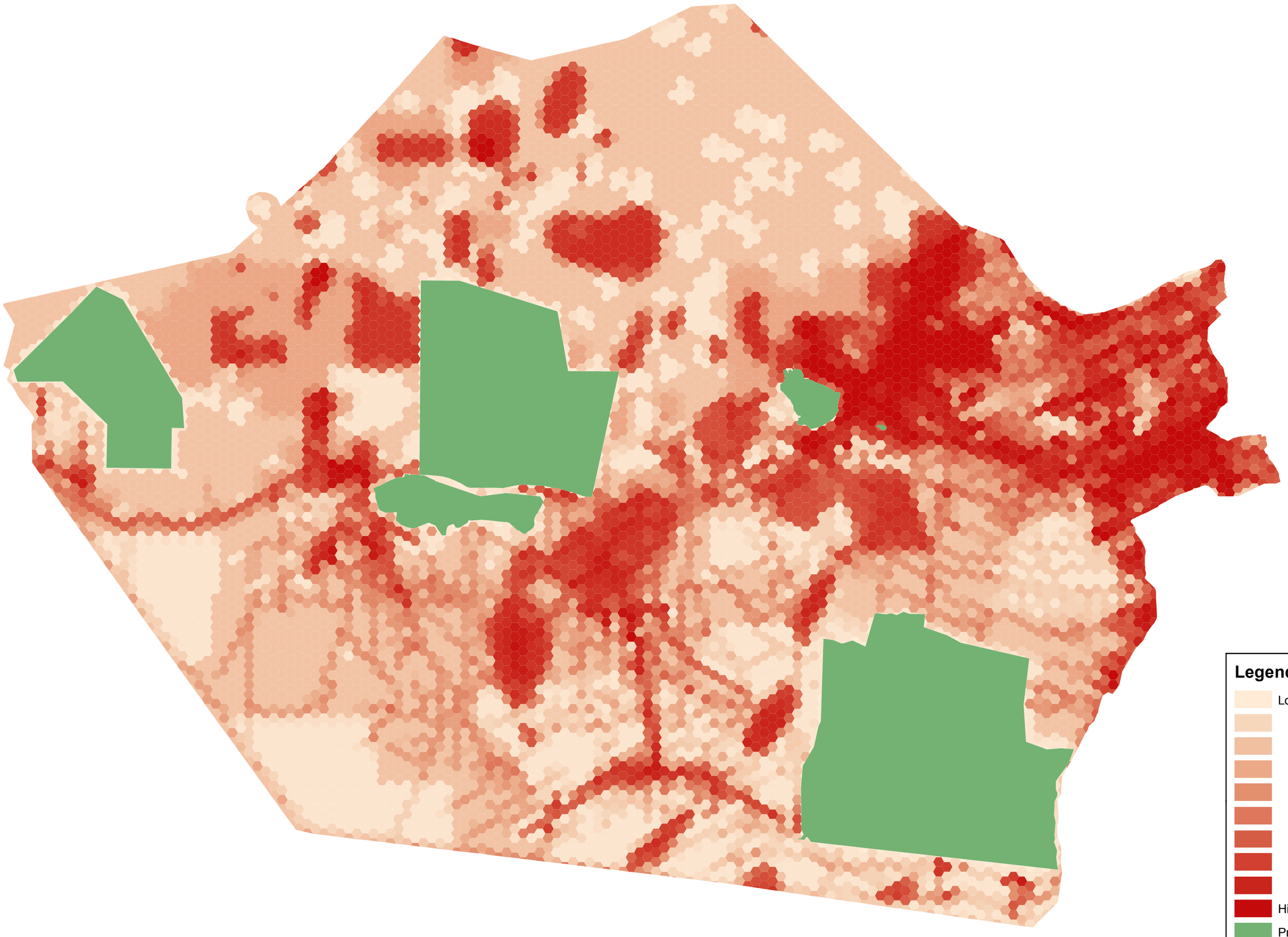


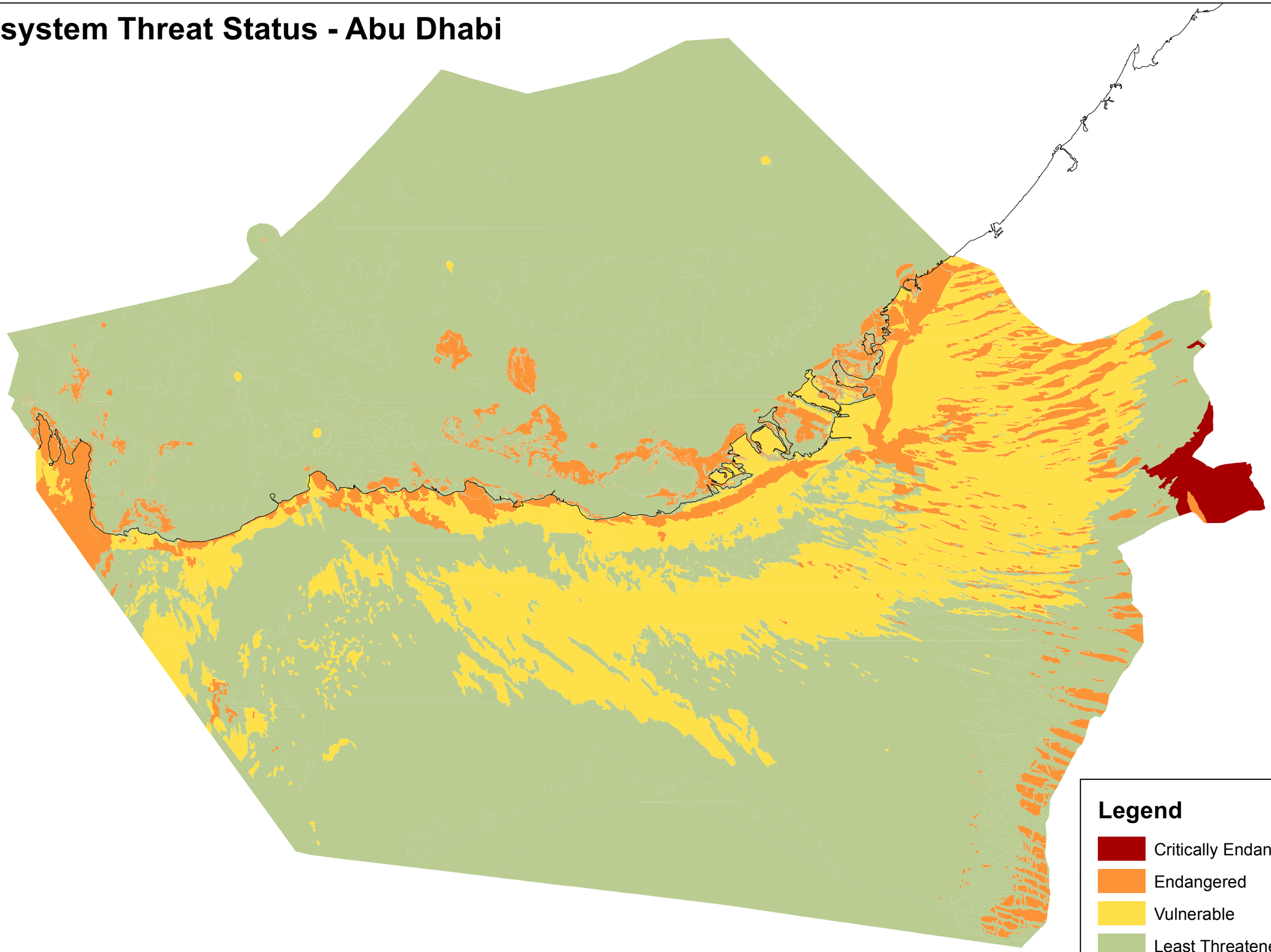
Legend

- Lowest cost
- Highest Cost
- Protected Areas

Appendix C.1

Abu Dhabi Ecosystem Threat Status Map

Ecosystem Threat Status - Abu Dhabi



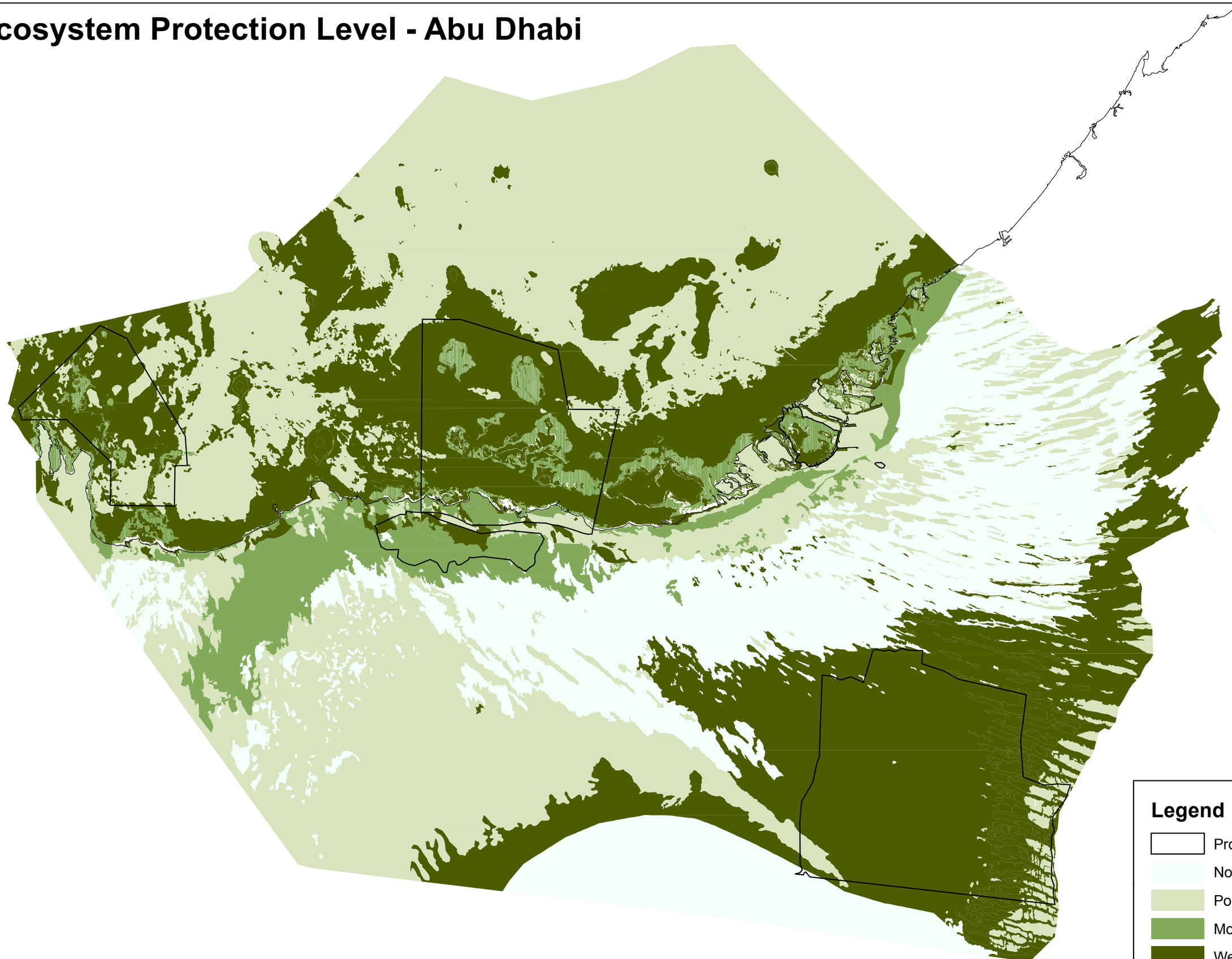
Appendix C.2

Abu Dhabi Ecosystem Protection Level Map

Ecosystem Protection Level - Abu Dhabi

N

1:1,260,000



Legend

- Protected Areas
- Not protected
- Poorly protected
- Moderately protected
- Well protected

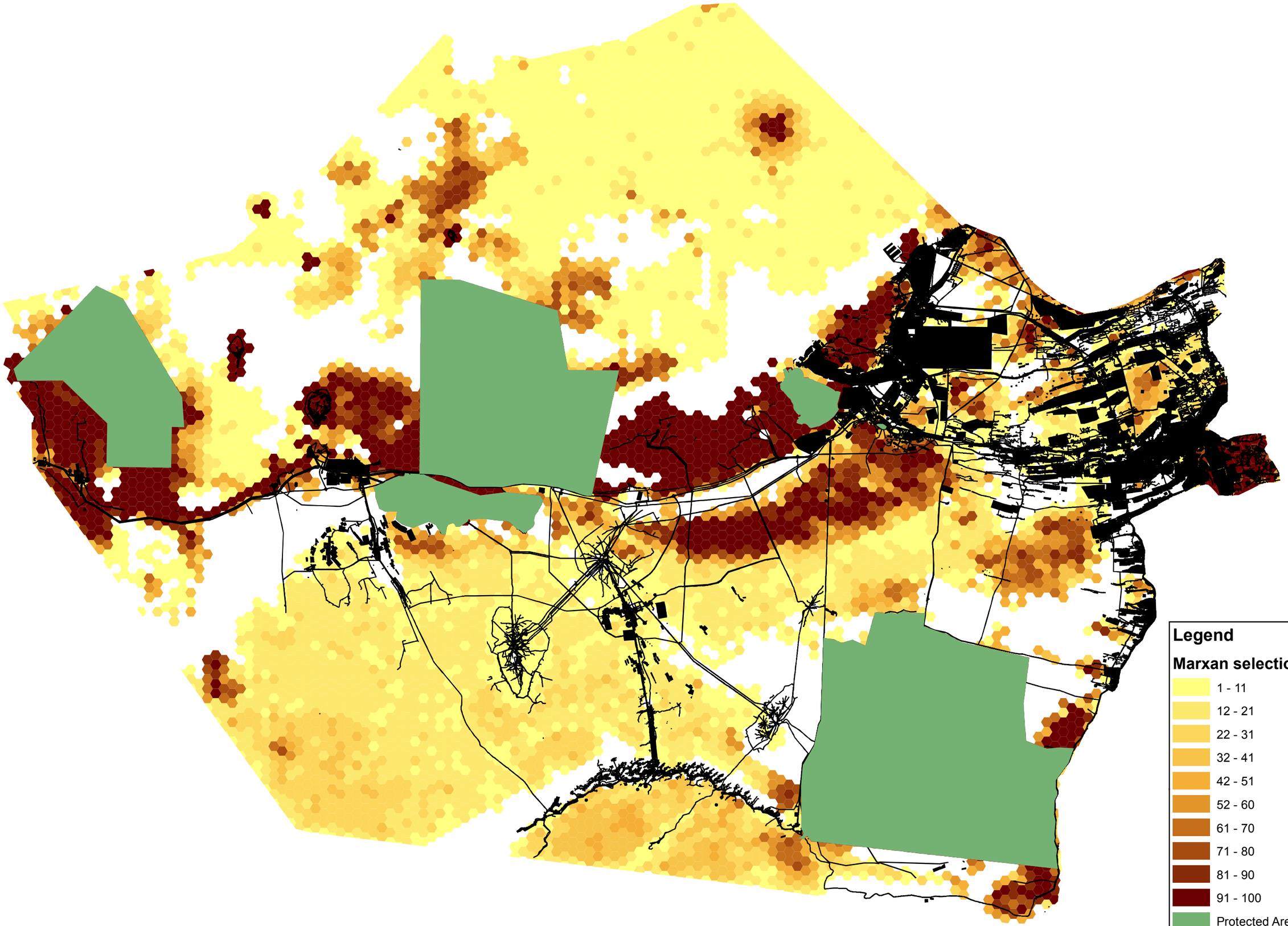
Appendix C.3

Abu Dhabi MARXAN Site Selection Frequency Map

MARXAN Site Selection Frequency for Abu Dhabi

N

1:1,260,000



Legend

Marxan selection frequency

- 1 - 11
- 12 - 21
- 22 - 31
- 32 - 41
- 42 - 51
- 52 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 100
- Protected Areas
- Transformed

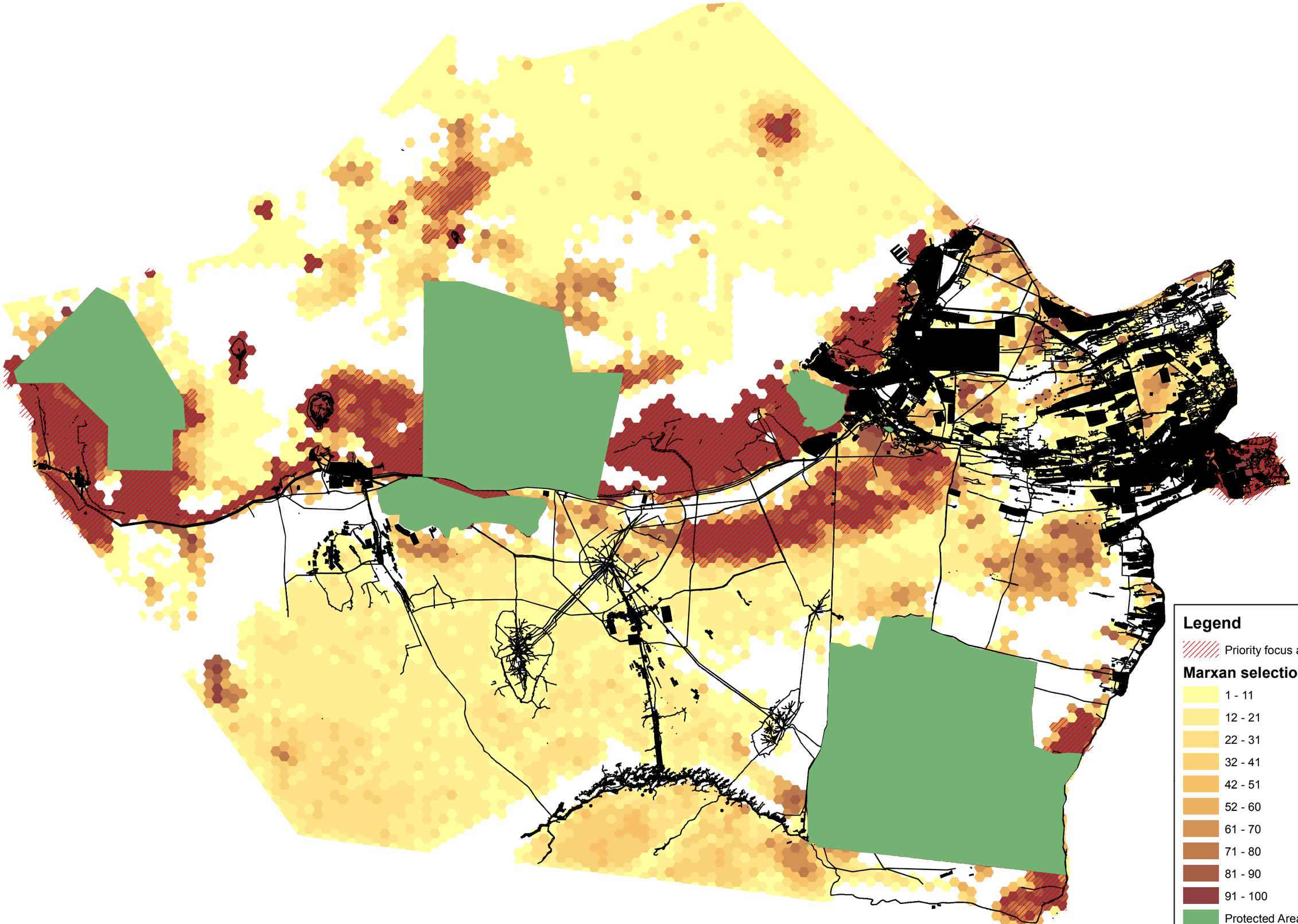
Appendix C.4

Abu Dhabi Priority Focus Areas Overlaid on the MARXAN Selection Frequency Map

Priority Focus Areas Overlaid on the MARXAN Selection Frequency - Abu Dhabi

N

1:1,260,000



Legend

Priority focus areas

Marxan selection frequency

- 1 - 11
- 12 - 21
- 22 - 31
- 32 - 41
- 42 - 51
- 52 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 100

Protected Areas

Transformed

Appendix C.5

Abu Dhabi Priority Focus Areas Map

Priority Focus Areas - Abu Dhabi

N

1:1,260,000

Legend

- Transformed
- Protected Areas

Priority Focus Areas

- Abu Al Abyad Island
- Al Ain Plain
- Jebel Hafit Upland
- North East Abu Dhabi Coast
- North and South of Arabian Oryx Protected Area
- Ras Ghanadah to Jebel Ali Coast
- Saxaul Forest
- Sila / Jebel Dhanna
- Sir Bani Yas / Baynunah
- Sir Bu Nuair Island
- Western Region Islands and Outlying Marine Areas

Appendix C.6

Abu Dhabi Potential Ecosystem Protection Level Map

Potential Protection Levels - Abu Dhabi

N

1:1,260,000

Legend

Priority focus areas

Protected Areas

Potential protection levels

Not protected

Poorly protected

Moderately protected

Well protected

Appendix D

Summary of PFA Expert Evaluation

Expert Evaluation of the Biodiversity Value and Urgency of Implementation for each of the PFAs

	Focus Area Value				Urgency of Implementation			
Priority Focus Area Name	**Group 1**	**Group 2**	**Group 3**	**Summary**	**Group 1**	**Group 2**	**Group 3**	**Summary**
Abu Al Abyad Island	1	2	2	1.67	1	2	1	1.33
Al Ain Plain	2	2	2	2.00	1	1	1	1.00
Western Region Islands and Outlying Marine Areas	2	1	1	1.33	2	1	1	1.33
Ras Ghanadah to Jebel Ali Coast	1	2	1	1.33	2	2	1	1.67
Jebel Hafit Upland	1	1	1	1.00	1	1	1	1.00
North and South of Arabian Oryx Protected Area	1	1	2	3.00	1	1	1	3.00
North East Abu Dhabi Coast	3	3	3	1.33	3	3	3	1.00
Saxaul Forest	2	2	2	2.00	2	2	3	2.33
Sila / Jebel Dhanna	1	1	2	1.33	1	1	1	1.00
Sir Bani Yas / Baynunah	1	1	2	1.33	1	1	1	1.00
Sir Bu Nuair Island	2	1	1	1.33	2	2	3	2.33