



A Protected Areas Strategy for the Kingdom of Bahrain

Project Title: Updating the National Biodiversity Strategy and Action Plan (NBSAP) of the Kingdom of Bahrain

Funding Agency: Global Environment Facility (GEF)

Executing Agency: Supreme Council for Environment, Kingdom of Bahrain

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Number of Pages: 71

Year of Publication: 2015

Version: Final

Acknowledgment

The author would like to thank the Supreme Council for Environment especially Dr. Mohamed Mubarak Bin Daina and the NBSAP Project Team that includes Ms. Nouf Al-Wasmi, Ms. Reem Al Mealla, Ms. Eman Husain and Ms. Tamera Alhusseini and also the NBSAP commissioned experts: Dr. Elsa Sattout and Dr. Jameel Alkhuzai for their valuable and constructive comments throughout the project. I would also like to thank the United Nations Environment Programme-Regional Office for West Asia, particularly Ms. Diane Klaimi for her guidance and support, in addition to all the NBSAP workshops participants and their organizations for their valuable participation, feedback, and genuine contributions. Further thanks goes to all the stakeholder that have participated in the various focus groups and consultation meetings thereby aiding the process in accumulating local knowledge that might not otherwise have been documented thereby creating a baseline for all future studies and generations.

Special thanks to the NBSAP National Reviewing Committee members Dr. Abdelmawgoud Ragab (Directorate of Agricultural Affairs), Mr. Bassam Al Shuwaikh (Directorate of Fisheries), Dr. Humood Naser (University of Bahrain), Mrs. Nouf Al Wasmi (Supreme Council for Environment) and Ms. Eman Husain (Civil Society)

Government Sector

Bahrain Authority for Culture and Antiquities (BACA)
Central Informatics Organisation (CIO)
Chamber of Commerce and Industry
Economic Development Board
Electricity and Water Authority
National Oil and Gas Authority
Ministry of Education
Ministry of Finance
Ministry of Interior
 Customs
 National Coast Guard
Ministry of Transport
Ministry of Works, Municipality and Urban Planning
Directorate of Fisheries
Directorate of Agriculture Affairs
Supreme Council for Environment
Supreme Council for Women
Survey and Land Registration Bureau
 Topographic Survey Directorate
 Hydrographic Survey Directorate

Private Sector

Environment Arabia Consultancy Services
Gulf Petrochemical Industries CO. (GPIC)
Mattar Jewellery
The Bahrain Petroleum Company (Bapco)
The National Initiative for Agricultural Development

Academic Sector

Arabian Gulf University
Bahrain Center for Strategic, International and Energy Studies
University of Bahrain

Civil Society & NGO's

Arab Youth Climate Movement, Bahrain Chapter
Bahrain Environment Society
National Institute for Human Rights
Youth and Environment Association

Intergovernmental

United Nations Development Programme (UNDP)
United Nations Environmental Programme –Regional Office of West Asia (UNEP-ROWA)

LIST OF ACRONYMS

AGU: Arabian Gulf University
BD: Bahraini Dinar
BDB: Bahrain Development Bank
CBD: Convention on Biological Diversity
DPSIR: Driving Forces, Pressures, States, Impacts, Responses
EBSA: Ecologically and Biologically Important Areas
ESV: Ecosystem Services Valuation
GDP: Gross Domestic Product
GEMS: Directorate of Precious Metals and Gemstones
IBA: Important Bird Areas
IUCN: International Union for Conservation of Nature
KoB: Kingdom of Bahrain
MEA: Millennium Ecosystem Assessment
MoC: Ministry of Culture
MPA: Marine Protected Area
MRD: Marine Resources Directorate
NAS: National Academies of Science (US)
PMA: Ports and Maritime Affairs
PPA: Proposed Protected Area
PPR: Proposed Protected Regulations
REDD+: UN Program on Reducing Emissions from Deforestation and Forest Degradation
SCE: Supreme Council for the Environment
UNCLOS: United Nations Convention on the Law of the Sea
UNEP: United Nations Environment Programme
UNESCO: United Nations Education, Scientific and Cultural Organisation
UOB: University of Bahrain

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Executive Summary

The Kingdom of Bahrain is an archipelago of 40 low-lying islands in addition to numerous islets, shoals and patches of reefs situated off the central southern coast of the Arabian Gulf. Even though Bahrain is a relatively small country in geographical extent and with extreme climate conditions, the Kingdom includes important biological diversity at regional and international level. In supporting the 2015 National Biodiversity Strategic Action Plan for the Kingdom of Bahrain the Supreme Council for the Environment (SCE) commissioned a report that develops strategy for meeting the CBD Aichi Target's 11 and 12 for protected areas (PAs) and threatened species through the development of a National Representative System of Protected Areas.

This report assesses the current system of PAs in Bahrain, evaluating the strengths, weakness, opportunities and threats associated with the 6 PAs and presents guidance on where management may be enhanced. The assessment suggests that biodiversity values are compromised in Bahrain and continue to degrade due to a number of anthropogenic impacts including pollution, dredging and reclamation, the accelerated rate of urbanization, particularly in northern Bahrain.

The current PA system in Bahrain needs to consolidate implementation of management and protection of national biodiversity by developing specific management objectives and operational management plans for each PA. In parallel, an expansion of the PA network with the gazetting of new areas is essential to ensure comprehensive protection of representative national natural and cultural heritage. Certain PAs such as Arad and Tubli Bay require immediate management intervention in order to prevent ecosystem collapse in the short term. Others such as Al Hawar Islands and Hayr Bul Thamah contain natural and cultural values of national and international importance and therefore need operational, on the ground, management in place. The Hawar Islands PA is currently on the tentative list for UNESCO World Heritage and should be nominated as a natural and cultural site. Alternatively the site could also be nominated as a UNESCO Biosphere Reserve Area where it could accommodate human use.

Furthermore it is clear from the assessment there is a significant proportion of ecologically important and sensitive habitats that are not currently part of the PA system. The Strategy does not provide prescriptive zoning of the Bahraini national waters based on the importance of the species and habitats they host, but rather makes available a selection of four marine and 2 terrestrial scenarios developed using available national scale ecological information that identify where protection of sites is necessary and would meet the objectives set by a National System of Representative Protected Areas that strives to meet international commitments under the CBD.

At least three main marine regions have emerged as priorities for conservation in Bahrain and should be prioritised. These are the i) Northern Hayrat, ii) Northwestern waters of the Hawar Islands, and iii) the area North of Bahrain / South of Fasht Al Jarim. The 23 terrestrial sites proposed by a previous study (Atkins, 2010) should be reviewed in light of the additional

analysis provided by this report on land use and according to the socio-economic viability and political feasibility for gazetting.

The Strategy highlights specific recommendations that allow evidence-based decision-making to reduce pressure on important biodiversity and to halt environmentally damaging activities in sites with high ecological values. It also discusses the importance of developing site-specific monitoring programmes in order to provide quantitative assessments on the state and trends of biodiversity in key biodiversity areas and existing PAs. Following on from this Strategy, individual PA management plans need to be developed and linked to clear management objectives within a five-year timeline (2016-2020) in order to meet the CBD Aichi targets. These management plans should identify the primary purpose behind gazetting a new PA and enable the monitoring of biodiversity trends by accounting for the number of species, their distribution, abundance, and population growth using a system of indicators.

Going forward, the Kingdom of Bahrain and the Supreme Council for the Environment should consider and address 2 fundamental concepts for long-term success of this Strategy and sustainability of a National System of Representative Protected Areas:

- The establishment of a legally mandated governing body for Protected Areas that would be able to make decisions regarding gazetting, zoning, and implementation of needed actions to create an effective managed network of Protected Areas.
- Develop a work program to operationalize management on the ground by increasing PA management capacity in SCE / Bahrain through recruitment of a PA manager and / or team of rangers with appropriate training in surveillance, enforcement, promotion, monitoring, and business planning for the PA system.

Between 2016 and 2020, this strategy provides a roadmap with clear steps to be implemented in order to develop a National System of Representative Protected Areas in Bahrain and to address international commitments under the CBD Aichi Targets 11 and 12.

1.0 Background

The Kingdom of Bahrain is an archipelago of 40 low-lying islands in addition to numerous islets, shoals and patches of reefs situated off the central southern coast of the Arabian Gulf. The country occupies a total area of approximately 728 km² and has sovereignty over approximately 3000 km² of territorial waters. The terrestrial landscape in Bahrain is predominately arid desert with limited inland waters. The marine biotopes are on the contrary diverse, even given the extreme physical conditions, and include extensive seagrass beds, mudflats, oyster and coral reefs as well as offshore islands.

Even though Bahrain is a relatively small country in geographical extent and with extreme climate conditions, the Kingdom includes important biological diversity at regional and international level. Hawar Island is the largest breeding area for the *Phalacrocorax nigrogularis*, a resident breeder (Hill & Hill, 1998) and the coastal waters of Bahrain host the second largest dugong (*Dugong dugong*) population in the world after Australia, a locally threatened species enjoying full legal protection in Bahrain (Kingdom of Bahrain, 2011).

The principal and current uses of biodiversity in Bahrain are primary extractive industries (agriculture, fisheries, and pearl diving) that are considered important sectors in the Kingdom of Bahrain due to their historical, cultural, and economic importance for the country (Kingdom of Bahrain, 2011). These uses have low rates of return compared to other industries (TEEB 2010) and are a major threat to biodiversity. The fisheries sector for example has shown significant increases in professional and recreational fishing (Kingdom of Bahrain, 2011).

Terrestrially, date palm farms are the most diverse habitat in the country and support a wide range of introduced and native species, including vascular plants and algae, insects, brackish water fish, amphibians as well as resident and migratory birds. Suitable strategies for the conservation and sustainable use of date palm biodiversity could minimize anthropogenic disturbance, optimize ecosystem functions and result in an integrated protection of environmental resources of fragile oasis agro-ecosystems (Jaradat, 2011).

Despite a decline in demand for land during recent years, the demand for residential space is still increasing, involving both dredging and infilling operations, and where urban sprawl is considered the major challenge facing biodiversity in the Kingdom of Bahrain (Kingdom of Bahrain, 2015). Other major anthropogenic stresses on local biodiversity include sewage outfall, industrial and oil pollution, over-fishing and invasive alien species. To reduce these increasing threats, efforts have been undertaken to promote the conservation and sustainable use of biodiversity in Bahrain. A legislative framework for biodiversity management exists and includes a wide range of national laws, multi-lateral agreements (Table 7, Annex 1) and international agreements (Table 8, Annex 1) pertaining to environmental protection in Bahrain with particular reference to the conservation of biodiversity.

It is important to note that the Kingdom of Bahrain signed the Convention on Biological Diversity (CBD) on 6 September 1992 and formally ratified it on 8 August 1996. The CBD aims to promote the conservation of biological diversity, the sustainable use of its components, and the

fair and equitable sharing of benefits arising from the use of genetic resources by setting the target of having a proportion of each of the world's ecological regions effectively conserved by 2020. In accordance with the provisions of Article (8) of the CBD, parties are requested to adopt a series of measures to conserve biodiversity in their natural environments, which include the establishment of protected areas, protection of threatened species, and restoration of habitat and control of alien species (CBD, 2011).

Based on this international commitment by the Kingdom of Bahrain, the First National Report to the Convention on Biological Diversity was published in 2006 and highlighted the major threats known to its biodiversity. The 2006 national report highlights that urbanization is the major threat to biodiversity in Bahrain, namely due to dredging and infilling operations, industrial pollution, over-fishing and alien species. However, the limited scale of national monitoring programmes make it difficult to draw comprehensive and quantitative conclusions regarding trends in biodiversity at an ecosystem, species or genetic level. The status of biodiversity is unlikely to be promising given the accelerated effects of urbanization, particularly in northern Bahrain. The National Biodiversity Strategy and Action Plan (NBSAP) developed in Bahrain in 2006 and updated regularly (Kingdom of Bahrain, 2015) needs therefore to be implemented.

2.0 The Convention on Biological Diversity

2.1 Convention on Biological Diversity and the Aichi Targets

The NBSAP proposes a National Representative System of Protected Areas (NRSPA) to address the CBD Aichi Targets 11 and 12. These targets specify the extent of coverage of protected areas and their level of management (Target 11) as well as the improvement of the condition of known threatened species (Target 12).

Target 11: By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.

Target 12: By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.

This Strategy proposes a system of protected areas (PAs) that builds on the existing protected areas in Bahrain with newly identified areas that canvass important, representative and ecologically sensitive biodiversity and natural heritage resources. The proposed system

addresses the most important biodiversity components as a means to achieve long-term conservation goals while balancing human needs and use within the context of climate change. The proposed network of PAs considers among others, ecological connectivity, species and habitat representativeness, climate change resilience and key emblematic and threatened species, as guiding principles to ensure long-term sustainability of biodiversity in Bahrain. Long-term sustainability of biodiversity in the PA network is directly linked to strong management and governance of individual sites. Sensitive biodiversity and distribution maps of protected areas have been developed using available literature and geospatial data. The Strategy evaluated current management efforts and suggests improvements to the current management of gazetted sites and identifies appropriate management tools for new protected areas.

2.2 Biodiversity policy and legislative framework

The legislative biodiversity framework in Bahrain is based on a range of national laws as well as regional and international agreements. Annex 1 of this report lists the most relevant national laws (Table 1) and multi-lateral agreements (Table 2) pertaining to environmental management in Bahrain with particular reference to the conservation of biodiversity. The implementation of these agreements is challenged, mainly due to the lack of adequate financial resources to support action as well as the difficulty to regulate or stop important economic benefits derived from resource exploitation, namely in fisheries, oil and gas, and coastal urbanization and development.

Nevertheless, during the last few years, some efforts towards environmental protection and conservation have transformed some legislation from policy to practice (Table 1). The main achievements include concrete actions towards a consolidation of environmental protection and regulation of the fisheries sector through the establishment of a national steering committee for biological diversity in 2011 (Resolution No. 81), the protection of shark species of Abu Sayyaf in 2012 (Resolution No. 1), and the zoning of shrimp fishing areas in Bahrain in 2013 (amendment of Resolution No. 12 of 2009).

Table 1. List of select legal legislation approved during the period 2011-2014 contributing to the promotion of biodiversity conservation.

n.	Legal legislation	Sectors
1	Resolution No. 44 for the year 2011 for the establishment of the National Steering Committee for Biological Diversity	Institutional arrangement
2	Resolution No. 81 for the year 2011 to form the National Steering Committee for Biological Diversity	Institutional arrangement

n.	Legal legislation	Sectors
3	Resolution No. 1 for the year 2012 on the protection of shark species of Abu Sayyaf	Fishing
4	Resolution No. 41 for the year 2013 amending resolution No. 12 of 2009 on the zoning of shrimp fishing areas	Fishing
5	Resolution No. 10 for the year 2013 on banning fishing, trading or selling lobster	Fishing
6	Resolution No. 1 for the year 2011 on the determination of the period of movement of horses approved under Resolution No. 62 of 2010 on the prohibition of the movement of horses	Livestock
7	Resolution No. 2 for the year 2011 on banning the import of dogs and cats from the Kingdom of Thailand	Commercial
8	Resolution No. 70 of 2011 on the determination of the reclamation line in Tubli Bay	Urban
9	Resolution No. 72 of 2011 to ban the import of horses from the Hashemite Kingdom of Jordan	Livestock
10	Resolution No. 37 regarding the regulation of the the utilization and dredging of marine sand	Urban

2.3 International Guidelines and Standards in Protected Area Management

The International Union for Conservation of Nature (IUCN) defines a Protected Area (PA) as “an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means”.

IUCN sets out a system and a range of management objectives that address:

- a. Inherent biodiversity and conservation value; and
- b. Site suitability for
 - Scientific research
 - Wilderness protection
 - Preservation of species and genetic diversity

- Maintenance of environmental services
- Protection of specific natural and cultural features
- Tourism and recreation
- Education
- Sustainable use of resources from natural ecosystems
- Maintenance of cultural and traditional attributes

Although all PAs should meet the general objectives contained in this definition, the precise objectives for which protected areas are managed differ greatly in practice and are very much related to the specific targets that particular policies have set for each PA. It is important to emphasise that PAs do not exclude people or all activities for the benefit of wildlife. There may be some areas where public access is discouraged or prohibited given sensitive biodiversity or ecological processes, but management objectives for many protected areas are set to encourage access while safeguarding natural resources for present and future generations to enjoy.

In order to provide guidance on suitable and appropriate management of PAs in different circumstances and conditions, the IUCN World Commission on Protected Areas (WCPA) developed several categories of management. The IUCN Protected Area Management Categories are the most widely used system for classifying PAs according to different management objectives (Stolton *et. al*, 2013). The categories are recognised by international bodies such as the United Nations (CBD, UNESCO, UNEP) and by state governments as the global standard and best practice for designing and managing PAs and, as such, are increasingly being incorporated into government legislation around the world.

The IUCN PA Categories are the following:

Ia - Strict Nature Reserve

Protected areas under Category Ia are strictly set aside to protect biodiversity and also possibly geological/geomorphic features, where human visitation, use and impacts are strictly controlled and limited to ensure the protection of conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring purposes.

Ib - Wilderness Area

Protected areas under Category Ib are usually large unmodified or slightly modified areas, retaining their natural character and influence without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.

II National Park

Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic

of the area, which also provide a foundation for environmentally and culturally compatible, spiritual, scientific, educational, recreational, and visitor opportunities.

III Natural Monument or Feature

Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small-protected areas and often have high visitor value.

IV Habitat/Species Management Area

Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many Category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.

V Protected Landscape/ Seascape

A protected area where the interaction of people and nature over time has produced an area of distinct character with significant, ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.

VI Protected area with sustainable use of natural resources

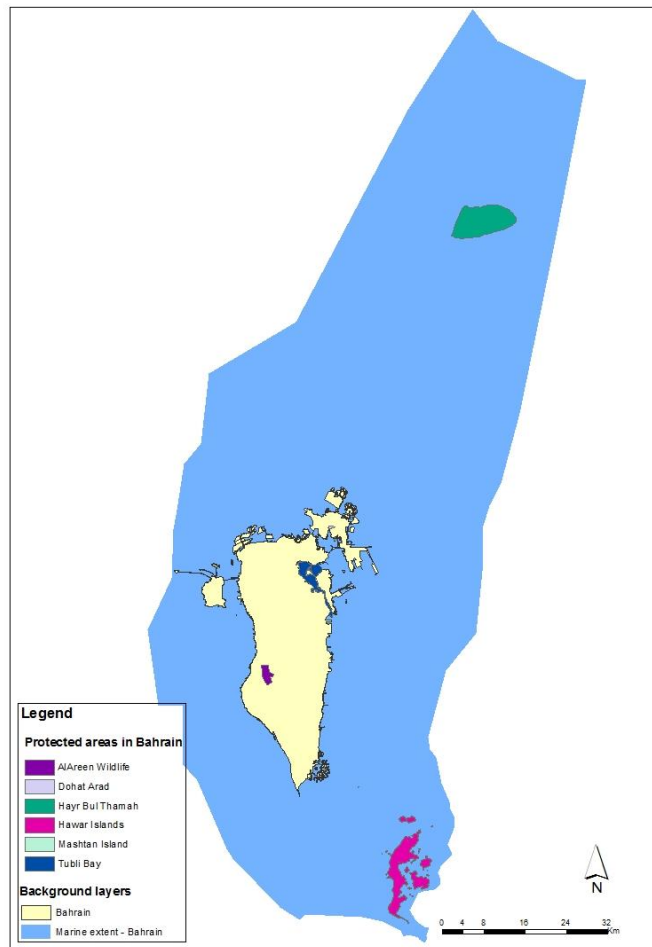
Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

The recommendations provided in this Strategy for existing terrestrial and marine PAs and for the new proposed PAs have adapted these IUCN broad criteria to site specific needs in Bahrain.

2.4 Existing Protected Areas in Bahrain

Figure 1 maps the location and distribution of current PAs of Bahrain and a detailed description of each site can be found in Table 9 (in the Annex). There are six Protected Areas in Bahrain: one terrestrial and five marine and which include important natural features representing national biodiversity in Bahrain. The impacts that threaten existing PAs in Bahrain are primarily focused on coastal and marine development, which has either taken place already or is planned for the future. This is exacerbated with the increase in fishing and the use of harmful fishing techniques such as the gillnets and trawling that damage coral and oyster reefs and seagrass habitats. Pollution from both the production and transport sectors, along with accumulated litter, is also threatening to overwhelm the physiological capacity of marine organisms to withstand elevated levels of pollution and the tolerance of ecosystems.

Figure 1. Location of the protected areas of the Kingdom of Bahrain. Dohat Arad and Mushtan can not be viewed due to their small size.



Al Areen Protected Area

The Al Areen Protected Area is a desert zone divided into two parts. The first part includes a dedicated area to preserve animal species and characteristic plants of the Bahrain desert environment including the Reem Gazelle, and plants representative of Bahraini. The second part is fitted with a centre for captive breeding with the objective of preserving living species representative of Bahrain and the Arabian Peninsula such as rare birds, deer, Oryx, amphibians, freshwater turtle and wild plant species. These animals and plants are kept in a park open to the public.

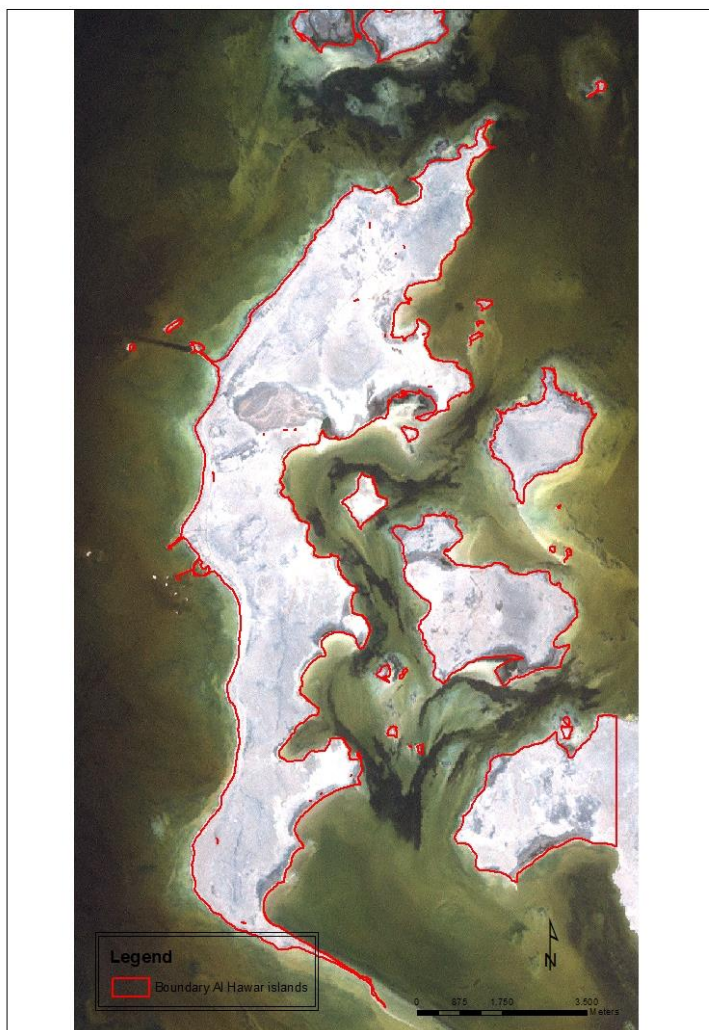
Figure 2. Al Areen Protected Area



Al Hawar Islands Protected Area

Al Hawar Islands was gazetted in 1997 and covers a total area of over 5,200 ha and are located 25°40'N 050°50'E. The islands are owned by the state. An archipelago of 16 small desert islands (of which the largest measures 4.1 ha) and islets in the Gulf of Bahrain, it is surrounded by shallow seas with extensive seagrass beds. The islands are in relatively pristine condition because access is severely restricted by the coast guard and the military. The islands support one of the world's largest concentrations of Socotra Cormorant in the world and significant numbers of Greater Flamingo and Black-headed Gull specimens. The waters around it host extensive seagrasses. Notable marine species in the surrounding area include the endangered dugong and several species of marine turtles. The islands are an internationally recognized Ramsar site (no. 920).

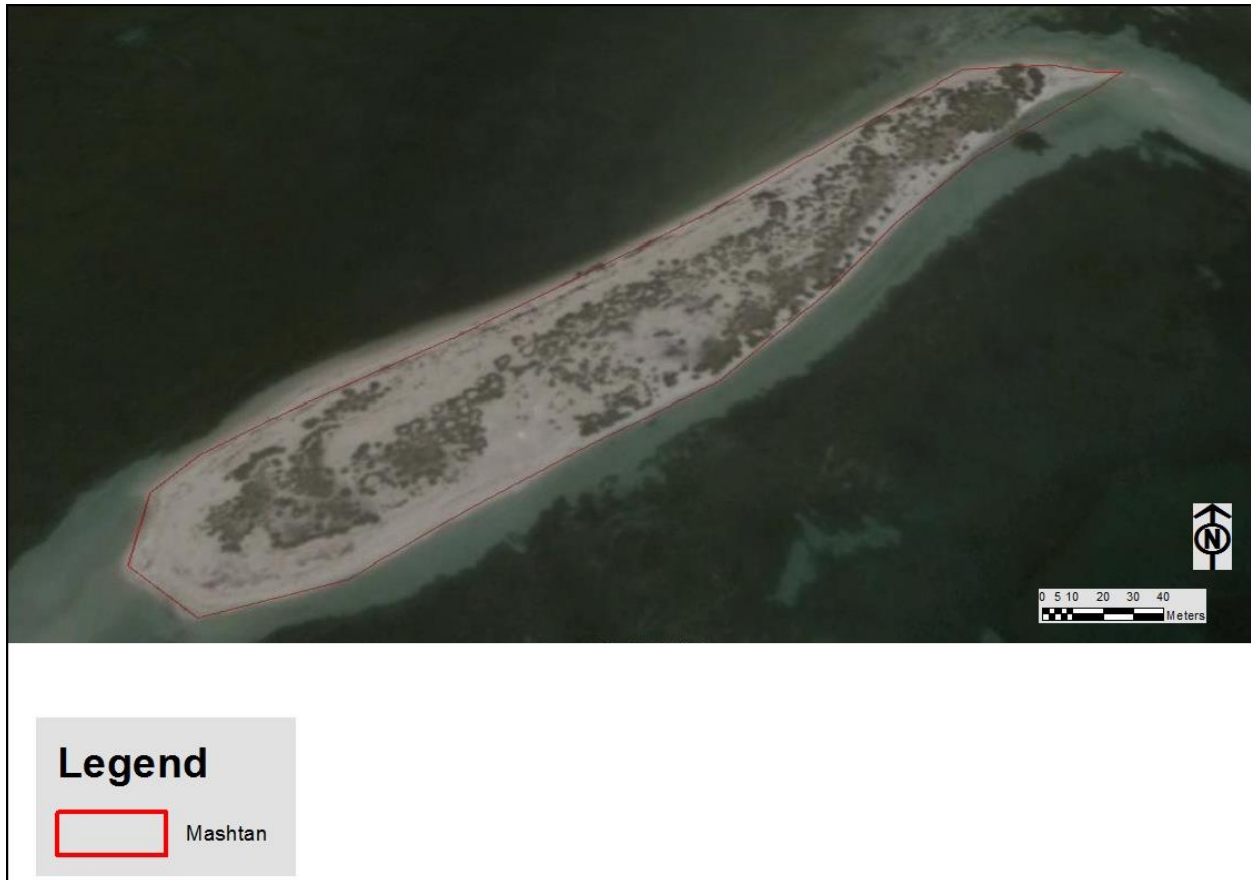
Figure 3. Location and Boundary of Al Hawar Islands Protected Area



Mashtan Island

Mashtan is a small sandy island of 2.5 km² in the southeast waters of Bahrain that surrounded by reef and some corals. The coastal area around the island hosts species of crustaceans (such as the ghost crab *Ocypode saratan*) and it also hosts extensive seagrass beds that provide feeding grounds for many species including the dugong, *Dugong dugon* and green turtle, *Chelonia mydas*, and serve as primary nursery recruitment and shelter habitat for shrimp, *Penaeus* sp., finfish species, and juvenile pearl oyster, *Pinctada* sp. Though small in size, the surrounding environment of the island is relatively rich in biodiversity and is classified as highly ecologically sensitive (GEOMATEC 2006). The marine system around this area may be affected by pollution from maritime transport and, to a lesser extent, sedimentation from dredging activities due to the Durrat al Bahrain project on the southeastern coast of the main island of Bahrain. Direct human impacts are scarce on the island, as it is not populated.

Figure 4. View of Mashtan Island Protected Area



Arad Bay (Dohat Arad) Protected Area

Arad Bay is a site of combined ecological and recreational value. The coastal landscape has high ecological sensitivity and is impacted at the same time by the resident human population and by visitors to an international hotel. It was declared a Protected Area in the year 2000 mainly because of its importance for wintering birds such as the Winged Stilt, Whimbrel and Redshank, and for tourism and recreational opportunities. Park facilities, including cafes, paths and landscaping, have been developed in the north-west corner of the bay after the designation of the protected area (Atkins, 2010). The PA seems to be heavily accessed by people for recreation and exercise.

No conservation measures are in place at present to regulate human use or to protect natural values in this bay. Furthermore, no nature interaction facilities have been developed on site i.e. specially designed viewing points (bird hides) or interpretation facilities for educational purposes. This type of infrastructure would attract eco-tourists and help reduce the impact of traditional tourism. Moreover, increased human activity in the park area may be preventing wintering wading birds from using this area (Atkins, 2010). Mangroves in this PA are few and insufficient to provide refuge or protection for birds to use the PA in the presence of people. The mangroves were planted by the Directorate of Fisheries between 1998-2005 in Dohat Arad, and were not originally present.

Figure 5. Arad Bay Protected Area



Tubli Bay

Tubli Bay was declared a protected area on 27 October 1997, is owned by the state, covers 1,610 ha and is located at 26°11'N 050°34'E. There is a Natural Reserve at Ras Sanad in Tubli Bay, which is a sheltered bay with extensive intertidal mud and sand flats south of the capital city of Manama. Before designating Tubli Bay as a protected area, there was an Amiri (Prince) Decree issued in the 1980s to consider Ras Sanad as an MPA with a land deed to the Supreme Council for the Environment (SCE). The only remaining natural mangrove stand in the country is located at Ras Sanad in the southwest corner of the site. Tubli Bay is an important nursery area for commercially important prawns and fish. It is also an important staging and wintering area for up to 45 species of water birds. Land use within and around the site is limited to small-scale commercial fishing, recreation and cultivation. Tubli Bay is an internationally recognized Ramsar site (no. 921).

There is no current management or protection of this area. There is evidence however that mangroves at Ras Sanad are degrading and that high pollution levels are affecting the health of the few remaining mangroves (Atkins, 2010). In addition, the salt marshes are deemed to be in a bad condition because they are facing reclamation activities and illegal dumping of waste (pers. comm.). Although some ongoing initiatives have been reported aimed at improving the health of the Protected Area, this study has not been able to acquire sufficient details about them.

Figure 6. Tubli Bay Protected Area

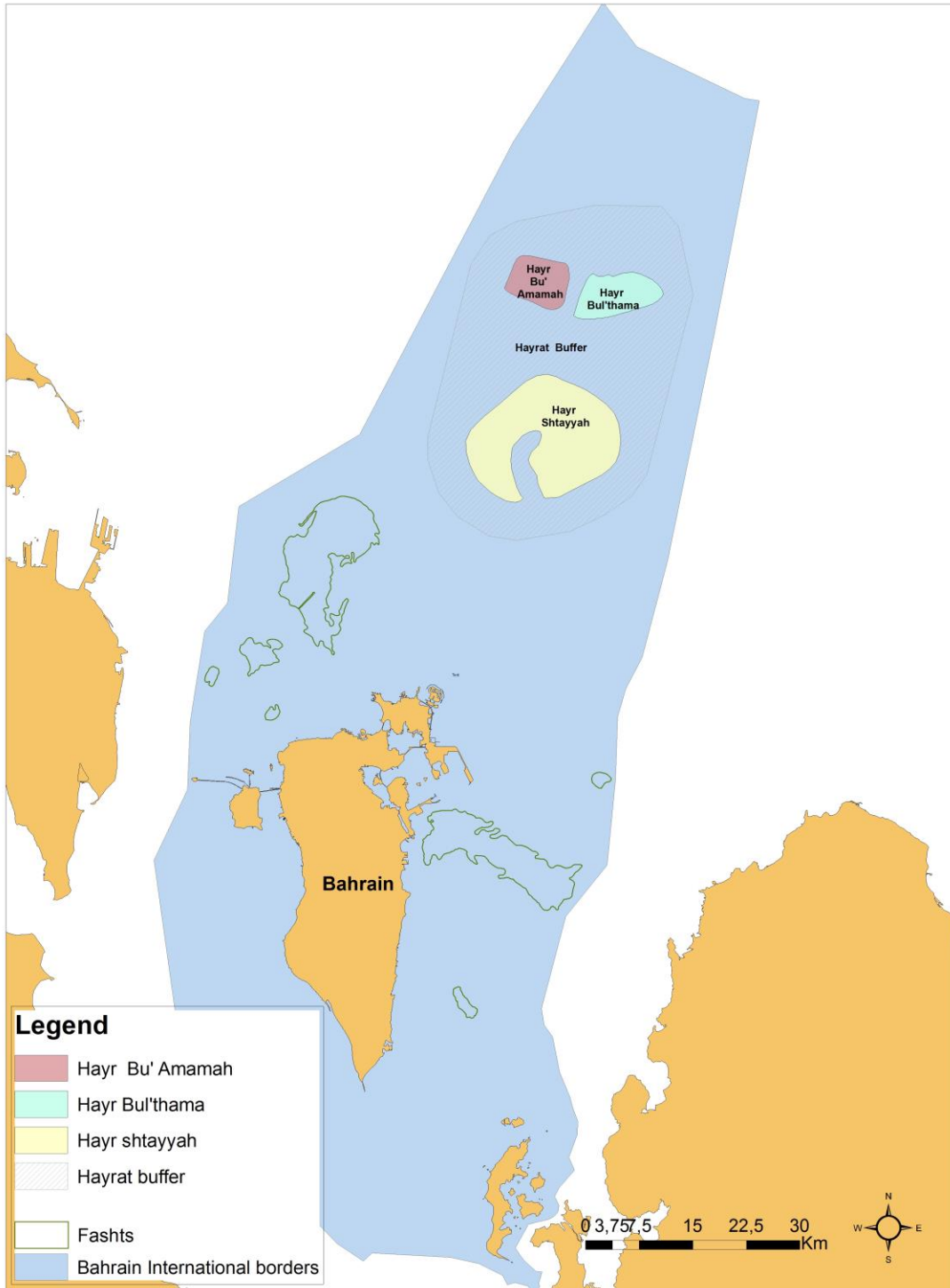


Hayr Bul Thamah

Located far north in the territorial waters of Bahrain (Figure 7). Hayr Bul Thamah together with Hayr Bu Am'amah and Hayr Shtayyah represent three oyster beds known as *Hayrs* in the local Arabic dialects, that have been internationally declared and recognised as a World Heritage Area in 2012. The hayrs are surrounded by a five kilometre wide buffer zone called the "Al Hayrat buffer", and located approximately at 67 km, 60 km and 44 km respectively from the northern shore of Muharraq (Arfa *et al.*, 2012). A "reef" defines coral reef habitat in close proximity of Hayr Bul Thamah and is labelled Reef Bul Thamah .

Hayr Bul Thamah was declared a Protected Area following the Ministerial Decree No. 8 of 2007 and has the Reef Bul Thamah in close proximity with the highest percentage of living hard coral coverage in Bahrain (Burt *et al.*, 2012). The area has shallow waters (10-14 m) which are dominated by rock but an area of 5,659,130 ha has an estimated oyster density of 23,000 oysters per hectare and the highest percentage of pearl incidence (7.36 %) between all three hayrs (Arfa *et al.*, 2012). The Pearl Oyster (*Pinctada sp.*) and Hammer Oyster (*Malleus sp.*) are present on the site though oyster distribution is limited to the western region of the hayr. Hard coral *Turbinaria peltata*, branching soft coral *Plexauridae sp.*, and Black Spiny Urchin (*Echinometra mathaei*) are characteristic in the area. This hayr used to be considered the best conserved natural oyster bed in Bahrain (Nayer and Al Rumaidh, 1993; Battis, 2012) but in the last two decades there has been a gradual deterioration (Arfa *et al.*, 2012) and a significant reduction in the size of Hayr Bul Thamah (Abdulla, 2013) as no protection measures have been implemented and increasing pressures are still ongoing and at a faster rate, in the region (pers. comm.). The area should be considered a top priority for conservation in a system of PAs.

Figure 7. Location of the Hayr Bul Thamah Protected Area in relation to the other Hayrat



3.0 Towards a National and Representative System of Protected Areas

This section of the Strategy provides recommendations for the protection and management actions needed in current existing protected areas of Bahrain. It also builds on the results of previous efforts to propose PAs in order to identify additional areas of high ecological value and compliment the existing PAs in order to develop a system representative of the biodiversity of Bahrain. This section prioritizes new areas with ecological and cultural heritage for two main purposes: 1) to conserve and sustainably use the resources of the area and 2) to support international and national efforts to reach the CBD Aichi targets mentioned earlier. This strategy identifies the major threats on existing PAs and highlights actions necessary in the next 5 years (2016-2020) to meet national and international biodiversity commitments.

The current PA system in Bahrain needs to consolidate implementation of management and protection of national biodiversity by developing specific management objectives and operational management plans for each PA. In parallel, an expansion of the PA network with the gazetting of new areas is essential to ensure comprehensive protection of representative national natural and cultural heritage (Fuller, 2005). This report evaluates both terrestrial and marine ecosystems of Bahrain and the associated anthropogenic impacts. Main pressures from urban development and change in land use, depleting groundwater, air pollution, invasive alien species, and overexploitation are discussed and priority remedial and management actions proposed.

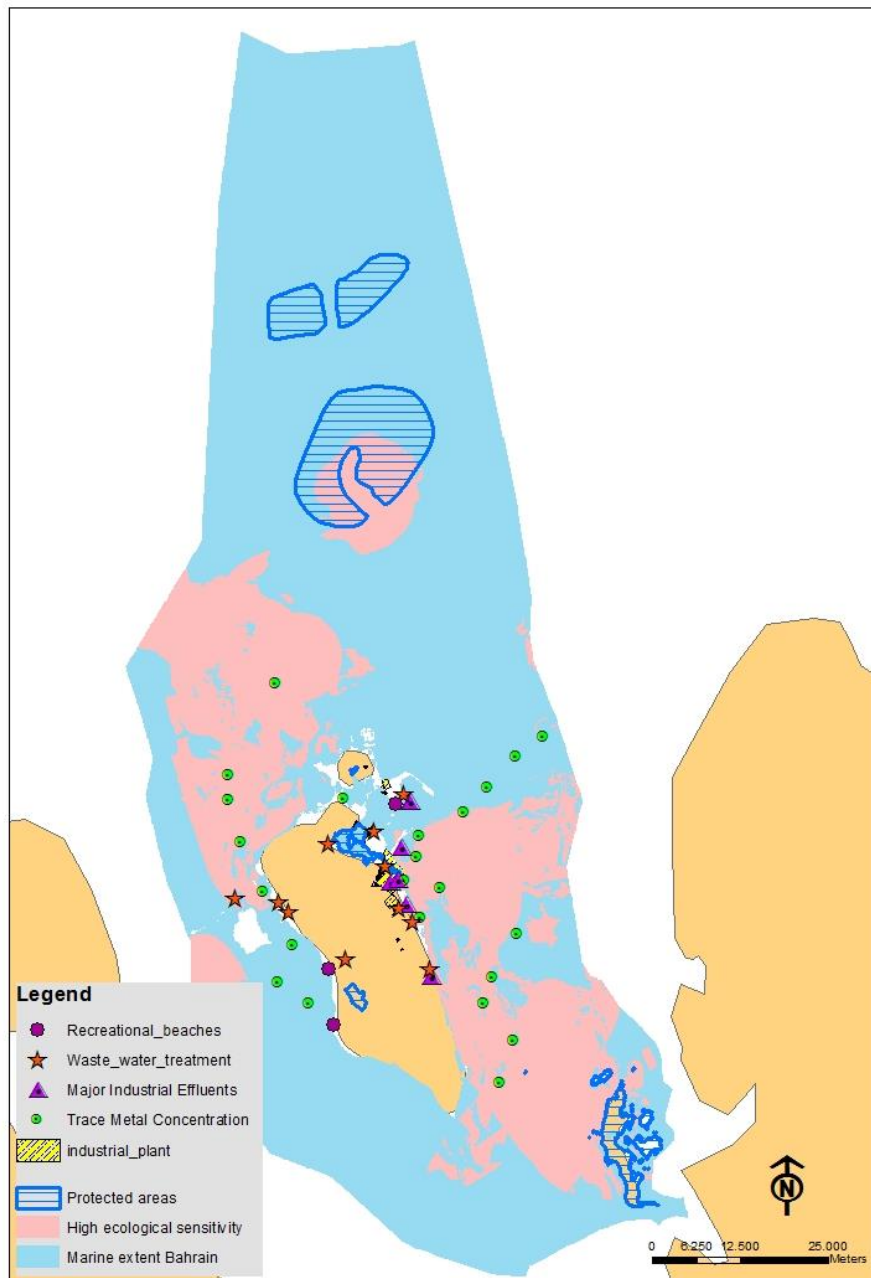
3.1. Threats to existing PAs

Figure 8 shows the distribution of existing gazetted PAs in the Kingdom of Bahrain, the spatial distribution of sensitive ecological areas, and the location of impacted regions. It is clear from the map that there is a significant proportion of ecologically important and sensitive areas that are not protected. Such is the case of Hayr Shtayyah, where the ecological value indicator (EVI) is very high, as it hosts high biodiversity, rare, vulnerable and resilient habitats and species (GEOMATEC, 2006) but is currently not protected. In addition, Hayr Bu Am'amah is considered one of the world's densest aggregations of oysters, representing a very important cultural and historical heritage of the Kingdom of Bahrain but is not protected. It is important to note that while this area (3 hayrat and Reef Bul Thamah) has been declared a World Heritage Area, no management exists for it.

In terms of national impacts, heavy metal traces and water pollution are present and are the result of urban encroachment, with untreated water and major industries including oil extraction and refining in Bahrain producing effluent that is often disposed of in the sea. The main industrial effluents concentrate on the eastern side of Bahrain, whereas trace metal concentrations are distributed on both the eastern and western sides of the island (Figure 8). A

spatial overlay of ecologically sensitive areas with the distribution of pollutants shows the hotspots of biodiversity under impact.

Figure 8. Map presenting ecologically sensitive marine areas (based on the MarGIS scenario 3) with major sources of pollution and current World Heritage and PAs in the Kingdom of Bahrain.



Current protected areas are located in zones where the EVI is high and in some cases management actions are urgently needed to ensure ecosystem functioning at the site and national levels. The southeastern waters are important habitats for seagrass, dugongs, turtles, and other species associated with marine meadows. The Hawar Islands Protected Area provides valuable feeding and breeding grounds to a variety of migratory seabirds. The breeding colony of the Socotra Cormorant on Hawar Islands is the largest in the world, while the dugongs foraging around the Bahraini archipelago form the second largest dugong aggregation second to Australia. Hawar Islands have been under full protection although with no active management. As they are remote, they maintain a reasonably high level of ecological integrity. Al-Areen Wildlife Park and Reserve supports breeding populations of rare and potentially threatened species including mammals, birds, reptiles and amphibians. Successful captive breeding and re-introduction programmes undertaken in Al-Areen have stimulated the recovery of rare antelopes, such as the Arabian Sand Gazelle.

Other PAs however face more challenging circumstances. Figure 8 shows how the various pressures are located in and around areas of high ecological diversity and sensitivity in Bahrain. Figure 8 shows that many PAs are threatened by an intensive urban development on the coast and by land filling activities. Furthermore, pollution outfalls occur close to most PAs. In the case of Tubli Bay PA, these high pollution levels will inevitable have a significant impact on the biodiversity values. The northern portion of national waters is characterized by high fisheries productivity and density of oysters. Hayr Bul Thamah Protected Area includes one of the most important oyster reefs located in the territorial waters of the Kingdom of Bahrain and features higher than average diversity in coral, algae, sponges and anemones. In spite of these exceptional ecological values, protection and management measures have not been implemented and a gradual deterioration of the site has been observed in the last decades (Afra et al, 2012; Abdulla 2013; pers. comm.) possibly due to unsustainable fishing practices such as trawling.

It is important to note that the limited monitoring of field variables and biodiversity indicators in Bahrain does not allow for comprehensive or quantitative conclusions regarding national trends. This needs to be considered when implementing the strategy to enable the setting up of a monitoring system to ensure addressing the management targets set and discussed in section 3.2.

3.2. Priority management action for existing PAs

A qualitative Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis suggests that biodiversity values are compromised given the accelerated rate of urbanization, particularly in northern Bahrain. Recent national evaluation and planning has documented continued degradation of Bahrain’s natural and semi-natural ecosystems (Atkins, 2010). Whereas there is awareness of the value of marine habitats in Bahrain, it is evident that the value of conserving at least some terrestrial and coastal /intertidal habitats is not widely appreciated. No terrestrial or coastal areas have been given operational management or real protection, while proposed conservation areas have either deteriorated or remained in a similar state and not improved. There is an urgent need to maintain all remaining agricultural areas as green spaces to be planned and actively managed for both recreational use and agricultural production (Atkins, 2010). For inter-tidal habitats, efforts should be made to develop proper management frameworks and designate new sites proposed for protection.

Table 2. SWOT analysis of current network of PAs

<p>Strengths</p> <ul style="list-style-type: none"> • Unique biodiversity biogeography • Representation of important types of habitats and species • Qualitative baseline information available on distribution of species and habitats • Sensitive biodiversity including mangrove swamps, seagrass beds, coral reefs, dugong population • Important ecosystem contribution to maintenance of genetic and biological diversity in the marine environment • Provide valuable ecological and economic functions as they form feeding and nursery grounds for a variety of commercially important marine organisms. 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Limited monitoring programmes do not allow information or evidence based decision making regarding biodiversity at the ecosystem, species or genetic levels • Lack of financial resources and inadequate technical and technological capacities make achievements incomprehensive and unsubstantial • Lack of accurate data on the impacts of human activities on biodiversity • Ongoing dredging activities within or very near sensitive ecological areas • Large-scale industrial activity e.g. more than 200 petrochemical and energy installations, chemical industries, and chlorine plants are located along the coast • There is a lack of concrete efforts to protect and conserve natural resources, particularly energy, water and soil resources, to improve efficiency in the use of non-renewable energy and water resources
<p>Opportunities</p> <ul style="list-style-type: none"> • Policy instruments in place to support conservation • Ratification of the main international conventions • National efforts to conserve biodiversity in place • Ongoing awareness raising in society 	<p>Threats</p> <ul style="list-style-type: none"> • High level of industrial pollution • High pressure from desalination and power plant intake • Overfishing • High impact on biodiversity in the eastern coasts and waters of Bahrain • Fast decrease and loss of biodiversity in the last

<ul style="list-style-type: none"> • Signs of political and social willingness to act provide hope for timely intervention • PA network can potentially canvass both natural and cultural values of Bahrain 	<p>two decades</p> <ul style="list-style-type: none"> • High impact due to increasing land reclamation and dredging activities • High level of chemical effluents and trace metals • Climate change, increases in sea temperatures, future oil exploration, shipping, and recreational activities
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Existing protected areas lack consistent plans with explicit management objectives and regulation measures articulated and customized to the characteristics of each site. This requires planning and implementation within the context of a wider ecosystem based management approach for Bahrain. For existing PAs in Bahrain, three broad categories of site management are addressed in the following section, highlighting the issues that need to be considered in the management in order to meet the objectives of the CBD Programme of Work on Protected Areas, the Aichi Targets, and the Bahrain National PA strategy:

a. Immediate prevention of further degradation for recovery of important communities

This category includes the Arad and Tubli Bay PAs that are under high anthropogenic stress and where no specific measures have been implemented to protect and conserve the health of these sites (Atkins, 2010). Intense human presence and use, pollution, and changes in hydrological systems have transformed these areas and changed their ecological communities. The priority is to safeguard the integrity of the habitat immediately to ensure the maintenance of ecosystem processes that contribute to the overall functioning of the Bahraini marine environment.

Tubli Bay is used here as a case study as its a hotspot of biodiversity for Bahrain and is increasing under threat. Current impacts in the area may be irreversible, with the potential death of the last remaining mangroves stand in Bahrain. The major issue in the Bay is urbanization, especially intense and ongoing reclamation, in addition to the high levels of pollution from industry and untreated waste. Coastal modification altering the natural current and water flows must be halted immediately, as this will affect important species such as the shrimp populations that may depend on this bay. A major part of Tubli Bay has been infilled and currently a large amount of untreated or partially treated wastewater is released. Such high levels of unnatural and organic waste can lead to lethal or sublethal effects on native species and can create an environment where only invasive foreign species may grow and thrive. There seems however to be a lack of willingness to stop reclamation and sewage dumping in and around this site. Restoration and monitoring activities are needed urgently at this site within the context of a management plan with clear objectives for the PA.

The SCE should prioritize prevention of more habitat degradation by banning human activities and impacts in these two PAs and ensuring that formal protection measures are in place and enforced. To assess the effectiveness of these measures, specific biodiversity targets and environmental indicators should be developed and a programme to monitor these indicators implemented. This monitoring programme will ensure coherent data collection and feedback to management.

Under this category the following issues must be considered:

- Reduce the impacts of pressures within and around the sites immediately;
- Rehabilitate degraded habitat and biodiversity; and
- Ensure enforcement of protection measures is in place.

b. Management of natural and cultural features in multiple use areas

This category includes Al Hawar Islands and Hayr Bul Thamah PAs. These are sites where the maintenance of ecosystem functioning of key and unique Bahraini habitats is important, though recreational and tourism is necessary and should be allowed as an example of sustainable socio-economic benefits. Management plans that define user zones and allowed activities must be developed for these areas. In the case of Hawar Islands, even though access to the islands group is controlled and the sites are still in a relatively pristine condition, no proper management plans have been developed and implemented in this region so far. The Hawar Islands is on the tentative list of UNESCO World Heritage where it could be nominated as a natural and cultural site. Alternatively the site could also be nominated as a UNESCO Biosphere Reserve Area where it could accommodate human use. Three main zones could be established: Core, Buffer, and Transition Zones, for the management of human use and the protection of important and iconic Bahraini biodiversity. The archaeological site is a very early prehistoric settlement (Pilcher *et al.*, 2003) and an example of the local traditional uses of land in Bahrain. As discussed, the Hayr Bul Thamah represents one of the most important oyster reefs in Bahrain and in the Gulf and is part of the World Heritage Area inscribed due to prominent cultural features of outstanding universal value (OUV).

Public involvement and raising awareness are essential to ensure appreciation and acknowledgement of the natural and traditional values of this site. Integrated management approaches are essential, at least in specific sites where cultural and environmental assets exist. Bahraini natural heritage values must be capitalised through encouraging local visitors to access the site more frequently through enabling visitation. In the Hawar Islands Protected Areas, the development of visitor tracks, bird watching devices, and explanatory boards about the native fauna and flora could attract national and international visitors and scientists.

Given the remoteness of the area and the lack of land, the Northern Hayrat is a more challenging location to manage. A full framework for implementation of a management plan has been developed as a case study for site-specific ecosystem based management within the context of this National Strategy. For more details, please refer to Abdulla's (2015a) report "A Framework for the Implementation of a Management Plan for the Northern Hayrat Region of the Kingdom of Bahrain".

Under this category, the following issues must be considered:

- Important natural and cultural features are protected;
- Sustainable use of resources within the sites is maintained;
- Cultural and traditional use is sustainable; and
- Socio-economic benefits of PAs is maximized while the potential social impacts are assessed and minimized.

c. Ensuring the survival of important Arabian habitats and species

This category is applicable Al Areen PA which aims to protect particular Arabian species or habitats. A management plan for this PA should focus on developing specific objectives for the protection of existing populations of endemic species and on enhancing their growth.

Under this category the following issues must be considered.

- Feeding, breeding, and nesting conditions of endemic and emblematic species are preserved;
- Socio-economic viability through visitation and public access programmes; and
- Awareness is raised through educational activities and public involvement.

3.3. Proposed new PAs in Bahrain

This section builds on the work developed by a number of national plans and studies that proposed new terrestrial and marine PAs and offers new specific recommendations for setting priority areas to protect on land and sea ensuring the representation of biodiversity and preservation of ecological integrity in Bahrain. This Strategy proposes areas to declare as PAs in order to progress on international targets (Aichi). Specific boundaries and management zones should be developed for these areas once national agreement is reached on priority regions, and management objectives are identified and approved by SCE following public consultation processes. As mentioned, a more detailed framework for the implementation of management plan of the Northern Hayrat has been developed as a separate report and is an example of how areas proposed as PAs in this report could develop a management plan.

3.3.1. Recommendations for new Marine Protected Areas in Bahrain

The identification of ecologically sensitive areas here aims to ensure the representativeness of important biodiversity and the long-term sustainability of natural resources. The adoption of these recommendations will increase the extent that important biodiversity in marine ecosystems are protected in Bahrain and supports the national efforts to reach the Aichi targets. To identify PAs in marine systems of Bahrain, we built on and used the Ecological Value Index (EVI). EVI was developed by the Marine Environmental Geographic Information System Project II based on the most comprehensive consideration of available data on biodiversity in Bahrain's territorial waters (GEOMATEC 2006).

Among the scenarios reviewed in the GEOMATEC study, scenario 3 in MARGIS II is the most relevant and considers information on habitats, endangered species, fisheries and birds. It ranks these information layers based on scientific agreement over the different weight factors for each data layer (i.e. habitats, fish grounds, endangered species and birds) using a ranking order from 1 (lowest) to 5 (highest). The ranking is based on the relative importance of each data layer to the area (as perceived by the scientists conducting the study). The EVI used the best available geospatial information for marine flora and fauna of Bahrain and was calculated based on information on marine habitats, fishing grounds, endangered species, and seabirds. Four different data layers were used to develop the "marine habitat" attribute layer, representing biodiversity, rarity, vulnerability and recoverability. Two additional variables for "fishing grounds" were used: productivity and diversity, and one each for the quality of "seabird" and for "endangered species" areas. In the case of seabird habitats, the areas were assessed according to importance for breeding, nesting and resting for seabirds. In the case of endangered species, variables included the number of animals and sightings recorded by researchers in specific areas. The ranking was based on the relative importance of each data layer to the area, as perceived by researchers. So, the data layer for endangered species was ranked 5, the highest in terms of importance for the study area, while the seabird data layer was ranked the lowest. According to the study, this ranking provided the best compromise between data layers and a realistic representation of the ecological value and scores used.

MARGIS concluded that 27% of national waters of Bahrain can be classified as high EVI and that these regions host the most important habitats for corals, seagrasses, algae and rocky reefs, have the highest productivity and diversity of fish, the highest abundance and habitat quality for seabirds and their nesting, feeding and resting, and the maximum number of endangered species. Consequently, these areas have been considered priority areas in this Strategy to conserve and protect and are the foundation used to identify new PAs. This Strategy does not provide a zoning of the Bahraini national waters based on the importance of the species and habitats they host, but rather makes available a selection of four possible scenarios where protection is necessary and would meet different objectives set by a National System of Representative Protected Areas that strive to meet international commitments under the CBD.

These objectives are:

- Scenario A: Priority areas for biodiversity conservation
- Scenario B: Priority areas for sustainable fisheries
- Scenario C: Priority areas for ecosystem service provision
- Scenario D: Cumulative / multiple management objectives (based on scenarios A, B, and C)

3.3.1.1. Scenario A: Sensitive areas for biodiversity conservation

In this scenario, two new regions are recommended as Marine Protected Areas (MPAs) in addition to wider management zone in the Northern Hayrat region that includes all three hayrs and reef Bul Thamah. (Figure 9). The proposed Marine Protected Areas include the most ecologically sensitive habitats and representative species of Bahrain. Scenario A builds on the high ecological sensitive areas proposed by the MARGIS II project. It considers both the high and very high sensitive areas identified for key species under the Ecological Value Index (EVI) as a basis for the selection of new MPAs. The most sensitive areas are the ones with the highest concentrations of *Dugong dugon*, sea turtles, and seabirds in addition to other marine species. The methodology and data layers used to develop these areas can be seen in Annex 2.

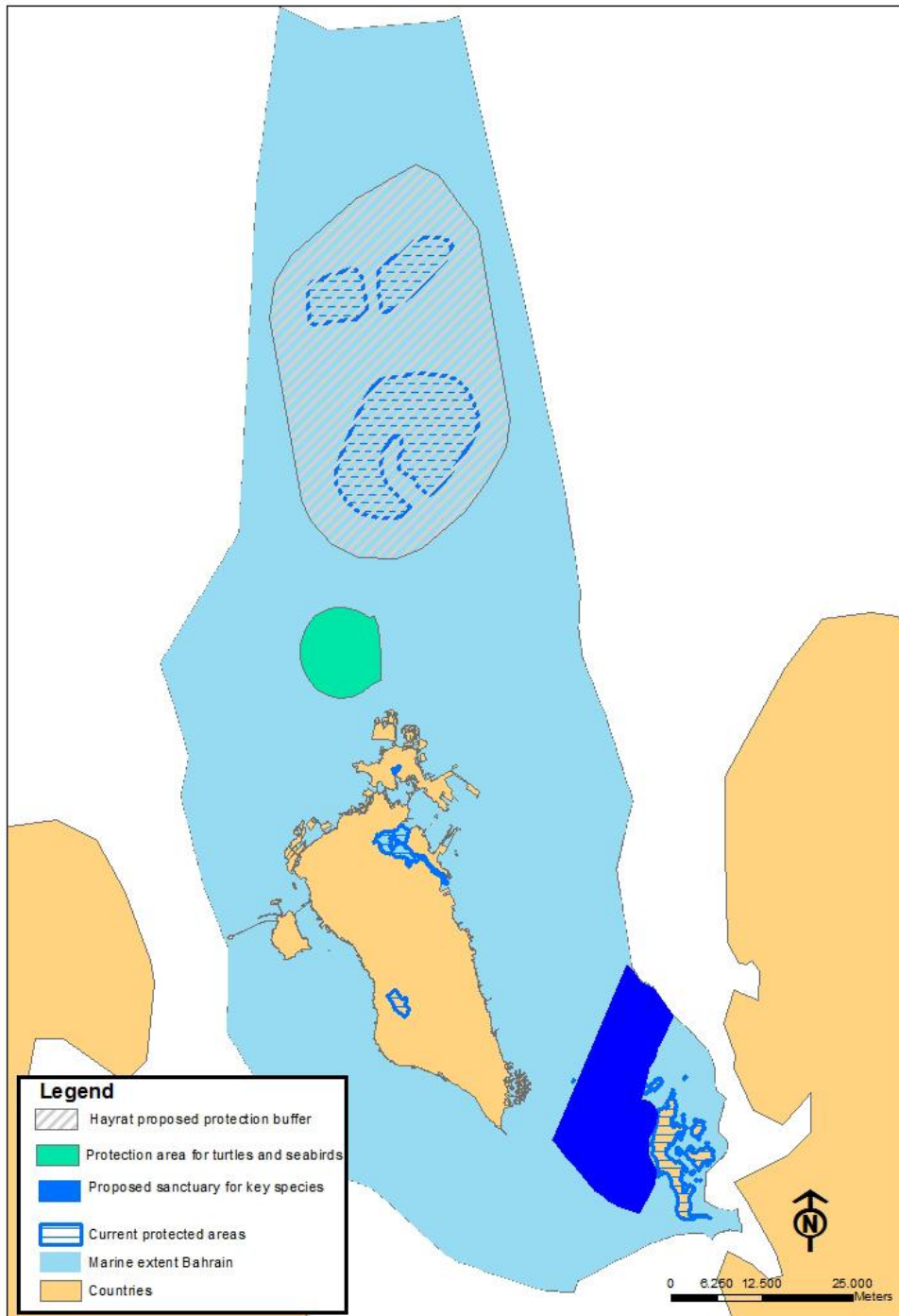
The north-western area adjacent to Hawar Islands is the region where the most important population of *Dugong dugon* concentrates in Bahrain waters. This proposed MPA is part of a larger area that extends between Qatar, Bahrain and Saudi Arabia, and constitutes a main feeding, resting, and potentially breeding ground for the second largest dugong aggregation in the world. The third MPA identified under this scenario is located in the north of Bahrain and has been selected for its high incidence of seaturtles and seabirds. The area is home to seagrass beds and is considered a highly sensitive area because of its relevance as feeding grounds for seaturtles, in particular the threatened *Chelonia mydas*, *Caretta caretta*, *Eretmochelys imbricate* and as major feeding and breeding grounds for migratory and resident seabirds.

These large near natural areas are proposed to become National Parks (IUCN Category II) for the conservation of large-scale ecological processes and the preservation of endangered species, providing essential feeding grounds for characteristic regional species threatened by the surrounding socio-economic drivers. The protection of these large zones would allow specific uses such as recreation, tourism, and scientific research. As naturally and culturally important and unique areas to Bahrain, it is important to extend the management area of Hayr Bul Thamah by including a buffer and 2 new core zones. This Strategy proposes a multi-use area for scuba diving and limited artisanal fishing with hand and line. A more detailed zoning plan and justification for a Northern Hayrat MPA can be found in a report by Abdulla (2015a).

Currently, MPA coverage in Bahrain constitutes 3.5% of the country's Exclusive Economic Zone (EEZ). Declaring the newly proposed areas as MPAs would increase the marine protected area in Bahrain by 5.6% to a total of 9.1% of the EEZ. If the proposed sites are considered and

gazetted, the average coverage of MPAs within Bahrain would therefore approach the Aichi Target of 10%.

Figure 9. Scenario A proposes areas for biodiversity (species and habitats) conservation and protection



3.3.1.2. Scenario B: Priority areas for sustainable fisheries

In the recent Bahrain Fifth National Report to the Convention on Biological Diversity (2015), fisheries were highlighted as one of the most prominent pressures on the marine habitats and species. Furthermore, the condition of marine species did not show any remarkable improvements since 2010 (Kingdom of Bahrain, 2015) highlighting an important need to set measures for the ecosystem-based management of fisheries resources.

Scenario B focuses on identifying important areas for the most targeted species in fisheries. This analysis considers that:

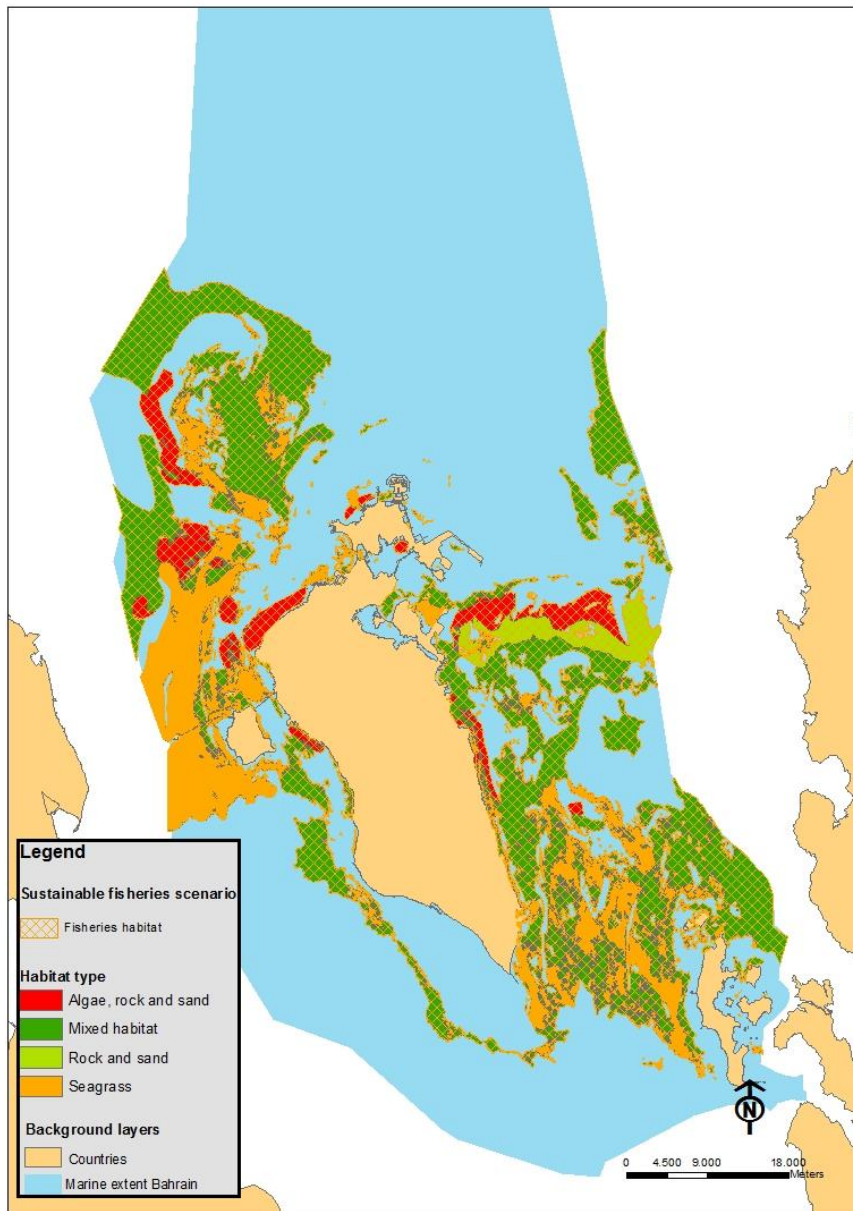
Seagrass meadows are essential habitats and feeding grounds for commercially important species including the rabbitfish, *Siganus canaliculatus*, nursery areas for the commercial prawn *Penaeus semisulcatus*, and a refuge for a high density of the spats of the pearl oyster *Pinctada radiata*. Also included are the pearl oyster beds and other important habitats distributed around seagrass habitats in Bahrain as small and scattered patches of rocks or fashts with pearl oysters attached to them as important mixed habitats that aggregate fish or supply larvae of commercial importance. A number of important features have been included in this scenario:

1. Sensitive habitats with priority grass meadows and some scattered mixed habitats are located in Figure B.1 (Annex 2). From the marine habitat map, the classes of seagrass meadows and the class of mixed habitat that includes a mixture of seagrasses, algae, rocks, sand and mud were selected to obtain the major habitat distribution of seagrass meadows in Bahrain. Shrimp catch, traditionally one of the most important fisheries in Bahrain, has considerably declined over the last decade, raising concerns and leading to an attempt to minimize adverse stresses imposed by over-fishing (Kingdom of Bahrain, 2006). Figure B.2 (Annex 2) shows the distribution of shrimp habitats around the Kingdom of Bahrain. This layer was digitised and is included in the development of scenario B as a sensitive habitat where management efforts need to be strengthened.
2. Annual landing of crab fishery have decreased during recent years, which has led the government of Bahrain to issue a Ministry Decree No. 3 for the year 2012, banning crab fishing in the territorial waters of the Kingdom of Bahrain for specific periods of the year, namely during the reproduction period. The areas of distribution of crab are included in the development of scenario B, where the distribution of crabs and the location of crab fishery are considered as sensitive areas and is represented in Figure B.3 (Annex 2).
3. The rabbitfish "Saffee" is a preferred fish in Bahrain and is considered one of the most important species in the local fishery. Catch in 2012 was 1,683,738 kg and increased by 53% compared to 2011. The average price of rabbitfish per mt amounted to BD 1922 in 2012 as compared to BD 2060 per mt in 2011. According to the 4th CBD national report

the spotted rabbitfish (*Siganus javus*) is within the list of threatened species in Bahrain, and recommend the need to develop scientific research to monitor the population.

Scenario B is presented in Figure 10 and shows high priority areas to manage or protect for fisheries sustainability in Bahrain. The habitats to conserve for fisheries resources are located in the north western portion of national marine waters.

Figure 10. Scenario B proposes priority areas for protection and management of targeted marine species in fisheries



In general, the IUCN Category VI for Protected Areas (to conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems) should be applied to this scenario, as it includes sustainable and traditional use and fisheries. Some examples of how to improve sustainable fisheries include the certifying and marketing of local fisheries as “sustainable brands” using traditional or sustainable fishing techniques. A consistent monitoring of these areas is important to assess any improvement in the condition of seagrass and algae within mixed, rocky and sandy habitats as well as any associated increase in shrimp, crab, or rabbitfish fisheries. Table 3 shows the areas proposed for management per habitat type. Protection of areas included in scenario B would cover more than 21% of Bahrain’s EEZ, approximately the double of Aichi’s target requirement for marine systems.

Table 3. Categorization of major marine habitat types in Bahrain by type and diversity of ecosystem services, and the area (%) covered by each habitat type

Habitat type	Total % of Bahraini marine area
Algae, Rock, and Sand	2.38
Mixed habitat (seagrass, algae, rock, sand and mud)	11.57
Seagrass	6.39
Rock and sand	0.80
Share (in %) of marine area proposed for protection	21.14

3.3.1.3. Scenario C: Priority areas for ecosystem service diversity

Scenario C presents marine ecosystem services provided by the different habitat types. It builds on initial work developed to estimate the potential value of each marine habitat type in the Northern Hayrat area (Abdulla, 2013) and another study that estimated potential value of ecosystem services of Bahrain (Abdulla, 2015b). Habitats in this map were defined by the marine habitat classification of Bahrain in 2006. The method used calculates the highest diversity of potential services that can be provided by each habitat type in Bahrain (Table 4). According to this methodology, the most diverse ecosystem services are provided by coral dominated habitats, followed by mangroves, salt marshes, and finally algae and seagrass dominated habitats (Table 4). Figure 11 shows that the habitats with the highest services’ diversity are located within and around the fashts/shoals, and within and around the Al Hayrat region, coinciding with sensitive biodiversity areas (see scenario A) and important fisheries areas (see scenario B).

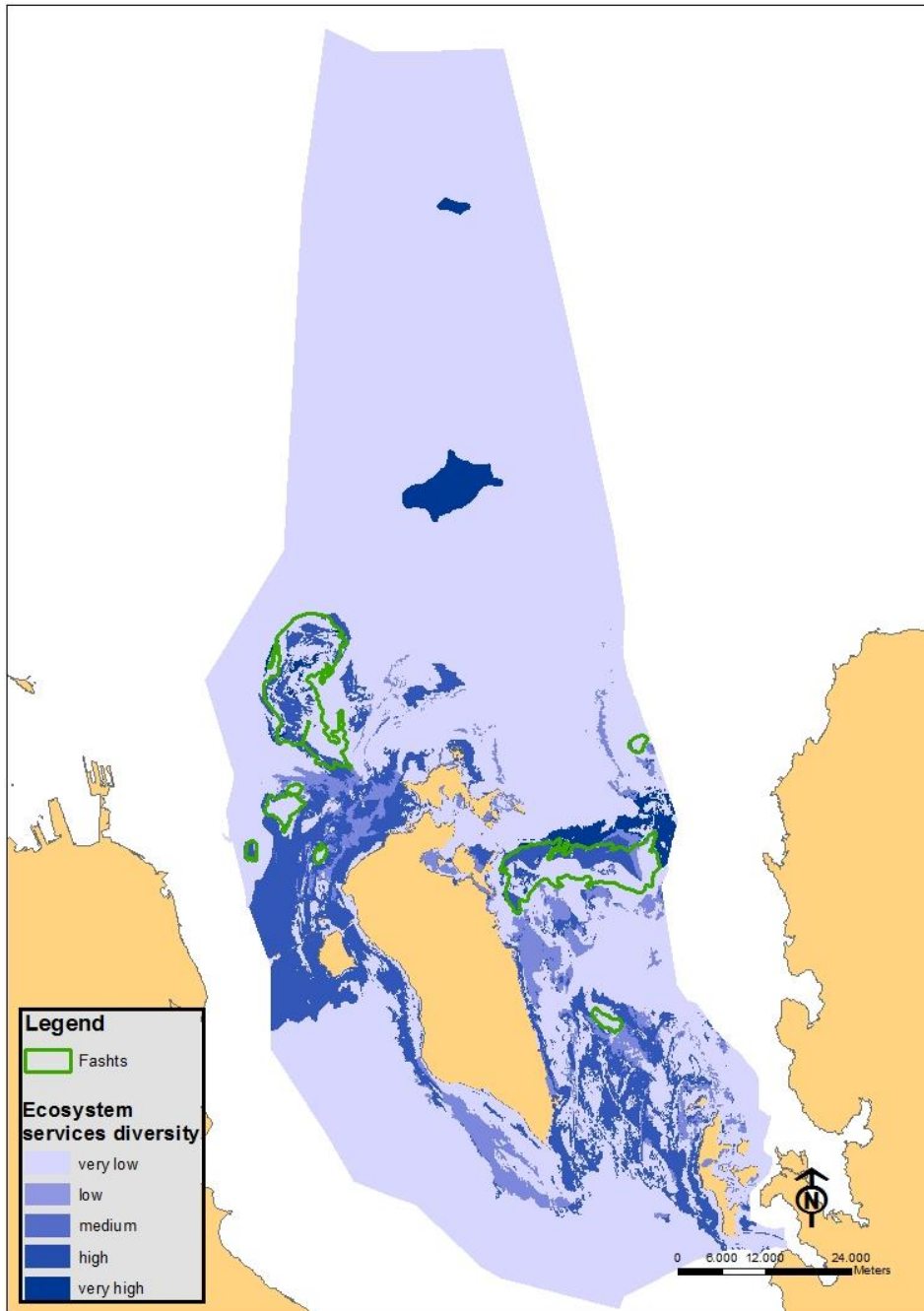
Scenario C presents a case for the conservation and protection of habitats based on their potential to provide the highest number of services to the Bahraini people, namely in the form of provisioning of cultural and recreational services (tourism), regulating services (storm buffers, shoreline stabilisation, and carbon sequestration), genetic diversity (biodiversity), etc. (Table 4). In terms of area coverage, these habitats providing “high” and “very high” levels of

ecosystem services represent approximately 12% of the marine territorial waters in Bahrain. The conservation areas proposed under scenario C would therefore increase marine protected areas in Bahrain to a level higher than the Aichi Target of 10%.

Table 4. Categorisation of major marine habitat types in Bahrain by type and diversity of ecosystem services, and the area (%) covered by each habitat type. * represents habitats/areas whose protection would meet and exceed the Aichi Target of 10%

Marine habitat type	Type/s of ecosystem services	Ecological services diversity	% Area
Coral	Biodiversity/ tourism/ shoreline/fisheries	Very High*	0.06
Coral, rock and sand	Biodiversity/shoreline stabilization/fisheries/cultural	Very High*	1.78
Mangrove	Shorelines/storm buffers/fisheries	High*	0.01
Salt marsh	Shorelines/water quality/carbon	High*	0.01
Algae, rock and sand	Support to biodiversity/carbon/fisheries	High*	4.28
Seagrass	Biodiversity/fisheries/carbon	High*	6.99
Sabkha	Biodiversity/cultural	Medium	0.08
Mud	Biodiversity/shell fisheries	Medium	0.17
Algae	Support to biodiversity/carbon	Medium	1.77
Mud and sand	Biodiversity/shell fisheries	Medium	2.57
Rock	Fisheries	Low	0.03
Deep water mud	Support to biodiversity	Low	1.46
Sand	Tourism	Low	4.35
Rock and sand	Biodiversity	Low	6.20
Mixed habitat (seagrass, algae, rock, sand and mud)	Fisheries	Low	12.67
Deep water mixed habitat	Fisheries	Low	57.58

Figure 11. Scenario C proposes priority areas for conservation of marine habitats with the capacity to provide the highest number of ecosystem services



3.3.1.4. Scenario D: Cumulative conservation priorities and multiple management objectives

This scenario integrates the areas identified under Scenarios A, B, and C and identifies the areas where significant biodiversity, important fisheries and the diversity of ecosystem services are located. These can be considered priority areas to protect, conserve, and manage and include locations with both high biological diversity and locations of high social importance for local livelihoods such as fishers. Based on this analysis, approximately 19% of marine areas in Bahrain are high or very high conservation priorities.

Figure 12. Conservation priorities as set for the marine region of Bahrain based on an overlay of Scenarios A, B, and C to produce Scenario D: Cumulative Conservation Priorities

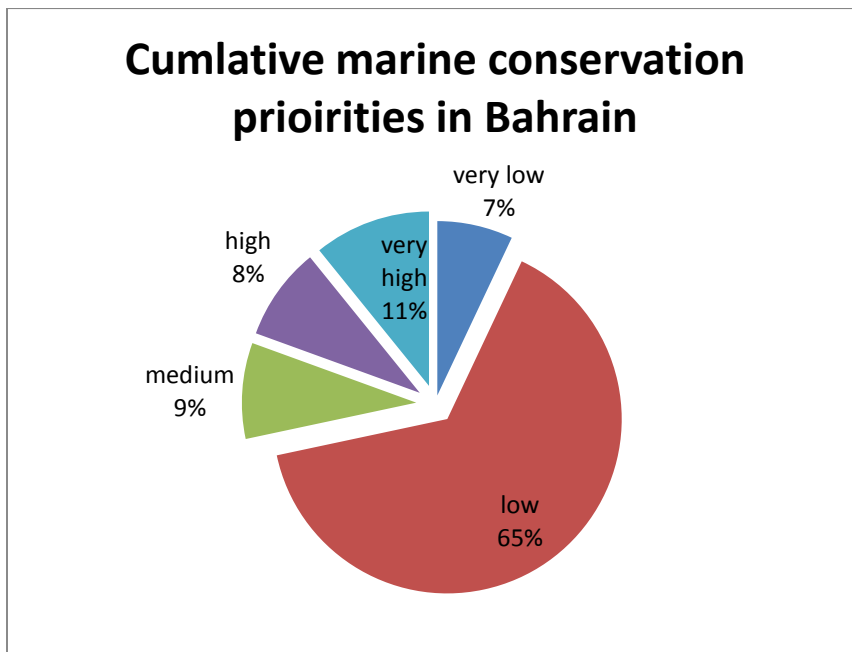
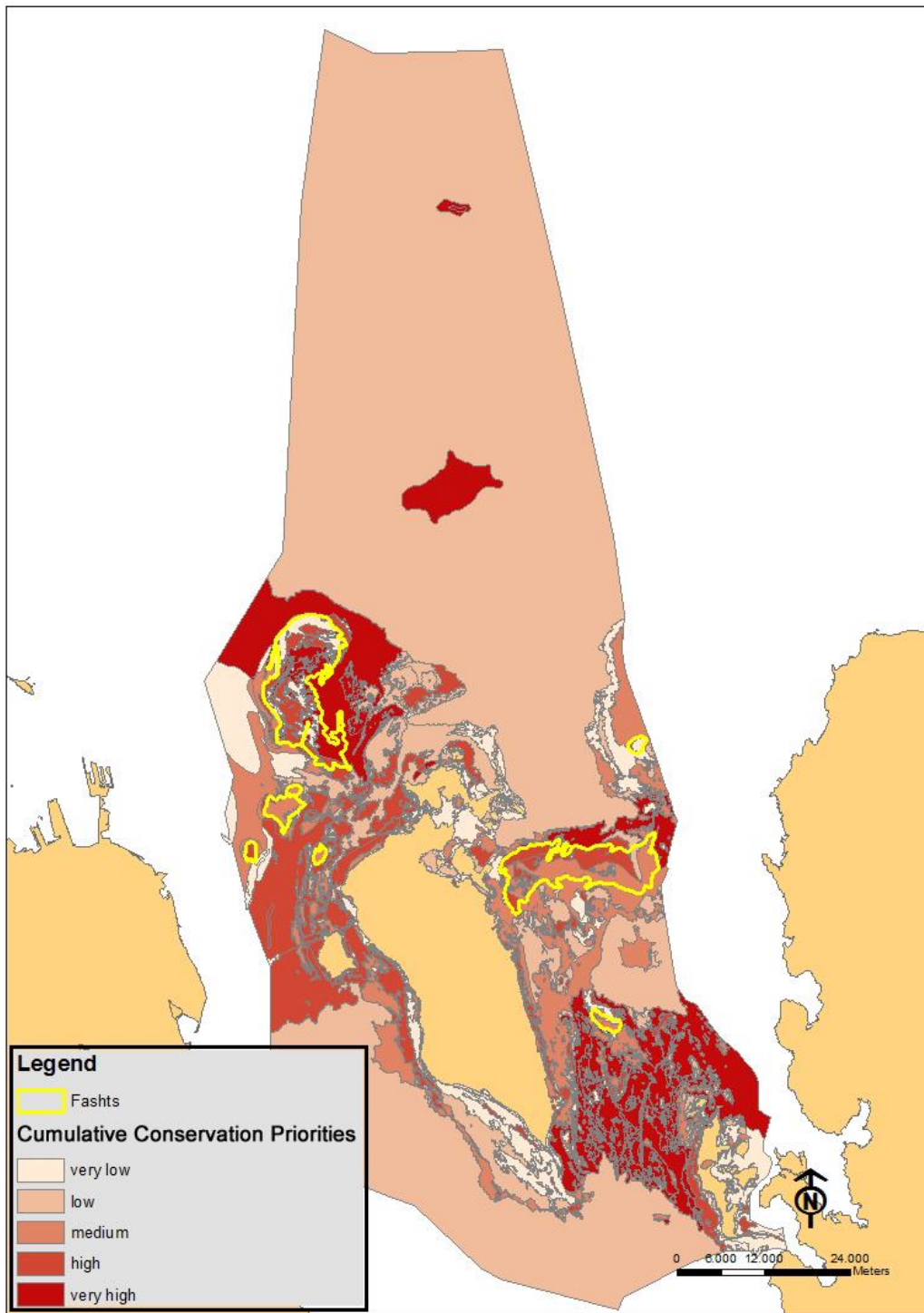


Figure 13 presents high priority areas for conservation, management, and protection in Bahrain. These include fashts, shoals, hayrat, and reefs host important sensitive biodiversity values in the form of a mosaic of habitats and species. The immediate protection of these formations is vital, specifically from dredging, land reclamation and pollution, which have all seen an increase in the past two decades. From this analysis, it is also evident that the Northern Hayrat area is also a high priority region to conserve and manage given its contribution to ecosystem service provision, fisheries, and biodiversity. A more detailed report outlining a framework for implementing management actions in the Northern Al Hayrat region has been prepared to support and enhance the management of that area (Abdulla, 2015a).

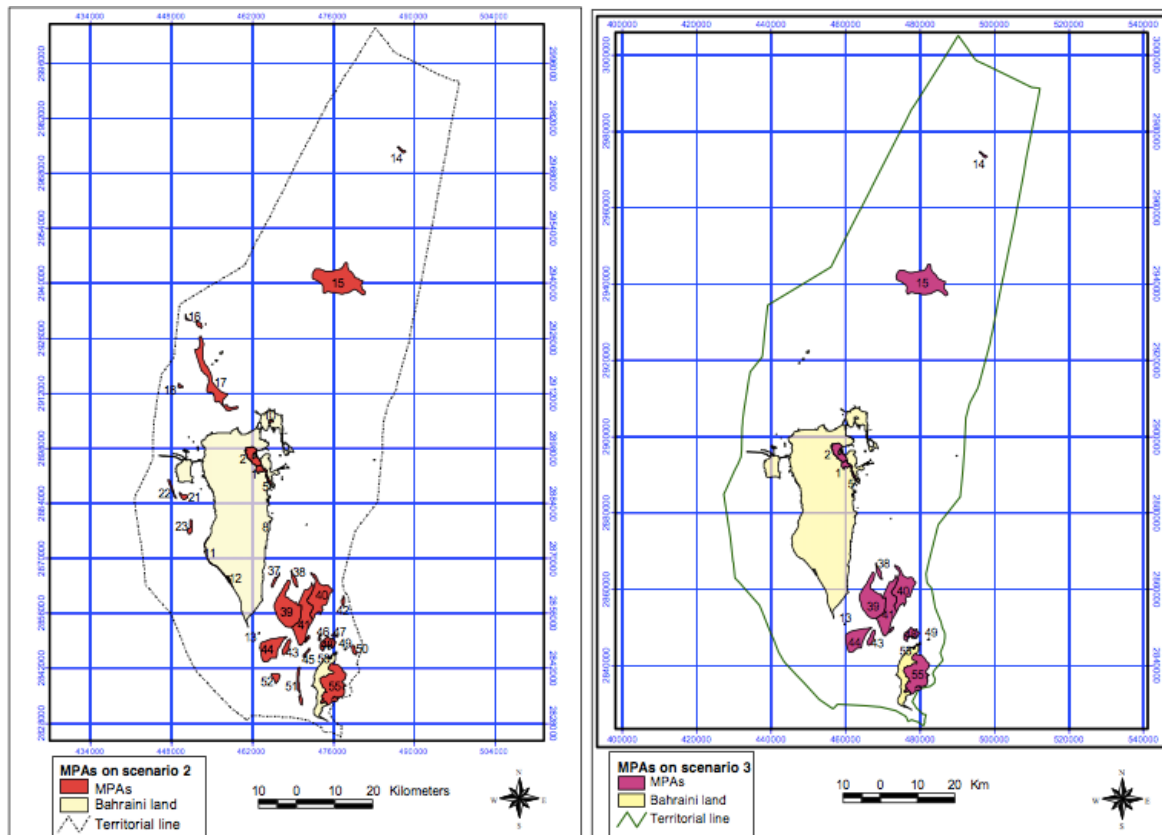
Figure 13. Scenario D presents an overlay of scenarios A, B, and C to identify cumulative priority conservation areas according to biodiversity, fisheries, and ecosystem services provided by the marine habitats



As stated under each section, the four scenarios proposed for marine ecosystems in Bahrain have different objectives. These can range from strict biodiversity conservation to conservation of habitats for fisheries, to a focus on sustaining ecosystem services, and a cumulative scenario showing an overlay of all three scenarios that address different objectives. The overall aim is to protect 10% or more of the national marine waters as stated by the Aichi targets of the Convention on Biological Diversity. The recommended scenarios on marine protection aim at the 10% target of protection.

In a different but comprehensive assessment to select new priority MPAs, a study by Al-Zayani (2003), used a multi-criteria analysis that included rare, sensitive and endangered species, high biodiversity habitat, fishing grounds, seabird habitats, tourism and recreation areas, and historic and cultural sites to identify important sites to gazette. The analysis results in two scenarios relevant to this national strategy as they present the maximum and minimum practical conservation scenarios that contain sites that fulfil the minimum MPA objectives (Figure 14). As can be seen from the Figure the scenarios present a high degree of concordance with the cumulative Scenario D developed in this strategy.

Figure 14. Two scenarios that present a) maximum (left) “unpragmatic” and b) minimum (right) “pragmatic” conservation scenarios needed to fulfil the minimum MPA objectives for Bahrain (Al-Zayani 2003)



Nevertheless, the selection of one scenario or a combination of areas from different scenarios as priorities for designation is a process that needs to be addressed through consultation with stakeholders and the local community. The selection and final ranking of sites is a national dialogue that is tabled by a taskforce and should be led by the Supreme Council of the Environment (SCE).

3.3.2. Terrestrial Protected Areas

As to what concerns the terrestrial side, biologically important habitats are located in traditionally cultivated date palm and alfalfa fields in the northern and western coastal areas of Bahrain. These areas represent fertile lands rich in biodiversity. Protection measures are essential for the survival of species aggregated over time within these habitats. In this section on the prioritization of terrestrial PAs in Bahrain, the work of Atkins (2010) is discussed and some priorities are defined based on 1) previous work done (Atkins, 2010), and additionally on 2) most fertile landscapes in Bahrain.

3.3.2.1. New PAs to designate and recommended management categories

In 2010, the Ministry of Municipality Affairs and Urban Planning requisitioned a study (Atkins, 2010) that suggested a network of 23 sites to be managed and protected as presented in Figure 15 (adapted from Atkins, 2010). A summary of the main features of terrestrial protected areas and the new areas proposed for protection is presented in the table below. This Strategy builds on Atkins (2010) work, who presented priority areas for management and protection (see Figure 15 and Table 5). During the development of that project and report, visits were made to some of the areas proposed for management and protection to assess their condition, land use and biodiversity conservation status. These visits were complemented with an analysis of recent satellite imagery. It is not clear to the author of this report what criteria and specific methods were used as the information was not accessible. However, the list of areas proposed was available and is presented below, showing sites from north to south, with a proposed IUCN Protected Area Management Category and a brief description of the site (made in 2010). Figure 15 also shows a newly proposed site (No. 23, Wadi Ali), designed for stricter protection within the Southern Desert National Park. As shown in Table 5, the major pressures that affect terrestrial proposed areas relate to industrial pollution, urban encroachment, population increase, and land reclamation. Although, the list provides a comprehensive proposal for a network of PAs in Bahrain, none of the recommendations for sites seem to have been implemented or a public consultation undertaken so far to determine the feasibility or opposition to declaring any of them as protected areas in the country.

Figure 12. A network of sites to be managed and protected (adapted from Atkins, 2010)



Table 5. Network of 23 sites to be managed and protected (adapted from Atkins 2010)

No.	Name	IUCN Protected Area Category	Site characteristics	Major pressures / threats	Implementation of measures
1	Arad Bay (Dohat Arad)	Category V – Protected Landscape/seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Important wading bird area	Heavy urbanization Dense population No in and out correct flow of water Increased pressures due to recreation	2010 study proved that no specific measures have been implemented to protect and conserve the lagoon
2	Hata an Ma'im	Category V- Protected Landscape/seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Important feeding grounds (mudflats) for wading birds Intertidal habitats Some “intact” habitats still persist	The Great harbour and the surrounding urbanization Poor tidal flows	Though some proposals were made for the improvement of tidal flows in this area, still no implementation was developed according to the Atkins study (2010).
3	Bahrain Fort	Category V – Protected Landscape/Seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Important ecological and cultural attributes Semi-natural agriculture ecosystem Presence of <i>Capparis spinosa</i> Important fauna under threat: Caspian turtle and marsh frog	Urban development	No plan is available for this area, but it provides a good example of traditional landscapes that need to be preserved

4	Maqabah	Category VI - Sustainable use of natural ecosystems (i.e. Managed Resource Protected Area)	Small site in urban context Used to be main roost sites for Grey hypocolius	Urban encroachment Solid and other waste	No implementation plan for the site Some recreation management efforts with incorporation of some water features are suggested by Atkins
5	Sar archaeological site and surroundings	Category V – Protected Landscape/seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Agriculture land Archaeological site of international importance Traditional irrigation channel remains Birds of interest (breeding, feeding)	Overall deterioration of the site (Atkins, 2010) Urban development Solid and other wastes Very poor environmental health	No measures taken and no implementation in the region (despite being a tentative World Heritage Site)
6	Dilmun Mounds	Category V – Protected Landscape/seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Archaeological, ecological, and landscape interest	Urban development and encroachment	No measures taken and no implementation in the region
7	Lawzi Lake/ Dumistan pool	Category IV – Conservation through active management (i.e. Habitat/Species Management Area)	Partial support of some bird life	Agriculture and urbanization	No measures taken and no implementation in the region Atkins (2010) proposes a further study for conservation/ recreation options

8	Umm Al Na'san Island	Category II – Ecosystem conservation and recreation (i.e. National Park)	Ecological interest Large herd of Reem Gazelle Sub-tidal habitats around the island	Private property expected to be in good status Potential threat from urban development	No measures taken or implemented Need for an ecological study to better define the ecological importance and protection measures needed
9	Tubli Bay	Category IV, V, VI – Conservation through active management (i.e. Habitat/Species Management Area) Landscape/seascape conservation and recreation (i.e. Protected Landscape/Seascape) Sustainable use of natural ecosystems (i.e. Managed Resource Protected Area)	Inter-tidal mudflats Last remaining stand of natural mangroves in Bahrain Important breeding and nursing site for fish and shrimps Important bird site	Urban development Industrial development Intensive reclamation and discharge Severe environmental degradation High pollution levels	Wildlife reserve (1988) Supervision entrusted to the Environmental Protection Committee (EPC) Need for management plan of a bigger surrounding area Important wetland under the Ramsar Convention
10	Wadi Buhayr	Category IV – Conservation through active management (i.e. Habitat/Species Management Area)	Distinctive geology-geomorphology Important site for birds	Water dumping Urban encroachment	No measures taken and no implementation in the region Active management needed
11	Wadi Hunayniyah	Category V – Protected Landscape/seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Freshwater well of historic value Clay for pottery (traditional value) Eggs of the desert shrimp hatch, develop and breed in pools of the Wadi	Oil exploitation Oil well drilling	Multiple use designation suggested (Atkins, 2010) No formal measures in place

12	Ras Abu Jarjur Marsh	Category IV – Conservation through active management (i.e. Habitat/Species Management Area)	Marsh Important area for birds	Industrial development Land reclamation Continued degradation	Planning, designation and management are suggested (Atkins 2010), but no formal measures taken
13	Jabal Ad-Dukhan	Category V – Protected Landscape/seascape, conservation and recreation (i.e. Protected Landscape/Seascape)	Geological – geomorphological importance Bahrain’s natural heritage Modern industrial archaeology Camping site	Oil production New oil production instalments	Multi-use protected area suggested (Atkins, 2010)
14	Al Areen Wildlife Park and Reserve (AAWPR)	Category IV – Conservation through active management (i.e. Habitat/Species Management Area)	Natural condition of part of the park Endangered animal species, mammals, birds Sanctuary for endangered Arabian wildlife Plant protection	Resort established on a slope compromising the reserve	Reserve area (Category IV) (1976-1979) Conservation programmes in place Plant protection measures in place

15	Ra's Hayan-Jaw Mudflats and salt marsh	Category IV – Conservation through active management (i.e. Habitat/Species Management Area)	Inter-tidal mudflats Rich salt marsh with very specific linked species Rich feeding ground for birds	Urban development Resorts and private developments Continuous pressure	A management plan is needed for the prioritization of areas for conservation within the salt marsh and the surrounding mudflats No clear strategy, continuing pressure on the area Consideration as a Ramsar site
16	Southern Desert National Park	Category II- Ecosystem conservation and recreation (i.e. National Park)	Diverse desert habitats Sandy areas and grasses Rangelands	Local tourist attraction	Conservation efforts needed as rangelands are essential in supporting the last remaining population of Reem Gazelle Proper management plan with different access licences is essential for conservation and already suggested by Atkins (2010).
17	Ras Mamtalah	Category II- Ecosystem conservation and recreation (i.e. National Park)	Sand dunes and inter-tidal mudflats and some sabkhah Important breeding and feeding site for birds	Relatively undisturbed area Low pressures	Good candidate for protection
18	Ra's Al Barr/Hid Al Bahrain	Category II Ecosystem conservation and recreation (i.e. National Park)	Important for seabirds National monument, part of Bahrain's natural heritage Roosting area for birds	Low pressures	No conservation measures in place

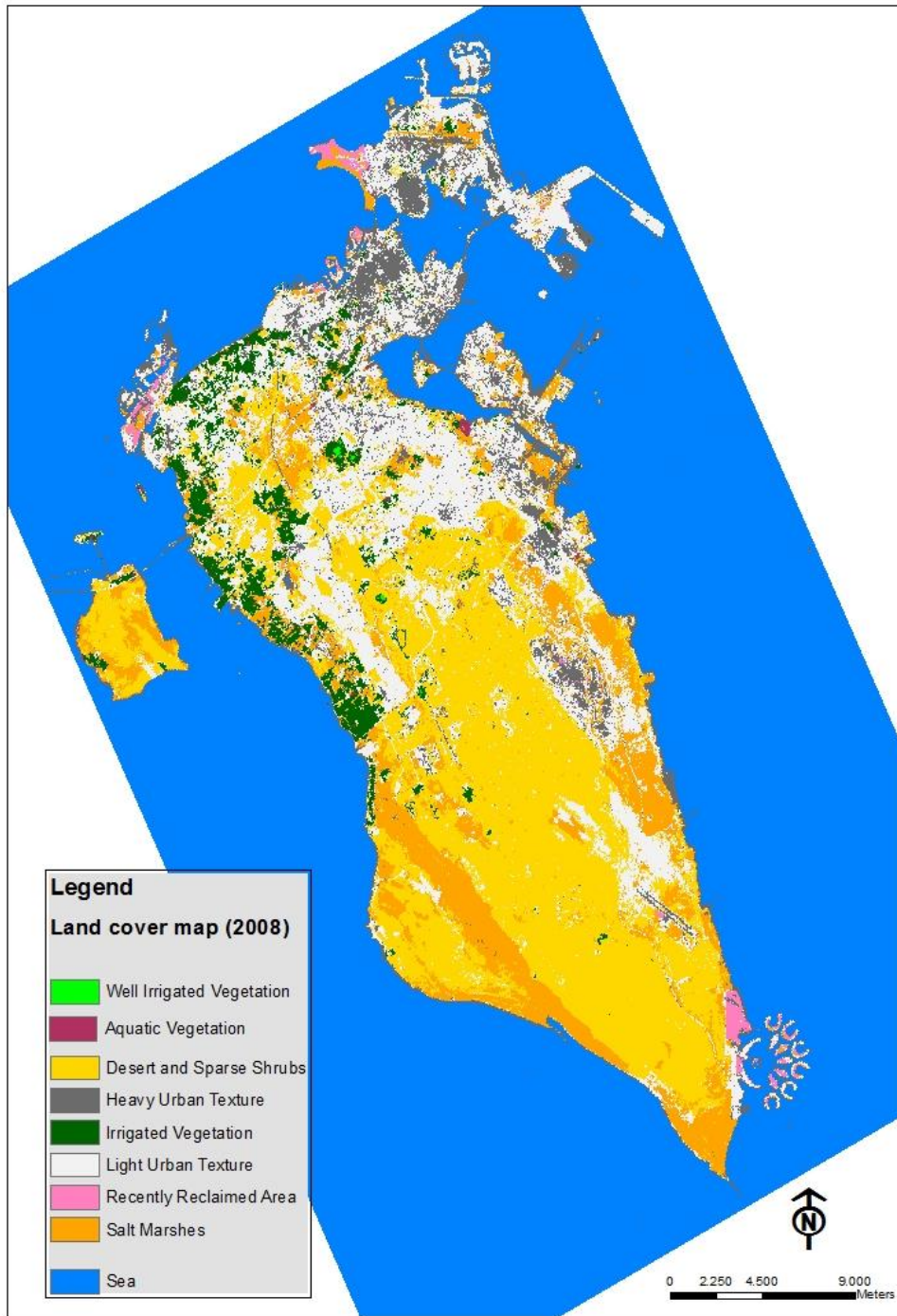
19	Hawar Islands	Category II – Ecosystem conservation and recreation (i.e. National Park)	Extensive seagrass beds Sea turtles, Dugong Seabirds Cultural/archaeological/ prehistoric sites Breeding sites	Pristine condition	Declared a protect area by the National Committee of Wildlife Protection (NCWP) Several public efforts from different ministries in place Area of international significance On the tentative list of World Heritage sites
20	Howrat A'Ali Forest Park, Salmabad	Category V – Protected Landscape/seascape, conservation and recreation	Forest plantation Migratory birds	Waste dumping	No protection measures in place
21	West Rifa'a Wadis	Category V – Protected Landscape/seascape, conservation and recreation	Wadi system	Damage of habitat from nearby construction	No protection measures in place
22	Al Jazayr Sand-dunes	Category V – Protected Landscape/seascape, conservation and recreation	Natural sand dunes	Recreational use	No protection measures in place Management plan needed (Atkins, 2010).
23	Wadi'Ali	Category V – Protected Landscape/seascape, conservation and recreation	Large wadi Draining Reem gazelle regularly present	Low pressures	New candidate site for protection (Atkins, 2010) and possible assignation of IUCN category I as a strict natural reserve

The Atkins (2010) list of areas to protect is comprehensive and accounts for major ecosystems in Bahrain. Given the extensive work undertaken this Strategy does not assess the merit of this work in proposing these sites but recognises that the size and location of these proposed areas may be controversial and opposed by local communities. A ranking of the sites according to ecological importance and minimal social impacts should be undertaken by the SCE. In the next section, new priorities for terrestrial conservation in Bahrain are presented based on an analysis of land fertility.

3.3.2.2. Priority terrestrial areas to conserve based on land use categories

Given that terrestrial species aggregate in agricultural lands in Bahrain, conservation priorities have also been developed based on the fertility of land as a proxy for habitat condition, complexity and ecological importance. A prioritisation of land cover types was developed based on potential agricultural productivity using MODIS satellite imagery at a resolution of 15m (Figure 16). Eight types of land cover are categorised in the land cover layer for the year 2008. The categories of land cover identified are: aquatic vegetation, desert and sparse shrubs, heavy urban texture, irrigated vegetation, light urban texture, recently reclaimed area, salt marshes, and well irrigated vegetation.

Figure 16. Land cover types in Bahrain based on MODIS 2008 imagery



A hypothesis based on land cover categories assigns three priority levels for conservation depending on the potential number of ecosystem services provided by cover type. The categories assigned are high, medium and low conservation priority.

This classification scheme is presented in Table 6:

- Land cover identified as irrigated croplands, aquatic vegetation and salt marshes are branded as providing the highest levels of ecosystem services and receive the highest scores;
- The medium conservation priority refers to desert and sparse shrubs, which are natural and important ecosystems but provide fewer services than the categories mentioned earlier;
- The lowest level of priority for conservation was given to the urban and reclaimed areas where ecosystem services are the lowest due to habitats altered, damaged, or completely removed.

Given this classification, high conservation priority areas cover around 22% of land in Bahrain; medium priority for conservation covers around 36%, and the remaining (42%) covers urban areas that have the lowest conservation priority assigned (Table 6).

Table 6. Categories of land cover classified under different levels of conservation priorities as per their capacity to provide ecosystem services

Dominant Land cover	Type of ecosystem services provided by LC types	Level of priority for conservation	% of terrestrial territory
Well Irrigated Vegetation Irrigated Vegetation Aquatic Vegetation Salt Marshes	Gas regulation Soil formation Nutrient regulation Habitat provision Food provision Raw material production	High conservation priority	21.94
Desert and Sparse Shrubs	Carbon sequestration Resistance to desertification	Medium conservation priority	35.89
Heavy Urban Texture Light Urban Texture Recently Reclaimed Area	Cultural value	Low conservation priority	42.16

Gazetting the areas proposed as “high priority conservation areas” to protect would lead to a total protected area of 23% of Bahrain, exceeding the Aichi targets of 17% protection for terrestrial ecosystems. It is clear that the “High” and “Medium” priority areas set for conservation cover a broad area of Bahrain, and that a selection process based on the socio-economic feasibility would need to be developed through a government and public consultation process. This consultation process should consider a broad range of stakeholders, decisions makers, and the local community. It should be led by the Supreme Council for Environment as the governmental agency in charge of PAs.

In order to fulfil national and international conservation targets for terrestrial ecosystems in Bahrain, it is recommended that a selection of sites be made to meet specific biodiversity and socio-economic objectives and the areas highlighted in this study be considered when developing biodiversity objectives. Such an approach would protect and maintain a representative set of truly Bahraini habitats and species.

4.0. Conclusions and recommendations for next steps

This Strategy highlights specific recommendations that allow evidence-based decision-making to reduce pressure on important biodiversity and to halt environmentally damaging activities in specific sites with high ecological values. It also discusses the importance of developing site-specific monitoring programmes in order to provide quantitative assessments on the state and trends of biodiversity in key biodiversity areas and existing PAs. Following on from this Strategy, individual PA management plans need to be developed and linked to clear management objectives within a five-year timeline (2016-2020) in order to meet the CBD Aichi targets. These management plans should identify the primary purpose behind gazetting a new PA and enable the monitoring of biodiversity trends by accounting for the number of species, their distribution, abundance, and population growth using a system of indicators.

In the waters of Bahrain, urgent efforts should designate and protect marine habitats (including fashts, hayrat, and reefs) by adopting sites within the regions proposed for protection (Scenario D) and developing the relevant management plans. Important resources linked to cultural heritage in Bahrain, such as the significant oyster reefs of the Northern Hayrat, should be prioritised. New areas for protection need to be considered within marine environments for conserving important biodiversity (Scenario A), managing and sustaining fisheries (Scenario B), and ensuring the persistence of ecosystem services (Scenario C). Terrestrially, a set of 23 proposed PAs by Atkins (2010) need to be reviewed and ranked, with priority given to agriculturally fertile lands that attract and aggregate land species. The selection of a mosaic of areas should fulfil both national and international objectives in terms of percentage of area protected. This Strategy identified the most important areas that should be considered on a

national scale. Designating, gazetting, and managing these areas must occur on a site-by-site basis. To this end, a comprehensive national multi-stakeholder consultation process should be undertaken to reach consensus for a national Marine and Terrestrial PA network. Raising awareness during this process is essential to increase the understanding of the importance of biodiversity to society and the role of PAs in safeguarding ecosystem services.

Going forward, the Kingdom of Bahrain and the Supreme Council for the Environment should consider and address 2 fundamental concepts for long term success of this Strategy and sustainability of a National Representative System of Protected Areas:

- The establishment of a legally mandated governing body for Protected Areas which would be able to make decisions regarding gazetting, zoning, and implementation of needed actions to create an effective managed network of Protected Areas.
- Develop a work program to operationalize management on the ground by increasing PA management capacity in SCE / Bahrain through recruitment of a PA manager and / or team of rangers with appropriate training in surveillance, enforcement, promotion, monitoring, and business planning for the PA system.

Between 2016 and 2020, this strategy recommends the following specific steps as the way forward to develop a system of PAs in Bahrain and reach the Aichi Targets 11 and 12:

1. A number of areas have been identified as important to protect. Four scenarios are proposed for new marine PAs in Bahrain and two scenarios for terrestrial PAs. These scenarios should be discussed internally by the Biodiversity Unit of the Supreme Council for the Environment (SCE) and the wider SCE units, including the identification of priority sites to initiate gazetting.
2. At least three main marine regions have emerged as priorities for conservation in Bahrain and should be prioritised in discussions within SCE. These are the i) Northern Hayrat, ii) Northwestern waters of the Hawar Islands, and iii) the area North of Bahrain / South of Fasht Al Jarim. The 23 sites proposed by Atkins (2010) should be reviewed and ranked in light of the additional analysis provided on by this report on landuse and according to their socio-economic viability and political feasibility for gazetting. These sites should be discussed internally in the Biodiversity Unit of the SCE and the wider SCE units, ranked, and a subset of site priorities identified.
3. The Northern Hayrat are currently a World Heritage Area and a management priority for Bahrain but require a management framework, management zones, clear management objectives, and a management plan. A recent report by Abdulla (2015a) has developed the framework, identified possible management objectives and designed management zones based on ecological values and ecosystem services. This report should be discussed and where acceptable approved. A parallel effort from the Office of the

Crown Prince has developed a draft Management Plan. These efforts should be discussed, harmonized, and approved by a Taskforce.

4. Once site priorities are developed, a more in depth analysis needs to be undertaken of existing traditional and scientific information regarding each of the marine and terrestrial areas in order to be selected by SCE for potential designation as protected areas and for appropriate zones to be developed. Ecological or social surveys may be needed to develop a better understanding of the condition and distribution of important biodiversity and resources.
5. One such site is the Hawar Islands Protected Area that may have the outstanding universal natural and cultural values to be nominated as another World Heritage Area.
6. The SCE should convene the relevant agencies and ministries to present and discuss the different scenarios and areas proposed for protection. A PA Taskforce can be developed during this forum and can consist of members from the SCE, the Ministry of Works, Municipalities Affairs and Urban Planning, the National Steering Committee for Biological Diversity, the Coast Guard, and the Ministry of Transportation and Telecommunications, and Ministry of Information Affairs.
7. A proposal to protect each area should be developed and circulated within government agencies to canvass support. The proposal should contain clear management objectives and targets. A management can be developed at this stage.
8. Simultaneously, funding should be sought from government, private sector, or international sources to implement and develop the management plan of the PAs proposed.
9. A public consultation process should be initiated to present the various marine and terrestrial scenarios and consult all communities and affected parties.
10. Subsequent to the consultation process, modified proposals with clear recommendations for each area's designation, boundaries, categories and location of zones, and management should be submitted for gazetting.
11. Approval, set up, and finalisation of the management plan for each selected protected area.
12. Managing, monitoring and reviewing the protected areas should be undertaken thorough clearly identified roles and responsibilities agreed with a group of government, non-government, and private sector stakeholders.

Bibliography

- Abdulla A., 2013. *A preliminary and rapid assessment of ecosystem services associated with the Pearling area and UNESCO World Heritage serial sites*, s.l.: UNEP-ROWA.
- Abdulla, A., 2015a. A framework for the implementation of a management plan in the Northern Hayrat Region of the Kingdom of Bahrain. SCE / UNEP-ROWA Report.
- Abdulla, A., 2015b. An initial assessment of the potential values of ecosystem services in the Kingdom of Bahrain. SCE / UNEP-ROWA Report.
- Al-Zayani, A., 2003. The selection of Marine Protected Areas: a model for the Kingdom of Bahrain. PhD Thesis, University of Southampton.
- Atkins, 2010. *National Planning Development Strategies report*, Manama: Ministry of municipality affairs and urban planning.
- Battis, E., 2012. Kingdom of Bahrain Ministry of Culture and Information. Pearling Testimony of an Island Economy-Management Plan for the Testimony of the Pearling Economy.
- Burt, J. *et al.*, 2012. The continuing decline of coral reefs in Bahrain. *Marine Bulletin*, 72(2), pp. 357-363.
- CBD, 2011. *Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets*, Quebec: UNEP - CBD.
- Fuller S., 2005. *Towards a Bahrain National Report to the Convention on Biological Diversity*, s.l.: GDEWP and UNDP.
- GEOMATEC, 2006. *Marine Environmental Geographic Information System (MARGIS II)*, Manama: Public Commission for the Protection of Marine Resources, Environment and Wildlife.
- Hill, M. and Hill, M., 1998. *Visitor's Guide to Bahrain Birds*. Bahrain: Ministry of Cabinet and Information Affairs.
- Jaradat, A., 2011. *Biodiversity of date palm*, Morris: UNESCO - EOLSS.
- Jawalat Al Malkiya, 2004. *Offshore survey*, Kingdom of Bahrain: Jawalat Malkiya.
- Kingdom of Bahrain, 2006. *The first national report to the Convention on Biological Diversity*, Manama: General Directorate for Environment and Wildlife Protection.
- Kingdom of Bahrain, 2011. *Bahrain Fourth National Report to the Convention on Biodiversity*, Manama: General Directorate for Environment and Wildlife Protection.
- Kingdom of Bahrain, 2015. *The Fifth National Report of the Kingdom of Bahrain to the Convention on Biological Diversity*, Manama: The Supreme Council for the Environment.

Pilcher, N.J., Phillips, R:C., Aspinall, S., Al-Madany, I., King, H., Hellyer, P., Beech, M., Gillespie, C., Wood, S., Schwarze, H., Al-Dosary, Al-Farraj Khalifa, A., M., Boer, B., 2003. *Hawar Islands Protected Area, Management Plan*, s.l.: Kingdom of Bahrain.

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

TEEB Foundation, 2010. *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*. London: Earthscan.

Annexes

Annex 1 National laws (Table 1) and international agreements (Table 2) pertaining to environmental protection in Bahrain with particular reference to the conservation of biodiversity.

Table 7. Selected national environmental legislation in Bahrain.

Legislation	Overview
Decree (2) 1995 concerning the protection of wildlife, and its amendments	Outlines the overall framework of the national policy for the conservation of wildlife supporting legislative regulations and identifying the responsibilities of the competent authority
Decree (21) 1996 concerning the environment, and its amendments	Establishes the overall framework of environmental policy in Bahrain setting legislative regulations and identifying the responsibilities of the competent authority
Decree (20) 2002 concerning the Regulation of fisheries and Exploitation of Marine Resources	Outlines the overall legislative framework regulating the exploitation of fisheries and other marine resources and identifies the responsibilities of the competent authority
Ministerial Order (1) 1998 concerning the Environmental Evaluation of Projects	Outlines the scope and mechanism of the Environmental Impact Assessment (EIA) and lists the categories of developments that should be compulsorily subject to EIA
Ministerial Order (10) 1999 with respect to Environmental Standards (Air and Water), and its amendments	Lists the national environmental standards for the quality of the environment in addition to air emissions and industrial effluents
Ministerial Order (4) 2000 concerning the Permission for Dredging Marine Sand	Details the mechanism and identifies the requirements of marine dredging applications
Ministerial Order (4) 2000 concerning the Permission of Infilling Submerged Marine Lands	Outlines the mechanism and identifies the requirements of marine infilling applications
Ministerial Order (1) 1995 concerning the Ban	Bans the reclamation and urbanization

Legislation	Overview
on Infilling and Urbanization in Tubli Bay.	developments in Tubli Bay
Prime Minister Order (16) 1996 concerning the Declaration of Hawar Islands and its Territorial Waters as Protected Area	Declares Hawar Islands and its territorial waters as protected area, in accordance with Decree (2) 1995 concerning the Protection of Wildlife
Ministerial Order (1) 2002 concerning the Declaration of Mashtan Island as Protected Area	Declares Mashtan Island as Protected Area in accordance to Decree (2) 1995 concerning the Protection of Wildlife
Ministerial Order (4) 2003 with respect to the Declaration of Dowhat Araad as a Marine Natural Protected Area	Declares Dowhat Araad as Marine Protected Area
Ministerial Order (3) 2003 concerning the Prohibition of Hunting all Species of Sea-Cows, Marine Turtles and Dolphins	Protects all species of sea cows, turtles and dolphins in the territorial waters of Bahrain from fishing activities
Ministerial Order (10) 1998 with respect to the Fees of Permissions and Services provided by Environmental Affairs	Identifies the fees of the permissions and services provided by the environmental government organization in Bahrain
Ministerial Order (10) 1998 with respect to the Control of Ozone Layer Depleting Substances	Outlines the regulations imposed by Bahrain regarding the protection of the ozone layer from depleting substances
Ministerial Order (10) 1998 concerning the Permission of Maintenance of Equipment and Buildings containing Asbestos, and the Disposal, Transfer and Treatment of Associated Wastes	Sets the environmental regulations adopted by Bahrain regarding the disposal, handling, and treatment of Asbestos
Ministerial Order (3) 2000 with respect to the Procedures of the Environmental Inspection	Establishes the procedures and requirements of environmental inspections, and lists the responsibilities of environmental inspectors
Ministerial Order (3) 2000 concerning the Registration of Environmental Consultants Conducting Environmental Impact Assessment of Projects and Environmental Studies	Lists the criteria of the registration and the responsibilities of environmental consultants

Legislation	Overview
Ministerial Order (1) 2000 concerning the Management of Medical Hazardous Wastes	Sets the regulations for the handling, transfer and treatment of medical hazardous waste in Bahrain
Ministerial Order (7) 2002 concerning the Control of the Import and Usage of Banned and Restricted Chemicals	Lists the regulations pertaining to the import and usage of banned and restricted chemicals

Table 8. Selected regional and international conventions acceded/ratified by Bahrain.

No.	Convention	Position of Bahrain	Progress of Implementation
1	United Nations Framework Convention on Climate Change	Ratified on 28 December 1994	Bahrain is currently implementing an enabling project with the financial support of GEF
2	Vienna Convention for the Protection of the Ozone Layer	Acceded on 27 April 1990 and ratified in London, Montreal and Copenhagen	Good progress has been attained; in 2002 the Ozone Unit in Bahrain was considered by UNEP one of the best three units in the world
3	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	Ratified in 1992	Many regulations have been adopted by Bahrain regarding the control of hazardous wastes
4	International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969	Acceded on 9 August 1995	Capacity building with respect to the implementation of the convention has somewhat been achieved and the Convention was applied in one case in 1997.
5	International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	Acceded on 9 August 1995	-
6	Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution	Ratified in 1978	Bahrain is an active member of the Regional Organization for the Protection of the Marine Environment (ROPME), and has taken many measures for the implementation of this convention
7	Agreement on the Establishment of a Regional Commission for Fishing Grounds	Ratified in 2002	A new convention
8	Convention on the Conservation of Wildlife and Natural Habitats of the Gulf Cooperation Council Countries	Ratified in 2009	A new convention

9	Convention on Biological Diversity	Ratified on 30 August 2003	No valuable progress has been achieved due to financial restrictions
10	Wetlands of International Importance Especially as Waterfowls Habitat (RAMSAR, 1971)	Acceded in 1997	No valuable progress has been achieved due to financial restrictions

Annex 2.

Figure A1. Location of high and very high concentration areas of sea turtles in Bahrain

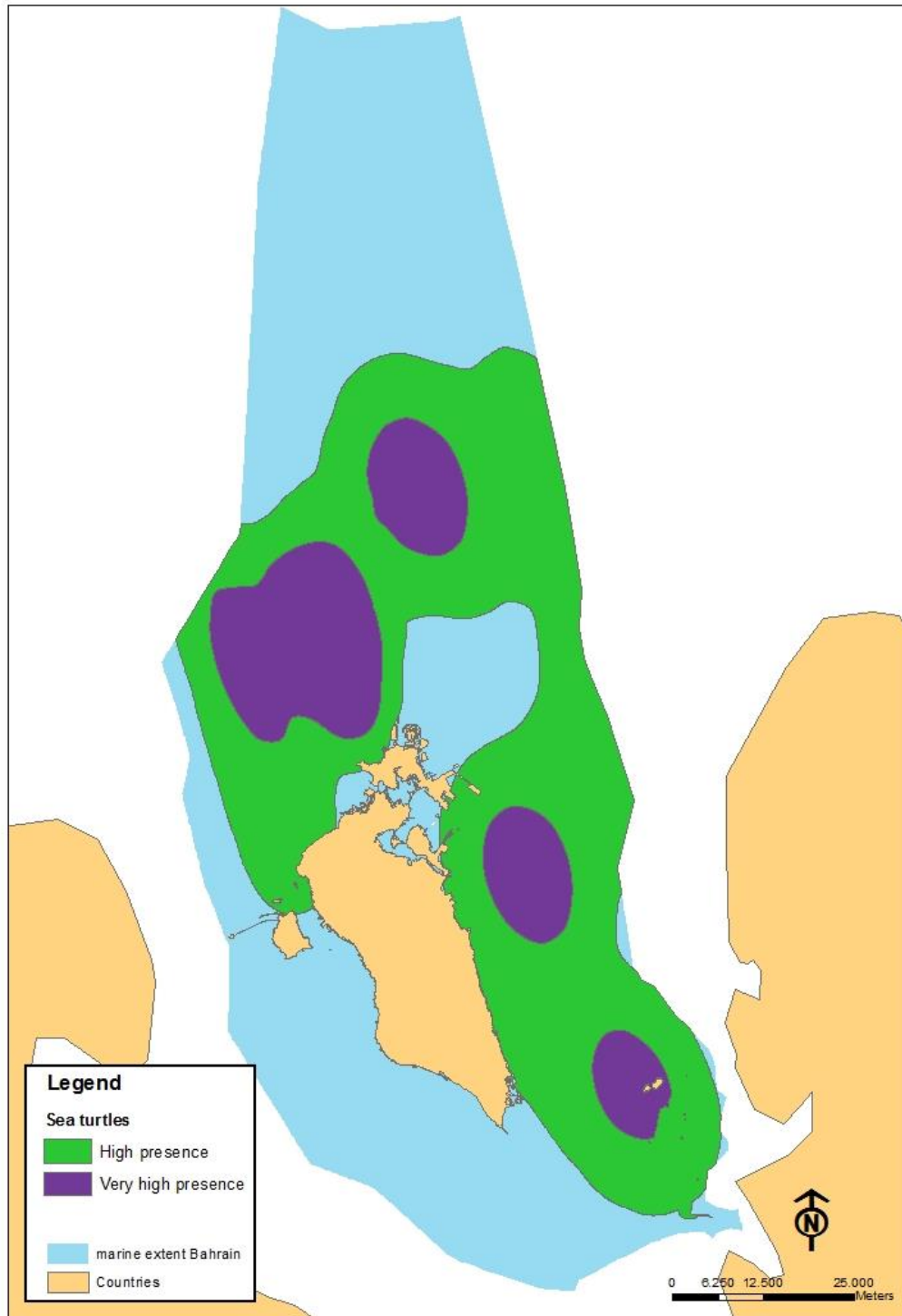


Figure A.2. Location of the highest concentrations of seabirds in Bahrain

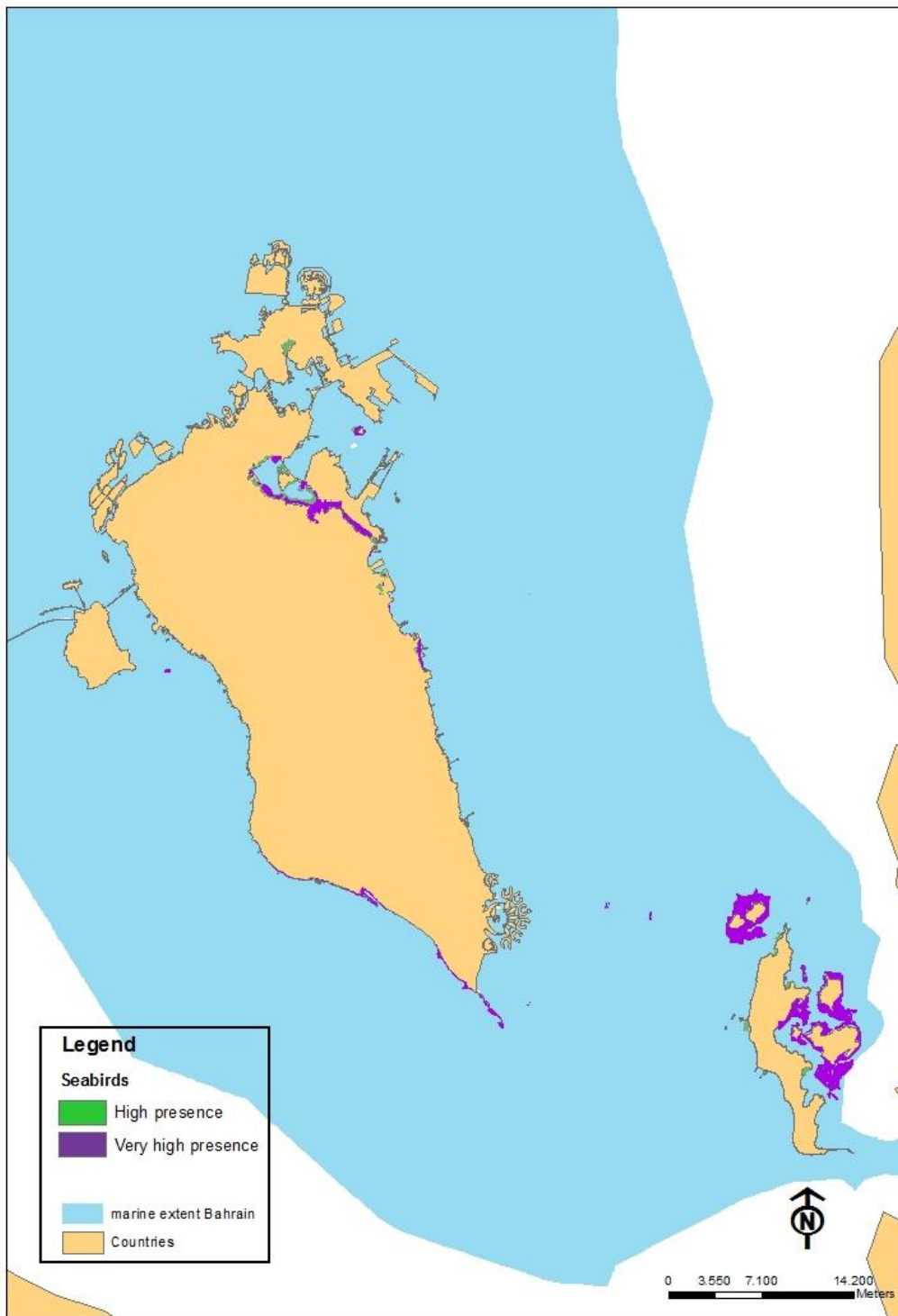


Figure A.3 Location of high concentrations of Dugong populations in Bahrain

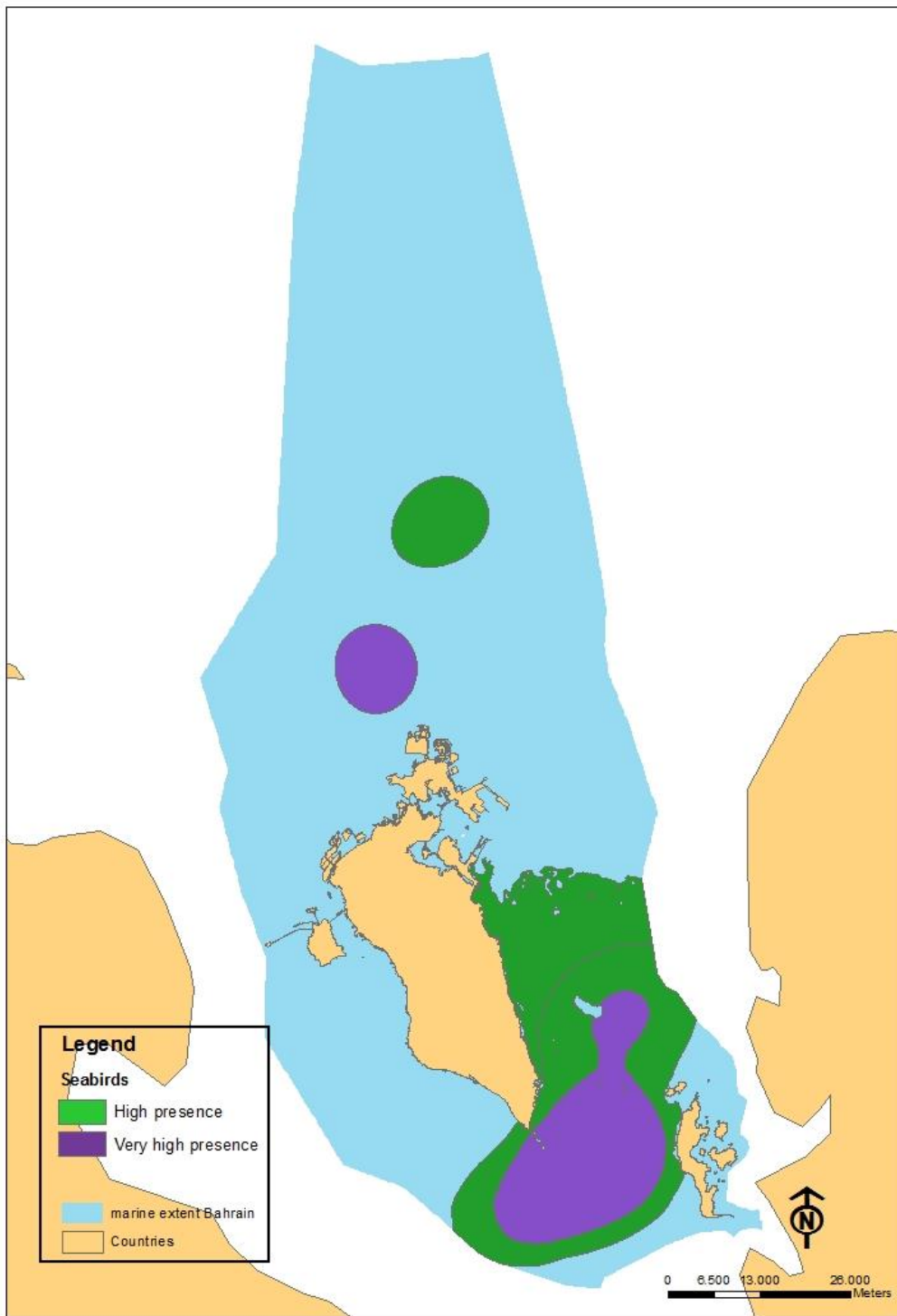


Figure B.1 Location of the highest concentrations of seagrass meadows in Bahrain

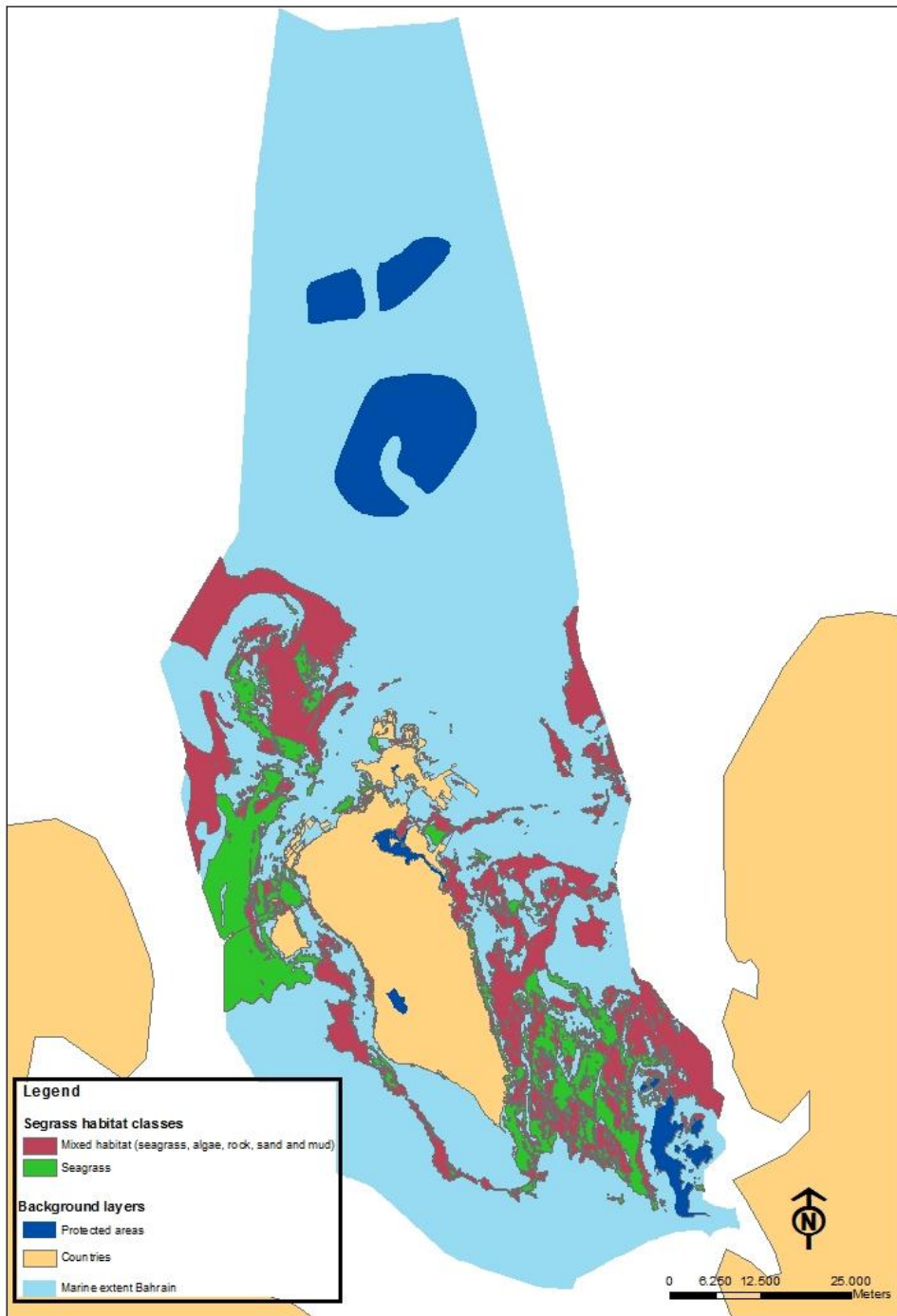


Figure B.2 Distribution range of the most targeted shrimp stocks in Bahrain

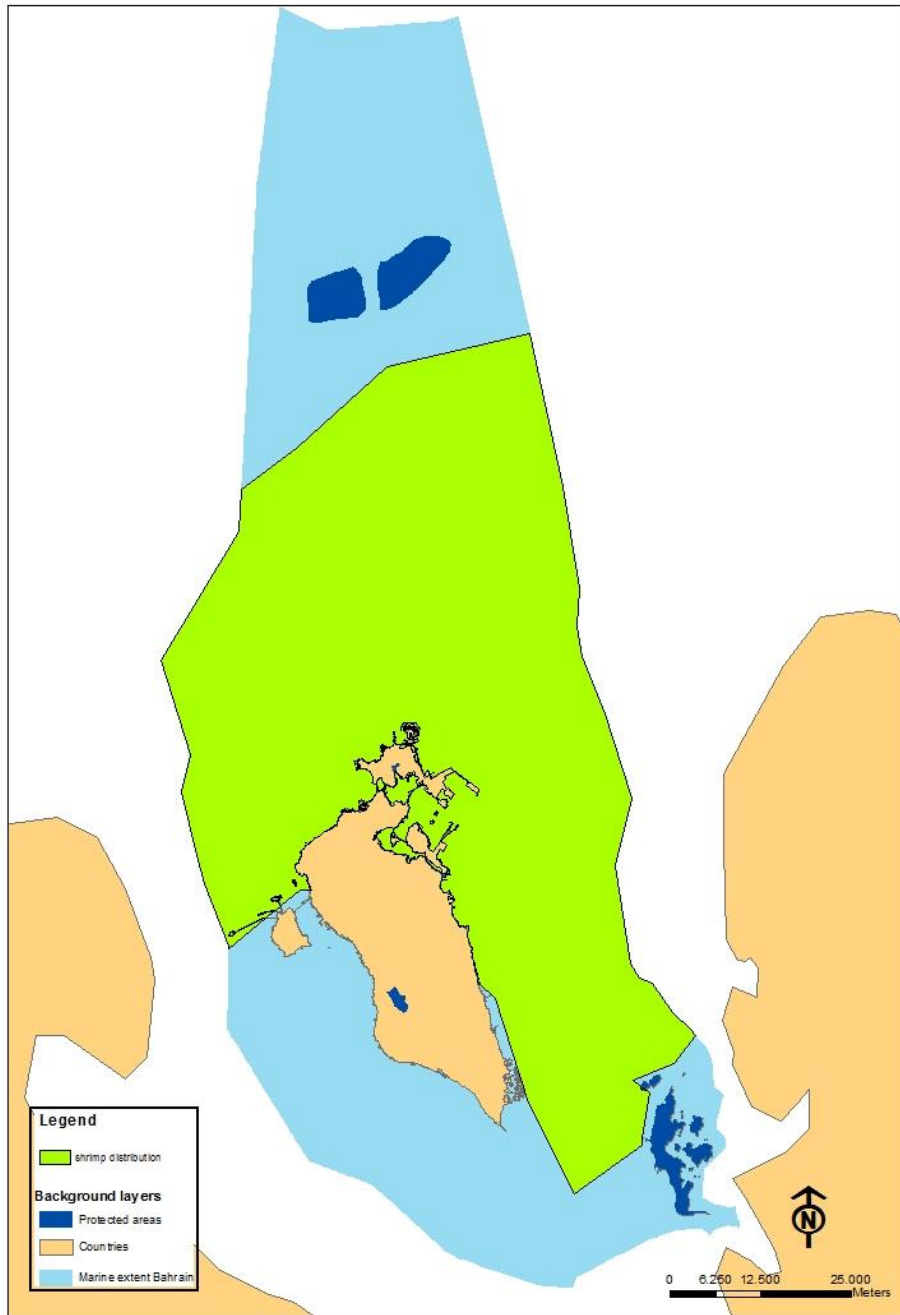


Figure B.3 Distribution range of most targeted crab stocks in Bahrain

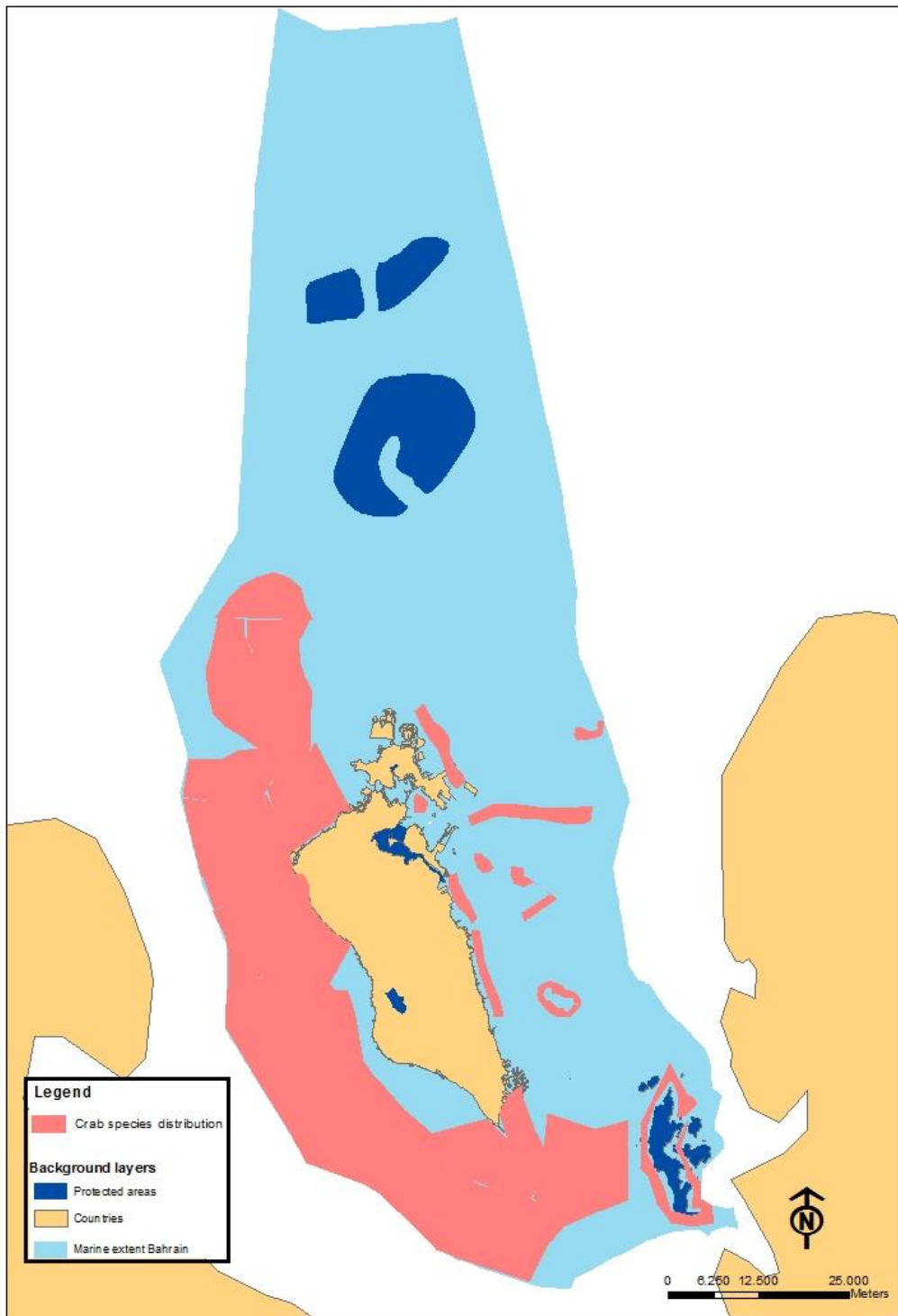


Table 9. General environmental features of protected areas declared in the Kingdom of Bahrain (translated from Kingdom of Bahrain, 2011).

number	Name of Protected Area (PA)	Type (T=terrestrial) (M= Marine)	General Description	Approx. area (km ²)	Legal protection	
					Year	Administrative decision or legal legislation
1	Al Areen PA	T	<p>Desert area divided into two parts. The first part includes a dedicated area to preserve animal species and representative plants of the Bahrain desert environment such as the Reem Gazelle, lizards and representative plants.</p> <p>The second part is composed of a centre for breeding in captivity. The objective of the centre is to preserve living species that are representative of the environment of Bahrain and the Arabian Peninsula such as rare birds, deer, oryx, frogs, freshwater turtles and wild plants. This part also includes an open park allowing collective and individual visits</p>	5.4	1976	Starting date of the implementation of protection activities in the Al Areen PA
					2000	Decree No. (28) of 2000 on the annexation of Al Areen Wildlife Park to the National Commission for Wildlife Conservation
2	Al Hawar PA	T,M	<p>Arid archipelago of islands that includes a marked diversity of habitats, such as mud flats and sandy beaches and rocky and salt marshes. Al Hawar is characterized by colonies of seabirds that breed on the Hawar Islands, and has a high diversity of seagrass beds surrounding the islands and providing important feeding grounds for dugongs and sea turtles and pasture grounds for shrimps and finfish</p>	51.4	1996	Decree No. (16) for the year 1996 on the consideration of the Hawar Islands and the surrounding territorial waters as a protected area, according to the Decree Law No. (2) for the year 1995 on the Protection of Wildlife
					1996	The decision of the Minister of Housing, Municipalities and Environment No. (6) for the year 1996 on the recommendations of the National Commission for Wildlife Conservation for Al Hawar Islands and their territorial waters
					1997	Decree No. (3) for the year 1997 to declare Al Hawar Islands a Ramsar site as a wetland of international importance. This decision resulted in its registration in the protected list of Wetlands of International Importance

					2005	Decision of the General Directorate for the Protection of Marine Resources, Environment and Wildlife No. (13) for the year 2005 on the regulation of fishing in Al Hawar territorial waters
					2010	Decision of the Directorate for the Protection of Marine Resources, Environment and Wildlife No. (4) for the year 2010 on the amendment of Resolution No. (13) for the year 2005 concerning the regulation of fishing in Al Hawar Islands and the territorial sea surroundings
3	Mashtan Island Nature Reserve	Marine	Sandy island surrounded by a wide number of coral species. The island hosts rare species of crustaceans (such as <i>Ocypode saratan</i>) and provides refuge for seagrasses, ensuring a feeding environment for several species namely dugongs and sea turtles, several shrimp species and finfish.	2.5	2002	Decision of the National Directorate for the conservation of Wildlife No. (1) for the year 2002 on considering the island of Mashtan as a protected area
4	Arad Bay (Dohat Arad)	Marine	Semi-tidal confined area dominated by mud flats and planted mangrove bushes. The protected area of Arad Bay assures a shelter for young fish larvae and other juvenile species. It is also considered an important shelter and feeding site for coastal resident and migratory birds	0.5	2003	Resolution of the General Directorate for the Protection of Marine Environment and Wildlife No. (4) for the year 2003 on the declaration of Arad Bay (Dohat Arad) as a protected area
5	Tubli Bay reserve	Marine	Semi-confined by features, known for its quiet currents and its low water salinity. It has a remarkable diversity of coastal and marine habitats namely mud flats, rocky beaches, mulch grasses and seaweeds. It contains the largest swamp for the black mangrove <i>Avicennia marina</i> in Bahrain. It is also an important nursery site for small fish, shrimp and other marine species. The region attracts large numbers of resident and migratory shorebirds that use this site for feeding and resting. Some birds also breed in its surroundings.	13.5	1988	Acquisition of Al Kurm region with support from the General Directorate for the Protection of Marine Environment and Wildlife
					1995	Resolution No. (1341) on the adoption of the recommendations of the General Directorate for the Protection of Marine Environment and Wildlife to preserve Tubli Bay
					1995	Resolution of the Central Municipal Authority No. (1) for the year 1995 related to the prevention of reclamation and reconstruction activities in Tubli Bay, including a note to the

						Council of Ministers' decision issued on 16 April for the consideration of Tubli Bay as protected area
					1997	Decree No. (3) for the year 1997 to join the Ramsar convention on Wetlands of International Importance. This decree ensured the registration of this protected area as a Ramsar site.
					2006	Law No. (53) for the year 2006 officially declaring Tubli Bay a nature reserve
6	Hayr Bul Thamah	Marine	It used to be considered the best conserved natural oyster bed in Bahrain (Battis, 2012) but in recent years it has been observed that it suffers from a gradual deterioration as no protection measures have been implemented and the increasing pressures are still ongoing around the region (personal communication).	7.8	2007	Decision of the General Directorate for the Protection of Marine Resources, Environment and Wildlife n. (8) for the year 2007 on the consideration of Hayr Bul Thamah as a natural marine protected area