Project: "Environmental Resources Monitoring in Lebanon - ERML"

Component A (i): Improved Understanding, Management and Monitoring in the Coastal Zone

Final Report
August 2012

Submitted by:
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Acknowledgements

This report comes within the framework of the project “Environmental Resources Monitoring in Lebanon” funded by the Directorate General of International Development Cooperation – Hellenic Aid, Ministry of Foreign Affairs, and Government of Greece, executed by the Ministry of Environment (MOE) in Lebanon, and implemented by United Nations Environment Program-Regional Office for West Asia (UNEP ROWA) and United Nations Development Program (UNDP).

Special recognition goes to the many organizations and government agencies as well as the experts and specialists for their support and participation, and for sharing their knowledge, information and expertise during workshops and interviews.

We would like to thank Ms. Nadine Panayot-Haroun, Director of Archaeology and Museology at the Institute of History Archeology and Near Eastern Heritage (IOHANES) at the University of Balamand (UOB) for contributing and guiding the process of identifying coastal cultural sites. In addition, we would like to thank the Council for Development and Reconstruction (CDR) for providing needed maps and information and the Geographic Information System (GIS) Center at UOB, for providing its resources and expertise to generate the required maps.

Further, we wish to extend our recognition to all the institutions and their representatives for attending the Expert Focus Group Meeting held on May 17, 2012 at the Main Campus-UOB, namely: MOE; Lebanese University; National Council for Scientific Research-National Center for Marine Sciences; International Ocean Institute; Lebanese Union of Professional Divers; Faculty of Health Sciences - UOB; Academic Urban Observatory at the Academie des Beaux Arts – UOB; and the Faculty of Arts & Sciences – UOB.

The team is grateful for all comments and suggestions provided during presentations of initial drafts to the final consultations. Particularly we would like to thank the different reviewers at the MOE for their valuable comments. Also, we are grateful to all the participants of the technical workshop that was held on Wednesday, 11 July 2012 at Gefinor Rotana Hotel Clemenceau for their useful comments and feedback. Last but not the least, this work would not have been possible without the constant contribution of key persons inside the United Nations Environment Program (UNEP) team, particularly Dr. Fouad Abou Samra, and Ms. Nour Masri, in addition to all the colleagues at the Institute of the Environment (IOE), UOB.

The success of the project would not have been possible without the helpful input of all these organizations, which significantly augmented the quality of the report.

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AECID	Agence Espagnole de Coopération Internationale pour le Développement
AHP	Analytical Hierarchy Process
CAMP	Coastal Area Management Programme
CBD	Convention on Biological Diversity
CDR	Council for Development and Reconstruction
CIDA	Canadian International Development Agency
DAR	Dar Al-Handasah
EC	European Commission
EC/JRC	European Commission/Joint Research Centre
EGEMP	European Group of Experts on Monitoring sea-based oil Pollution
EU	European Union
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GOL	Government of Lebanon
GPA/UNEP	Global Programme of Action of the United Nations Environment Programme
IAURIF	Institut d'Aménagement et d'Urbanisme de la Région d'Ile de France
ICZM	Integrated Coastal Zone Management
IDF	Israeli Defense Force
IMAC	Integrated Management of East Mediterranean Coastlines
IMO	International Marine Organization
IOE	Institute of the Environment
IOHANES	Institute of History Archeology and Near Eastern Heritage
IUCN	International Union for the Conservation of Nature
MADM	Multi-Attribute Decision Making
MOA	Ministry Of Agriculture
MOC	Ministry Of Culture
MOE	Ministry Of Environment
MOWE	Ministry Of Water and Energy
MOPWT	Ministry Of Public Works and Transport
MPA	Marine Protected Area
MRCZM	Marine Resources and Coastal Zone Management Program
NGO	Non-Governmental Organizations
OCHA	Office for the Coordination of Humanitarian Affairs (United Nations)
OPEC	Organization of Petroleum Exporting Countries
OSOCC	Oil Spill Operations and Coordination Centre

OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
PINR	Palm Islands Nature Reserve
RAC-SPA	Regional Activity Centre for Specially Protected Areas
REMPEC	Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea
SAP BIO	Strategic Action Plan for the Conservation of Mediterranean Marine and Coastal Biological Diversity
SISPAM	Stable Institutional Structure for Protected Areas Management
SPAMI	Specially Protected Areas of Mediterranean Importance
SPAW	Specially Protected Areas and Wildlife
STP	Sewage Treatment Plants
TCNR	Tyre Coast Nature Reserve
UOB	University of Balamand
UN	United Nations
UN-GA	United Nations - General Assembly
UN-SG	United Nations – Secretary General
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNEP-MAP	United Nations Environment Program – Mediterranean Action Plan
UNEP-ROWA	United Nations Environment Program-Regional Office for West Asia
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
WHC	World Heritage Convention
WHO	World Health Organization

Executive summary

Following the Israeli War on Lebanon in July 2006 and the resulting oil spill on Lebanese shores from the bombardment of the heavy fuel tanks of the Jiyeh Power Plant, the Government of Greece allocated $1.64 million for the implementation of an “Environmental Resources Monitoring in Lebanon” (ERML) as part of the financial and technical assistance to the Government of Lebanon (GOL), requested by the UN General Assembly’s (UN-GA) resolutions in December 2006. The project is administered by UNEP in close cooperation with UNDP Lebanon and close consultation with the Ministry of Environment (MOE) in Lebanon.

Component A (i) of the ERML has an overall objective “the assessment of the status of Coastal Sensitive Areas of interest in Lebanon in terms of ecological systems, in addition to the identification of the main threats with the focus on land-based sources of pollution especially river discharges in the coastal and marine environments”. An extensive background literature review was conducted allowing the preparation of a database of degraded natural and cultural sites. Parameters for the evaluation of the identified coastal and marine areas included geographical, biological and cultural features, the potential and existing stresses, and current conservation status. In order to select the most sensitive sites, evaluation criteria from the Convention on Biological Diversity and United Nations Educational, Scientific and Cultural Organization (UNESCO) - World Heritage Center (WHC) reports were adopted. Accordingly, sites were given a priority ranking from the most to the least sensitive. Applying the Analytic Hierarchy Process, the relative importance of each evaluation criterion was derived using pairwise comparisons. This was followed by priority ranking of the natural and cultural sites using multi-criteria analysis.

The background search indicated high level of degradation in the highly fragmented and urbanized coastal zone of Lebanon. Although, few sites in the North and in the South appeared to be in a slightly better situation than other areas on the coast, still they are under various pressures including land-based sources of pollution. The disastrous oil slick of 2006 Israeli War on Lebanon increased the risks of degradation along the coast that are mostly due to the lack of coastal management and monitoring plans, and weak law enforcement for the prevention and protection of sensitive sites from potential or existing threats.

Based on the results of the Expert Meeting on the ranking and weighing of both ecological and cultural criteria, fifteen sensitive sites were selected as high priority for protection and mapped as follows: eight ecological sites; three cultural sites; and

four clustered ecological and cultural sites. These sites are recommended for immediate protection and management through a precautionary approach. This should be done under the responsibility of the relevant authorities and based on the biological and physical properties of the site. Ecological sites are to be managed by the MOE and related authorities, cultural sites are to be managed by the Ministry of Culture (MOC) and related authorities, and sites with both cultural and ecological characteristics are to be managed by a joint committee which should be established in this purpose.

Moreover, this study showed the important deficiency in the information system about coastal and marine environments. Therefore achieving a better and Integrated Coastal Zone Management (ICZM) urgently requires detailed data collection to improve the knowledge about the biological features and the existing habitat types of sensitive sites in particular and marine ecosystems in general. It is recommended to address high and medium ranked sensitive sites as hotspots through their preservation as an initial step followed by restoration where applicable. Starting with the highly ranked sites, each should be evaluated on a case by case basis and its current status and future prospects investigated in detail.

1. Introduction

Lebanon's value lies in its geography, landscape, climate and a liberal democratic system. The latter is the main theme that is constantly discussed, criticized, researched and taught, while the former, Lebanon's environment, has been, and still is neglected. Needless to say, the many war years that ravaged the country have intensified our destructive behavior of the surrounding environment through constant attacks from unregulated development and the depletion of the indigenous fauna and flora. These attacks come in different forms which include: pollution, deforestation, seafilling, siphoning of sand from beaches, indiscriminate fishing using conventional and non-conventional methods, unregulated hunting of native and migrating birds, indiscriminate construction, quarrying in mountain sites, activities that are leading towards the ultimate destruction of the Lebanese natural coastal habitat including massive deterioration of the Mediterranean Sea and therefore the rapid loss of Lebanon's natural assets. Nevertheless, Lebanon has recently made significant progress towards integrated and sustainable management, and has placed more attention to socio-economic and environmental matters. Hence, the need to improve the socio-economic status and concurrently the urgent need to reduce the burden on the environment has resulted in the deployment of a variety of integrated development programs (IMAC 2007; MOE/UNDP/ECODIT, 2011).

Various ministries and governing bodies such as the Council for Development and Reconstruction (CDR) have been able to improve considerably their capabilities to fulfill their main roles of rebuilding and rehabilitation whilst protecting the environment from the various sources of pollution. Mainly, financed by international organizations and donors mostly from Europe, Arab countries, and the World Bank, several working units within the CDR have worked on setting a 15 year development master plan in the fields of basic infrastructure, socio-economic sectors and productive sectors such as Education, Health, Power and Energy, Solid waste, Telecommunications, Terrains, Transportation, Wastewater and Water, based on integrated and sustainable management concepts (IMAC 2007).

Within this context, the Government of Lebanon (GOL) has drafted a variety of laws that would sharpen the mission and mandate of the Ministry of Environment (MOE) and reorganize it along the following principles:

- Regionally balanced development.
- Protection through prevention.
- The polluter pays.
- Integration of environmental policies into other sectoral development policies.

In Lebanon, the coastline stretches over 240 km in length from north to south. It is highly populated and it comprises most of the economic activities of the country (IMAC 2007; MOE/UNDP/ECODIT, 2011). Whereas, the coastal zone does not have a rigid definition and the delimitation of its boundaries in a given zoning area varies according to political and administrative considerations. The coastal area is defined as a geographic space of transition between land and sea, which has not been defined as a zone (UNEP/MAP/RAC-SPA, 2006; UNEP/MAP/RAC-SPA, 2010) and includes:

- Inland areas, which affect the oceans mainly via rivers and non-point sources of pollution.
- Coastal lands including wetlands.
- Coastal waters (estuaries, lagoons and shallow waters).
- Offshore water, mainly out to the edge of national jurisdiction (200 nautical-miles of shore).
- High seas, beyond the limit of national jurisdiction.

In addition, the coastal zone is not easily defined. It is considered as the spatial zone between the sea & land or more specifically as the landward limit of marine influence/seaward limit of terrestrial influence. According to Haslett 2000, different countries have different definitions for planning and management of their coasts:

- United States of America (USA): Coastal waters & the adjacent shorelands strongly influenced by each other & include islands, transitional & intertidal areas, salt marshes, wetlands, & beaches. The zone extends inland from the shorelines only to the extent necessary to control shorelands, the uses of which have a direct & significant impact on the coastal waters.
- Australia: as far inland & as far seaward as necessary to achieve the Coastal Policy objectives, with a primary focus on the land-sea interface.
- United Kingdom of Great Britain and Northern Ireland: definitions may vary from area to area and from issue to issue, and that a pragmatic approach must therefore be taken.
- World Bank: the special area, endowed with special characteristics of which the boundaries are often determined by the special problems to be tackled.

In the last decades, an increase in human and natural pressures has jeopardized the ecological and socio-economic integrity of the coast and has threatened the survival of coastal areas as providers of socio-economic wellbeing.

Lands located along the coastal area in Lebanon are in extremely high demand due to their tourism potential, proximity to the sea, and a booming real estate sector.

This pressure has led to the implementation of large-scale seafilling projects (public and private), the construction of dozens of marinas (for leisure boats and fisheries), and rampant urbanization stretching along vast coastal areas. Violations of the maritime public domain are significant. During the period 1975-2001, an estimated 1,269 unlicensed developments mushroomed along the coastline covering about 3.2 Million m² of the maritime public domain. The GOL, usually represented by the Ministry of Public Works and Transport (MOPWT), receives frequent permit applications to lease the maritime public domain for large-scale developments including marinas, tourism resorts, and other commercial facilities (IMAC 2007; MOE/UNDP/ECODIT, 2011).

Rising awareness about the necessity of properly managing the Lebanese coastline, government agencies along with local and international Non-Governmental Organizations (NGOs) are playing important roles in environmental protection pertaining to coastal zones. Many of these agencies have taken serious actions by incorporating environmental considerations into their respective sectors or mandates (Ministry of Water and Energy (MOWE), the MOPWT, the Green Plan of the Ministry of Agriculture (MOA), etc...).

A few coastal areas have preserved their natural biotopes and beauty. These, together with a number of river valleys, must be properly identified and protected. Within this context, two coastal nature reserves were declared by law: “Tyre Coast Nature Reserve” (TCNR; Decree 708, 12/11/1998) and the Palm Islands Nature Reserve (PINR; Decree 121, 12/03/1992). Furthermore, four Ramsar sites have been announced in Lebanon, of which three are coastal sites: TCNR, PINR and Ras Shaqaa (Annex I). Nevertheless, several additional coastal habitats are of great ecological value and certain sites need to be conserved in order to protect rare plants and landscapes of biological interest. These include terraces, river mouths, coastal dunes, coastal springs, sandy beaches, rocky beaches, abandoned fields, cliffs, and cliff faces (Abboud-Abi Saab & Nader, 2002; Nader, 2011).

On July 12, 2006, Israel launched a full-scale war against Lebanon that lasted for several weeks. Even though a ceasefire was reached on August 14, the military blockade by air, land and sea lasted weeks beyond the formal end of the war. More than 1,300 Lebanese citizens were killed and severe damages were caused to the Lebanese infrastructure and economy as well as to its environment. The Israeli onslaught on Lebanon resulted in an oil spill of 15,000 m^3 spilled in Lebanese coastal waters through the bombardment of the Jiyeh Power Plant fuel tanks. More than 150 Km of the Lebanese coastline were contaminated. The oil spilled had a devastating impact on the Lebanese marine environment and even impacted

neighboring countries (IUCN 2006; UNEP, 2007; World Bank, 2007; UN General Assembly, 2011).

In response to the conflict of July-August 2006 and the subsequent oil slick on Lebanese shores, the United Nations General Assembly (UN-GA), in paragraph 4 of its Resolution 61/194 “encouraged” Member States, regional and international organizations, regional and international financial institutions, NGOs, and the private sector to provide financial and technical assistance to the GOL in support to its efforts to clean up the polluted shores and seas of Lebanon with a view to preserving its ecosystem. In response to this request, the Government of Greece allocated 1.64 USD million for the implementation of an environmental monitoring project in Lebanon, to be administered by the UNEP in close cooperation with the UNDP Lebanon and close consultation with the MOE in Lebanon.

The objective of the current project is to improve the understanding of the quality of ecological systems in Lebanon through the assessment of the status of Coastal Sensitive Areas of interest, especially those affected by the oil slick of 2006, by untreated river discharges and other land-based sources of pollution affecting the coastal zone.

2. Oil spill 2006

2.1. Introduction

The 34-day Israeli hostilities in Lebanon started on July 12, 2006 and continued until August 14, 2006, when the ceasefire entered in force (World Bank, 2007). Lebanon was under blockade from air and sea, and attacks were mainly concentrated on the area of South Lebanon, Beirut and Bekaa valley. The infrastructure of Lebanon was severely damaged and all economic sectors were affected. In the energy sector, key infrastructure damaged during the war included the Jiyeh Power Plant fuel storage tanks, located about 30 km south of Beirut. The site was targeted by the Israeli Defense Force (IDF) on July 13 and 15, 2006. Two of the fuel storage tanks containing 10,000 m^3 and 15,000 m^3, respectively, were directly hit and damaged. Both tanks caught fire. The fire spread to the remaining tanks and continued to burn for 12 days. It is estimated that approximately 60,000 m^3 of fuel oil may have burned. About 15,000 m^3 spilled into the Mediterranean sea, sinking on the seafloor in front of the power plant or floating and being dragged northward by winds and currents leading to the contamination of 150 km of coastline in Lebanon and the Syrian Arab Republic (UNEP/MOE/ELARD, 2007).

Because of the ongoing hostilities until August 14, 2006 and the following air and naval blockade, only limited mitigation was possible before September 9, 2006. As oil transport is dominated by currents and winds, the spilled oil moved northward and onto the shoreline as the dominating winds for that period of the year were from the West - Southwest. The heaviest observed impacts occurred between Jiyeh and Beirut, between Jbeil and Chekka by July 18-19, 2006, and onto the PINR offshore of Tripoli by July 29, 2006, while other areas generally showed patchy impacts. The spilled product was particularly concentrated on the northern sides of bays and in correspondence of ports and marinas that behaved as “traps” for the oil slicks. Most of the oil remained relatively close to the shoreline. Reports produced by the MOE with international assistance, from August/early September, 2006, indicated that heavy pooled oil was present in coastal coves and harbors, and that sand and gravel beaches south of Beirut and around Jbeil to the north showed surface and sunken oil. Sunken oil has been observed lying on rocky and sandy sea-bottoms at a depth of 1.5 meters, and principal areas where bottom oil was observed were adjacent to and offshore of the Jiyeh Power Plant, and offshore of heavily oiled coastal areas in Beirut and Jbeil (EC/JRC/EGEMP, 2006).

Several United Nations (UN) and international agencies, government entities, NGOs and other public and private institutions have been involved in assessing the repercussions of the July 2006 hostilities, especially the impacts of the oil spill disaster, in terms of social, economic and environmental damages.

2.2. Environmental impact of the oil spill

After the review of publications and surveys held by different involved parties for the assessment of the impacts of the oil spill, the UN-GA (2009) considered that "*the oil slick has heavily polluted the shores of Lebanon and consequently has serious implications for human health, biodiversity, fisheries, and tourism, all four of which in turn have serious implications for livelihoods and the economy of Lebanon*".

The agencies involved in assessing those implications include the UN-GA (A/62/343, A/63/225 and A/64/259), the Food and Agriculture Organization (FAO, 2006), the International Union for the Conservation of Nature (IUCN, 2006), the UNDP (2007); the UNEP (UNEP/MOE/ELARD, 2007), the European Commission (EC) (EC/JRC/EGEMP, 2006) and the World Bank (2007). In addition, the GOL (2006), through the Presidency of the Council of Ministers, provided a total estimate for direct damages based on (i) each ministry's assessment; (ii) an assessment undertaken by the consulting firm Khatib & Alami (2006); (iii) an assessment carried out by the CDR; and (iv) an assessment undertaken by the Order of Engineers.

The reports provided a prompt and reasonably comprehensive account of immediate impacts of the spill on the coastal and marine environments. It has been found (UNEP, 2007) that the impact of the oil is related to its physical properties. The part of the oil with high viscosity had mostly affected benthic ecosystems since it sank to the bottom. This fraction significantly affected the sediments and seabed and the associated biota. For instance the benthic ecosystem close to Jiyeh has been severely damaged because of the oil that has sunken in the area. Smothered sponges and corals (Madrepores) in the vicinity of the Power Plant were observed by the Italian Mission (World Bank, 2007). Such impact may well be irreversible in nature as baseline conditions prior to the War in the area will most likely not be recovered (UNEP/MOE/ELARD, 2007).

The environmental effects of the remaining floating oil were observed along the coast, especially on beaches. Coastal sandy and rocky stretches, especially from Jiyeh to Beirut and Jbeil to Chekka, were severely damaged by the oil spill (World Bank, 2007). As well, other environmentally sensitive ecosystems were intensely affected such as the vermetid terraces, coralline and reef communities in Cheikh Zennad, Al Mina seashore, the Palm Islands, Batroun marine reserve, Jbeil to Amshit, and Rocks of Wata Slim. In addition, a significant impact on the seabed was detected especially on the seagrass meadows at Aarida, Amshit, Jbeil and Beirut Airport wave breaker (MOE/UNDP/ECODIT, 2011; IUCN, 2006). Because oil greatly adheres to rocky shorelines, natural cleansing in these areas is slow and mitigation efforts (high-pressure washing) are tedious and time-consuming. These areas tend

to suffer the highest degree of damage while the impact on seawater and offshore freshwater marine resources, for example Chekka and Batroun freshwater springs, is considered to be temporary as previous studies demonstrate that seawater concentrations of pollutants tend to return to normal values within a few months (World Bank, 2007; Annex I).

Furthermore, numerous coastal species were also affected by this oil slick. The highest mortality was observed in invertebrate communities (gastropods, crustaceans and algae) which are expected to recover relatively faster than other organisms due to their rapid reproduction cycle. No significant mortalities or contamination were detected in other species such as birds, fish, reptiles and mammals; however, concentrations of hydrocarbons in these organisms were found to be similar to what is expected for coastal areas under the influence of urban zones, industry and transport (UNEP, 2007). Nevertheless, according to the World Bank report (2007), shorebirds and marine waterfowl birds are likely to have been injured because the oil stayed fairly close to shore and oiled large sections of the coastline where birds typically forage. A major reduction in the number of visiting birds on the PINR has been observed by the Government Appointed Committee managing the Reserve due to the contamination of habitats and possible loss of access to food. Three contaminated rocky and sandy areas on the PINR represent the feeding site of many marine and shore birds, whereas the rocky areas correspond to the breeding site of the Yellow-Legged Gulls. Moreover, marine turtles that are present in Lebanese waters were most likely affected by the oil spill. Three of the oiled beaches, Jbeil, the PINR, and Ramlet El-Bayda are sites for nesting sea turtles. Nesting activity generally starts in May and lasts until late August, with a peak around mid-July, and the hatching season generally ranges from late June / early July to September, both occurring at the time of the spill. Although no turtles or hatchlings were observed to be oiled, there is a strong likelihood that many individuals were affected by the spill since oil was floating northward in the same waters used by the turtles. It should be noted that three loggerhead turtles were found dead on the PINR after the cleaning of the oiled sandy beaches in 2007. While this was the case at this single locality, what happened at other sites is unknown. Nevertheless, even though the number of dead turtles may not be significant, there is a strong possibility that the spill has a longer-term impact on the already low population in this area. Although there was no direct, observed impact on marine mammals and fish species, indirect effects may have occurred. Damage to fish larvae and eggs, impacts to the near shore breeding areas, as well as oil uptake during feeding, are likely to have injured individual fish and may have reduced the fish population in Lebanon on a short term basis. Plants on the Palm and Sanani Islands were also heavily impacted. Rocky Salicorn and

Sandy Euphorb plants were contaminated to the extent that some were totally covered by oil. The toxins in the oil most probably killed the plants, which could lead to erosion of the beaches. In addition to the impacts on natural coastal sites, historical and cultural heritage sites on the coast were affected as well by the oil slick, most importantly in Jbeil and Enfeh.

2.3. Response efforts

As the bombing of the Jiyeh Power Plant occurred on the first days of the conflict, the mitigation efforts were impeded during the first critical days of the oil spill due to security conditions.

The initial emergency response was implemented by the MOE through constructing sand barriers at the plant to prevent further oil spillage to the sea. Some local efforts were also implemented towards the end of the conflict in early August, as the cleaning of Jbeil Sporting Club and Chekka beach. According to the World Bank (2007), International assistance was provided by sending equipment (Kuwait, Norway, Cyprus, Finland, France, Sweden, Canada, the USA, Italy, Monaco and Spain), personnel and experts (Government of France, Italy and European Union Monitoring and Information Centre – Danish experts) and financial aid (UNDP, Japan, Canadian International Development Agency (CIDA), Organization of Petroleum Exporting Countries (OPEC)/ Office for the Coordination of Humanitarian Affairs -United Nations (OCHA), Monaco, Canada, and the Swiss Agency for Development and Cooperation). After the cease fire on August 14, an International Assistance Action Plan (hosted by UNEP and the International Marine Organization (IMO) in Athens, and prepared by the Experts Group for Lebanon with the supervision of UNEP- Mediterranean Action Plan's (UNEP-MAP's) Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea "REMPEC") was agreed upon to increase and coordinate the international efforts. A plan was therefore enacted to implement the MOE mitigation priorities (World Bank 2007). Following MOE priorities, the bulk and mobile oil in ports was recovered using skimmers (September/early October 2006). Additional effort went to recover bottom oil and place booms to contain the floating oil. By October 2006, only limited quantities of floating oil were present, and mitigation activities shifted to surf washing of oily beach sands and gravel, and high-pressures spraying of oiled rocks, seawalls, marinas, and boats. Outside of MOE supervision, heavy machinery was used at several beach areas to move oiled sand from the intertidal area. These efforts served to reduce the amount of oil in the environment and its potential environmental impacts.

Furthermore, the Joint UNEP/OCHA Environment Unit, together with the MOE, the EU, and with technical support from the IUCN, developed and implemented a proposal for the establishment of an Oil Spill Operations and Coordination Centre (OSOCC), to ensure effective clean-up of the oil spill at the national level. The final challenge dealt with during the response efforts is the sustainable disposal of the cleaned-up accumulated quantities of oily solids and oil-contaminated debris and soil. As no environmentally acceptable disposal option (biological remediation or mobile incinerators) currently exists in Lebanon, the MOE had identified appropriate temporary storage sites for the oil spill clean-up wastes. Wastes were collected and transported by different parties in accordance to the highest standards of international hazardous waste transportation and handling procedures. Currently these wastes are still stored at the Zahrani Power Plant and the oil refinery in Tripoli (formerly known by IPC).

Latest updates on the progress made in the implementation of the UN-GA resolutions 61/194, 62/188, 63/211, 64/195 and 65/147 related to the oil slick on Lebanese shores and are presented in the report of 2011 of the Secretary General (SG) (66/297). It states that the GA(65/147, paragraph 7) welcomed the agreement of the Lebanon Recovery Fund to host the Eastern Mediterranean Oil Spill Restoration Trust Fund and invited States, intergovernmental organizations, NGOs and the private sector to make voluntary financial contributions to the Trust Fund (65/147, paragraph 8). In that regard, the Assembly requested the SG to mobilize international technical and financial assistance, in order to ensure that the Trust Fund had sufficient and adequate resources, since Lebanon is still engaged in the treatment of wastes and the monitoring of recovery. To date no contributions have been made to the Trust Fund. Also, it should be noted that no suitable mechanism for compensation was found since all conventions are inapplicable during armed hostilities. In fact, the agreements that relate to oil spill compensation pertain only to oil spills from tanker vessels at sea, not land-based incidents. Consequently, there is still a lack of any acknowledgment of responsibility on the part of the Government of Israel (UN General Assembly, 2011).

3. Degraded habitats on the coastal zone

3.1. Description of evaluation parameters

In order to introduce sustainable and integrated management of the coastal zone of Lebanon, several plans and strategies have been developed; however, the focus has been on the few sensitive areas that were already designated as protected areas (natural reserves, natural sites, hima and touristic sites). Lebanon has been designating protected areas since the 1930's. Responsibility for such designation originally fell under the jurisdiction of the Ministry of National Economy. Since, this mandate has been reattributed to several parties including the Ministries of Environment, Agriculture, Culture and others. Existing classification of Protected Areas in Lebanon includes eight nature reserves, 24 natural sites, five himas, 12 protected forests, 14 touristic sites, and a multitude of sites that are worth protecting. In this regard, the MOE, within the framework of the Stable Institutional Structure for Protected Areas Management (SISPAM) Project, is preparing a new system to categorize Protected Areas. This system consists in defining criteria for the establishment of each category, in addition to their management objectives and model, in order to ensure a better Protected Areas management in Lebanon (MOE, 2006; Nader, 2011). Nevertheless, until now, many coastal areas that are proving to be of high ecological and cultural values are still neglected and subject to increasing environmental pressures and threats.

This report identifies additional atypical and typical coastal habitats and sites in need of conservation. These are considered hotspot areas with characteristics varying between natural, historical and cultural.

The sites were evaluated according to the following parameters:

- Geographical features.
- Biological features.
- Cultural/Historical features.
- Stresses and threats.
- Conservation status.

3.1.1. Geographical features

The geographical features categories summarize the natural aspects generally found on the Lebanese coastal zone, in addition to important artificial features such as cultural heritage (Table 1).

Table 1: Geographic features of the Lebanese coast[1]

Natural features	Definition
Coastal dune	A ridge or hill which forms when marine deposits of sand are blown to the back of the beach. The rate of formation and the extent of these dunes are dependent upon the supply of sand to the beach.
Wetland	A general term describing swamps, bogs, marshes, and shallow (up to 5 meters) lagoons and lakes. In coastal environments, these include salt marshes (Salinas), mangrove swamps, reed swamp, rush swamp, and seagrass beds.
Promontory	A coastal protrusion or headland, high and bordered by cliffs or bluffs, usually smaller than a Cape.
Cliff	A steep coastal slope cut, usually>40 , often vertical and sometimes over-hanging into rock formations produced by basal marine erosion, but occasionally by faulting or earlier fluvial or glacial erosion.
Beach	An accumulation on the shore of generally loose, unconsolidated sediment, ranging in size from very fine sand up to pebbles, cobbles, and occasionally boulders; often also containing shelly material.
Bay	A general term for wide coastal re-entrant between two headlands, typically >1 km, its seaward boundary generally wider than the extent of landward penetration. A small bay is termed a cove, a large bay a gulf.
Cape	A large, often rounded coastal protrusion, located where the coastline intersects a range of mountains, hills, or a plateau, usually where a drainage divide reaches the coast. However, some capes are low-lying e.g., Cape Canaveral (Kennedy) and others on the American Atlantic coast.
Spring	In hydrology, an opening at or near the Earth's surface where water from underground sources is discharged. Springs discharge either at ground level or directly into the bed of a stream, lake, or sea.
Estuary	The seaward end of a river, opening toward the sea, typically through a funnel-shaped inlet, and usually subject to tidal movements and incursions of salt water from the sea.
Island	A body of land completely surrounded by water.
Offshore zone	Zone that lies below the mean storm wave base and is characterized by fine-grained sediment settling out of the water.
Cultural heritage	Cultural heritage sites include the significant monuments, architecture, artistry, archaeology, artifacts and other human works of outstanding universal value from the point of view of history, art or science.

[1] Sources: Lebanon's second national communication to the United Nations framework Convention on Climate Change (2011). Beirut: Republic of Lebanon, Ministry of Environment, GEF, UNDP; Schwartz, M.L. (2005) Encyclopedia of Coastal Science, the Netherlands: Springer; Haslett, S.K. (2000) Coastal Systems, London and New York: Routledge -Taylor & Francis Group.
WHC, 2011

3.1.2. Biological features

The biological features constitute the broad set of native wildlife, fish and plants and the ecosystems/habitats they rely on for survival[2]. The review of coastal areas and their biological aspects resulted in the following categories:

- Marine turtles nesting sites.
- Endemic species: flora, fauna and micro-organisms.
- Threatened/rare species.
- Critical habitats.
- Migration routes.
- Biodiversity.
- Distinctive landscape.
- Unique biogeography.

Abboud-Abi Saab and Nader (2002) described some of the important Lebanese coastal habitats with emphasis on their vulnerability and need for conservation:

Terraces are highly dynamic as a result of wave action, and hostile due to sudden changes in temperature and salinity. Accordingly, organisms have to be well adapted to survive in such habitats. Furthermore, the terraces are typically Levantine with various mollusks and coralline algae. Brown algae are particularly abundant and exhibit clear zonation. These habitats are very rich in biodiversity and several of these zones require protection.

Sand beaches form a small percentage of the Lebanese coastline, which by itself constitutes a reason for conservation measures; however, they have tremendous value in terms of their biological significance. Their value is in the diverse organisms that inhabit such ecosystems, including marine turtles.

Sand dunes formed by natural processes are under the influence of a set of dynamic processes, which cause shifting in their geography, hence the need for their stabilization and protection. The coastal sand dunes are of great ecological importance and provide a niche for several special plants that also stabilize them. In Lebanon, unfortunately, this ecosystem is threatened due to land appropriation and coastal sand extraction for construction.

Estuaries or river-mouths of major rivers constitute brackish water habitats that are inhabited by organisms of great osmoregulatory capacity (i.e. with high tolerance of salinity fluctuations). These habitats also act as barriers for organisms with low osmoregulation capabilities. In addition, rivers are credited with exporting

[2](http://cpr.ca.gov/CPR_Report/Issues_and_Recommendations/Appendix/Glossary_of_Terms.html)

organic matter in the form of nutrients into marine ecosystems and therefore contributing to the local productivity of the river mouth area. Furthermore, due to their high productivity and structural complexity, brackish waters are important feeding areas for the larvae and immature stages of many fish and invertebrates that later complete their life cycles in the sea. For all of the above stated reasons, and given the special habitats they create, it is essential to protect river outlets along the Lebanese coast.

3.1.3. Cultural/Historical features

Cultural and historical features mainly include sites, buildings, structures, and objects that are significant in the countries' history, architecture, archaeology, engineering, and culture. Cultural and historical features also referred to as cultural and/or natural heritage include: (a) tangible culture such as buildings, monuments, landscapes, books, works of art, and artifacts, (b) intangible culture such as folklore, traditions, language and knowledge, and (c) natural heritage including culturally-significant landscapes and biodiversity. Cultural heritage is unique and irreplaceable, which places the responsibility of preservation on the current generation. Cultural and Natural Heritage are defined in Articles 1 and 2 respectively of the WHC, (2011) as follows.

"Cultural heritage" *(*Article 1; WHC, 2011):

Monuments: architectural works, works of monumental sculpture and painting, elements or structures of an archaeological nature, inscriptions, cave dwellings and combinations of features, which are of Outstanding Universal Value from the point of view of history, art or science;

Groups of buildings: groups of separate or connected buildings which, because of their architecture, their homogeneity or their place in the landscape, are of Outstanding Universal Value from the point of view of history, art or science;

Sites: works of man or the combined works of nature and man, and areas including archaeological sites which are of Outstanding Universal Value from the historical, aesthetic, ethnological or anthropological points of view.

"Natural heritage" (Article 2; WHC, 2011):

Natural features consisting of physical and biological formations or groups of such formations, which are of Outstanding Universal Value from the aesthetic or scientific point of view; geological and physiographical formations and precisely delineated areas which constitute the habitat of threatened species of animals and plants of Outstanding Universal Value from the point of view of science or conservation;

Natural sites or precisely delineated natural areas of Outstanding Universal Value from the point of view of science, conservation or natural beauty.

3.1.4. Stresses and threats

The Strategic Action Plan for the Conservation of Mediterranean Marine and Coastal Biological Diversity (SAP BIO) has identified 149 specific threats adversely affecting marine and coastal biodiversity from a country-by-country analysis (UNEP/MAP/RAC-SPA, 2003). Several categories of threats have been derived which can be applicable to the Lebanese coastal areas (Table 2):

- Uncontrolled coastal development and coastal tourism.
- Fishing on sensitive ecosystems.
- Invasion by non-indigenous species.
- Pollution.
- Global phenomena.
- Trade in endangered or threatened species.
- Damming.

Table 2: Classes and description of threats[3]

Classes of threat	Description
Uncontrolled coastal development and coastal tourism	Include problems such as coastal urbanization (housing, industries, sea backfilling) and illegal dwellings, land use change through construction activities accompanied with quarrying and sand dredging, increased tourism and development of touristic resorts, aquaculture activities and coastal erosion...
Fishing on sensitive ecosystems	Include fishing on fragile biotopes and habitats, in small bays and caves; illegal fishing especially using nets with small mesh sizes increasing the by-catch of immature individuals, use of explosives and toxic bait, spear-fishing with scuba diving equipment etc…; incidental capture; over-fishing and lack of data and monitoring.
Invasion by non-indigenous species	The consequent deformation of the natural dynamics and biodiversity, ballast water, out-competing of natural communities as overgrazing, predation of turtle eggs… are the main emerging issues in this field.
Pollution	Includes a variety of problems, from eutrophication, light pollution and industrial/urban pollution to underwater pipeline deployment (solid waste and wastewater carried by river discharges to the sea, oil spills from ships and war conditions) and harmful agriculture practices (excessive fertilization and use of pesticides, overgrazing and groundwater overexploitation for irrigation).
Global phenomena	Such as desertification (also caused by war, land

[3] UNEP/MAP/RAC-SPA (2003)

Classes of threat	Description
	abandonment and migration of populations), soil erosion, sea level rise (climate change) and the increase in salinity and water temperature, seismic activity, landslide, and floods.
Trade in endangered or threatened species	Several endangered or threatened species populations are decreasing because of the takings for commercial purposes (sponges, sharks, turtles, sea horses, shells, etc.).
Damming	The main negative effects are: changes in food web structure; reduced freshwater supply to the estuaries; increasing salinity at river delta; in addition to the alteration in the sedimentary processes which might have deleterious effects on marine fauna and flora.

Other studies, specially focusing on the Lebanese coastal zone, also listed major stresses on the local marine and coastal environment. Abboud-Abi Saab and Nader (2002) found that most of the threats in Lebanon are due to urbanization, pollution, lack of law enforcement and lack of knowledge of the biological and cultural value of existing habitats. Furthermore, Lebanon's Marine Protected Area Strategy (MOE/IUCN/AECID, 2011) relates the degradation of marine and coastal ecosystems to an ever increasing range of threats including coastal urbanization, land and sea-based sources of pollution such as sewage and oil dumping, habitat degradation, unsustainable fisheries, an increasing demand on marine resources, invasive species and larger scale impacts such as global climate change.

3.1.5. Conservation status

Conservation categories were included to facilitate the identification of areas in need for protection versus areas that are already under some kind of protection through laws, decisions or any other strategic plan. The categories consist of the following:

- National conservation.
- International conservation.
- Recommended/proposed conservation.
- Private/educational area.
- None (No conservation or ownership of any kind).

3.2. Main threats on the Lebanese marine and coastal habitats

The types, causes and the location of the different stresses were identified in order to subsequently determine the hotspot areas in urgent need for protection.

3.2.1. Pollution

Pollution of marine and coastal areas is a chronic problem threatening biodiversity as well as the socio-economic well-being of the country. The causes and sources of pollution can be divided into land-based and sea-based sources, with the solution for each requiring different approaches.

3.2.1.1. Land-based sources of pollution

In Lebanon, there are 12 major coastal rivers (Annex I): one is an inner river, Litani River which originates from the Bekaa Plain and flows southward, then diverts to the West where it outlets into the sea; the others are coastal rivers flowing from the Lebanese mountains directly to the Mediterranean Sea (Shaaban et al., 2009).

Due to the lack of infrastructure and proper management of urban/domestic, industrial and agricultural effluents, most of these land-based sources of pollution will find their way to the waterways and eventually to coastal waters. Therefore, river discharges are considered as the major land-based source of pollution affecting the marine and coastal environment of Lebanon (UNEP/MAP/RAC-SPA, 2002b; Houri and El-Jeblawi, 2007), although impacts from solid waste disposal are recognized as additional sources of land-based pollution (MOE/UNDP/ECODIT, 2011).

- **Urban/Domestic pollution**: About 70% of Lebanon's population, plus hundreds of thousands of tourists are concentrated on the coast and generate about 65% of the total sewage load of Lebanon, which is directly discharged into coastal waters. Untreated sewage is one of the main forms of urban pollution due to the lack in operational Sewage Treatment Plants (STP). Out of 53 major sewage outfalls, two are connected to operational treatment plants (Ghadir and Saida) and provide only preliminary treatment before discharge to the sea (MOE/UNDP/ECODIT, 2010). In addition to untreated wastewater from major cities and towns, coastal waters are also affected by large seafront dumpsites (MOE/UNDP/ECODIT, 2011; Annex I):
    - Tripoli: active but contained; leachate generation and benthic litter are affecting the surrounding marine waters and the historical Mamluks Lion's Tower in Al-Mina.
    - Bourj Hammoud: closed but not rehabilitated.
    - Beirut: closed and rehabilitated.

- Naameh: active and causing environmental pollution including marine pollution as the site has expanded well beyond its initial designed capacity (MOE/UNDP/ECODIT, 2011).
- Saida: active and causing severe environmental and more specifically marine pollution through leaching of effluents and the collapse of solid waste piles into the sea (MOE/UNDP/ECODIT, 2011).
- Tyre: still active. Solid waste pollution produces noxious leakage of effluents that seep into rivers and aquifers, harmful odor and gas releases in addition to visual pollution (MOE/UNEP/MAP, 2005) which negatively impacts the economic activities such as fishery and tourism.

In addition, open dumping and burning of solid waste outside landfills is a widespread phenomenon caused by the lack of the implementation of a solid waste management program, due in part to the strong public opposition to proposed landfill sites and on the other part to financial shortage. Solid waste can also be brought through rivers and streams. Open dumping is mainly detected in the following hotspots: towards the North on Cheikh Zennad beach, the coastal dunes and agricultural plains of Akkar and Hamat; in Mount Lebanon as in Hbaline, besides other limited open dumping sites. In the Bekaa, open dumps are mainly in Rachaya and Zahleh while towards the South in the Damour River basin and on the sandy beaches of Rmeileh, Jiyeh, Saida and Sarafand, Ras El Ain in Tyre, as well as on the bay of Naqoura (MOE/UNDP/ECODIT, 2011; Annex I).

- **Industrial effluent:** The overwhelming presence of heavy industries along the coast for faster transportation and fewer costs towards their destination markets is resulting in additional pollution of coastal waters. Near industrial sites, high levels of heavy metals such as Arsenic, Lead, Zinc and Chromium are detected in coastal waters (UNEP/MAP/RAC-SPA, 2002b; MOE/UNDP/ECODIT, 2011); such industrial pollutants are known to be toxic to ecosystems and biota. Sources of industrial wastewater vary from phosphogypsum slurry discharged into the sea to olive mill wastewater discharged into public sewers and streams during the olive pressing season. Several coastal sites have been recorded to suffer from industrial wastewater discharges (Table 3).

Table 3: Coastal sites affected by industrial wastewater discharges

Coastal site	Industrial pollution
Coastal dunes of Akkar Plain	Polyethylene, polyvinyl chloride and fiber glass factory.
Tripoli Port	Slaughterhouse: No treatment – Solid waste (bones & contents) are sent to Tripoli Landfill – No treatment of liquid waste.
Heri-Chekka beaches	Chekka Cement Factory: non-metallic mineral industry, sea discharge of asbestos and other suspended particulate matter.
Ras Shaqaa cape	Industrial pollution from nearby industries.
Selaata beach	Selaata fertilizers manufacturing industry: chemicals and heavy metals contamination, sea discharges of phosphates and sulphates.
Front rocks of Wata Slim (Tabarja)	Industrial effluents with concentrations of Pb and Hg; Zouk Mosbeh – Zouk Mkayel: various industrial discharges to streams and sea (bleaches, dyes, etc.); Shoueifate, Ain Anoub, and Bchamoun industrial areas: wastewater discharge to the sea via the Ghadir stream.
El Kelb estuary	High levels of Cd and signs of eutrophication of the coastal waters related to high nutrient loads from industrial effluents. Zouk Mosbeh – Zouk Mkayel: various industrial discharges to streams and sea (bleaches, dyes, etc.).
Beirut	Karantina slaughterhouse: Double cycle composting plant which handles all organs including stomach/intestines and bones. Liquid parts are not treated because of the slaughterhouse configuration.
Bourj Hammoud/Dora	Bourj Hammoud Industrial area: slaughterhouse, drainage system discharges liquid waste (including blood) into the public sewer system; Dora industrial complex: tanneries (Cr contamination), petroleum storage...
Damour River estuary	Industrial wastewater from nearby industries.
South Saida beach (Ghaziyeh)	Ghaziyeh industrial zone: sewage and industrial outfalls discharging directly into the beach (tanneries, soap factories…)
Zahrani estuary	Industrial and slaughterhouses effluent discharges.
Tyre	Slaughterhouse: Waste is sent to open dumps without prior treatment. Blood is filtered on site then discharged into the sewer system.

- **Agricultural run-off:** Agriculture on the Lebanese coast is mainly concentrated in Akkar and Damour agricultural plains, although some farming practices can be found on a smaller scale in several other areas such as the protected TCNR (Annex I). Agricultural practices are mostly traditional and unsustainable disregarding the impacts on natural resources especially soil

and water. Pollution generated by this sector results from the uncontrolled use of chemicals such as fertilizers and pesticides. Chemicals such as nitrates infiltrate very easily into the aquifers causing pollution of groundwater. Other accumulating chemicals cause the salinization and degradation of fertile soils. Also, the polluted run-off from agricultural fields through rivers and streams reach coastal waters threatening the sensitive coastal ecosystems (MOE/UNDP/ECODIT, 2011).

- **Oil Pollution:** Lebanon's coastal environment has suffered from repeated wars and conflicts. The "worst oil spill that the Eastern Mediterranean has ever witnessed" according to the UN-GA was identified to be the Jiyeh oil spill caused by the Israeli Air Force on the 13th and 15th of July 2006. However, in spite of the obvious consequences of big oil spill disasters, small-scale land-based sources of marine oil pollution are still superior in terms of long-lasting and devastating effects on the marine environment. Land-based oil-containing discharges and diffuse sources of pollution continuously create relatively low but persistent chronic contamination over large areas. The oil leaked by human activities, such as oil runoff from cars and trucks, is increasing in coastal areas where population is growing and roads are expanding. In addition to street run-off, industrial waste, municipal wastewater and wastewater from refineries are a considerable part of marine oil pollution. Rivers polluted by oil in wastewater or the improper disposal of petroleum products are also a significant source of oil in the sea (GPA/UNEP, 2012). Examples are the thermal power plants on the Lebanese coastline (Beddawi, Hrayche, Zouk, Jiyeh, Zahrani and Tyre) and the hydroelectric power plants (El Aabdeh and Ibrahim River) which cause additional pollution of coastal waters (Annex I).

- **Visual and noise pollution:** Part of coastal pollution is due to noise pollution coming from planning and implementing coastal highways parallel to shorelines while the other is visual pollution caused by the disordered construction of tourism complexes and human settlements that lack the least aesthetic parameters and conceal the sea view (MOE/UNEP/MAP, 2005).

3.2.1.2. Sea-based sources of pollution

The UNEP Regional Seas Program states that of all the sources of marine pollution, the discharge of oily engine wastes and ballast waters from day-to-day shipping operations may be the worst, because it is steady and occurs everywhere. Moreover, even low levels of contamination can kill larvae and cause disease. Oil slicks kill

birds, marine mammals and fish, particularly near coasts, and coagulated oil destroys coastal habitats.

Most of Lebanon's primary energy consists of imported hydrocarbon fuels which are only supplied by sea tankers. Fuel transportation can impact the marine and coastal waters through cargo spillage and ballast water unloading. No information exists in Lebanon to quantify this type of pollution and determine its environmental impact (MOE/UNDP/ECODIT, 2011). However, shipping or commercial harbors on the Lebanese coast, where loading and unloading terminals for oil and other products are located, form major pollution hotspots. These are the ports of: Tripoli, Chekka, Selaata, Jounieh, Zouk Mosbeh, Bourj Hammoud, Beirut, Saida and Tyre (Annex I).

3.2.2. Impact of exploitation of natural resources

3.2.2.1. Impact of marine fishing

The fisheries sector in Lebanon is artisanal and traditional with regulations dating back to 1929 (Decision 2775/29). The Lebanese fishing fleet is made up of a total of 2700 fishing boats spread along the Lebanese coast. An average of 4,000 fishermen are based in the ports of Tripoli, Jbeil, Jounieh, Beirut, Saida, Sarafand, Tyre and few fishermen in Naqoura, all amongst the poorest communities in the country (Annex I). In the absence of an updated fisheries law coupled with quasi-absence of law enforcement, they heavily exploit the potentials offered by the actual fishing zones (Majdalani, 2004; MOE/UNEP/MAP, 2005; IMAC 2007). Apart from the above listed ports, some smaller harbors and natural beaches with high ecological value are also affected by fishing practices. Those include the Aarida estuary, Cheikh Zennad and Qleiaat sandy beaches, the coastal dunes of Akkar Plain, El Aabdeh beaches, Qalamoun beach, Ras Shaqaa, Amshit beach, Aaqaibeh beach, Damour estuary, and Mhayleeb beach (Annex I).

The fishing sector is managed and controlled by the MOA which has banned dynamite fishing and trawling nets, fishing of marine turtles, cetaceans and monk seals (Decision 125/1 issued in 1999), the use of small mesh sizes (Decision 408/1 issued in 2007), regulated the scuba-diving industry including permitting procedures and safety measures (Decision 93/1 issued in 2008), and banned the fishing, landing, trade and consumption of puffer fish species (Decision 676/1 issued in 2011). The Ministry has also banned the use of spear fishing by scuba divers as well as the sale and trade of any of its derivate (Majdalani 2004; MOE/UNDP/ECODIT, 2011; Nader, 2011). Before setting this legal framework, fishermen used to expansively catch fish using nets with illegal mesh sizes which increases the catch of immature organisms and leads to negative impacts on recruitment rates and stocks. As well, the use of dynamite and toxic substances for

fishing heavily impacted fish stocks, marine biodiversity and habitats. Species such as turtles, monk seals, and others are mainly caught accidently and not always intended for consumption (Abboud Abi Saab and Nader, 2002; Nader, 2011). Over the last years, the illegal use of dynamite and poison in fishing have been significantly reduced but the use of nets with small mesh size remains rampant along the Lebanese coast. Fishermen lack awareness about specific matters related to sustaining fisheries and maintaining fish stocks (MOE/UNEP/MAP, 2005). It is therefore essential to examine the negative impact of the above listed inappropriate fishing techniques on fish species diversity in particular and marine biodiversity in general in order to devise appropriate conservation strategies for marine life (Abboud Abi Saab and Nader, 2002; Nader, 2011).

For the above reasons, and in order to set up efficient management plans, catch and effort data from all Lebanon are essential for assessing the status of the fisheries sector. Available data in Lebanon are scarce and sporadic except for the coast of North Lebanon where the Marine Resources and Coastal Zone Management Program (MRCZM) at the IOE of the UOB have started collecting catch and effort data from the four main harbors of North Lebanon since January 2006 (monitoring still on-going). The geographical coverage of the monitoring program represents approximately 42% of the Lebanese coast. The main goal of the initiative is to establish long-term monitoring of commercial fish species landings and fishing effort in order to contribute to developing appropriate management plans based on scientific data to sustainably benefit from the resource. Data is then entered into a utility dubbed FLOUCA (Lebanese term for fishing boat and stands for **F**ish **L**anding **O**perational **U**tility for **C**atch **A**ssessment) based on the generic software and standard statistical methodology available on the web by the FAO. The sampling scenarios used by the system (particularly those related to fishing effort) are flexible and capable of responding to specific needs and field conditions. Such flexibility of action has made the system independent of eventual external changes to its statistical structure and/or sampling operations, thus eliminating the need for software maintenance and ensuring robustness and sustainability.

As well, the MRCZM at the IOE at the UOB in addition to few other universities, have started evaluating the biological parameters and assessing the stocks of several species of fish in order to contribute to a national management plan of the sector in Lebanon (EASTMED, 2010a).

3.2.2.2. Impact of the exploitation of wetlands on natural resources

Wetlands are sensitive ecosystems providing special environments and habitats for living organisms. In addition, they act as sponges preventing flooding in coastal regions. Over-exploitation of water and land resources in these areas leads to their deterioration and the loss of their biodiversity. The main risks and problems affecting coastal wetlands include (UNEP/MAP/RAC-SPA, 2003):

- Inappropriate fishing practices such as the use of fine nets and other methods.
- Excessive hunting of coastal birds in wetlands dramatically reduces their populations.
- Overgrazing of coastal areas resulting in disappearance of vegetation and the subsequent soil erosion.
- Uncontrolled and successive sand extraction for use in construction leading to the destruction of habitats, to erosion and to irreversible damage to the landscape.
- Draining and filling of coastal wetlands for the construction of resort facilities or to obtain agricultural areas; this is happening/happened in most of the coastal wetlands of North Lebanon (IMAC, 2009).

The Ramsar Convention on Wetlands of international importance listed three Lebanese coastal sites: Promontory cape and cliffs of Ras Shaqaa, PINR and TCNR including Ras El Ain springs. Other existing coastal wetlands in Lebanon are also in need for protection: Salinas and wetlands of Qleiaat in Akkar, and Salinas and wetlands of Enfeh in Koura (Annex I).

The Ramsar Convention defines wetlands as “Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters”. According to this definition, the numerous river valleys and estuaries of the Lebanese coast should also be considered as potential Ramsar sites in need for protection. Those include from North to South: Aarida estuary, Aarqa River estuary, El Jawz River estuary, Ibrahim River valley and estuary, Ghadir River estuary, El Kelb River valley and estuary, Damour River valley and estuary, Awally River estuary, Zahrani River estuary, Qasmiyeh River estuary, and Iskandarouna springs (Annex I).

Furthermore, including “areas of marine water the depth of which at low tide does not exceed six meters”, many additional marine areas on the seashore could be

taken into account depending on their sensitivity, such as coralline reefs, terraces, cliffs and capes, and sandy beaches amongst others.

3.2.2.3. Impact of exploitation of freshwater resources

Groundwater is the main source of freshwater in Lebanon. Over 50% of irrigation water comes from underground wells and boreholes while 80% of potable water comes from groundwater sources. In addition, private wells have increased greatly in the last few years (UNEP/MAP/RAC-SPA, 2002b; MOE/UNDP/ECODIT, 2011).

The principal aquifers in the country are affected or threatened by overexploitation of groundwater and seawater intrusion from the Mediterranean Sea and information available from the MOWE supports the subjective evidence of wells drying up or increasing in salinity.

Three of these aquifers supply the major coastal cities of Lebanon (Amin, et al., 2008; Annex I):

- The Damour Aquifer in central Lebanon, which supplies the capital Beirut.
- The Koura-Zgharta Aquifer in the North, which supplies Tripoli, the second largest city in the country.
- The Sannine Aquifer in the South, which supplies Saida.

Factors such as their location on the coast and high population densities in those cities resulted in the mining of groundwater in the Koura-Zgharta Aquifer and seawater intrusion in the Damour Aquifer. Moreover, the tourism industry on the coast overuses water resources for hotels, swimming pools, gardens, and tourists' personal use (IMAC, 2009). On the other hand, the over-pumping of groundwater on the coast for irrigational purposes is mainly located in Akkar and Damour Agricultural Plains.

3.2.3. Uncontrolled urbanization and construction of infrastructure

Urban development on the Lebanese coastal area is entirely related to the centralization of economic and commercial activities in this strategic location. This development is clearly represented by uncontrolled urban expansion with the corresponding construction of infrastructure.

Urban sprawl is initially a result of demographic growth and rural population migration towards the cities, such as Beirut suburbs (Maameltein to Khaldeh), the northern and southern entrances of Saida, as well as along the main transportation roads such as the ribbon construction strips observed on El Aabdeh – Halba road (UNEP/MAP/RAC-SPA, 2002a; IMAC, 2009). Moreover, the weak law enforcement

and monitoring during the civil war period between 1975 and 1990, prolonged by the Israeli occupation until 2000, had greatly increased chaotic developments including the refugee camps such as the one in Rachidiyeh near the TCNR (Annex I).

Another cause for the intensive urban development along the coast is the growing tourism sector which is mainly based on activities within urban structures such as beach resorts, hotels, restaurants, country clubs and casinos. This traditional trend of Lebanese tourism has a destructive impact on the environment. The unregulated building of coastal resorts and the illegal violation of the maritime public domain (e.g. Tell of Sarafand) have resulted in coastal privatization, beach erosion, and land and ecosystem degradation.

Furthermore, this uncontrolled spreading of populated zones requires more space and land resources for the construction of roads, buildings and other infrastructural projects. These requirements are provided through sand extraction from beaches, sediment dredging offshore, gravel quarrying in river beds (El Jawz River, Ibrahim River), sea embankment near the shore (Heri to Chekka, Mhayleeb, Jiyeh, Rmeileh, Qasmiyeh), and urban encroachment on agricultural lands (Akkar Plain, Damour Plain, areas between Saida and Tyre, Ghaziyeh to Naqoura; Annex I). Most of these practices are irreversible, transforming the natural and agricultural areas into constructed properties (CDR/DAR/IAURIF, 2005; MOE/UNDP/ECODIT, 2011).

Although some rural populations are still surviving from agriculture (Akkar, Damour, Ras El Ain - Tyre and Naqoura), increased revenues of constructed properties in comparison to agricultural production revenues are diminishing the value of agricultural lands. This fact increases the risks of continued urban encroachment.

Terraces (Vermitid platforms) are among the most impacted coastal features due to tourism and highway construction. Terraces of Tabarja and El Mina regions are already heavily degraded and other Vermetid reefs such as the platforms abundant from Batroun to Jbeil and in Ras Beirut and Saadiyat are under a high risk of disappearance. The ecological importance of such systems resides in their high rate of biodiversity and their function as wave barriers that protect the coast from erosion and storm surges, such as the small islets formed by the reef communities between the PINR and El Mina in Tripoli (Abboud –Abi Saab and Nader, 2002; Annex I).

Sandy beaches and dunes are vulnerable ecosystems that are threatened due to land appropriation and coastal sand extraction for construction. The resulting loss of vegetation from sand dunes destabilizes them and causes a shifting in their

geography. This is the case of Akkar and Tyre sand dunes that are prone to erosion and in urgent need for protection.

Additional susceptible natural features are the coastal woodlands restricted to only few areas including the slopes of El Kelb, Damour and Awally River valleys. These are significantly decreased mostly due to urbanization, in addition to other agricultural practices like overgrazing and industrial activities as charcoal production (MOE/UNEP/MAP, 2005).

Apart from the natural heritage threatened by urbanization, the coastal area of Lebanon includes a wide range of sites identified as important architectural and archeological heritage sites. Following the destruction by the civil war, traditional core villages such as in Sarafand and Damour are facing the risk of architectural identity loss due to the reconstruction efforts. Other old cities like Tyre, Saida, and Tripoli as well as the Khaldeh archaeological site are also threatened by the surrounding haphazard and chaotic urban expansion. Furthermore, quarrying activities and construction works are noticed around Msaylha fortress in Batroun and Umm El Amad archaeological site in Naqoura, in addition to the gradual destruction of the archaeological remains in the ancient tell of Jiyeh and Nabi Younes due to the execution of a major project for the construction of a tourist marina and resort (MOE/UNEP/MAP, 2005; Annex I).

3.2.4. Invasive and alien species

Invasive species can be either introduced directly by people (aquaculture or accidentally by fouling and ballast waters ships) or allowed passage by human actions. The opening of the Suez Canal established a direct, major route of invasion for Indo-Pacific fauna and flora. To date, hundreds of Lessepsian species have become a familiar sight, at least in the Levantine corner of the Mediterranean. The Lebanese coast, which at its southern end is about 400 Km distant from the Suez Canal, is fully exposed to the arrival of exotic tropical species. A review study on alien species along the Mediterranean coastline from the 20th and 21st century revealed that there are around 558 alien metazoan species spread in the Mediterranean. There are almost four times as many alien species along the Levantine coast (409) in comparison to the westernmost Mediterranean (110) and the list is still growing (Galil 2008; EASTMED, 2010b; MOE/UNDP/ECODIT, 2011). Certain species have already established viable communities and are competing for space and resources with the natives. For instance, several puffer fish species belonging to the Terodontidae family have invaded the Mediterranean, and they are considered as serious threats to consumers due to the lethal levels of the strong Tetrodotoxin poison that the fish may contain. Several studies are targeting alien species in order to understand their behavior in their new habitat and their impact on

the surrounding environment as well as on the related socio-economic sectors. In Lebanon studies concerning exotic, non-indigenous and invasive species are insufficient. There are several scientific publications reporting new sightings of alien species in the coastal waters of Lebanon, but there is no official comprehensive list adopted for such aliens in Lebanon (EASTMED, 2010a; EASTMED, 2010b; Nader, 2011).

On the other side, plastic debris floating in the sea or thrown on the beach have been proposed as an important source of colonization of several terrestrial alien species. This is the case in the PINR. Although part of the garbage left by visitors is removed, the remaining garbage constitute a source of attraction for insects and their predators such as lizards, but also a source of food for Yellow-Legged Gulls which dominate the Islands during the breeding season without even leaving a place for the Audouin's Gull to nest as it was the case prior to the seventies (MOE/UNDP, 2004a; EASTMED, 2010b; Nader 2011).

3.2.5. Global phenomena and natural hazards

Serious risks to the natural resources and Lebanon's heritage in coastal areas can be caused by several types of natural hazards with some having been identified (CDR/DAR/IAURIF, 2005; Annex I).

3.2.5.1. Floods

Sites reported to be prone to flood risk include the coastal zone of Chekka, Khaldeh archaeological site, Damour coastal plain, Awally river estuary, Zahrani estuary and Qasmiyeh estuary (Annex I). The causes of the floods in these regions vary between soil saturation – usually barely permeable – that leads water level to rise, to torrential floods of rivers or sea storms (coastal plains around estuaries) that create storm surges that invade lands and accentuate floods caused by river saturation and rainfall (CDR/DAR/IAURIF, 2005).

3.2.5.2. Landslides

Sites reported to be prone to landslides include El Kelb River historical site, Ibrahim River archaeological sites and promontory cape and cliffs of Ras Shaqaa. The causes of high landslide risks are steep stream basins and steep slopes often located along faults such as Ras Shaqaa in the Caza of Batroun (CDR/DAR/IAURIF, 2005; Annex I).

3.2.5.3. Seismic hazards

Sites reported to be prone to seismic hazards include Damour traditional village, Khaldeh archaeological site and promontory cape and cliffs of Ras Shaqaa. Although Seismic hazard is omnipresent in every region of Lebanon as a result of its geographical position over two tectonic plates that slide facing each other and induce readjustment faults, hazards are maximal around active faults. Anti-seismic construction regulations are the best solutions to diminish damages and losses.

In addition to those previously mentioned risks, global warming and climate change are also acknowledged to affect Mediterranean coastal and marine biodiversity. Although it is just becoming visible in the region, the rise in sea level will certainly have a major impact, especially on coastal wetlands. Furthermore, temperature increase will compound already existing pressures on coastal fauna and flora which will be forced to adapt to such changes, shift or migrate to cooler regions or will be wiped out from the area. Other consequences include changes in rainfall patterns. Decrease in soil humidity and increased water scarcity in some areas leads to aridity and desertification (UNEP/MAP/RAC-SPA, 2003). All these disturbances will cause the degradation of natural habitats and consequently the loss of biodiversity.

3.2.6. Changes in landcover/landuse

According to the “Situational Analysis of the current land use of the coastal zone, particularly in terms of socio-economic activities” (Component B (i) of the ERML) on changes in landcover/landuse between 1998 and 2010 on the coastal zone of Lebanon, the major types of change recorded (in terms of area in hectares and in decreasing order) are:

- Changes from grassland to artificial land.
- Changes from forest to artificial land.
- Changes from agricultural to artificial land.
- Changes from sea to artificial land.

It is therefore obvious that, as most Mediterranean countries, Lebanon’s coast has undergone drastic landuse changes, from natural to bio-cultural (linked to traditional activities such as agriculture), and from there to urban environments. Landcover/landuse changes especially from natural environments to artificial land can be the result of various practices namely:

- Sea filling affecting Heri-Chekka beaches, Batroun National Marine Reserve, and Qasmiyeh beach.
- Sand extraction and narrowing of the sandy beaches of Tyre, Qasmiyeh, Rmeileh, Jiyeh, Damour, Jnah, Ramlet El Bayda, Tabarja; as well as Al Mina seashore, El Aabdeh port and beach, and the coastal dunes of Akkar Plain.

- Land abandonment and desertification mostly present in the southern part of the coast due to the civil war such as in Damour Agricultural Plain.
- Quarrying and removal of the vegetation cover affecting the river valleys and estuaries of El Jawz and Ibrahim River.
- Changes due to construction practices and the effect of urbanization particularly noticed around Maameltein, Ghadir River and Beirut River. Also, the reconstruction efforts after the war are obvious in Damour and Sarafand where land use changes to agricultural areas at the expense of natural areas, then from agricultural to urban areas, affected a large part of these regions.

These main threats are a result of the following (UNEP/MAP/RAC-SPA, 2003):

- Desertification including soil erosion and increase in soil salinity.
- Destruction and fragmentation of sensitive coastal habitats due to uncontrolled plowing, coastal erosion, urbanization, construction of transport infrastructure, etc…
- Arrival of chemical substances to the sea originating from the compounds used in agriculture.
- Changes in the sedimentary processes: increase in sediment deposition (hyper-sedimentation) and reduction of sedimentary deposits leading to erosion.

There are no detailed studies on sedimentation on Lebanese beaches; however, in light of significant numbers of construction and quarries, soil erosion, desertification processes and seafilling, deposition of significant quantities of sediments mainly at the rivers and sea shore is expected (IMAC, 2009; Nader, 2011). Such activities are highly practiced on the northern Lebanese coastlines such as:

- A major rock calcium carbonate quarry in Chekka intended for cement factories.
- Urban expansion, excavation activities for roads, buildings and others along with the dumping of construction by-products in rivers and on seashores.
- Sea filling by the private sector to expand land surface area. This is mostly practiced by the tourism sector while some private property owners also indulge in this practice.
- A variety of agricultural activities such as erosion caused by the desertification resulting from over grazing, forest exploitation, loss of terraces, intensive farming such as excessive and repetitive plowing of agricultural soils especially on the northern Akkar Plain.
- The direct dumping of the by-products of the Chemical Compound Fertilizers Plant in Selaata, the fine Gypsum slurry, into the sea.

The concentration of such deposition in specific periods surely has acute detrimental effects on coastal and marine fauna and flora. Cases of reduced deposition of sediments also exist such as the dams of El Aabdeh Hydroelectric Power Plants trapping Al Bared River waters thus reducing freshwater supply to the estuaries including sediments carried by river flow.

3.2.7. Uncontrolled recreational activities

Seashore destinations witness the largest mass of tourism, often frequented by foreign tourists rather than by locals. This is reflected by the rising number of visitors to beaches such as the rocky beaches located to the south of Batroun and the sandy beaches of Jbeil, Jiyeh, Rmeileh and Tyre (MOE/UNEP/MAP, 2005). The resulting effect is usually uncontrolled development of recreational activities on the coastal areas and shallow water especially during the summer period (UNEP/MAP/RAC-SPA, 2003). Activities such as unregulated recreational fishing, scuba diving, jet-skiing and boating are located on the various coastal marinas and sea fronts which spread along the Lebanese coast (IMAC, 2009).

Furthermore, ecosystems such as sandy beaches and coastal wetlands which are ecologically sensitive areas are at the same time very attractive to tourists, developers, and local residents. Over-frequentation by tourists of natural, well-conserved sites such as the PINR and the TCNR as well as Mhayleeb Scientific Reserve constitutes a real problem. The disturbances caused by visitors through trampling, noise and littering are a real threat especially to the turtle nests and the unique insular vegetation, the unique freshwater vegetation, and the special plants that stabilize the sand dunes. It is also reported that parts of the sand dunes of the TCNR are being flattened by bulldozers for the practice of recreational activities during summer (MOE/UNDP, 2004b).

Other examples listed are the degraded terraces of the coastal front rocks of Wata Slim in Tabarja and the Salinas and wetlands of Qleiaat and Enfeh. Other beaches considered as tourist destinations or located near touristic areas include Tripoli to Qalamoun beaches, Jbeil to Amshit beaches, sandy beaches of Rmeileh and Jiyeh, beach of Damour and beach and coastal dunes of Ras-Siddine-El-Bahr. Main roads connecting those areas host a large number of restaurants, nightclubs and coffee shops (IMAC, 2009; MOE/UNDP/ECODIT, 2011) which represent a source of impact through noise, solid and liquid waste, as well as lights at night. This leads to a considerable decrease in the potential of marine turtles nesting on these sandy beaches. In the marine environment, the main problems are caused by water activities such as over-frequentation by divers. The special underwater habitats of

the marine springs of Chekka and of the Batroun Marine Reserve are especially affected by such activities.

3.3. Background research and determination of potential sites for protection

In the purpose of identifying the hotspot areas, the Lebanese coast was divided into 70 coastal municipalities extending from the northern border (Aarida) to the southern border (Naqoura). After an extensive review of the potential sites for protection mentioned in the literature, a general database was produced including 59 potential sites for protection along with their location per municipality and the existing information about each of the evaluation parameters (Annex I). The current protection status of the 59 selected sites was determined, allowing the exclusion of official protected sites from the evaluation (Table 4). It should be noted that although ruins within the city of Beirut may be considered as potential sensitive sites, they were not included in the evaluation given the complexity of their preservation.

After the examination of the identified sites, and given that some specific stresses are considered more critical and largely spread along the coast (UNEP/MAP/RAC-SPA, 2003; Nader, 2011), the focus of the evaluation, to determine the most sensitive sites, was on the following main issues of the coastal zone:

- Degradation and pollution resulting from coastal river discharges.
- Degradation and pollution induced by oil spills, especially the one caused by the Israeli Air Forces bombing of the Jiyeh Power Plant during the 2006 Israeli War on Lebanon.
- Degradation due to severe land use change from agricultural and natural areas towards urban and industrial areas.

The combination of those pressures on the coastal zone may increase even more the vulnerability of the selected sensitive areas which may require new and improved plans for their protection and conservation.

In the next sections, potential sensitive areas are investigated and ranked from the most to the least sensitive, based on the available information and according to the adopted evaluation criteria.

Table 4: Conservation status of 59 potential coastal sites in need for protection

Site Name	Location/ Municipality	Conservation Status	Sources
Aarida estuary	Qleiaat.	Recommended/proposed conservation.	CDR/ECODIT/IAURIF, 1997.
Cheikh Zennad Beach	Qleiaat.	Recommended/proposed conservation.	MOE; CDR/ECODIT/IAURIF, 1997.
Salinas and wetland of Qleiaat	Qleiaat.	Recommended/proposed conservation.	CDR/ECODIT/IAURIF, 1997.
Coastal dunes of Akkar Plain	Qleiaat. Mqeitaa. Qoubbet Chamra.	Recommended/proposed conservation.	CDR/ECODIT/IAURIF, 1997.
Aarqa river estuary	Qoubbet Chamra.	National conservation.	MOE, Decision no. 188/1998.
City of Orthosia in El Bared River	Mhamrat.	N/A*	
Terraces of El Mina beach	El Mina.	N/A	
Terraces and Beach of southern Tripoli towards Qalamoun	Tripoli. Qalamoun.	National conservation.	Decree No. 3362/1972.
Ras Enfeh	Enfeh.	N/A	
Salinas, wall promenade of Enfeh and Our Lady of Natour Monastery	Enfeh.	N/A	
Heri - Chekka beaches	Chekka. Heri.	N/A N/A	
Offshore freshwater marine springs in Chekka	Chekka.	N/A	
Promontory cape and cliffs of Ras Shaqaa and Saydet El Nouriyeh Monastery	Hamat.	Recommended/proposed conservation - International conservation.	CDR/DAR/IAURIF, 2005; IMAC, 2009; MOE/IUCN/AECID, 2011; CDR/ECODIT/IAURIF, 1997.
Selaata terraces	Selaata.	N/A	
El Jawz River estuary	Koubba.	National conservation.	MOE, Decision no. 22/1998
Batroun National Marine Hima at the National Centre for Marine Sciences	Batroun.	National conservation.	MOA, Decision no. 129 of 1991.

Site Name	Location/ Municipality	Conservation Status	Sources
Historical Center and Fishing Harbor of Batroun	Batroun.	N/A	
Beaches of Kfaraabida	Kfaraabida.	N/A	
Fadaous ancient tell	Kfaraabida.	None.	Recently discovered.
Medfoun rocky area	Thoum (kaemakamiyeh).	N/A	
Beaches in the south and north of Jbeil (Amshit-Jbeil)	Mounsef.	Recommended/proposed conservation.	CDR/ECODIT/IAURIF, 1997.
	Aamshit.		
	Jbeil.		
Marine environment in front of the fishing harbor of Jbeil	Jbeil.	N/A	
Ibrahim River estuary (and archaeological sites)	Ibrahim River.	National conservation - Recommended/proposed conservation.	MOE, Decision no. 34/1997; CDR/DAR/IAURIF, 2005; CDR/ECODIT/IAURIF, 1997.
Aaqaibeh beach	Aaqaibeh.	N/A	
Coastal Front Rocks and terraces of Wata Slim (Tabarja)	Tabarja-Kfaryassin.	National conservation.	MOE, Decision no. 200/1997.
Maameltein promontory	Jounieh.	N/A	
Bay of Jounieh	Jounieh.	N/A	
Ghadir River estuary	Jounieh.	N/A	
El Kelb River estuary (and historical site)	Dbayeh.	National conservation - Recommended/proposed conservation.	MOE, Decision no. 97/1998; CDR/DAR/IAURIF, 2005; CDR/ECODIT/IAURIF, 1997.
Beirut River estuary	Beirut.	National conservation.	MOE, Decision no. 130/1998.
The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	Beirut.	N/A	
Ancient Persian Harbor	Beirut.	N/A	
Sandy beach of Ramlet El Bayda in Beirut	Beirut.	N/A	

Site Name	Location/ Municipality	Conservation Status	Sources
Sandy beaches of Jnah	Beirut.	N/A	
Sea grass meadow in front of the Airport wave breaker	Tahwitat El Ghadir.	N/A	
Khaldeh archaeological site	Tahwitat El Ghadir.	Private/educational area.	MOE/UNEP/MAP, 2005.
Beaches and estuary of Damour	Damour.	Private/educational area. National conservation - Recommended/proposed conservation.	UNEP/MAP/RAC-SPA, 2002a; MOE, Decision no. 29/1998; CDR/DAR/IAURIF, 2005; CDR/ECODIT/IAURIF, 1997.
Ras Saadiyat	Damour.	N/A	
Sandy beaches of Rmeileh and Jiyeh	Jiyeh. Rmeileh.	Private/educational area.	UNEP/MAP/RAC-SPA, 2002a.
Awally river estuary	Saida.	National conservation.	MOE, Decision no. 131/1998; CDR/DAR/IAURIF, 2005.
Beaches north and south of Saida	Saida.	N/A	
Saida Zeereh	Saida.	N/A	
Zahrani estuary	Saida.	N/A	
The sea castle and underwater city of Saida & sea façade & old harbor	Saida.	N/A	
Tell El Burak	Aadousieh.	Private/educational area.	MOE/UNEP/MAP, 2005.
Ancient tell of Sarafand	Sarafand.	N/A	
Aadloun beach and caves	Aadloun.	None	UNEP/MAP/RAC-SPA, 2002a.
Qasmieh estuary	Bereghlieh.	N/A	
Mhayleeb beach	Bereghlieh.	None.	Personal communication with Municipality of Bereghlieh.
North Tyre beach (Ras-Siddine-El-Bahr)	Tyre.	Recommended/ proposed conservation.	MOE, 1991; UNEP/MAP/RAC-SPA, 2002a.
Bakbouk hot water springs	Abbassiyeh.	N/A	
Mansouri beach	Mansouri.	None - Recommended/ proposed conservation.	UNEP/MAP/RAC-SPA, 2002a; MOE; Municipality Mansouri/Qleileh.
White cliffs of Bayada	Naqoura.	Recommended/ proposed conservation.	

Site Name	Location/ Municipality	Conservation Status	Sources
Iskandarouna springs and beach	Naqoura	N/A	CDR/ECODIT/IAURIF, 1997.
White cliffs and bay of Naqoura	Naqoura	Recommended/ proposed conservation.	CDR/ECODIT/IAURIF, 1997.
Umm El Rabb site	Naqoura	N/A	
Umm El Amad site	Naqoura	None	MOE/UNEP/MAP, 2005.

*N/A: Information Not Available

4. Priority list of coastal and marine sensitive areas

The objective is the identification and mapping of sensitive coastal areas using an ecological/cultural approach which should include all the following components as per the project Terms of References:

- Coral habitats, benthic habitats and open water habitats.
- Status of fauna, flora and micro-organisms (plankton communities) in each habitat type.
- Species composition in near shore ecosystems.
- Geographical characteristics, management status and other environmental parameters such as physical oceanography affecting the ecological state of the sites.
- Sites with key biodiversity species.
- Sensitive habitats and endangered species including fish, water birds and plants.
- Historical/Cultural heritage sites.

A review of the existing cultural and ecological criteria already in use by national and international instruments and organizations was undertaken to facilitate the process of identification of the key sensitive areas present on the coastal zone of Lebanon.

4.1. Review and selection of criteria for the identification of sensitive areas

Review of ecological criteria:

Ecological criteria were selected based on the extensive review done by the Conference Of Parties to the Convention on Biological Diversity (CBD), for the identification of potential marine areas for protection (UNEP/CBD, 2000; UNEP/CBD, 2006). The CBD review included criteria used by countries, regional bodies, conventions and organizations and ranked them according to their frequency of utilization (Annex II). The criteria are commonly used by countries in building their own guidelines for the selection of priority areas for the establishment of marine and coastal protected areas, or used directly in identifying national sensitive areas.

In addition, many of the submissions to the CBD contained criteria which are not purely ecological in nature, but whose application will require taking into account ecological information. These considerations may be incorporated into the site selection or designation processes, either as part of guidance for application of the ecological criteria, or as part of any practical and/or socio-economic criteria. Such criteria include:

- Replication (as a way to decrease the risk of losing species and habitat types to unexpected natural or man-made disasters).
- Threats and risks to the area, for example from pollution and other human activities.
- The level of existing protection (conservation status).
- The importance of an area to research and/or monitoring.
- Potential of an area for restoration.
- Aesthetic importance and natural beauty values of the area.

Review of cultural criteria:

The compilation of the final list of cultural criteria was based on two main sources:

- The "Operational Guidelines for the Implementation of the WHC" (2011) and,
- A study done by the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity (UNEP/CBD, 2012).

In its latest revised version of the Operational Guidelines, the WHC decided to merge the former two separate sets of natural and cultural heritage criteria into one common list which was adopted for the selection of sensitive sites. In addition to the WHC list, the cultural criteria suggested by the CBD for the "identification of ecologically or biologically significant areas as well as the establishment and management of Marine Protected Areas", were used.

The ecological and cultural criteria for the selection of sensitive sites on the Lebanese Coastal Zone were then compiled into two independent lists (Table 5 & Table 6).

Table 5: Ecological criteria[4]

Criteria	Description	Sources	Ecological	General[5]
Representativeness	Area includes physiographic features, populations of species, habitats and ecosystem types or ecological processes, which are representative of the region or ecoregion.	CBD/COP, SPAW, Baltic Convention, OSPAR Convention, SPABD Protocol (SPAMI List), EU Habitats Directive, IMO, Greenpeace, UNESCO - WHC. New Zealand and Australia, India, Iran, Madagascar, Argentina, Trinidad and Tobago.	X	
Importance for threatened, endangered, declining, rare or endemic species and/or habitats	Area containing habitat of critical importance for survival or recovery of endangered, threatened, rare or endemic species; or area with significant assemblages of such species.	CBD/COP, SPAW, OSPAR Convention, SPABD Protocol (SPAMI List), IMO, IUCN, Ramsar Convention on Wetlands, UNESCO - WHC, New Zealand and Australia, India, Iran, Ecuador, Madagascar, Argentina, Mauritius, Trinidad and Tobago.	X	
High diversity	Area contains high diversity of ecosystems, habitats, communities, or species, or has high genetic diversity.	CBD/COP, SPAW, Baltic Convention, OSPAR Convention, SPABD Protocol (SPAMI List), IMO, Ramsar Convention on Wetlands, UNESCO - WHC, New Zealand and Australia, India, Iran, Mauritius.	X	
Uniqueness/rarity/ endemism	(i) Area contains unique ("the only one of its kind"), rare (occurs only in few locations, or has	CBD/COP, SPAW, Baltic Convention,	X	

[4] Sources: UNEP/CBD/COP(2000); UNEP/CBD/COP/8/1/INF/16(2006)
[5] Criteria not purely ecological in nature, but its application will require taking into account ecological information.

Criteria	Description	Sources	Ecological	General[5]
	been seriously depleted across its range), distinct and/or endemic species, populations, communities, habitats or ecosystems; and/or, (ii) Area contains unique or unusual geographic features.	SPABD Protocol (SPAMI List), IMO, UNESCO - WHC, IUCN, New Zealand, Iran, Canada, Argentina, Mauritus, Trinidad and Tobago.		
Importance for life history stages of species, or for migratory species	(i) Area containing breeding grounds, spawning areas, nursery areas, juvenile habitat or other areas important for life history stages of species; and/or, (ii) Area containing habitats of migratory species (feeding or rest areas, breeding, molting, wintering or resting areas, migratory routes).	CBD/COP, Baltic Convention, OSPAR Convention, EU Habitat Directive, IMO, IUCN, Ramsar Convention on Wetlands, Greenpeace, New Zealand and Australia, India, Iran, Canada, Ecuador, Madagascar, Argentina, Mauritius, Trinidad and Tobago.	X	
Naturalness	Area has a high degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.	CBD/COP, SPAW, Baltic Convention, OSPAR Convention, SPABD Protocol (SPAMI List), IMO, IUCN, New Zealand and Australia, India, Iran, Canada, Argentina, Mauritius.	X	
Integrity of the area in surrounding landscape/seascape	The area is a biologically functional unit, an effective, self-sustaining ecological entity.	CBD/COP, IMO, IUCN, Greenpeace, India, Iran, Mauritius, Trinidad and Tobago.	X	
Connectivity/ coherence	(i) Area provides for ecosystem linkages, and/or contributes to the maintenance of essential ecological processes or life-support systems; and/or, (ii) Area contributes to a	CBD/COP, EU Habitat Directive, SPAW, Greenpeace, Madagascar.	X	

Criteria	Description	Sources	Ecological	General[5]
	network: protected areas that are adjacent, transboundary or ecologically connected.			
Biogeographic importance	An area that either contains rare biogeographic qualities or is representative of a biogeographic "type" or types, or contains unique or unusual biological, chemical, physical, geological or geomorphological structures or features.	CBD/COP, EU Habitats Directive, IMO, IUCN, UNESCO - WHC, Great Barrier Reef Marine Park, New Zealand and Australia, India, Iran.	X	
High biological productivity	Area containing species, populations or communities with high natural biological productivity.	CBD/COP, OSPAR Convention, IMO, New Zealand and Australia, Iran, Argentina.	X	
Vulnerability/ fragility/ sensitivity	The area contains a high proportion of sensitive habitats/biotopes or species, or is fragile (highly susceptible to degradation by natural events or by the activities of people).	CBD/COP, OSPAR Convention, IMO, New Zealand and Australia, Iran, Argentina.	X	
International or national importance	Area containing habitats or species of importance locally or globally (existing or potential value).	CBD/COP, EU Habitat Directive, New Zealand and Australia, Mauritius.	X	
Size	Area is of sufficient size to fulfill its objectives.	CBD/COP, SPAW, Baltic Convention, EU Habitats Directive, Great Barrier Reef Marine Park, India.	X	
Comprehensiveness	Area adds to the coverage of the full range of ecosystems recognized at an appropriate scale within and across each bioregion; or adds to	CBD/COP, New Zealand, EU Habitats Directive.	X	

Criteria	Description	Sources	Ecological	General[5]
	national/regional or global system of marine protected areas.			
Resilience	The area may contain components of biodiversity that have the ability to recover from disturbances in a reasonable timeframe, or are naturally resistant to threats, such as climate change, and the protection of such areas could enhance the recovery of damaged ecosystems elsewhere in the ecoregion by providing a source of larvae and juveniles.	CBD/COP, SPAW, Canada.	X	
Dependency	An area where ecological processes are highly dependent on biotically structured systems.	CBD/COP, IMO, Iran.	X	
Replication	Areas which contain habitats replicated in two or more spatially separated reserves within one network, as a way to decrease in the risk of losing species and habitat types to unexpected natural or man-made disasters and disease**.**	CBD/COP, Greenpeace.	X	
Threats and risks	Area with risks from human-induced or natural stresses.	CBD/COP, India, Baltic Convention.		X
Management and protection	Area with management systems through conservation of the structure, functions and features of the existing critical habitats; and/or,	CBD/COP, India, EU Habitats Directive.		X
Scientific importance	Area with high value for	CBD/COP, IUCN,		X

Criteria	Description	Sources	Ecological	General[5]
	research, education and monitoring.	Ramsar Convention, UNESCO - WHC, SPAW, SPABD Protocol, IMO, India, Mauritius, Trinidad and Tobago.		
Restoration	Degraded areas which can be restored to an acceptable natural condition and which can serve the purpose of conservation of biodiversity.	CBD/COP, India, EU Habitats Directive.		X
Aesthetic importance	Area that contains superlative natural phenomena or areas of exceptional natural beauty	CBD/COP, Trinidad and Tobago.		X

Table 6: Cultural criteria[6]

Criteria	Description	Sources	Cultural	General[7]
Representativeness	(i) Type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history; and/or, (ii) Traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change; and/or, (iii) Area representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.	UNESCO - WHC.	X	
Uniqueness	Area that bears a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared.	UNESCO - WHC.	X	
Ingenuity	Monuments, group of buildings or sites that represent a masterpiece of human creative genius.	UNESCO - WHC.	X	
Cultural and traditional use	(i) Area that is directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria) (ii) Areas that have traditional uses by indigenous and local	UNESCO - WHC, CBD/SBSTTA.	X	

[6] Sources: "Operational Guidelines for the Implementation of the World Heritage Convention" (2011); UNEP/CBD/SBSTTA/16/INF/10 (2012).
[7] Criteria not purely cultural in nature, but its application will require taking into account cultural information.

Criteria	Description	Sources	Cultural	General[7]
	communities, as well as areas that are important for maintaining or restoring productivity, diversity and/or integrity of resources and places used for traditional and cultural activities, including sustainable economic uses.			
Interchange of cultural value	Exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design	UNESCO - WHC.	X	
Cultural value other than direct use (Indirect cultural value)	Areas that include sacred sites, and areas that have religious, historic, artistic or other cultural value	CBD/SBSTTA.	X	
Cultural Heritage	Areas that have important historical and archaeological sites.	CBD/SBSTTA.	X	
Management and protection	Customary management systems: Areas and resources being managed by indigenous or local communities using their local and/or traditional knowledge.	CBD/SBSTTA.		X
Aesthetic importance	Area that contains superlative natural phenomena or areas of exceptional natural beauty	UNESCO - WHC.		X

4.2. Prioritization of criteria for the identification of sensitive areas

4.2.1. Methodology

Knowing that the identification and ranking of sensitive sites is now concerned with several criteria based on which a decision should be made, the Multi-Attribute Decision Making (MADM) methodology was adopted. MADM is implicated with the ranking of decision alternatives based on preference judgments formulated on the decision alternatives over a number of criteria or attributes. Many MADM approaches have been developed to aid decision makers in different MADM environment. Amongst these methods is the Analytical Hierarchy Process (AHP), originally proposed by Saaty (1977, 1980), which has been widely used in many areas including environmental impact assessment, natural resource management and prioritization of sites (Kiker et al., 2005).

The first step for the application of the AHP methodology was the prioritization (weighing) of criteria. In order to endorse and prioritize the selected ecological and cultural criteria, a focus group meeting was held (Annex III). The meeting hosted leading archeology, coastal zone and marine scientists and experts who discussed the reviewed criteria. Each criterion was evaluated by the attendees to determine its relative importance in the identification of coastal sensitive areas using the method of pairwise comparisons as a part of the AHP for Decision Making. This method compares criteria by pairs using Saaty's 9-point rating scale (Figure 1) in order to produce priority matrices (Annex IV).

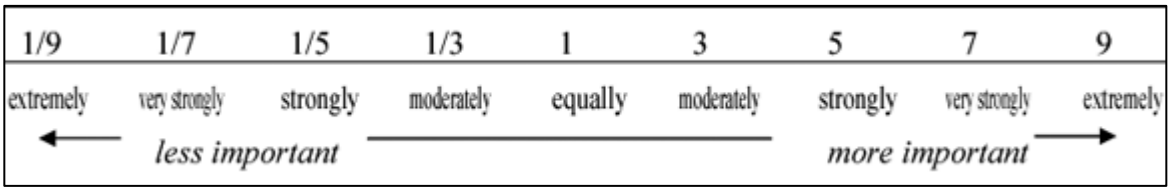

Figure 1: Saaty's 9-point rating scale of measurement for AHP

4.2.2. Results of priority ranking of cultural criteria

The process resulted first in a ranking of the criteria, indicating the relative importance of each criterion (Annex V). The highest priority (22.9%; Figure 2) for the identification of culturally sensitive areas is the presence of cultural heritage sites including historical and archaeological sites represented by the "Cultural Heritage" criterion. "Uniqueness", "Aesthetic Importance" and "Ingenuity" followed with 22.7%, 21 % and 14.5% respectively.

The criterion of "Cultural and Traditional Use" is related to areas associated with events or living traditions, ideas, beliefs, or artistic and literary works of significance. Also it is concerned with areas that have traditional uses by indigenous and local communities to promote productivity, diversity and sustainable economic uses. This

criterion, created a debate on whether the loss of these specific areas and locations necessarily results in the loss of the traditions of the local communities. Several participants suggested that people take their traditions, culture and beliefs with them even when they are relocated. Another opinion was that some events and traditions are geographically related to specific locations, and the loss of these areas may lead to the destruction of a certain culture or historical memory. This divergence in opinions resulted in an average raking of 7.2% relative importance, which is considered in the medium range of priorities. There were some reservations recorded reference this result, since some experts consider that "Cultural and Traditional Use" have the same importance as "Aesthetic Importance" in selecting culturally sensitive areas for protection.

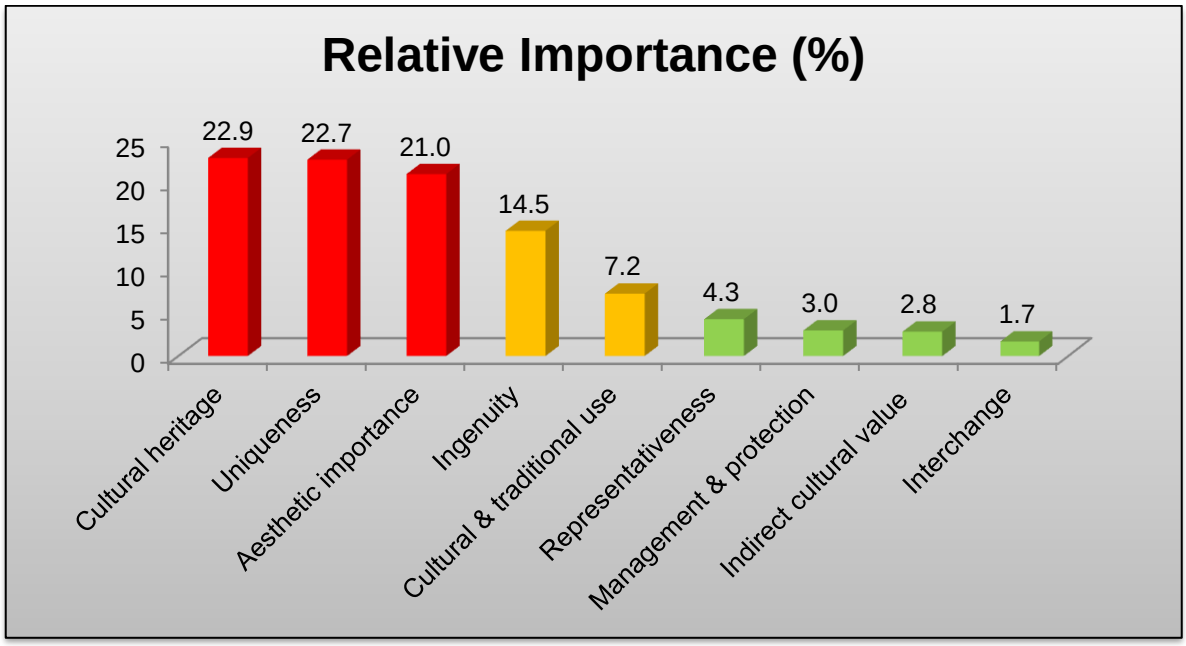

Figure 2: Relative importance of cultural criteria identified by the workshop participants.
(Red = High Priority, Orange = Medium Priority, Green = Low Priority).

4.2.3. Results of priority ranking of ecological criteria

The same process for cultural criteria was repeated for ecological criteria giving their relative importance in the selection of sites. Given that the purpose of the ecological criteria is to assist "scientists" in selecting "sensitive" areas, it is perfectly justified to have the highest priorities for "Scientific Importance" (Figure 3; 12.5%), then for "Fragility" (11.9%) and "Threats" (11.7%). Those are followed by medium priority criteria: resilience (8.7%), "Biogeographic importance" (7.5%) and "Biological productivity" (7.1%), which help in the understanding of the general status of coastal areas including their biological and geographical characteristics as well as their predisposition to threats and capabilities of adaptation or recovery. The remaining

16 criteria appear to have relatively low to very low individual weights (5.8% to 0.6%); however they cannot be ignored as they represent, together, a total weight of about 40% in the decision-making process. Criteria having 5.8% to 3.4% relative importance include: areas important for "Life history stages" of local or migratory species, "Comprehensiveness" of an ecosystem or bioregion, areas with "Unique Species or Geographical Features", "Degree of Naturalness" or "Level of Disturbance", "Management or Conservation Status", and "Presence of Threatened or Endangered Species".

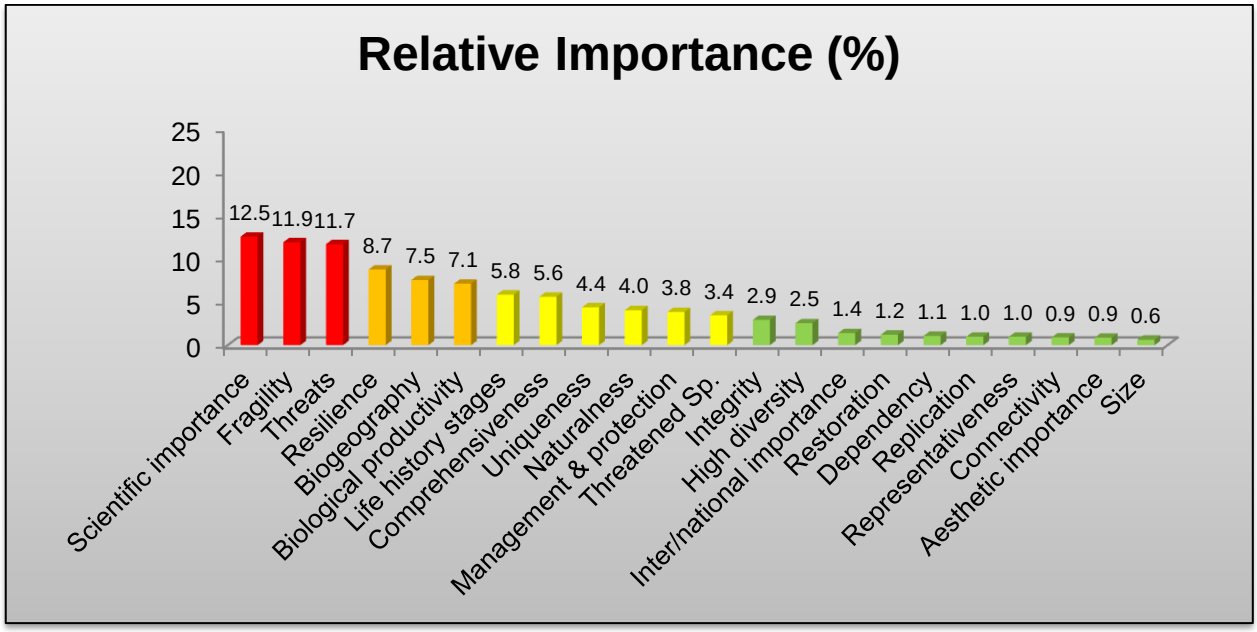

Figure 3: Relative importance of ecological criteria identified by the workshop participants.
(Red = High Priority, Orange = Medium Priority, Yellow = Low Priority, Green = Very Low Priority).

4.3. Prioritization of sensitive areas based on the selected weighed criteria

4.3.1. Methodology

The next step in the AHP method was the rating of the 59 potential sites for protection based on the previously weighed criteria (Annex VI). The method employs numerical scores to communicate the merit of one site in comparison to others on a single rating scale. Scores are developed from the performance of alternatives with respect to an individual criterion and aggregated into an overall score (Kiker et al., 2005).

The rating scale adopted for the evaluation of alternatives represented five levels of performance of sites against each criterion:

- Score of 5 = Very Good Performance.
- Score of 4 = Good Performance.

- Score of 3 = Fair Performance.
- Score of 2 = Poor Performance.
- Score of 1 = Very Poor Performance.

The aggregation process consisted in:

- The multiplication of the individual ratings (*a)* of the potential sites (scores between 1 and 5) by the correspondent criteria weights (*w)* giving individual scores for each site against each criterion.
- The summation of the obtained individual scores into overall scores (*A*) for each site $A = \Sigma (a * w)$ (Annex VII).

The ranking of the coastal and marine sites from the highest to lowest scores resulted in the priority ranking of sensitive areas (Annex VIII).

4.3.2. Priority lists of coastal and marine sensitive areas based on cultural and ecological criteria

The application of the AHP in the multi-criteria analysis for the selection of key sensitive coastal areas resulted in two sets of priority sites for protection:

- The first set is based on the evaluation of sites according to their cultural properties (Table 7).
- The second set represents priority sites in need for protection based on their ecological properties (Table 8).

Tables 7 and 8 include only sites that have a Fair, Good or Very Good performance (scores between 3 and 5) against the evaluation criteria. Among the 59 sites evaluated, 24% (14 sites; Figure 4) have Fair, Good or Very Good performance on the cultural criteria; and 75% (44 sites; Figure 5) have Fair, Good or Very Good performance on ecological criteria.

Table 7: Sensitive sites based on cultural criteria

Ranking	Site Name	Performance	Priority
1	Ras Enfeh	Good - Very Good	High
2	The sea castle of Saida and underwater city & Sea façade & old harbor	Good - Very Good	High
3	Historical Center and Fishing Harbor of Batroun	Good - Very Good	High
4	Ancient tell of Sarafand	Good - Very Good	High
5	El Kelb River historical site and estuary	Good - Very Good	High
6	Promontory cape and cliffs of Ras Shaqaa & Saydet El Nouriyeh Monastery	Good - Very Good	High
7	Saida Zeereh	Fair - Good	Medium
8	Umm El Rabb site	Fair - Good	Medium
9	Umm El Amad site	Fair - Good	Medium

Ranking	Site Name	Performance	Priority
10	Aadloun beach and caves	Fair - Good	Medium
11	Salinas, wall promenade and our Lady of Natour Monastery	Fair - Good	Medium
12	Khaldeh archaeological site	Fair - Good	Medium
13	Tell El Burak	Fair - Good	Medium
14	Bay of Jounieh	Fair - Good	Medium

Table 8: Sensitive sites based on ecological criteria

Ranking	Site Name	Performance	Priority
1	Promontory cape and cliffs of Ras Shaqaa & Saydet El Nouriyeh Monastery	Good – Very Good	High
2	Salinas, wall promenade and our Lady of Natour Monastery	Good – Very Good	High
3	Beaches in the south and north of Jbeil (Jbeil-Amshit)	Good – Very Good	High
4	Medfoun rocky area	Good – Very Good	High
5	Damour River estuary	Good – Very Good	High
6	Sandy beach of Ramlet El Bayda in Beirut	Good – Very Good	High
7	Qasmieh estuary	Good – Very Good	High
8	Selaata terraces	Good – Very Good	High
9	Mhayleeb beach	Good – Very Good	High
10	Terraces of Al Mina	Good – Very Good	High
11	Mansouri beach	Good – Very Good	High
12	North Tyre beach (Ras-Siddine-El-Bahr)	Good – Very Good	High
13	El Kelb River historical site and estuary	Good – Very Good	High
14	Aadloun beach and caves	Good – Very Good	High
15	Sandy beaches of Rmeileh and Jiyeh	Fair – Good	Medium
16	Bakbouk hot water springs	Fair – Good	Medium
17	Awally river estuary	Fair – Good	Medium
18	Coastal Front Rocks and terraces of Wata Slim	Fair – Good	Medium
19	Heri-Chekka beaches	Fair – Good	Medium
20	Seagrass meadow in front of the Airport wave breaker	Fair – Good	Medium
21	Offshore freshwater marine springs in Chekka	Fair – Good	Medium
22	Aarqa river estuary	Fair – Good	Medium
23	Ibrahim River archaeological sites and estuary	Fair – Good	Medium
24	Ras Enfeh	Fair – Good	Medium
25	Ras Saadiyat	Fair – Good	Medium
26	Iskandarouna springs and beach	Fair – Good	Medium
27	Sandy beaches of Jnah	Fair – Good	Medium
28	Beaches north and south of Saida	Fair – Good	Medium
29	El Jawz River estuary	Fair – Good	Medium
30	Zahrani estuary	Fair – Good	Medium
31	Beaches of Kfaraabida	Fair – Good	Medium
32	Saida Zeereh	Fair – Good	Medium
33	Cheikh Zennad Beach	Fair – Good	Medium
34	Aarida estuary	Fair – Good	Medium

Ranking	Site Name	Performance	Priority
35	Beaches of Damour	Fair – Good	Medium
36	Batroun National Marine Hima at the Marine Sciences Center	Fair – Good	Medium
37	Bay of Jounieh	Fair – Good	Medium
38	Coastal dunes of Akkar Plain	Fair – Good	Medium
39	The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	Fair – Good	Medium
40	Marine environment in front of the fishing harbor of Jbeil	Fair – Good	Medium
41	Salinas and wetland of Qleiaat	Fair – Good	Medium
42	White cliffs and bay of Naqoura	Fair – Good	Medium
43	Beaches and terraces of Tripoli towards Qalamoun	Fair – Good	Medium
44	White cliffs of Bayada	Fair – Good	Medium

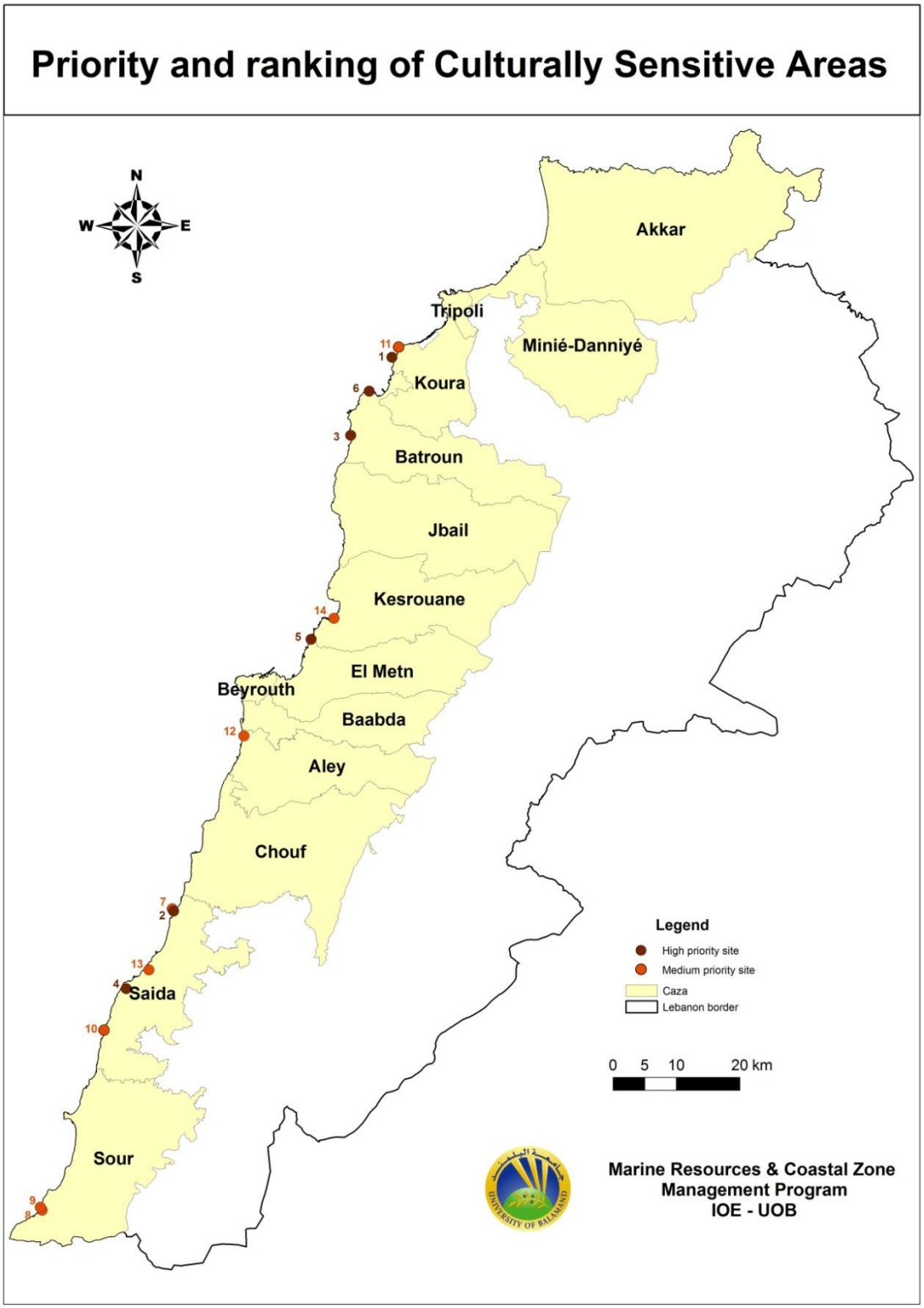

Figure 4: Priority and ranking of identified sensitive sites based on cultural criteria.

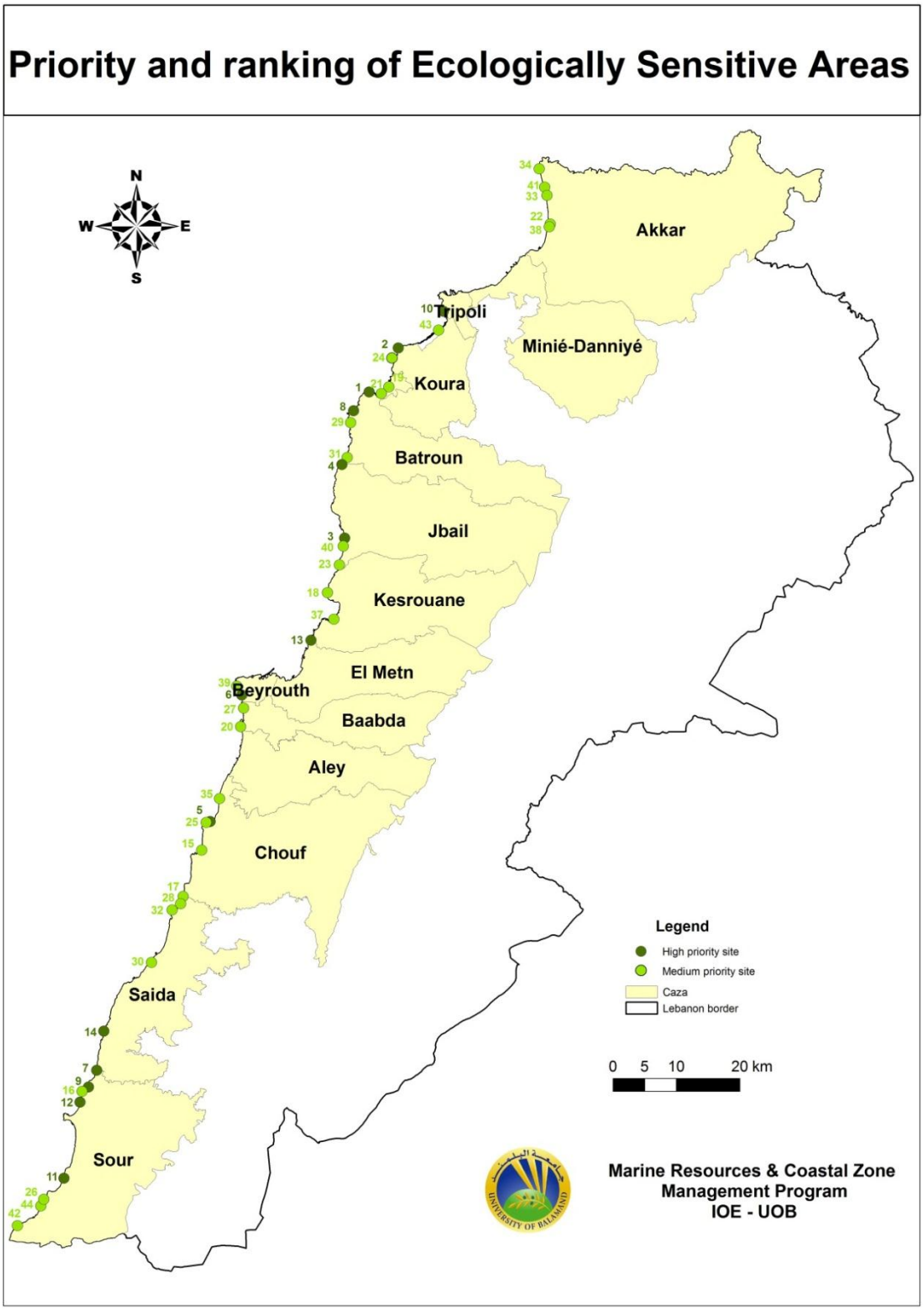

Figure 5: Location and priority of identified sensitive sites based on ecological criteria.

Areas that gave Poor or Very Poor performance (scores<3) were considered less sensitive thus were not included in the priority lists (Annex IX). In addition, seven coastal areas appear as common priority sites, achieving Fair, Good or Very Good performance on both cultural and ecological criteria (Table 9; Figure 6).

Table 9: Sensitive sites based on both cultural and ecological criteria

Site Name	Cultural performance	Ecological performance	Overall performance
El Kelb River historical site and estuary	Good – Very Good	Good – Very Good	Good – Very Good
Promontory cape and cliffs of Ras Shaqaa & Saydet El Nouriyeh Monastery	Good – Very Good	Good – Very Good	Good – Very Good
Ras Enfeh	Good - Very Good	Fair - Good	Fair – Very Good
Aadloun beach and caves	Fair - Good	Good – Very Good	Fair – Very Good
Salinas, wall promenade and our Lady of Natour Monastery	Fair - Good	Good – Very Good	Fair – Very Good
Saida Zeereh	Fair – Good	Fair - Good	Fair - Good
Bay of Jounieh	Fair – Good	Fair – Good	Fair – Good

Nevertheless, it should also be noted that the decision making process is highly dependent on the available data acquired through the extensive literature review and which revealed an important lack of information. Therefore, the ranking results are expected to vary according to the quality of additional evidence and data about the evaluated sites, whenever obtained. Some coastal areas have low performance against the evaluated criteria due to the incomplete or uncertain information and thus require further investigation in the future (Table 10).

Table 10: Coastal and marine areas in need for further investigation

Site Name	Cultural information	Ecological information
The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	X	N/A*
Aarqa River estuary	N/A	X
Selaata terraces	N/A	X
Coastal dunes of Akkar Plain	N/A	X
Abou Ali estuary	N/A	X
City of Orthosia in El Bared River	X	N/A
Fadaous ancient tell	X	N/A
Marine environment in front of the fishing harbor of Jbeil	X	X
Aaqaibeh beach	N/A	X
Maameltein promontory	N/A	X
Ghadir River estuary	N/A	X
Ancient Persian Harbor (Beirut)	X	N/A
Beaches north and south of Saida	N/A	X
North Tyre beach (Ras-Siddine-El-Bahr)	X	X

Site Name	Cultural information	Ecological information
Iskandarouna springs and beach	N/A	X

*N/A: Not Available

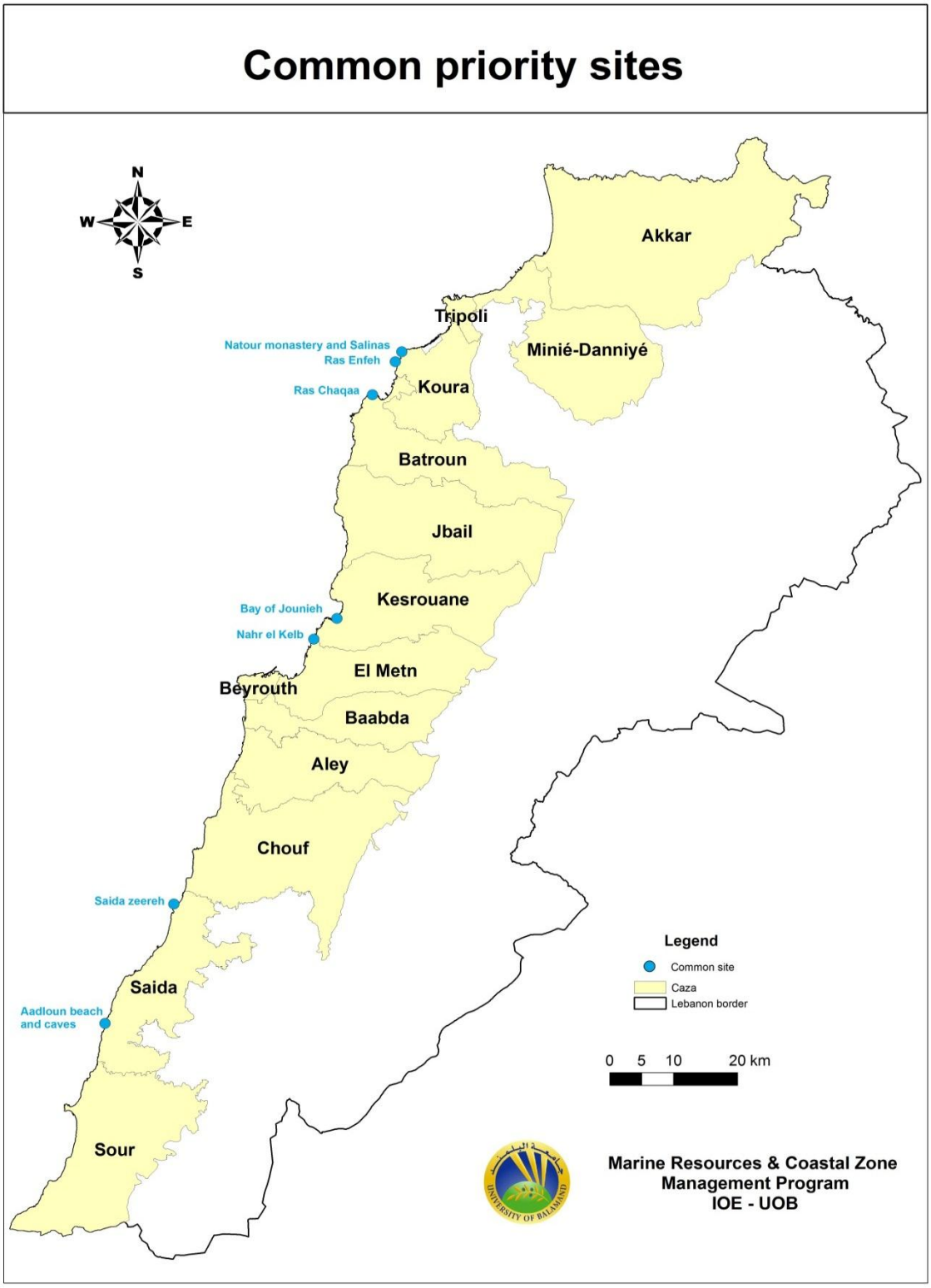

Figure 6: Cultural and Ecological common priority sites.

4.4. Geographical clustering of sites

The next step in the identification of coastal sensitive sites is the geographical clustering or grouping of adjacent areas in order to reduce the number of sites for recommendation. According to the availability of resources, a reduced number of sites recommended for protection provide a better chance of success for management and monitoring strategies. The approach consists in examining the identified areas by priority levels and distributing the resulting clusters according to the responsible authority for its subsequent management and monitoring. Nevertheless, integrated management of the sites is also recommended through the involvement of related ministries, related public institutions and municipalities, in addition to local communities and NGOs. The proposed responsibilities are divided as follows:

- MOE as the leading authority for the management of ecological sites.
- MOC as the leading authority for the management of cultural sites.
- A joint committee from the MOE and MOC for the management of sites with both cultural and ecological importance.

The clustering of the high priority sites resulted in 15 clusters (Table 11; Figure 7), four of which are common cultural and ecological sites (H1 to H4), three of which are cultural sites (H5 to H7) and eight of which are ecological sites (H8 to H15).

Table 11: Clustering results of high priority sites

Cluster ID	High priority sites	Type	Responsibility
H1	Ras Enfeh Salinas, wall promenade and our Lady of Natour Monastery	Ecological and Cultural	Committee
H2	El Kelb River historical site and estuary	Ecological and Cultural	Committee
H3	Promontory cape and cliffs of Ras Shaqaa & Saydet El Nouriyeh Monastery	Ecological and Cultural	Committee
H4	Aadloun beach and caves	Ecological and Cultural	Committee
H5	The sea castle of Saida and underwater city & Sea façade & old harbor	Cultural	MOC
H6	Historical Center and Fishing Harbor of Batroun	Cultural	MOC
H7	Ancient tell of Sarafand	Cultural	MOC
H8	Beaches in the south and north of Jbeil (Jbeil-Amshit)	Ecological	MOE
H9	Medfoun rocky area	Ecological	MOE
H10	Damour River estuary	Ecological	MOE
H11	Sandy beach of Ramlet El Bayda in Beirut	Ecological	MOE

Cluster ID	High priority sites	Type	Responsibility
H12	Qasmieh estuary Mhayleeb beach North Tyre beach (Ras-Siddine-El-Bahr)	Ecological	MOE
H13	Selaata terraces	Ecological	MOE
H14	Terraces of Al Mina	Ecological	MOE
H15	Mansouri beach	Ecological	MOE

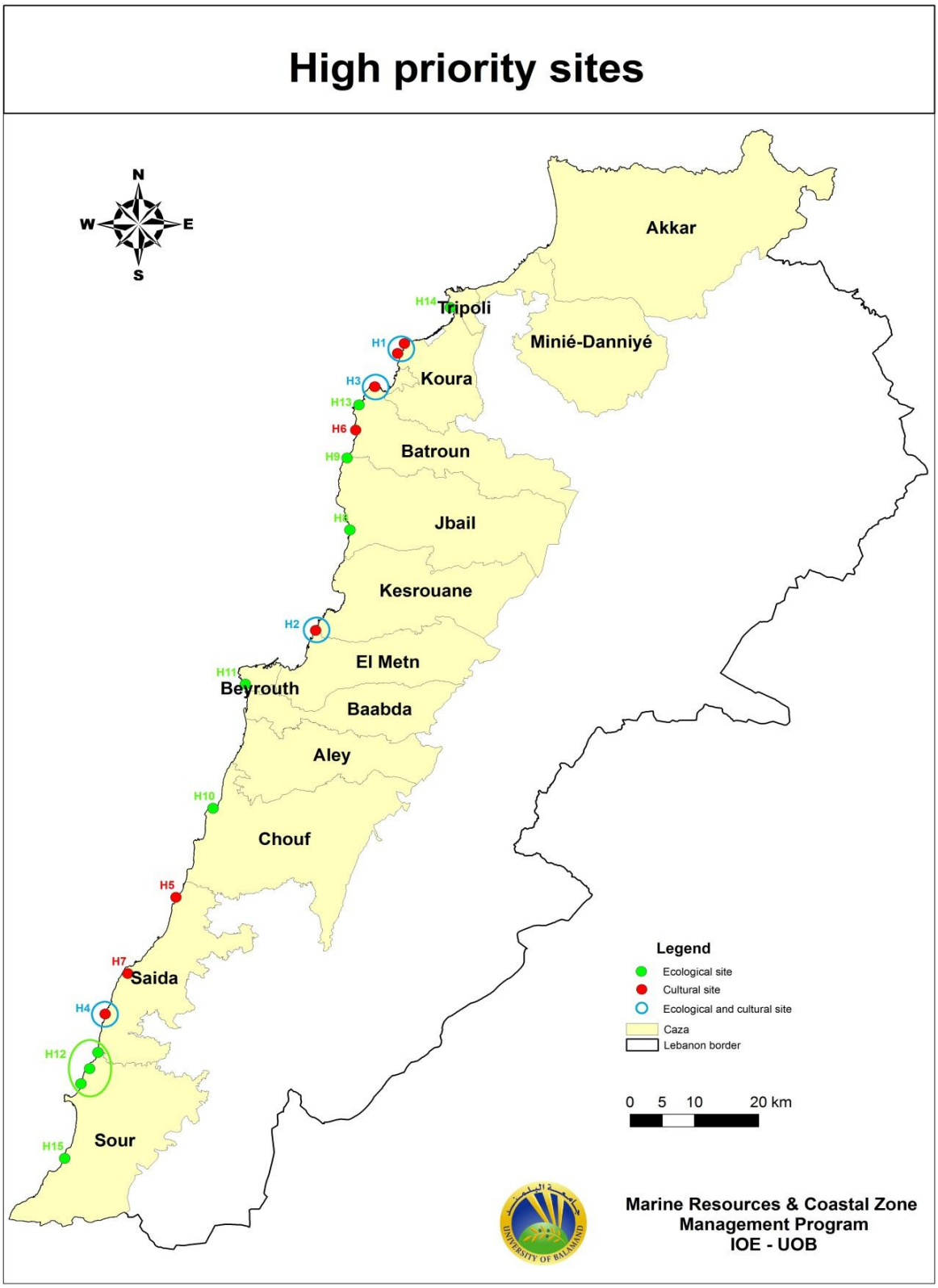

Figure 7: Clustered high priority sites

The clustering of the medium priority sites resulted in 20 clusters (Table 12; Figure 8), five of which are common cultural and ecological sites (M1 to M5), 15 of which are ecological sites (M6 to M20) while no cultural medium priority sites were clustered. It should be noted that sites M4, M8, M11 and M19 are proposed as potential MPAs due to their offshore location.

Table 12: Clustering results of medium priority sites

Cluster ID	Medium priority sites	Type	Responsibility	Note
M1	Saida Zeereh Awally River estuary Beaches north and south of Saida	Ecological and Cultural	Committee	
M2	Bay of Jounieh	Ecological and Cultural	Committee	
M3	Khaldeh archaeological site Seagrass meadow in front of the Airport wave breaker	Ecological and Cultural	Committee	MPA
M4	Tell El Burak Zahrani estuary	Ecological and Cultural	Committee	
M5	Umm El Rabb site Umm El Amad site Iskandarouna springs and beach White cliffs and bay of Naqoura White cliffs of Bayada	Ecological and Cultural	Committee	
M6	Aarqa River estuary Cheikh Zennad Beach Salinas and wetland of Qleiaat Coastal dunes of Akkar Plain Aarida estuary	Ecological	MOE	
M7	Sandy beaches of Rmeileh and Jiyeh	Ecological	MOE	
M8	Bakbouk hot water springs	Ecological	MOE	MPA
M9	Coastal Front Rocks and terraces of Wata Silm (Tabarja)	Ecological	MOE	
M10	Heri-Chekka beaches	Ecological	MOE	
M11	Offshore freshwater marine springs in Chekka	Ecological	MOE	MPA
M12	Ibrahim River archaeological sites and estuary	Ecological	MOE	
M13	Ras Saadiyat	Ecological	MOE	
M14	Sandy beaches of Jnah	Ecological	MOE	
M15	El Jawz River estuary	Ecological	MOE	
M16	Beaches of Kfaraabida	Ecological	MOE	
M17	Beaches of Damour	Ecological	MOE	
M18	The rock and the small bay of Grotte aux Pigeons in Beirut	Ecological	MOE	

Cluster ID	Medium priority sites	Type	Responsibility	Note
	and prehistoric site near the rock			
M19	Marine environment in front of the fishing harbor of Jbeil	Ecological	MOE	MPA
M20	Beaches and terraces of Tripoli towards Qalamoun	Ecological	MOE	

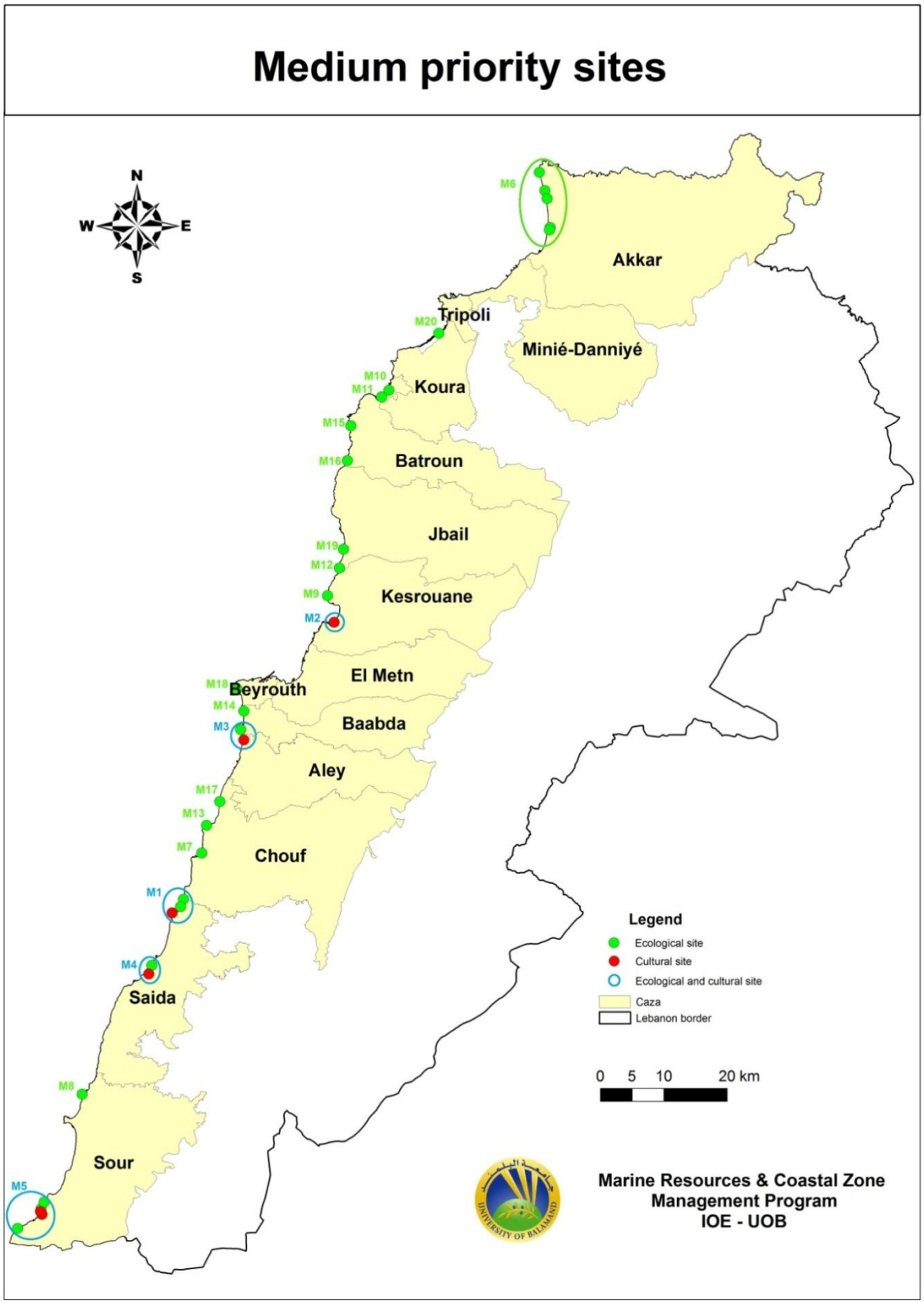

Figure 8: Clustered medium priority sites

4.5. Status of the key sensitive areas identified on the coastal zone of Lebanon

The high priority list (Table 11) of sensitive sites identified on the coastal zone of Lebanon will be the main focus of the following analysis, given that they are recommended to be the main areas of concern for the management and monitoring strategies on the short term. Thus, the medium priority sites are proposed for medium term consideration for environmental management and monitoring projects.

The high priority areas consist of three river estuaries, 10 beaches comprising rocky shores (terraces), pebbly and sandy stretches in addition to the few headlands and cliffs distributed along the highly fragmented coastline. In between these natural sensitive sites, seven cultural sites appear as high priority. They include cultural heritage sites or complexes of outstanding universal value as well as areas of other cultural value. The identified sites are affected by different kinds of threats which increase their vulnerability and need for protection (Table 13).

As previously mentioned in Section3.2.1.1, river discharges are considered as the major land-based source of pollution affecting the marine and coastal environments (UNEP/MAP/RAC-SPA, 2002b; Houri and El-Jeblawi, 2007). The land-based pollutants constituting the greatest threat from river discharges are municipal wastewater and sewage discharges, followed by agrochemicals (pesticides, nitrates, phosphates…), industrial waste and effluents, domestic solid waste and others (Karaa and Karam, 2001; Korfali and Davies, 2005; Kabbara and Benkhelil, 2008; Massoud, 2012). Due to the lack of infrastructure from which the water sector suffers in Lebanon, wastewater from urban areas is mostly being discharged without adequate treatment or monitoring into the river system or directly into the sea. This latter issue is creating a potential public health risk and raising a serious geo-environmental problem that might affect the coastal shoreline of the eastern Mediterranean Sea, threatening the coastal marine ecosystems (Geara et al., 2010).

The prioritization and ranking of the coastal sensitive sites identified El Kelb, Damour and Qasmiyeh estuaries as being of priority for conservation. Several studies have been done on the water quality of coastal rivers of Lebanon including Ibrahim, Antelias (Houri and Jeblawi, 2007), Awally (Korfali and Jurdi, 2011), Damour (Massoud, 2012) and Litani/Qasmiyeh Rivers (El-Fadel and Maroun, 2003; Assaf and Saadeh, 2008; Saadeh and Amacha, 2010) and their estuaries; however few studies have been done on the status of El Kelb River and estuary.

According to Houri and Jeblawi (2007), Damour River has the most basic pH (> 8.5), above the World Health Organization (WHO) limits for drinking water. It has also the

highest level of dissolved oxygen that is due to increased algal growth. Sulfate analysis also showed that Damour River has the highest level. Although sulfate levels above 250 mg/l may alter the taste of water, no limiting guideline has been set by the WHO. Nevertheless, none of the other analyzed rivers exceeded the 40 mg/l sulfate level. According to Massoud (2012), results for Damour River water quality revealed an impact from anthropogenic activities taking place along its entire watershed. The best quality was found in the upper locations and the worst at the estuary.

Moreover, significant levels of total coliform and *E. Coli* are found in all rivers, but the highest levels are obtained in Abu Ali and Antelias. The rivers to the South (Damour, Awally and Qasmiyeh) have consistently lower bacterial levels than the rivers to the North of Beirut. This fact may be attributed to the higher population concentrations to the North with the cities of Beirut, Jounieh, Jbeil, Batroun, and Tripoli almost lining up one after the other all along the coast. This overall presence of *E. Coli* is a direct result of the fact that, to date, wastewater is still flowing untreated into rivers, valleys and coastal waters across the Lebanese territories (Houri and Jeblawi, 2007). Furthermore, remote sensing data analysis by Shabaan et al. (2009) show that Damour, Awally and Ibrahim Rivers have the largest extent of plumes indicating the pollutant discharges along the Lebanese coast.

The main inland Litani River is named Qasmiyeh on its coastal stretch. Qasmiyeh waters are found to have the least basic pH. Also, the range of Total Dissolved Solids and Electrical Conductivity progressively increases from the headwaters of the river to its estuary. This could be attributed to an increased input of both particulate and dissolved particles that originate from sea salt spray and intensified agricultural activity in coastal plains (Saad et al., 2006). Awally and Qasmiyeh Rivers are found to be the richest in nitrates while Ibrahim River has the lowest recorded level. A peak in nitrate is pronounced in the estuary sites of Qasmiyeh due to a larger input of fertilizers in this area drained by additional tributaries to the river. It reaches a concentration of 110 mg/L, which exceeds the permissible range in water (Saad et al., 2006). This is in line with the fact that Ibrahim watershed has increased industrial activity in its basin as compared to the mostly agricultural activities lining the paths of the other rivers (Houri and Jeblawi, 2007).

Those facts about the status of the water quality of coastal rivers support the urgent need for management and monitoring of the quality of estuary waters and the surrounding ecosystems and their biodiversity, along with the monitoring of the anthropogenic activities of the watersheds which affect the quality of river discharges into the sea.

Besides land-based pollution from river discharges, Lebanon's catastrophic oil spill of 2006 due to the Israeli War on Lebanon is a one of a kind additional source of land-based oil pollution affecting the marine environment. Among the high priority sensitive sites identified in this study, some sites are also identified by Phase II of the oil spill clean-up operations in 2007 initiated by the MOE, and are: Ras Enfeh, beaches of south and north of Jbeil, terraces of Al-Mina and terraces of Selaata (Figure 6). The combination of impacts from continuous land-based sources of pollution with the serious impact of the oil spill places those areas on urgent need for protection through management and monitoring strategies, in addition to evaluating their potential for restoration to an environmentally healthy state.

Table 13: Stresses affecting high priority sites

Cluster ID	High priority sites	Stresses	Categories
H1	Ras Enfeh Salinas, wall promenade and our Lady of Natour Monastery.	Tourism, untreated wastewater discharges, oil spill 2006.	Pollution - Recreational activities.
H2	El Kelb River historical site and estuary.	Urbanism, landslide, Wastewater discharges - high Cadmium concentration, eutrophication of the coastal water, Industrial pollution.	Pollution - Urbanization - Natural hazards.
H3	Promontory cape and cliffs of Ras Shaqaa & Saydet El Nouriyeh Monastery.	Tourism, seismic hazard, landslide, Industrial pollution, heavy fishery.	Pollution - Recreational activities - Natural hazards - Exploitation of natural resources.
H4	Aadloun beach and caves.	Predation of turtle eggs by dogs.	Predation.
H5	The sea castle of Saida and underwater city & Sea façade & old harbor.	Fishery, wastewater discharges, urban sprawl, tourism, dumping site, industrial pollution.	Pollution – Exploitation of natural resources – Recreational activities – Urbanization.
H6	Historical Center and Fishing Harbor of Batroun.	Tourism, fishery, floods.	Pollution - Exploitation of natural resources - Natural hazards - Recreational activities.
H7	Ancient tell of Sarafand.	Land use change (1975-2002): Increase of urban areas from 6 to 21% at the expense of agricultural and natural areas, urban encroachment on the maritime public domain, wastewater discharges into the sea, solid waste dumpsites.	Pollution - Urbanization - Changes in landcover/landuse.
H8	Beaches in the south and north of Jbeil (Jbeil-Amshit).	Tourism, oil spill 2006, fishery.	Pollution - Exploitation of natural resources - Recreational activities.

Cluster ID	High priority sites	Stresses	Categories
H9	Medfoun rocky area.	Tourism.	Recreational activities.
H10	Damour Rriver estuary.	Land abandonment during the war- deserted agricultural plain reconstruction efforts - land use changes from forests and herbaceous zones to urban and agriculture and from agriculture to urban (1994-1998), domestic & industrial wastewater, fertilizers and pesticides, solid waste dumping in the river basin, floods.	Pollution - Natural hazards -Changes in landcover/landuse.
H11	Sandy beach of Ramlet El Bayda in Beirut.	Urbanism, sand dredging, wastewater discharges.	Pollution - Urbanization - Changes in landcover/landuse.
H12	Qasmieh estuary. Mhayleeb beach. North Tyre beach (Ras-Siddine-El-Bahr).	Erosion, floods, sea filling, sand dredging, legal and illegal houses, tourism, urbanization, fishery.	Urbanization - Natural hazards - Changes in landcover/landuse - Exploitation of natural resources - Recreational activities.
H13	Selaata terraces.	Tourism, fertilizer manufacturing (chemicals and heavy metals contamination = industrial waste), discharge of contaminated ballast water with oil and tar residues from ships and oil tankers (Selaata port), untreated wastewater discharges, oil spill 2006.	Pollution - Recreational activities.
H14	Terraces of Al Mina.	Tourism, urban sprawl, sand extraction, fishery, oil spill 2006.	Pollution - Exploitation of natural resources - Recreational activities - Changes in landcover/landuse – Urbanization.
H15	Mansouri beach.	Predation of turtle eggs by dogs.	Predation.

5. Recommendations

The assessment of the status of Coastal Sensitive Areas of interest in Lebanon resulted in the identification and mapping of high priority sites which are proposed for urgent protection. Nevertheless, the study revealed numerous discrepancies and deficiencies in the information system concerning the coastal and marine environments in general and the identified sites in particular. Extensive information and better knowledge about biological features and habitat types is necessary for their conservation. Therefore, the following recommendations are suggested:

- The scientific evaluation of each site, according to an ecosystem-based approach, should be simultaneously carried out with the process of designation of the sites for protection.
- The process of designation of protected areas should be based on precise, internationally standardized evaluation criteria, such as the lists used in this study which consist of all the existing cultural and ecological criteria used by the international community.
- Further damage to the ecosystems of the all listed sites should be controlled through an immediate action to help the enhancement of the condition of the identified sites, while conducting the required research to develop appropriate management and monitoring strategies.
- The precautionary approach needs to be implemented as an initial step to prevent any potential development from occurring in the identified high priority sensitive areas.
- An integrated approach is advised for the process of site designation and management, through the collaboration of all related government authorities and the public.
- Given the properties of the identified sites, the primary administrative assignments must be distributed according to each authority's mandates and a joint committee is recommended to be established for the management of sites with both ecological and cultural characteristics.
- Incorporate the process of the declaration of the sites in national and regional initiatives on ICZM and MPAs.
- Invest effort on the political arena early on in the process to ensure the quick and smooth declaration of the sites as Sensitive Areas.

The implementation of the afore-mentioned recommendations will provide a step forward towards the improvement and preservation of the Lebanese coastal and marine resources. However, it must be remembered that this analysis is but a first step in a process, and a greater depth of understanding and evaluation can only occur with the development of case by case studies to evaluate the status of each

site in more detail and therefore forward future prospects for management and conservation.

6. Conclusions

The present report shapes the current understanding of the coastal zone of Lebanon and helps the subsequent improvement of the quality and conditions of ecological systems and of cultural sites through the development of management and monitoring strategies. The main findings of the study indicate a serious and continuous degradation of the natural and historical sites on the Lebanese coast. The identification of stresses shows that sites are affected by a wide range of threats which vary between small-scale pressures to large-scale disasters such as the oil spill of 2006. Urban sprawl and pollution from wastewater effluents, including river discharges, appear to be the most severe and permanent problems of the coastal zone. In addition, the main difficulty in the restoration of the natural sites resides in the high level of fragmentation and landuse change due to urban sprawl, especially around the major cities along the coast. Urbanization also includes the many infringements that occurred on the maritime public domain during the succeeding wars and are still occurring today, mainly due to touristic reasons.

The process applied for this study produced a list of coastal and marine sites in critical need for protection and conservation. Among the identified sensitive sites several are considered of higher priority for management. The prioritization of the sites is based on their performance against the existing ecological and cultural criteria which are commonly used by national and international instruments and organizations for the designation of protected sites. The relative importance of the criteria in the selection of sensitive sites was evaluated by leading marine, environmental and archeology experts hosted by the MRCZM at the IOE at the UOB. The basis of site selection according to the evaluation criteria will also help in identifying and collecting the missing data and thus, is highly recommended for site designation in the future.

Lastly, the outcome of this report indicates the main areas of focus that should be initially addressed by the developed management and monitoring strategy, hence facilitating the inauguration of one of the main aspects of ICZM in Lebanon.

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Annex I: Map of the Lebanese coastal zone

Source: NPMPLT project, amended by MRCZM-IOE.

Annex II: Ecological Criteria Ranked According to the "Frequency of their Utilization" by Countries, Regional Bodies, Conventions and Organizations[8].

Rank	Criteria	Sources
1	Representativeness	SPAW, Baltic Convention, OSPAR Convention, SPABD Protocol (SPAMI List),EU Habitats Directive, IMO, Greenpeace, New Zealand and Australia, India, Iran, Madagascar, Argentina, Trinidad and Tobago.
2	Importance for threatened, endangered, declining, rare or endemic species and/or habitats	SPAW, OSPAR Convention, SPABD Protocol (SPAMI List), IMO, IUCN, Ramsar Convention on Wetlands, New Zealand and Australia, India, Iran, Ecuador, Madagascar, Argentina, Mauritius, Trinidad and Tobago.
3	High diversity	SPAW, Baltic Convention, OSPAR Convention, SPABD Protocol (SPAMI List), IMO, Ramsar Convention on Wetlands, UNESCO - WHC, New Zealand and Australia, India, Iran, Mauritius.
4	Uniqueness/rarity/ Endemism	SPAW, Baltic Convention, SPABD Protocol (SPAMI List), IMO, UNESCO - WHC, IUCN, New Zealand, Iran, Canada, Argentina, Mauritus, Trinidad and Tobago.
5	Importance for life history stages of species, or for migratory species	Baltic Convention, OSPAR Convention, EU Habitat Directive, IMO, IUCN, Ramsar Convention on Wetlands, Greenpeace, New Zealand and Australia, India, Iran, Canada, Ecuador, Madagascar, Argentina, Mauritius, Trinidad and Tobago.
6	Naturalness	SPAW, Baltic Convention, OSPAR Convention, SPABD Protocol (SPAMI List), IMO, IUCN, New Zealand and Australia, India, Iran, Canada, Argentina, Mauritius.
7	Integrity of the area in	IMO, IUCN, Greenpeace,

[8]UNEP/CBD, 2000; UNEP/CBD, 2006

Rank	Criteria	Sources
	surrounding landscape/seascape	India, Iran, Mauritius, Trinidad and Tobago.
8	Connectivity/ coherence	EU Habitat Directive, SPAW, Greenpeace, Madagascar.
9	Biogeographic importance	EU Habitats Directive, IMO, IUCN, UNESCO - WHC, Great Barrier Reef Marine Park, New Zealand and Australia, India, Iran.
10	High biological productivity	OSPAR Convention, IMO, New Zealand and Australia, Iran, Argentina.
11	Vulnerability/ fragility/ sensitivity	OSPAR Convention, IMO, New Zealand and Australia, Iran, Argentina.
12	International or national importance	EU Habitat Directive, New Zealand and Australia, Mauritius.
13	Size	SPAW, Baltic Convention, EU Habitats Directive, Great Barrier Reef Marine Park, India.
14	Comprehensiveness	New Zealand, EU Habitats Directive.
15	Resilience	SPAW, Canada.
16	Dependency	IMO, Iran.

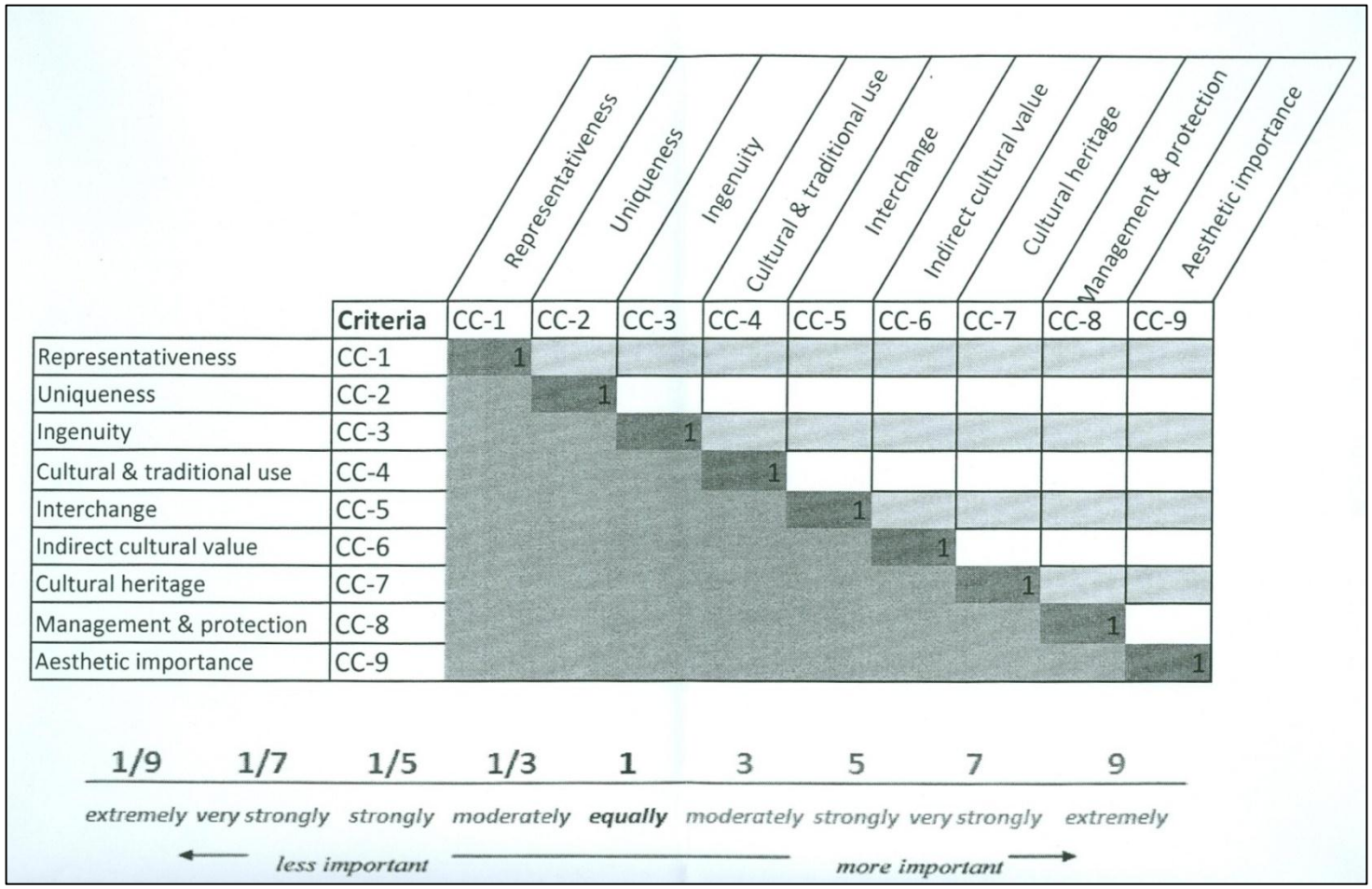
Annex III: List of Invitees/Attendees

Names	Institution	Telephone	E-mail	Invitees	Attendees
Hani El Shaer	MOE			X	
Gaby Khalaf	NCSM - CNRSL			X	
Marie Abboud	NCSM - CNRSL	03-256695	mabisaab@cnrs.edu.lb	X	X
Michel Bariche				X	
Mohammed El Sargi	International Ocean Institute - Lebanese Union of Professional Divers	03-665489	mohamedelsarji@hotmail.com	X	X
Jihad Attieh	UOB	03-511782	jihad.attieh@balamand.edu.lb	X	X
Samir Majdalani				X	
Dr. Mokdad				X	
Ghassan Jaradi				X	
Fadwa Kallab				X	
Milad Fakhry	NCSM - CNRSL	03-496680	milosman@cnrs.edu.lb	X	X
Alya Hamdan	ALBA/MAJAL	70-537636	hamdanalia@gmail.com	X	X
Serge Yazigi				X	
Nadine Haroun	UOB			X	
Hasan Hamza	Tyre Nature Reserve			X	
Anis Chaaya	USJ			X	

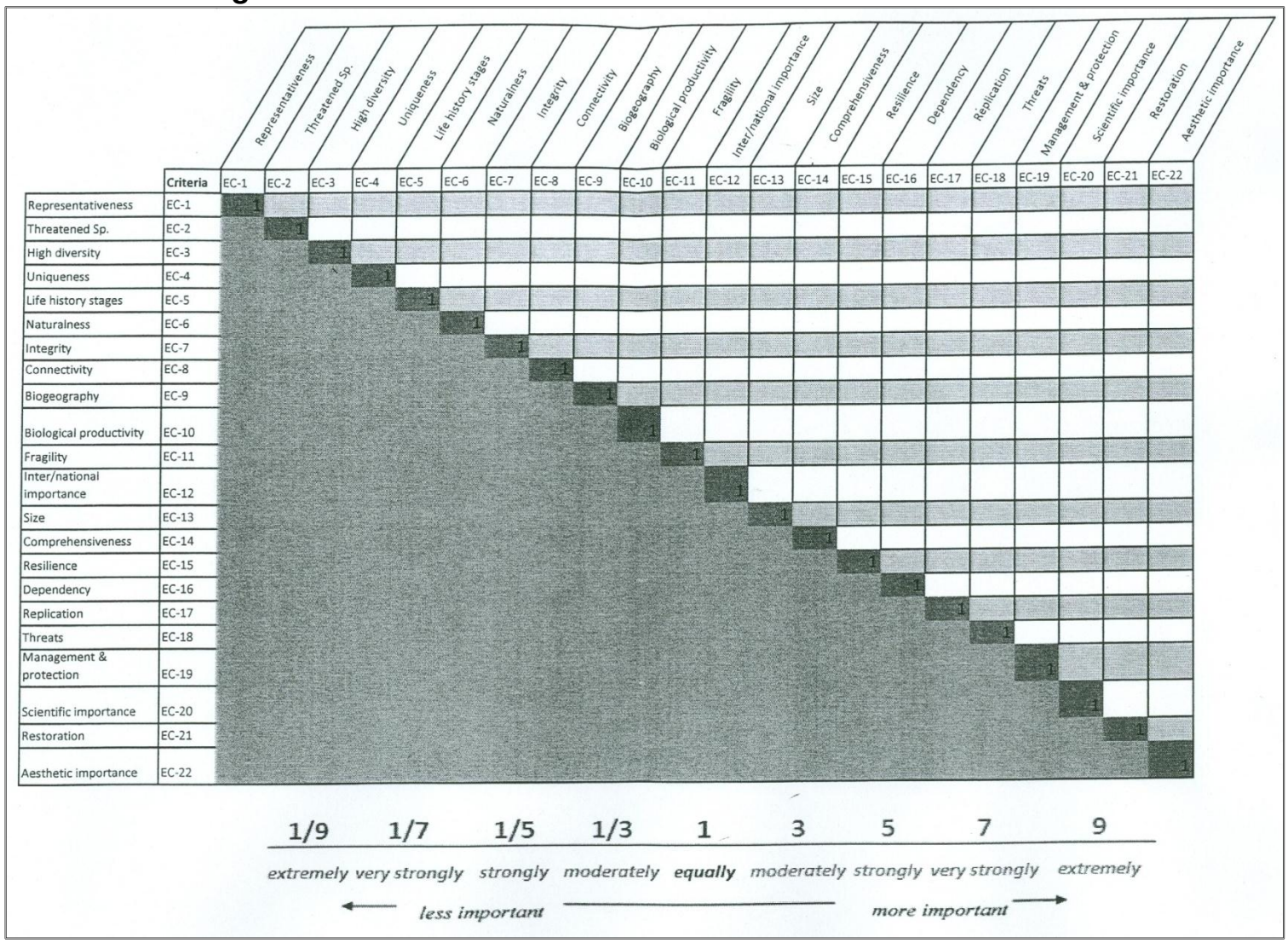
Names	Institution	Telephone	E-mail	Invitees	Attendees
Naji karam				X	
Lina Nacouzi				X	
Jeanine Abdulmassih	Lebanese University	03-305544	abdulmassih.j@gmail.com	X	X
Maya Boustany				X	
Leila Badre				X	
Joyce Nassar				X	
Zeina Fani				X	
Mathilde Gelin				X	
Najib Abi Chedid	MOE	70-290650	n.abichedid@moe.gov.lb	X	X
Lara Samaha	MOE			X	
Nour Masri	UNDP			X	
مديرية الآثار	مديرية الآثار			X	
Sami Ofeish	UOB - Faculty of Arts& Social Sciences	03-680124	sami.ofeish@balamand.edu.lb	X	X
Habbouba Aoun	UOB - FHS	03-658573	habbouba.aoun@balamand.edu.lb	X	X
Laurie Abi Habib	UOB - FHS			X	
Samer Amhaz	UOB	03-858113	samer.amhaz@balamand.edu.lb	X	X
Nadine Haroun	UOB		nadine.haroun@balamand.edu.lb	X	

Annex IV: Templates of Pairwise Comparisons

Matrix of Cultural Criteria



Matrix of Ecological Criteria



Annex V: Ranking results

Ranking	Culturally sensitive sites Site Name	Overall score
1	Ras Enfeh	4.7601
2	The sea castle of Saida and underwater city & Sea façade & old harbor	4.5792
3	Historical Center and Fishing Harbor of Batroun	4.4314
4	Ancient tell of Sarafand	4.1318
5	El Kelb River historical site and estuary	4.0603
6	Promontory cape and cliffs of Ras Chaqaa & Saydet El Nouriyeh Monastery	4.0052
7	Saida Zeereh	3.9579
8	Umm El Rabb site	3.9301
9	Umm El Amad site	3.9301
10	Aadloun beach and caves	3.7404
11	Salinas, wall promenade and our Lady of Natour Monastery	3.6891
12	Khaldeh archaeological site	3.5387
13	Tell El Burak	3.3163
14	Bay of Jounieh	3.1102
15	The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	2.7576
16	Beaches in the south and north of Jbeil (Jbeil-Amshit)	2.0799
17	Salinas and wetland of Qleiaat	2.0412
18	White cliffs and bay of Naqoura	1.7327
19	Offshore freshwater marine springs in Chekka	1.6312
20	Bakbouk hot water springs	1.6312
21	White cliffs of Bayada	1.6312
22	Ibrahim River archaeological sites and estuary	1.5725
23	Aarqa River estuary	1.4578
24	Heri-Chekka beaches	1.3839
25	Damour River estuary	1.3839
26	Batroun National Marine Hima at the Marine Sciences Center	1.2104

Ranking	Culturally sensitive sites Site Name	Overall score
27	Aarida estuary	1.1735
28	Cheikh Zennad Beach	1.1735
29	Terraces of Al Mina	1.1735
30	Beaches and terraces of Tripoli towards Qalamoun	1.1735
31	Coastal Front Rocks and terraces of Wata Silm (Tabarja)	1.1735
32	Beaches of Kfaraabida	1.1015
33	Mhayleeb beach	1.1015
34	Selaata terraces	1.072
35	Coastal dunes of Akkar Plain	1
36	City of Orthosia in El Bared River	1
37	Abou Ali Estuary	1
38	El Jawz River estuary	1
39	Fadaous ancient tell	1
40	Medfoun rocky area	1
41	Marine environment in front of the fishing harbor of Jbeil	1
42	Aaqaibeh beach	1
43	Maameltein promontory	1
44	Ghadir River estuary	1
45	Beirut River estuary	1
46	Ancient Persian Harbor	1
47	Sandy beach of Ramlet El Bayda in Beirut	1
48	Sandy beaches of Jnah	1
49	Seagrass meadow in front of the Airport wave breaker	1
50	Beaches of Damour	1
51	Ras Saadiyat	1
52	Sandy beaches of Rmeileh and Jiyeh	1
53	Awally River estuary	1
54	Beaches north and south of Saida	1
55	Zahrani estuary	1
56	Qasmieh estuary	1
57	North Tyre Beach (Ras-Siddine-El-Bahr)	1

Ranking	Culturally sensitive sites Site Name	Overall score
58	Mansouri beach	1
59	Iskandarouna springs and beach	1

Ranking	Ecologically sensitive sites Site Name	Overall score
1	Promontory cape and cliffs of Ras Chaqaa & Saydet El Nouriyeh Monastery	4.6935
2	Salinas, wall promenade and our Lady of Natour Monastery	4.4453
3	Beaches in the south and north of Jbeil (Jbeil-Amshit)	4.4293
4	Medfoun rocky area	4.2393
5	Damour River estuary	4.1777
6	Sandy beach of Ramlet El Bayda in Beirut	4.1678
7	Qasmieh estuary	4.1282
8	Selaata terraces	4.1075
9	Mhayleeb beach	4.0888
10	Terraces of Al Mina	4.0883
11	Mansouri beach	4.0305
12	North Tyrebeach (Ras-Siddine-El-Bahr)	4.0182
13	El Kelb River historical site and estuary	4.0081
14	Aadloun beach and caves	4.0057
15	Sandy beaches of Rmeileh and Jiyeh	3.9453
16	Bakbouk hot water springs	3.9417
17	Awally River estuary	3.9365
18	Coastal Front Rocks and terraces of Wata Silm (Tabarja)	3.9187
19	Heri-Chekka beaches	3.9005
20	Seagrass meadow in front of the Airport wave breaker	3.8765
21	Offshore freshwater marine springs in Chekka	3.8474
22	Aarqa River estuary	3.8183
23	Ibrahim River archaeological sites and estuary	3.7282
24	Ras Enfeh	3.6807

Ranking	Ecologically sensitive sites Site Name	Overall score
25	Ras Saadiyat	3.6286
26	Iskandarouna springs and beach	3.6167
27	Sandy beaches of Jnah	3.6073
28	Beaches north and south of Saida	3.6053
29	El Jawz River estuary	3.6
30	Zahrani estuary	3.5959
31	Beaches of Kfaraabida	3.5695
32	Saida Zeereh	3.5567
33	Cheikh Zennad Beach	3.5294
34	Aarida estuary	3.4932
35	Beaches of Damour	3.486
36	Batroun National Marine Hima at the Marine Sciences Center	3.4608
37	Bay of Jounieh	3.43
38	Coastal dunes of Akkar Plain	3.4233
39	The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	3.3755
40	Marine environment in front of the fishing harbor of Jbeil	3.217
41	Salinas and wetland of Qleiaat	3.1998
42	White cliffs and bay of Naqoura	3.1506
43	Beaches and terraces of Tripoli towards Qalamoun	3.1021
44	White cliffs of Bayada	3.0237
45	Beirut River estuary	2.6318
46	Aaqaibeh beach	2.2444
47	City of Orthosia in El Bared River	2.0298
48	Abou Ali Estuary	1.9898
49	Maameltein promontory	1.5602
50	Historical Center and Fishing Harbor of Batroun	1.4775
51	Khaldeh archaeological site	1.4668
52	The sea castle of Saida and underwater city & Sea façade & old harbor	1.4668
53	Ancient tell of Sarafand	1.4668
54	Umm El Rabb site	1.4668

Ranking	Ecologically sensitive sites Site Name	Overall score
55	Umm El Amad site	1.4668
56	Tell El Burak	1.0144
57	Fadaous ancient tell	1.0004
58	Ghadir River estuary	1.0004
59	Ancient Persian Harbor	1.0004

Annex VI: Priority Matrices

Cultural criteria priority matrix

		Representativeness	Uniqueness	Ingenuity	Cultural & traditional use	Interchange	Indirect cultural value	Cultural heritage	Management & protection	Aesthetic importance			
	Criteria	CC-1	CC-2	CC-3	CC-4	CC-5	CC-6	CC-7	CC-8	CC-9	Mean	Weight	Relative Importance (%)
Representativeness	CC-1	1.00	0.33	0.20	0.33	5.00	1.00	0.14	3.00	0.14	0.574364	0.042586019	4.25860193
Uniqueness	CC-2	3.00	1.00	3.00	5.00	5.00	5.00	1.00	7.00	3.00	3.061471	0.226991861	22.69918611
Ingenuity	CC-3	5.00	0.33	1.00	1.00	7.00	5.00	1.00	7.00	1.00	1.950351	0.144608174	14.46081743
Cultural & traditional use	CC-4	3.00	0.20	1.00	1.00	5.00	3.00	0.20	3.00	0.14	0.971577	0.072037293	7.203729323
Interchange	CC-5	0.20	0.20	0.14	0.20	1.00	0.33	0.11	0.33	0.11	0.22648	0.016792272	1.679227213
Indirect cultural value	CC-6	1.00	0.20	0.20	0.33	3.00	1.00	0.11	0.33	0.11	0.379845	0.028163463	2.816346284
Cultural heritage	CC-7	7.00	1.00	1.00	5.00	9.00	9.00	1.00	9.00	1.00	3.087763	0.228941243	22.8941243
Management & protection	CC-8	0.33	0.14	0.14	0.33	3.00	3.00	0.11	1.00	0.11	0.398242	0.029527497	2.952749661
Aesthetic importance	CC-9	7.00	0.33	1.00	7.00	9.00	9.00	1.00	9.00	1.00	2.83705	0.210352177	21.03521775
	Total										13.48714	1	100

Ecological criteria priority matrix

Criteria		Representativeness	Threatened Sp.	High diversity	Uniqueness	Life history stages	Naturalness	Integrity	Connectivity	Biogeography	Biological productivity	Fragility	Inter/national importance	Size	Comprehensiveness	Resilience	Dependency	Replication	Threats	Management & protection	Scientific importance	Restoration	Aesthetic importance			
		EC-1	EC-2	EC-3	EC-4	EC-5	EC-6	EC-7	EC-8	EC-9	EC-10	EC-11	EC-12	EC-13	EC-14	EC-15	EC-16	EC-17	EC-18	EC-19	EC-20	EC-21	EC-22	Mean	Weight	Relative Importance (%)
Representativeness	EC-1	1.00	0.14	0.33	0.11	0.11	0.11	0.20	0.33	0.11	0.14	0.11	0.14	7.00	0.20	0.11	1.00	3.00	0.11	0.14	0.11	3.00	5.00	0.32062	0.009694	0.969363
Threatened Sp.	EC-2	7.00	1.00	5.00	0.20	0.20	0.20	7.00	7.00	0.33	1.00	1.00	5.00	7.00	0.33	0.14	5.00	5.00	0.20	0.20	0.11	3.00	7.00	1.139779	0.03446	3.446009
High diversity	EC-3	3.00	0.20	1.00	0.14	0.33	0.20	5.00	5.00	1.00	1.00	0.14	3.00	7.00	0.20	0.14	5.00	5.00	0.14	0.20	0.11	3.00	7.00	0.837863	0.025332	2.533194
Uniqueness	EC-4	9.00	5.00	7.00	1.00	1.00	1.00	5.00	7.00	1.00	0.33	0.14	7.00	7.00	0.33	0.20	5.00	5.00	0.14	0.20	0.11	5.00	5.00	1.447231	0.043756	4.375558
Life history stages	EC-5	9.00	5.00	3.00	1.00	1.00	5.00	5.00	7.00	1.00	0.33	0.20	7.00	9.00	1.00	1.00	5.00	5.00	0.20	1.00	0.11	5.00	7.00	1.930638	0.058371	5.837089
Naturalness	EC-6	9.00	5.00	5.00	1.00	0.20	1.00	0.20	5.00	0.33	0.33	0.20	7.00	7.00	1.00	1.00	5.00	5.00	0.20	1.00	0.11	3.00	7.00	1.334519	0.040348	4.034783
Integrity	EC-7	5.00	0.14	0.20	0.20	0.20	5.00	1.00	5.00	0.20	0.20	0.20	7.00	7.00	3.00	0.33	5.00	5.00	0.14	1.00	0.11	3.00	7.00	0.96595	0.029205	2.920454
Connectivity	EC-8	3.00	0.14	0.20	0.14	0.14	0.20	0.20	1.00	0.14	0.14	0.14	1.00	1.00	0.14	0.14	1.00	1.00	0.11	0.14	0.11	0.33	1.00	0.29663	0.008968	0.89683
Biogeography	EC-9	9.00	3.00	1.00	1.00	1.00	3.00	5.00	7.00	1.00	1.00	1.00	5.00	7.00	1.00	1.00	5.00	7.00	1.00	3.00	1.00	7.00	7.00	2.487817	0.075217	7.521666
Biological productivity	EC-10	7.00	1.00	1.00	3.00	3.00	3.00	5.00	7.00	1.00	1.00	0.33	3.00	7.00	1.00	1.00	3.00	7.00	1.00	3.00	1.00	7.00	7.00	2.347952	0.070988	7.098798
Fragility	EC-11	9.00	1.00	7.00	7.00	5.00	5.00	5.00	7.00	1.00	3.00	1.00	5.00	9.00	3.00	3.00	7.00	7.00	3.00	5.00	1.00	5.00	7.00	3.931951	0.118879	11.88786
Inter/national importance	EC-12	7.00	0.20	0.33	0.14	0.14	0.14	0.14	1.00	0.20	0.33	0.20	1.00	3.00	0.14	0.14	1.00	1.00	0.14	1.00	0.20	3.00	3.00	0.461446	0.013951	1.395135
Size	EC-13	0.14	0.14	0.14	0.14	0.11	0.14	0.14	1.00	0.14	0.14	0.11	0.33	1.00	0.14	0.14	1.00	1.00	0.11	0.20	0.11	0.20	0.14	0.208316	0.006298	0.629822
Comprehensiveness	EC-14	5.00	3.00	5.00	3.00	1.00	1.00	0.33	7.00	1.00	1.00	0.33	7.00	7.00	1.00	1.00	7.00	7.00	0.20	3.00	0.20	5.00	3.00	1.850179	0.055938	5.593831
Resilience	EC-15	9.00	7.00	7.00	5.00	1.00	1.00	3.00	7.00	1.00	1.00	0.33	7.00	7.00	1.00	1.00	7.00	7.00	3.00	5.00	1.00	5.00	5.00	2.890961	0.087405	8.740531
Dependency	EC-16	1.00	0.20	0.20	0.20	0.20	0.20	0.20	1.00	0.20	0.33	0.14	1.00	1.00	0.14	0.14	1.00	1.00	0.11	0.33	0.14	0.33	5.00	0.352599	0.01066	1.066047

		Representativeness	Threatened Sp.	High diversity	Uniqueness	Life history stages	Naturalness	Integrity	Connectivity	Biogeography	Biological productivity	Fragility	Inter/national importance	Size	Comprehensiveness	Resilience	Dependency	Replication	Threats	Management & protection	Scientific importance	Restoration	Aesthetic importance			
Replication	**EC-17**	0.33	0.20	0.20	0.20	0.20	0.20	0.20	1.00	0.14	0.14	0.14	1.00	1.00	0.14	0.14	1.00	1.00	0.14	0.33	0.14	0.33	5.00	0.321504	0.00972	0.972035
Threats	**EC-18**	9.00	5.00	7.00	7.00	5.00	5.00	7.00	9.00	1.00	1.00	0.33	7.00	9.00	5.00	0.33	9.00	7.00	1.00	7.00	3.00	7.00	7.00	3.856605	0.116601	11.66006
Management & protection	**EC-19**	7.00	5.00	5.00	5.00	1.00	1.00	1.00	7.00	0.33	0.33	0.20	1.00	5.00	0.33	0.20	3.00	3.00	0.14	1.00	0.20	3.00	5.00	1.264609	0.038234	3.823418
Scientific importance	**EC-20**	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	1.00	1.00	1.00	5.00	9.00	5.00	1.00	7.00	7.00	0.33	5.00	1.00	7.00	7.00	4.146225	0.125357	12.5357
Restoration	**EC-21**	0.33	0.33	0.33	0.20	0.20	0.33	0.33	3.00	0.14	0.14	0.20	0.33	5.00	0.20	0.20	3.00	3.00	0.14	0.33	0.14	1.00	0.20	0.398786	0.012057	1.205689
Aesthetic importance	**EC-22**	0.20	0.14	0.14	0.20	0.14	0.14	0.14	1.00	0.14	0.14	0.14	0.33	7.00	0.33	0.20	0.20	0.20	0.14	0.20	0.14	5.00	1.00	0.28317	0.008561	0.856135
	Total																							33.07535	1	100

Annex VII: Rating matrices

Rating of sites against cultural criteria

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange
Site Name									
Aarida estuary	1	1	1	1	3	1	2	1	1
Cheikh Zennad Beach	1	1	1	1	3	1	2	1	1
Salinas and wetland of Qleiaat	1	4	1	1	4	3	3	1	1
Coastal dunes of Akkar Plain	1	1	1	1	1	1	1	1	1
Aarqa River estuary	3	1	1	1	1	1	1	1	1
City of Orthosia in El Bared River	1	1	1	1	1	1	1	1	1
Abou Ali Estuary	1	1	1	1	1	1	1	1	1
Terraces of Al Mina	1	1	1	1	3	1	2	1	1
Beaches and terraces of southern Tripoli towards Qalamoun	1	1	1	1	3	1	2	1	1
Ras Enfeh	5	5	4	5	5	5	4	5	5
Salinas, wall promenade and our Lady of Natour Monastery	4	3	3	5	4	4	3	5	3
Heri-Chekka beaches	1	1	2	1	3	1	2	1	1
Offshore freshwater marine springs in Chekka	1	1	4	1	1	1	1	1	1
Promontory cape and cliffs of Ras Chaqaa & Saydet El Nouriyeh Monastery	4	4	5	3	3	4	4	5	3
Selaata terraces	1	1	1	1	2	1	1	1	1
El Jawz River estuary	1	1	1	1	1	1	1	1	1

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange
Batroun National Marine Hima at the Marine Sciences Center	1	1	2	1	1	1	1	1	1
Historical Center and Fishing Harbor of Batroun	5	5	3	5	4	5	3	5	4
Beaches of Kfaraabida	1	1	1	1	2	1	2	1	1
Fadaous ancient tell	1	1	1	1	1	1	1	1	1
Medfoun rocky area	1	1	1	1	1	1	1	1	1
Beaches in the south and north of Jbeil (Jbeil-Amshit)	2	1	4	1	3	1	3	1	2
Marine environment in front of the fishing harbor of Jbeil	1	1	1	1	1	1	1	1	1
Ibrahim River archaeological sites and estuary	3	1	1	1	1	3	2	1	1
Aaqaibeh Beach	1	1	1	1	1	1	1	1	1
Coastal Front Rocks and terraces of Wata Silm (Tabarja)	1	1	1	1	3	1	2	1	1
Maameltein promontory	1	1	1	1	1	1	1	1	1
Bay of Jounieh	4	2	4	2	4	3	2	3	3
Ghadir Rriver estuary	1	1	1	1	1	1	1	1	1
El Kelb River historical site and estuary	5	5	4	2	4	5	2	2	2
Beirut River estuary	1	1	1	1	1	1	1	1	1
The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	4	1	5	1	2	4	2	1	1
Ancient Persian Harbor	1	1	1	1	1	1	1	1	1
Sandy beach of Ramlet El Bayda in Beirut	1	1	1	1	1	1	1	1	1

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange
Sandy beaches of Jnah	1	1	1	1	1	1	1	1	1
Seagrass meadow in front of the Airport wave breaker	1	1	1	1	1	1	1	1	1
Khaldeh archaeological site	5	4	1	4	4	4	2	4	4
Beaches of Damour	1	1	1	1	1	1	1	1	1
Damour Rriver estuary	1	1	2	1	3	1	2	1	1
Ras Saadiyat	1	1	1	1	1	1	1	1	1
Sandy beaches of Rmeileh and Jiyeh	1	1	1	1	1	1	1	1	1
Awally Rriver estuary	1	1	1	1	1	1	1	1	1
Beaches north and south of Saida	1	1	1	1	1	1	1	1	1
Saida Zeereh	4	4	4	4	5	4	3	1	4
Zahrani estuary	1	1	1	1	1	1	1	1	1
The sea castle of Saida and underwater city & Sea façade & old harbor	5	5	3	5	5	5	5	5	5
Tell El Burak	4	4	2	3	3	4	3	4	3
Ancient tell of Sarafand	5	4	3	4	5	5	3	5	4
Aadloun beach and caves	5	4	3	3	4	4	1	3	3
Qasmieh estuary	1	1	1	1	1	1	1	1	1
Mhayleeb beach	1	1	1	1	2	1	2	1	1
North Tyrebeach (Ras-Siddine-El-Bahr)	1	1	1	1	1	1	1	1	1
Mansouri beach	1	1	1	1	1	1	1	1	1
Bakbouk hot water springs	1	1	4	1	1	1	1	1	1
White cliffs of Bayada	1	1	4	1	1	1	1	1	1
Iskandarouna springs and beach	1	1	1	1	1	1	1	1	1
White cliffs and bay of Naqoura	1	1	4	1	2	1	2	1	1

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange
Umm El Rabb site	5	4	3	4	3	5	2	4	4
Umm El Amad site	5	4	3	4	3	5	2	4	4

Rating of sites against ecological criteria

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquenness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
Site Name																						
Aarida estuary	4	5	5	3	2	3	3	4	3	2	1	2	3	3	3	4	4	3	5	5	3	4
Cheikh Zennad Beach	4	5	5	2	2	3	4	4	3	2	1	4	3	3	3	5	3	5	4	5	2	3
Salinas and wetland of Qleiaat	4	4	5	2	2	4	4	3	3	2	2	3	1	2	3	1	1	1	2	3	2	3
Coastal dunes of Akkar Plain	5	5	5	2	4	2	2	3	4	1	1	3	1	2	3	4	4	4	3	4	2	4
Aarqa Rriver estuary	4	5	5	3	3	3	3	4	4	4	1	3	4	3	5	5	4	5	5	5	4	3
City of Orthosia in El Bared River	1	5	5	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Abou Ali Estuary	1	5	5	1	1	1	1	1	1	1	1	1	1	1	3	1	1	3	1	1	1	1

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquenes	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
Terraces of Al Mina	4	4	5	4	5	4	5	4	3	3	2	4	4	4	3	4	5	5	4	3	4	4
Beaches and terraces of southern Tripoli towards Qalamoun	4	5	5	2	2	2	2	1	3	2	1	3	2	3	5	3	5	5	4	2	2	2
Ras Enfeh	3	4	3	4	5	4	4	4	3	3	3	3	3	4	4	5	5	5	4	3	5	4
Salinas, wall promenade and our Lady of Natour Monastery	5	5	4	5	3	5	5	5	3	4	4	4	4	5	4	4	5	5	4	4	4	4
Heri-Chekka beaches	5	4	5	3	4	4	4	3	3	3	2	4	4	4	3	5	4	2	4	3	3	4
Offshore freshwater marine springs in Chekka	5	2	2	5	5	5	4	4	5	5	1	4	4	4	4	5	4	2	3	3	5	5
Promontory cape and cliffs of Ras Chaqaa & Saydet El Nouriyeh Monastery	5	5	4	5	5	5	5	5	5	4	4	4	4	5	5	5	4	2	4	5	5	5

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquuenness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
Selaata terraces	5	4	5	5	4	4	3	4	3	4	1	3	4	4	4	4	4	5	5	5	4	4
El Jawz River estuary	4	5	5	3	3	3	3	3	3	3	1	3	3	3	5	4	4	4	4	4	3	3
Batroun National Marine Hima at the Marine Sciences Center	4	3	4	4	3	3	3	4	2	3	4	3	4	3	5	4	3	4	4	2	3	3
Historical Center and Fishing Harbor of Batroun	1	1	4	1	1	1	1	1	1	1	4	1	1	1	1	2	1	1	1	1	1	1
Beaches of Kfaraabida	4	4	4	3	4	3	3	3	3	4	3	3	4	4	3	4	3	4	4	2	4	4
Fadaous ancient tell	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Medfoun rocky area	5	5	5	4	4	5	4	3	3	4	3	3	4	4	3	5	3	4	4	3	4	4
Beaches in the south and north of Jbeil (Jbeil-Amshit)	5	5	5	4	5	5	4	4	4	3	4	3	4	4	3	5	4	4	4	3	4	5

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquuness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
Marine environment in front of the fishing harbor of Jbeil	4	4	3	3	2	4	4	2	2	3	2	3	4	4	2	4	4	4	3	2	2	3
Ibrahim River archaeological sites and estuary	4	4	5	3	3	4	3	4	3	3	2	3	4	4	5	4	4	4	5	5	4	3
Aaqaibeh beach	2	2	3	3	2	3	2	2	1	2	1	2	3	2	1	4	3	4	1	1	2	2
Coastal Front Rocks and terraces of Wata Silm (Tabarja)	4	4	5	4	4	4	3	3	3	4	4	3	4	4	4	5	3	4	5	2	4	4
Maameltein promontory	1	1	5	1	1	1	1	1	1	1	2	1	1	1	3	2	1	1	1	1	2	2
Bay of Jounieh	4	4	5	3	5	3	2	2	5	2	1	3	2	2	2	3	4	2	3	2	4	5
Ghadir Rriver estuary	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
El Kelb River historical site and estuary	5	5	5	4	4	4	4	3	3	2	2	3	2	4	5	3	4	4	4	4	4	3
Beirut Rriver estuary	3	5	5	2	1	2	2	1	1	1	1	2	1	2	5	3	3	4	2	2	1	3

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquuness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	3	3	5	3	5	3	2	2	3	5	4	3	4	3	2	4	2	1	1	2	5	3
Ancient Persian Harbor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sandy beach of Ramlet El Bayda in Beirut	5	5	5	4	4	4	4	4	3	3	4	3	3	3	3	5	3	4	4	3	4	4
Sandy beaches of Jnah	5	5	5	5	2	2	2	2	3	3	1	3	3	3	3	4	3	4	4	4	3	4
Seagrass meadow in front of the Airport wave breaker	5	4	4	4	3	4	4	4	3	3	4	3	3	4	3	5	3	4	4	4	3	3
Khaldeh archaeological site	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Beaches of Damour	4	4	3	4	4	4	3	3	3	3	2	3	4	3	2	5	3	4	2	2	4	4
Damour Rriver estuary	5	5	5	4	4	4	3	4	3	4	4	3	3	3	5	5	3	4	4	3	4	4
Ras Saadiyat	4	4	3	4	4	4	4	3	3	4	2	3	3	4	4	5	3	4	4	3	3	4

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquuness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
Sandy beaches of Rmeileh and Jiyeh	5	5	4	4	4	4	3	4	3	3	3	3	3	3	2	4	4	4	4	3	4	5
Awally Rriver estuary	5	5	3	4	3	4	4	4	3	4	3	3	4	4	5	4	4	4	4	4	3	3
Beaches north and south of Saida	5	5	5	3	2	3	3	2	3	3	2	3	3	3	4	4	3	4	4	3	3	4
Saida Zeereh	4	4	5	3	4	3	3	3	4	3	2	2	4	3	3	5	2	2	2	3	4	3
Zahrani estuary	5	5	5	3	2	3	3	2	1	2	4	3	4	3	5	4	4	4	4	4	2	2
The sea castle of Saida and underwater city & Sea façade & old harbor	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tell El Burak	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
Ancient tell of Sarafand	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Aadloun beach and caves	5	5	3	4	4	4	4	4	3	5	2	4	4	4	1	5	3	4	4	3	4	5
Qasmieh estuary	5	5	5	3	4	4	4	4	3	3	2	4	4	4	5	4	4	4	4	4	4	4
Mhayleeb beach	5	5	4	4	4	4	4	4	3	4	4	3	3	4	1	5	3	4	4	3	4	4

Ecological Criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniquenness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size
North Tyre Beach (Ras-Siddine-El-Bahr)	5	5	5	4	4	3	3	3	3	3	3	4	4	4	3	5	3	4	4	3	3	3
Mansouri beach	5	5	3	4	4	4	4	4	3	4	4	4	4	4	2	5	3	2	4	3	4	4
Bakbouk hot water springs	5	2	3	4	5	4	4	5	5	5	2	5	5	4	5	5	5	1	3	1	5	2
White cliffs of Bayada	3	2	2	4	5	3	2	3	4	5	2	2	4	3	3	5	1	2	2	2	5	4
Iskandaroona springs and beach	5	5	3	3	3	4	3	3	4	3	2	3	3	3	5	4	3	4	4	2	3	3
White cliffs and bay of Naqoura	3	2	2	4	5	3	2	3	5	5	4	2	4	3	3	5	1	2	2	2	5	5
Umm El Rabb site	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Umm El Amad site	1	1	5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Annex VIII: Aggregation matrices and overall scores

Aggregation of scores against cultural criteria

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange	Overall score
Weights	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	
Site Name										
Aarida estuary	0.229	0.227	0.21	0.145	0.216	0.043	0.059	0.028	0.017	1.174
Cheikh Zennad Beach	0.229	0.227	0.21	0.145	0.216	0.043	0.059	0.028	0.017	1.174
Salinas and wetland of Qleiaat	0.229	0.908	0.21	0.145	0.288	0.128	0.089	0.028	0.017	2.041
Coastal dunes of Akkar Plain	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Aarqa Rriver estuary	0.687	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1.458
City of Orthosia in El Bared River	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Abou Ali Estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Terraces of Al Mina	0.229	0.227	0.21	0.145	0.216	0.043	0.059	0.028	0.017	1.174
Beaches and terraces of Tripoli towards Qalamoun	0.229	0.227	0.21	0.145	0.216	0.043	0.059	0.028	0.017	1.174
Ras Enfeh	1.145	1.135	0.842	0.723	0.36	0.213	0.118	0.141	0.084	4.76
Salinas, wall promenade and our Lady of Natour Monastery	0.916	0.681	0.631	0.723	0.288	0.17	0.089	0.141	0.05	3.689
Heri-Chekka beaches	0.229	0.227	0.421	0.145	0.216	0.043	0.059	0.028	0.017	1.384
Offshore freshwater	0.229	0.227	0.842	0.145	0.072	0.043	0.03	0.028	0.017	1.631

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange	Overall score
marine springs in Chekka										
Promontory cape and cliffs of Ras Chaqaa & Saydet El Nouriyeh Monastery	0.916	0.908	1.052	0.434	0.216	0.17	0.118	0.141	0.05	4.005
Selaata terraces	0.229	0.227	0.21	0.145	0.144	0.043	0.03	0.028	0.017	1.072
El Jawz River estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Batroun National Marine Hima at the Marine Sciences Center	0.229	0.227	0.421	0.145	0.072	0.043	0.03	0.028	0.017	1.21
Historical Center and Fishing Harbor of Batroun	1.145	1.135	0.631	0.723	0.288	0.213	0.089	0.141	0.067	4.431
Beaches of Kfaraabida	0.229	0.227	0.21	0.145	0.144	0.043	0.059	0.028	0.017	1.102
Fadaous ancient tell	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Medfoun rocky area	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Beaches in the south and north of Jbeil (Jbeil-Amshit)	0.458	0.227	0.842	0.145	0.216	0.043	0.089	0.028	0.034	2.08
Marine environment in front of the fishing harbor of Jbeil	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Ibrahim River archaeological sites and estuary	0.687	0.227	0.21	0.145	0.072	0.128	0.059	0.028	0.017	1.573

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange	Overall score
Aaqaibeh beach	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Coastal Front Rocks and terraces of Wata Silm (Tabarja)	0.229	0.227	0.21	0.145	0.216	0.043	0.059	0.028	0.017	1.174
Maameltein promontory	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Bay of Jounieh	0.916	0.454	0.842	0.289	0.288	0.128	0.059	0.085	0.05	3.11
Ghadir Rriver estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
El Kelb River historical site and estuary	1.145	1.135	0.842	0.289	0.288	0.213	0.059	0.056	0.034	4.06
Beirut Rriver estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	0.916	0.227	1.052	0.145	0.144	0.17	0.059	0.028	0.017	2.758
Ancient Persian Harbor	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Sandy beach of Ramlet El Bayda in Beirut	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Sandy beaches of Jnah	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Seagrass meadow in front of the Airport wave breaker	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Khaldeh archaeological site	1.145	0.908	0.21	0.578	0.288	0.17	0.059	0.113	0.067	3.539

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange	Overall score
Beaches of Damour	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Damour Rriver estuary	0.229	0.227	0.421	0.145	0.216	0.043	0.059	0.028	0.017	1.384
Ras Saadiyat	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Sandy beaches of Rmeileh and Jiyeh	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Awally Rriver estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Beaches north and south of Saida	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Saida zeereh	0.916	0.908	0.842	0.578	0.36	0.17	0.089	0.028	0.067	3.958
Zahrani estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
The sea castle of Saida and underwater city & Sea façade & old harbor	1.145	1.135	0.631	0.723	0.36	0.213	0.148	0.141	0.084	4.579
Tell El Burak	0.916	0.908	0.421	0.434	0.216	0.17	0.089	0.113	0.05	3.316
Ancient tell of Sarafand	1.145	0.908	0.631	0.578	0.36	0.213	0.089	0.141	0.067	4.132
Aadloun beach and caves	1.145	0.908	0.631	0.434	0.288	0.17	0.03	0.085	0.05	3.74
Qasmieh estuary	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Mhayleeb beach	0.229	0.227	0.21	0.145	0.144	0.043	0.059	0.028	0.017	1.102
North Tyre Beach (Ras-Siddine-El-Bahr)	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Mansouri beach	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
Bakbouk hot water springs	0.229	0.227	0.842	0.145	0.072	0.043	0.03	0.028	0.017	1.631

Cultural Criteria	Cultural Heritage	Uniqueness	Aesthetic importance	Ingenuity	Cultural & traditional use	Representativeness	Management & protection	Indirect cultural value	Interchange	Overall score
White cliffs of Bayada	0.229	0.227	0.842	0.145	0.072	0.043	0.03	0.028	0.017	1.631
Iskandarouna springs and beach	0.229	0.227	0.21	0.145	0.072	0.043	0.03	0.028	0.017	1
White cliffs and bay of Naqoura	0.229	0.227	0.842	0.145	0.144	0.043	0.059	0.028	0.017	1.733
Umm El Rabb site	1.145	0.908	0.631	0.578	0.216	0.213	0.059	0.113	0.067	3.93
Umm El Amad site	1.145	0.908	0.631	0.578	0.216	0.213	0.059	0.113	0.067	3.93

Aggregation of scores against ecological criteria

Ecological criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniqueness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/ national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size	Overall scores
Weights	0.125	0.119	0.117	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	
Site Name																							
Aarida estuary	0.502	0.595	0.583	0.262	0.15	0.213	0.175	0.224	0.131	0.081	0.038	0.069	0.088	0.076	0.042	0.048	0.043	0.029	0.049	0.045	0.026	0.025	3.4932
Cheikh Zennad Beach	0.502	0.595	0.583	0.175	0.15	0.213	0.234	0.224	0.131	0.081	0.038	0.138	0.088	0.076	0.042	0.061	0.032	0.049	0.039	0.045	0.017	0.019	3.5294
Salinas and wetland of Qleiaat	0.502	0.476	0.583	0.175	0.15	0.284	0.234	0.168	0.131	0.081	0.077	0.104	0.029	0.051	0.042	0.012	0.011	0.01	0.019	0.027	0.017	0.019	3.1998
Coastal dunes of Akkar Plain	0.627	0.595	0.583	0.175	0.301	0.142	0.117	0.168	0.175	0.04	0.038	0.104	0.029	0.051	0.042	0.048	0.043	0.039	0.029	0.036	0.017	0.025	3.4233
Aarqa River estuary	0.502	0.595	0.583	0.262	0.226	0.213	0.175	0.224	0.175	0.161	0.038	0.104	0.117	0.076	0.07	0.061	0.043	0.049	0.049	0.045	0.034	0.019	3.8183
City of Orthosia in El Bared River	0.125	0.595	0.583	0.175	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	2.0298
Abou Ali Estuary	0.125	0.595	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.042	0.012	0.011	0.029	0.01	0.009	0.009	0.006	1.9898
Terraces of Al Mina	0.502	0.476	0.583	0.35	0.376	0.284	0.292	0.224	0.131	0.121	0.077	0.138	0.117	0.101	0.042	0.048	0.054	0.049	0.039	0.027	0.034	0.025	4.0883
Beaches and terraces of Tripoli towards Qalamoun	0.502	0.595	0.583	0.175	0.15	0.142	0.117	0.056	0.131	0.081	0.038	0.104	0.058	0.076	0.07	0.036	0.054	0.049	0.039	0.018	0.017	0.013	3.1021
Ras Enfeh	0.376	0.476	0.35	0.35	0.376	0.284	0.234	0.224	0.131	0.121	0.115	0.104	0.088	0.101	0.056	0.061	0.054	0.049	0.039	0.027	0.043	0.025	3.6807
Salinas, wall promenade and our Lady of Natour Monastery	0.627	0.595	0.466	0.437	0.226	0.355	0.292	0.28	0.131	0.161	0.154	0.138	0.117	0.127	0.056	0.048	0.054	0.049	0.039	0.036	0.034	0.025	4.4453
Heri-Chekka beaches	0.627	0.476	0.583	0.262	0.301	0.284	0.234	0.168	0.131	0.121	0.077	0.138	0.117	0.101	0.042	0.061	0.043	0.019	0.039	0.027	0.026	0.025	3.9005
Offshore freshwater marine springs in Chekka	0.627	0.238	0.233	0.437	0.376	0.355	0.234	0.224	0.219	0.202	0.038	0.138	0.117	0.101	0.056	0.061	0.043	0.019	0.029	0.027	0.043	0.032	3.8474

Ecological criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniqueness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size	Overall scores
Promontory cape and cliffs of Ras Chaqaa & Saydet El Nouriyeh Monastery	0.627	0.595	0.466	0.437	0.376	0.355	0.292	0.28	0.219	0.161	0.154	0.138	0.117	0.127	0.07	0.061	0.043	0.019	0.039	0.045	0.043	0.032	4.6935
Selaata terraces	0.627	0.476	0.583	0.437	0.301	0.284	0.175	0.224	0.131	0.161	0.038	0.104	0.117	0.101	0.056	0.048	0.043	0.049	0.049	0.045	0.034	0.025	4.1075
El Jawz River estuary	0.502	0.595	0.583	0.262	0.226	0.213	0.175	0.168	0.131	0.121	0.038	0.104	0.088	0.076	0.07	0.048	0.043	0.039	0.039	0.036	0.026	0.019	3.6
Batroun National Marine Hima at the Marine Sciences Center	0.502	0.357	0.466	0.35	0.226	0.213	0.175	0.224	0.088	0.121	0.154	0.104	0.117	0.076	0.07	0.048	0.032	0.039	0.039	0.018	0.026	0.019	3.4608
Historical Center and Fishing Harbor of Batroun	0.125	0.119	0.466	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.154	0.035	0.029	0.025	0.014	0.024	0.011	0.01	0.01	0.009	0.009	0.006	1.4775
Beaches of Kfaraabida	0.502	0.476	0.466	0.262	0.301	0.213	0.175	0.168	0.131	0.161	0.115	0.104	0.117	0.101	0.042	0.048	0.032	0.039	0.039	0.018	0.034	0.025	3.5695
Fadaous ancient tell	0.125	0.119	0.117	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.0004
Medfoun rocky area	0.627	0.595	0.583	0.35	0.301	0.355	0.234	0.168	0.131	0.161	0.115	0.104	0.117	0.101	0.042	0.061	0.032	0.039	0.039	0.027	0.034	0.025	4.2393
Beaches in the south and north of Jbeil (Jbeil-Amshit)	0.627	0.595	0.583	0.35	0.376	0.355	0.234	0.224	0.175	0.121	0.154	0.104	0.117	0.101	0.042	0.061	0.043	0.039	0.039	0.027	0.034	0.032	4.4293
Marine environment in front of the fishing harbor of Jbeil	0.502	0.476	0.35	0.262	0.15	0.284	0.234	0.112	0.088	0.121	0.077	0.104	0.117	0.101	0.028	0.048	0.043	0.039	0.029	0.018	0.017	0.019	3.217
Ibrahim River archaeological sites and estuary	0.502	0.476	0.583	0.262	0.226	0.284	0.175	0.224	0.131	0.121	0.077	0.104	0.117	0.101	0.07	0.048	0.043	0.039	0.049	0.045	0.034	0.019	3.7282
Aaqaibeh beach	0.251	0.238	0.35	0.262	0.15	0.213	0.117	0.112	0.044	0.081	0.038	0.069	0.088	0.051	0.014	0.048	0.032	0.039	0.01	0.009	0.017	0.013	2.2444
Coastal Front Rocks and terraces of Wata Silm (Tabarja)	0.502	0.476	0.583	0.35	0.301	0.284	0.175	0.168	0.131	0.161	0.154	0.104	0.117	0.101	0.056	0.061	0.032	0.039	0.049	0.018	0.034	0.025	3.9187
Maameltein	0.125	0.119	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.077	0.035	0.029	0.025	0.042	0.024	0.011	0.01	0.01	0.009	0.017	0.013	1.5602

Ecological criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniqueness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size	Overall scores
promontory																							
Bay of Jounieh	0.502	0.476	0.583	0.262	0.376	0.213	0.117	0.112	0.219	0.081	0.038	0.104	0.058	0.051	0.028	0.036	0.043	0.019	0.029	0.018	0.034	0.032	3.43
Ghadir Rriver estuary	0.125	0.119	0.117	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.0004
El Kelb River historical site and estuary	0.627	0.595	0.583	0.35	0.301	0.284	0.234	0.168	0.131	0.081	0.077	0.104	0.058	0.101	0.07	0.036	0.043	0.039	0.039	0.036	0.034	0.019	4.0081
Beirut Rriver estuary	0.376	0.595	0.583	0.175	0.075	0.142	0.117	0.056	0.044	0.04	0.038	0.069	0.029	0.051	0.07	0.036	0.032	0.039	0.019	0.018	0.009	0.019	2.6318
The rock and the small bay of Grotte aux Pigeons in Beirut and prehistoric site near the rock	0.376	0.357	0.583	0.262	0.376	0.213	0.117	0.112	0.131	0.202	0.154	0.104	0.117	0.076	0.028	0.048	0.021	0.01	0.01	0.018	0.043	0.019	3.3755
Ancient Persian Harbor	0.125	0.119	0.117	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.0004
Sandy beach of Ramlet El Bayda in Beirut	0.627	0.595	0.583	0.35	0.301	0.284	0.234	0.224	0.131	0.121	0.154	0.104	0.088	0.076	0.042	0.061	0.032	0.039	0.039	0.027	0.034	0.025	4.1678
Sandy beaches of Jnah	0.627	0.595	0.583	0.437	0.15	0.142	0.117	0.112	0.131	0.121	0.038	0.104	0.088	0.076	0.042	0.048	0.032	0.039	0.039	0.036	0.026	0.025	3.6073
Seagrass meadow in front of the Airport wave breaker	0.627	0.476	0.466	0.35	0.226	0.284	0.234	0.224	0.131	0.121	0.154	0.104	0.088	0.101	0.042	0.061	0.032	0.039	0.039	0.036	0.026	0.019	3.8765
Khaldeh archaeological site	0.125	0.119	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.4668
Beaches of Damour	0.502	0.476	0.35	0.35	0.301	0.284	0.175	0.168	0.131	0.121	0.077	0.104	0.117	0.076	0.028	0.061	0.032	0.039	0.019	0.018	0.034	0.025	3.486
Damour Rriver estuary	0.627	0.595	0.583	0.35	0.301	0.284	0.175	0.224	0.131	0.161	0.154	0.104	0.088	0.076	0.07	0.061	0.032	0.039	0.039	0.027	0.034	0.025	4.1777
Ras Saadiyat	0.502	0.476	0.35	0.35	0.301	0.284	0.234	0.168	0.131	0.161	0.077	0.104	0.088	0.101	0.056	0.061	0.032	0.039	0.039	0.027	0.026	0.025	3.6286
Sandy beaches of Rmeileh and Jiyeh	0.627	0.595	0.466	0.35	0.301	0.284	0.175	0.224	0.131	0.121	0.115	0.104	0.088	0.076	0.028	0.048	0.043	0.039	0.039	0.027	0.034	0.032	3.9453
Awally River estuary	0.627	0.595	0.35	0.35	0.226	0.284	0.234	0.224	0.131	0.161	0.115	0.104	0.117	0.101	0.07	0.048	0.043	0.039	0.039	0.036	0.026	0.019	3.9365

Ecological criteria	Scientific importance	Fragility	Threats	Resilience	Biogeography	Biological productivity	Life history stages	Comprehensiveness	Uniqueness	Naturalness	Management & protection	Threatened species	Integrity	High diversity	Inter/national importance	Restoration	Dependency	Replication	Representativeness	Connectivity	Aesthetic importance	Size	Overall scores
Beaches north and south of Saida	0.627	0.595	0.583	0.262	0.15	0.213	0.175	0.112	0.131	0.121	0.077	0.104	0.088	0.076	0.056	0.048	0.032	0.039	0.039	0.027	0.026	0.025	3.6053
Saida Zeereh	0.502	0.476	0.583	0.262	0.301	0.213	0.175	0.168	0.175	0.121	0.077	0.069	0.117	0.076	0.042	0.061	0.021	0.019	0.019	0.027	0.034	0.019	3.5567
Zahrani estuary	0.627	0.595	0.583	0.262	0.15	0.213	0.175	0.112	0.044	0.081	0.154	0.104	0.117	0.076	0.07	0.048	0.043	0.039	0.039	0.036	0.017	0.013	3.5959
The sea castle of Saida and underwater city & Sea façade & old harbor	0.125	0.119	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.4668
Tell El Burak	0.125	0.119	0.117	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.028	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.0144
Ancient tell of Sarafand	0.125	0.119	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.4668
Aadloun beach and caves	0.627	0.595	0.35	0.35	0.301	0.284	0.234	0.224	0.131	0.202	0.077	0.138	0.117	0.101	0.014	0.061	0.032	0.039	0.039	0.027	0.034	0.032	4.0057
Qasmieh estuary	0.627	0.595	0.583	0.262	0.301	0.284	0.234	0.224	0.131	0.121	0.077	0.138	0.117	0.101	0.07	0.048	0.043	0.039	0.039	0.036	0.034	0.025	4.1282
Mhayleeb beach	0.627	0.595	0.466	0.35	0.301	0.284	0.234	0.224	0.131	0.161	0.154	0.104	0.088	0.101	0.014	0.061	0.032	0.039	0.039	0.027	0.034	0.025	4.0888
North Tyre beach (Ras-Siddine-El-Bahr)	0.627	0.595	0.583	0.35	0.301	0.213	0.175	0.168	0.131	0.121	0.115	0.138	0.117	0.101	0.042	0.061	0.032	0.039	0.039	0.027	0.026	0.019	4.0182
Mansouri beach	0.627	0.595	0.35	0.35	0.301	0.284	0.234	0.224	0.131	0.161	0.154	0.138	0.117	0.101	0.028	0.061	0.032	0.019	0.039	0.027	0.034	0.025	4.0305
Bakbouk hot water springs	0.627	0.238	0.35	0.35	0.376	0.284	0.234	0.28	0.219	0.202	0.077	0.173	0.146	0.101	0.07	0.061	0.054	0.01	0.029	0.009	0.043	0.013	3.9417
White cliffs of Bayada	0.376	0.238	0.233	0.35	0.376	0.213	0.117	0.168	0.175	0.202	0.077	0.069	0.117	0.076	0.042	0.061	0.011	0.019	0.019	0.018	0.043	0.025	3.0237
Iskandarouna springs and beach	0.627	0.595	0.35	0.262	0.226	0.284	0.175	0.168	0.175	0.121	0.077	0.104	0.088	0.076	0.07	0.048	0.032	0.039	0.039	0.018	0.026	0.019	3.6167
White cliffs and bay of Naqoura	0.376	0.238	0.233	0.35	0.376	0.213	0.117	0.168	0.219	0.202	0.154	0.069	0.117	0.076	0.042	0.061	0.011	0.019	0.019	0.018	0.043	0.032	3.1506
Umm El Rabb site	0.125	0.119	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.4668
Umm El Amad site	0.125	0.119	0.583	0.087	0.075	0.071	0.058	0.056	0.044	0.04	0.038	0.035	0.029	0.025	0.014	0.012	0.011	0.01	0.01	0.009	0.009	0.006	1.4668

Annex IX: Map of low priority sites