BIODIVERSITY MANUAL

A Tool for Biodiversity Integration in EIA and SEA

Final Draft, July 2005

SOCIETY FOR THE PROTECTION OF NATURE IN LEBANON
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ACRONYMS

ACCOBAMS  Agreement for the Conservation of Cetaceans Of the Baltic And Mediterranean Seas
AEWA    African-Eurasian Waterbird Agreement
AFDC    Association for Forest Development and Conservation
CBD     Convention on Biological Diversity
COP     Conference of the Parties
EA      Environmental Assessment
EIA     Environmental Impact Assessment
EIS     Environmental Impact Statement
ELARD   Earth Link and Advanced Resources Management s.a.r.l
EMP     Environmental Management Plan
GMOs    Genetically Modified Organisms
IA      Impact Assessment
IAIA    International Association for Impact Assessment
IEE     Initial Environmental Evaluation
JREDS   Jordanian Royal Environment and Development Society
MEA     Multilateral Environmental Agreement
MoE     Ministry of Environment
NBSAP   National Biodiversity Strategy and Action Plan
NCSR    National Council for Scientific Research
NGO     Non Governmental Organization
PAP-RAC Priority Action Program / Regional Activity Center
SEA     Strategic Environmental Assessment
SPNL    Society for the Protection of Nature in Lebanon
UNDP    United Nations Development Programme
UNECE   United Nations Economic Commission for Europe
UNEP    United Nations Environment Programme
Introduction

The “Strategic Environmental Assessment (SEA) and Land Use Planning Project” aims at integrating environmental considerations into public decisions and undertakings on par with social and economic considerations in order to alleviate major problems facing sustainable development in the country. Accordingly, the following objectives were set for the project:

- Developing a regulatory, institutional and procedural framework for implementing SEA in Lebanon
- Strengthening concerned public institutions and building capacities in public administrations, and the civil society (non-governmental organizations, academia and private consultants, etc.)
- Applying the proposed SEA framework in the development of environmental directives to be applied to land use planning
- Undertaking a demonstration activity in the field of land use management.

Based on evidence that biodiversity constitutes the weakest link in environmental assessment in Lebanon, the SEA Project secured a small grant from the International Association for Impact Assessment (IAIA) to develop practical guidelines, in the form of a manual, for the integration of biodiversity in SEA and Environmental Impact Assessment (EIA). This initiative falls within the framework of the “Capacity Building for Biodiversity and Impact Assessment (CBBIA) Program”, a targeted capacity-building program intended to promote good practice in biodiversity and impact assessment. The CBBIA program is administered by the IAIA and funded by the Dutch Government. It builds on work carried out in support of the biodiversity-related global conventions, including the Convention on Biological Diversity, the Ramsar Convention and the Convention on Migratory Species.

The implementation of the project was outsourced to a local non-governmental organization (NGO), the Society for the Protection of Nature in Lebanon (SPNL) selected on a competitive basis. This initiative actively includes the civil society in environmental management, and is expected to provide a practical tool for the integration of biodiversity considerations in decision making both at the strategic (SEA) as well as at the project level (EIA).

SPNL aims at ensuring that natural resources are used in a sustainable manner, by protecting nature, birds and the biodiversity of Lebanon and highlighting their values and linkages to human livelihoods. Being the national partner to BirdLife International, SPNL is advocating for establishing Important Bird Areas (IBAs), a network of classified sites in Lebanon that can be considered globally important for biodiversity. Besides, SPNL is reviving the Hima concept, an old traditional system of conserving significant sites in close collaboration with local communities. In doing so, SPNL attempts to bring practical responses to the conservation of species, sites and habitats by improving human practices that have detrimental impacts on the natural resources. As such, this manual corresponds to the latter aspect of SPNL’s activities, and contributes to achieving its mission.

This manual will not discuss the process of conducting EIAs or SEAs however it will outline the fundamental components, point to the differences between them and stress on the integration of biodiversity aspects in Impact Assessments.
Definitions & Key Principles

Strategic Environmental Assessment is “a systematic process for evaluating the environmental consequences of proposed policy, plan or program (PPP) initiatives in order to ensure they are fully included and appropriately addressed at the earliest appropriate stage of decision-making on par with economic and social considerations” (Sadler and Verheem, 1996).

Environmental impact assessment is “the process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of development proposals prior to major decisions being taken and commitments made” (IAIA-IEA, 1989).

Environment is the natural (physical, chemical, and biological) and social (humans) entourage where all living and nonliving things live and interact with each other and with their entourage (Law 444/2002, Article 1).

Biodiversity “is the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (CBD, Article 2).

SPNL: Anjar – Lebanon’s topography and climate endow it with a rich variety of biotopes, here a mixed forest/wetland ecosystem.

FUNDAMENTAL PRINCIPLES IN IMPACT ASSESSMENT
(Draft Compendium on International Law, IUCN)

- **Respect for all life forms** entails that every form of life is unique and hence safeguarded regardless of its value (economic or else) to humanity.
- **Intergenerational equity** is a fundamental principle of sustainable development whereby the freedom of action of each generation in regard to the environment is qualified by the needs of future generations.
- **Prevention** constitutes the basis of environmental management, recognizing that the protection of the environment is better achieved by preventing environmental harm than by attempting to remedy or compensate for such harm.
- **Precaution** is the underlying principle for environmental assessment. It requires taking appropriate action to anticipate, prevent and monitor the risks of potentially serious or irreversible damage from human activities, even without scientific certainty.
Environmental Impact Assessment

The EIA is an important tool for minimizing adverse effects from project-related activities on the environment in general and biodiversity in particular. EIAs are useful in producing environmentally sustainable designs of projects with better compliance to environmental standards. The components of EIA would necessarily involve the following stages (see the diagram on following page):

1. Screening
2. Initial environmental evaluation
3. Scoping
4. Environmental impact study (baseline studies): this process is addressed in six sub-steps.
   a. Identification of objectives, targets and indicators
   b. Examination of alternative means/paths for achieving the set goals above
   c. Prediction of impacts
   d. Evaluation of significance of impacts
   e. Mitigation of potential negative impacts and enhancement of positive ones
   f. Documentation of the assessment methodology, analysis and results
5. Review of the study
6. Monitoring of mitigation measures and impacts
7. Post-project audit

LIST OF PROJECTS FOR WHICH AN EIA IS REQUIRED
(Adapted from Draft EIA Decree, MoE)

- Projects related to irrigation schemes, dam development, water supply networks, water treatment plants...
- Projects related to solid waste treatment plants and landfills
- Projects related to agricultural development and forest clearing
- Projects related to construction of roads, bridges, and railroads
- Projects related to construction of airports and harbors
- Projects related to construction of power-generating and power-transforming plants
- Projects related to construction of pipelines and plants for handling petrol
- Projects related to any kind of mining and quarrying
- Projects related to touristic purposes such as constructing ski resorts
- Projects related to urban development
- Projects related to construction of industrial cities and factories for the production of food, paper, and chemical products, construction material, tanneries...
Strategic Impact Assessment

SEAs have been developed for plan- and programme-making in particular, and policy appraisals for higher level decisions. Therefore an SEA covers a wider range of activities and often occurs over a longer time frame than EIAs; usually SEAs are applied to an entire sector or to a geographical area. The basic steps of SEA are similar to those in EIA procedures; it is only the scope that differs. These steps include screening, scoping, the SEA study, reviewing, mitigation, and monitoring. The key here is that decisions are assessed at early stages for their potential environmental effects, and enable alternative options to be considered more easily. This also enables a more positive approach of biodiversity conservation, particularly through identifying opportunities for enhancement. It is important to note that an SEA cannot replace or reduce the need for project-level EIA; on the contrary it can help to streamline the incorporation of environmental concerns (including biodiversity) into the decision-making process, often enhancing the project-level EIA process.

LIST OF SPECIFIC SITUATIONS IN WHICH THE IMPLEMENTATION OF SEA IS RECOMMENDED (CBD, 2003)

- Where comprehensive monitoring of biodiversity has not been instituted. In such a case, SEA can provide baselines and indicators
- Where SEA enables assessment of the risk of cumulative impact on biodiversity
- Where ecosystem behavior is poorly understood and long lead-times are required to collect reliable baseline information
- Where ecosystems are unstable or fluctuating, more baseline data are required for predictions and these can reliably be obtained in the framework of an SEA
- Where important biodiversity resources are limited and fragmented SEA is more effective than project EIA and resources can be assessed throughout their range
- Where mitigation options are limited e.g. few suitable alternative sites are available
- Where replacement options are all long-term e.g. restored habitats will take a long time to establish
- Where biodiversity resources are threatened from many directions or by activities in a number of sectors
- Where there are many stakeholders requiring local uses of biodiversity to be sustained

SPNL: Marj Hin – Gullies and soil erosion typically occur when practices are not in adequacy with soil types.
## Decision-making context and tool characteristics of EIA and SEA (Petts 1999, chap 3)

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✓, always relevant or appropriate; (✓) sometimes relevant or potentially appropriate; ×, not relevant
Multilateral Environmental Agreements & their Relevance to Biodiversity Assessment

The topic of impact assessment was globally discussed in the Rio Declaration on Environment and Development which pointed to the importance of conducting impact assessment studies for proposed activities likely to adversely impact the environment. These considerations have resulted in many ‘biodiversity-related’ conventions or Multilateral Environmental Agreements (MEA) dealing with the topic of impact assessment, not only in the context of protected areas and sites, but extending to wider environments and sectoral activities, in an effort to ensure that all earth’s resources are used in a sustainable manner. These conventions include:

- **Convention on Biological Diversity - CBD** (Rio de Janeiro, 1992)

One of the key agreements adopted at the 1992 Earth Summit in Rio de Janeiro was the Convention on Biological Diversity. The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources.

In its text, it calls for impact assessment measures to ensure that biodiversity is addressed in projects, plans and policy decisions. Article 14.1 states that “Each Contracting Party, as far as possible and as appropriate, shall:

(a) Introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures;
(b) Introduce appropriate arrangements to ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are taken into account…”

- **Convention on Wetlands of International Importance especially as Waterfowl Habitat - Ramsar Convention** (Ramsar, 1971)

The mission of the Convention on Wetlands, signed in Ramsar, Iran, in 1971, “is the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world” (Ramsar COP8, 2002).

Under Objective 2 of the Strategic Plan – developing Ramsar Wise Use Guidelines impact assessment tools were viewed as a core component of modern land-use planning and resource management toolkit. This is made clear in the Operational Objective 2.5 of the Strategic Plan which calls for Parties to “carry out EIA . . . particularly of proposed developments or changes in land/water use which have potential to affect [wetlands] whose ecological character is likely to change as the result of technological development, pollution or other human influences”.

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11
**Convention on the Conservation of Migratory Species Of Wild Animals - CMS**
(Bonn,1979)

This convention, also known as Bonn Convention, is an intergovernmental treaty, concluded under the guidance of the United Nations Environment Programme (UNEP). It is concerned with the conservation of wildlife and their habitats on a global scale and aims to conserve terrestrial, marine and avian migratory species throughout their range.

Resolution 7.2 (Impact Assessment and Migratory Species) which was adopted by the Conference of the Parties at its seventh meeting “emphasizes the importance of good quality environmental impact assessment (EIA) and strategic environmental assessment (SEA) as tools for implementing Article II (2) of the Convention on avoiding endangerment of migratory species and Article III (4) of the Convention on protection of Appendix I species...Urge Parties to include in EIA and SEA, wherever relevant, as complete a consideration as possible of effects involving impediments to migration, in furtherance of Article III (4) (b) of the Convention, of transboundary effects on migratory species, and of impacts on migratory patterns or on migratory ranges...Further urges Parties to make use, as appropriate, of the “Guidelines for Incorporating Biodiversity-related Issues into Environmental Impact Assessment Legislation and/or Processes and in Strategic Environmental Assessment” endorsed by Decision VI/7 of CBD COP 6...”
Other biodiversity-related conventions may have no articles pertaining directly to impact assessment issues in their original convention texts, perhaps because of the relative youth of the impact assessment concept at the time of their drafting. On the other hand, some may have few articles which might indirectly mention issues on impact assessment. However the conventions have addressed varying aspects of impact assessment in their more recent decisions and COPs. These conventions and their relative articles include:

- **Convention for the Protection of the Mediterranean Sea against Pollution-Barcelona Convention (Barcelona, 1976):** The articles of the convention call for the protection of marine and coastal resources from land-based sources of pollution.
- **Convention Concerning the Protection of World Cultural and Natural Heritage (1972):** No mention of impact assessment.

**STATUS OF LEBANON WITH RESPECT TO MEAS**

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National Legislations & their Relevance to Biodiversity Assessment

The MoE was established in 1993 as an obligation to the Rio Declaration. A major step in legislation was the issuance of EIA and SEA decrees as cornerstones for biodiversity conservation. These decrees are implementation decrees based on Articles 4, 21, 22, and 23 of The Framework Law for the Protection of the Environment (Code of the Environment, Law #444/2002) which constitutes the basis for sound environmental protection and management.

Article 4 of the Code of the Environment states that every individual or organization whether public or private should abide by a set of environmental principles. The following principles would most likely explain and link the environment and natural resources management to impact assessment in a way or another:

1- **Prevention** principle stipulates that all activities should avoid causing irreversible damages to natural resources through the use of the best available technologies

2- **Biodiversity conservation** principle which stipulates that any action taken should not affect the biological diversity of the area

3- **Minimizing environmental degradation** principle through minimizing all activities that might cause irreversible damage to natural resources such as water, air, soil, forests, sea, rivers among others.

4- **EIA principle** which should be used as a planning and management tool for preventing pollution and minimizing degradation of natural resources

Article 21, which relates directly to EIA, stipulates that concerned institutions, both in public and private sectors should carry out Initial Environmental Evaluation (IEE) or EIA studies to projects likely to threaten the environment due to their extent, nature, impact or activities. The MoE undertakes the review of studies and consequently provides its approval after verification of their compliance with environmental safety and sustainability of natural resources.

Article 22 elaborates on the word ‘project’ to include all activities dealing with construction or the likes, all activities affecting the natural environment through extraction or dumping of natural resources, or any proposed program, study, investment, or management that might affect a whole Lebanese area or a certain sector. The projects also include any change, addition, expansion, rehabilitation or closure of any of the activities mentioned above. The IEE or EIA study and its respective monitoring are done on the expense of the project developer.

Article 23 proposes a list of all projects for which an IEE is mandatory and another list of all projects for which an EIA is mandatory.

Despite the production of a National Biodiversity and Action Plan (NBSAP) in 1998, Lebanon has still not fully integrated biodiversity conservation and sustainable use into national decision-making. The problem lies in the absence of a shared vision regarding biodiversity at a national level and the lack of stewardship for the protection of the biological resources otherwise known as the “tragedy of commons”.
This consequently results in a significant divergence on several levels between the willingness to address biodiversity-related issues and their effective implementation:

- At national level, priorities are given to projects and plans related to construction and development rather than biodiversity in the policy and decision making process.
- At governmental level, resources and expertise are available to address biodiversity-related issues however the current situation does not permit enforcement and implementation.
- Significant difference in level of awareness and knowledge regarding biodiversity issues exists between the scientific community and all other institutions involved in biodiversity on one hand and the general public and private sector and decision- and policy-makers on the other hand.
- Lack of proper communication between the scientific community and the decision-makers.
- Field studies and on the ground research are fragmented or outdated, thus resulting in a lack of an up-to-date national data-base and clearing-house mechanism on biodiversity.

Apart from the national-based constraints, the ecosystem approach in addressing biodiversity issues is not yet adopted since most funded proposals and projects refer to limited study areas and sites rather than ecosystems. The reasons behind the absence of such an approach are numerous. First, there is an apparent absence in multidisciplinary national teams. Second, most projects deal with short term activities rather than long term national agenda-driven activities. Third, studies undertaken on the academic level do not take into consideration the ecosystem approach since their studies are limited to specific issues such as species inventories. Finally, many NGOs who have attempted to address biodiversity with an ecosystem approach do not have the adequate multidisciplinary infrastructure that permits them to do so. As an example, SPNL relies on bird species to identify its network of IBAs (2004), while the Association for Forest Development and Conservation (AFDC) Important Forest Areas looks at forest resources in its assessments (1997). Here it is important to note that these seldom overlap and key sites are actually important biodiversity areas.

**SPNL : Horsh Ehden Nature Reserve – Designated as an important bird area and an important forest area, it qualifies as an important biodiversity area.**
Beside the limited adoption of the ecosystem approach, natural areas are looked at as islands of species richness rather than as wider landscapes with relations to natural and human processes and habitats. This is exemplified in the lack of national inventories categorizing areas of natural importance and classifying them within systems of protected sites that can then guide the development process. In addition, the top-down approach adopted by many institutions and projects primarily leads to ignoring immediate priorities and concerns of biodiversity stakeholders in Lebanon.

The first EIAs received by the MoE, were willingly prepared and submitted by the private sector. They contained limited background information and mitigation measures related to biodiversity however, over the past years reports became more professional and comprehensive. Almost 90 EIA studies have been conducted over the past five years mostly for wastewater treatment systems, solid waste, one marina, and hospital waste treatment. The sections on biodiversity assessments rely mainly on literature review and limited field work, since the timing, duration and budget allocated for such studies have not been enough for the meaningful assessment of baseline biodiversity components and proposition of viable alternatives or mitigation measures. In their preparation and implementation, EIA studies have not included proper public participation and consultation processes, resulting in limited awareness of the studies and restricted participation of the affected communities in the elaboration of alternatives. Since the decree is not yet endorsed, not all projects are yet subjected to EIA.

**EIA PROCEDURES for CONSTRUCTION PROJECTS (ELARD, personal communication)**

In the process of delivering a construction permit, the EIA study is only requested once the maps and permits have already been delivered. This limits the potential for changing the drawings and proposing alternative designs, especially in the case of large resorts and marinas.

With regards to SEAs, they are still in their infancy stage and are currently tackled mainly on the academic level through student projects and thesis. Once the SEA decree is approved, the studies will become mandatory for all plans and programs. A first SEA study has been lately implemented for the coastal area of Jounieh (Kesrouan Caza) to review the seafront of the city and its urban planning.

![SPNL: Jounieh seafront – Unplanned urban development and contiguous wave blocks hinder the flow of marine currents thus affecting sea-based biodiversity.](image)
Status of Biodiversity in Lebanon

Biodiversity components are usually grouped into four ecological systems: terrestrial, freshwater, marine and agrobiodiversity systems. Each system has an individual set of processes that are the primary factors affecting biodiversity in the absence of man-made disturbance. However major changes in the functioning of systems occur whenever an induced perturbation or damage takes place. This is why a clear understanding of the ecological systems constitutes a critical basis for sound biodiversity assessment. The basic units in these systems include primary producers, primary, secondary and tertiary consumers, and decomposers. The characteristics of each system are determined by the interaction between the basic units and the interaction of the units with the environment.

In addition to the ecological processes governing each system, this section will try to describe the status of biodiversity in Lebanon, the problems facing it, and the actions that need to be taken for the consequent conservation of biodiversity mainly based on the National Biodiversity Strategy and Action Plan (MoE/UNDP/GEF, 1998).

<table>
<thead>
<tr>
<th>Primary producers</th>
<th>Primary consumers</th>
<th>Secondary &amp; higher order consumers</th>
<th>Decomposers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trees, shrubs, wild flowers and grasses.</td>
<td>Large diversity of mammals, insects, birds, reptiles and amphibians.</td>
<td>Different types of predators.</td>
<td>Bacteria, fungi, earthworms and other living organisms</td>
</tr>
</tbody>
</table>

The picture above clearly represents a typical food web. The arrows in this diagram connect the prey to the predator showing the dynamic flow of energy in natural systems. The colored dots on the animals and plants are coded to the colors in the triangular diagram at the upper right.

1. Terrestrial biodiversity:

**Ecological processes:**
Important ecological processes that take place in terrestrial systems include *population dispersal, ecological succession,* and *nutrient cycling.* When assessing any project it is crucial to study the movement of species in the project area in order to define the impact that the project might have on the dispersal of these species; any disturbance in the species' habitat may induce a forced migration. With regards to ecological succession, it is important to know the current stage of succession in the study area. Finally understanding how nutrient cycling naturally takes place can help assess the impacts of any additional nutrient dumping in the environment that might result from the proposed project.

**Status of biodiversity:**
Among the 4633 species of flora identified in Lebanon, half of the wild species of fodder plants are endangered while highly endemic species are at a lower risk. According to the Biological Diversity Study Report (1997), ferns face 42% risk, endemic plants 41.3% and medicinal plants 6.8%. However, observations from the field hint at increased pressures on these endemic and medicinal species resulting from uncontrolled collection and use. Terrestrial flora in Lebanon is distributed according to the bio-geographic climate prevalent in the area, academic studies having identified 9 main bioclimatic vegetation zones. The destruction of the vegetation cover as a result of uncontrolled urban development, overgrazing and land reclamation has in turn disturbed the overall terrestrial fauna.

Terrestrial fauna in Lebanon includes invertebrates, amphibians (such as toads, frogs, salamanders), reptiles such as (lizards, geckos, chameleons, snakes, turtles), birds (such as eagles, owls, warblers, etc), mammal insectivores (bats, porcupine, hedgehog etc), mammal carnivores (jackal, fox, hyaena, etc), mammal herbivores (boar). Despite the decision of the government to ban hunting in 1996, animal species remain at risk due to the high occurrence of illegal, uncontrolled and indiscriminate hunting. The risk of extinction has not vanished for reptiles which stand at 16.3% risk, birds at 11% and mammals at 6.9%. Among invertebrates which form the most abundant and widespread group of land-based fauna, spiders are found to be highly vulnerable with 21.8% of them being endangered.

SPNL; Jurd el Hermel – Volunteer initiatives to protect certain areas from hunting are not backed by proper enforcement and battered “no hunting” signs need to be continuously replaced.
Problems facing biodiversity:
Problems affecting terrestrial ecosystems and natural habitats include all events that are due to extreme climatic phenomena such as excessive snowing, flooding, global warming, fire hazards, etc. Problems also include uncontrolled and/or abusive anthropogenic activities such as deforestation, quarries tapping, logging, fire, overgrazing, hunting, pollution and urban development, and conversion of wild areas into agriculture lands.

EXAMPLE OF IMPACT ON TERRESTRIAL SYSTEMS (Erickson, 1994)

Impacts on the migratory behavior of animals are typically associated with design features of projects including cuts, fills, and structures (buildings, fences, roads) that may act as physical barriers to migrations occurring during the night (nocturnal) or day (diel). Area lighting such as spotlights might affect nocturnal migration whereas noise from construction might affect diurnal migration.

Actions:
The NBSAP goal related to terrestrial ecosystems and natural habitats is to protect Lebanon’s terrestrial biodiversity from degradation and ascertain their availability for environmental and economic benefits. The objectives are to provide stability for the ecosystems to permit the establishment of ecological equilibrium and; to manage forests and ranges for productivity and sustainability. This can be achieved through preventing and combating forest fires, regulating hunting, protecting remarkable natural habitats characterized by their ecology, developing exhaustive databases, rehabilitating and reforesting degraded zones, providing qualified staff, establishing forest management plans...

2. Freshwater biodiversity:

Ecological processes:
These systems include lacustrine (lakes), riverine (river), groundwater, and wetland systems. Concerning lakes, they receive nutrients through the decomposition of their own detritus, land runoff, inflowing streams and groundwater, or human activity. Depending on the concentration of nutrients entering the lakes, they may be classified as either eutrophic or oligotrophic systems. If nutrient concentration is allowed to increase, plants increase and compete for sunlight. Consequently, the temperature and oxygen concentration will drop and in turn affect biodiversity.

The basic ecological processes that take place in lacustrine systems also take place in riverine systems. In such systems stream bank vegetation should be given particular attention in impact assessment since it is a source of energy for herbivores as well as a source of high-energy detritus. It also regulates the temperature of streams since the removal of overhanging vegetation can result in an increase of 10-15°C in some areas leading to a significant change in the biological system of the river.

As mentioned earlier, groundwater is part of the freshwater systems. In this system biodiversity may be affected indirectly through well field development which may result in a persistent drawdown of the water table, leading to the loss of vegetation and subsequent soil erosion.
Wetlands are the last ecological system to be discussed in this part. They play an important role in groundwater recharge and discharge, flood storage and desynchronization, sediment trapping, nutrient retention and removal, pollution filtration, food web support, habitat for fisheries and wildlife, and finally active and passive human recreation and heritage value. Nutrient cycling and energy utilization are important processes in ecosystem dynamics of wetlands.

**Status of biodiversity:**
Lebanon harbors a large diversity of species in its freshwater habitat such as worms, fish, crustaceans, mollusks, insects, algae, aquatic plants, etc. There is also a large variety of waterbirds and very rare mammals such as the river otter. The risk of extinction on freshwater fauna is very high for Plecoptera (81%), Coleoptera (11.4%) and Ephemenoptera (8.7%). Crustaceans are 8.2% at risk, fish 4% and mollusks 3.0%. Fresh water fishing is practised as a hobby. Fish species inhabiting fresh water sources are not numerous and their carrying capacity is low.

**Problems facing biodiversity:**
The most threatened forms of life in Lebanon belong to organisms inhabiting the fresh water ecosystems. This is due to drainage, pollution and human interference. This resulted in the weakening of freshwater communities leading to a high proportion of endangered species, especially those sensitive to pollution. Some actions that have negative effects on moisture availability in the fresh water ecosystems include piping fresh water for urban use, bottling the highest quality water, improving irrigation systems by cement canals or pipes, lining drainage canals along road sides, and pumping water for irrigation. Chemical pollution from industries, organic pollution from sewers, storage dams, and pools constitute a major threat to biodiversity in aquatic habitats. The use of explosives, poisonous chemicals, and small-eyed nets for fishing reduces fish populations and endangers other plant and animal species. The almost complete disappearance of Mugil fish from the Awali River near Sidon, is an example of pollution and over-fishing.
Improper agricultural policies such as subsidies for the production of crops with high water demand (e.g. sugar beetroots) can result in over-pumping of water leading to shrinkages of wetlands and disappearance of temporary ponds.

### Example of Impact on Riverine Systems (Erickson, 1994)

Project design features such as check dams can act as barriers altering the whole ecological system (e.g. nutrient cycling, migration of fishes etc). They also alter the temperature due to removal of stream vegetation and increase turbidity due to excavation or land clearing consequently affecting biodiversity.

### Actions:
The NBSAP goal related to fresh water biodiversity conservation is to conserve fresh water biodiversity, manage and wise use fresh water resources sustainably. The objective is to save, use and study biodiversity in fresh water ecosystem. This can be achieved through the management of well-drilling, performing impact assessment of projects dealing with water storage, reducing pollution of water, conserving wetlands, establishing a database system for fresh water richness and endangered species, expanding freshwater fish farms...

### 3. Marine and Coastal Biodiversity:

#### Ecological Processes:
Marine systems harbor a wide number of species. Coastal vegetation is important for the survival and regeneration of sand dunes which protect against floods. Marine systems include estuaries which are the places where freshwater from rivers empty into the sea; estuaries are places of very high biological diversity due to the particular salinity and currents in the area. Coastal wetlands can also be part of these systems. These play a role in shoreline anchoring and dissipation of erosive forces. Some ecological processes such as bioaccumulation and bio-magnification may occur in certain filter-feeding organisms, such as clams and oysters, if small amounts of toxic chemicals are found in the water. Other processes are similar to freshwater systems.

#### Status of Biodiversity:
The marine ecosystem comprises 1685 species of fauna of which 50 are commercially important fish species. The following species may be found on the Lebanese coasts: microscopic species (zooplanktons, phytoplanktons, algae, benthic fauna, etc), reptiles (sea turtles), birds, octopus, squid, mammals (dolphins), etc... The sighting of turtles, Mediterranean monk seals and sea horses are now a rare phenomenon due to loss of habitat. Phytoplankton, such as the microphytic algae, along with the micro and macrophytic benthic algae are highly affected by coastal pollution. Macro-zooplanktons are highly abundant in the Lebanese waters and these include crustaceans which are prevalent. Both types of planktons may reach up to 1250 species in Lebanese waters.

#### Problems Facing Biodiversity:
Coastal and marine biodiversity is affected by a wide array of human actions damaging large sensitive zones of biodiversity. These actions include sand and pebble extraction, development of marinas, touristic resorts, highways and other projects (power plants and oil lines, etc.), land appropriation, dumping of untreated sewage and industrial wastes into the open sea, pesticide residues from agricultural use, unsustainable fishing methods... Not to forget the natural problems facing this ecosystem such as coastal and beach erosion.
Exceptional ministerial decrees, emanating from the council of ministers, enable the establishment of large scale development projects along the coast without taking into consideration the recommendations of neither EIAs nor SEAs. These exceptions have a detrimental effect on the image of law enforcement and impede on proper IA studies.

**Actions:**
The NBSAP goal related to marine biodiversity conservation is to protect Lebanon’s coastal and marine biodiversity and develop their resources in a sustainable way. The objectives are to protect marine ecosystems and biodiversity; and to use marine resources in a sustainable manner by creating partnerships with the stakeholders, in particular, the local communities. This can be achieved through the identification of hot spots and land based sources of pollution in addition to human induced maritime sources of pollution, limiting further industrial development along the coast, conducting EIA surveys prior to construction of treatment plants, enhancing law enforcement authorities, establishing natural reserves and marine parks representing major eco-geographical areas, compiling an updated national database of local flora and fauna.

Some actions that have been already implemented include the declaration of Palm Islands (1992) and Tyre Coast (1998) as Nature Reserves; conducting studies for the protection of Nakoura and Damour basin (through the Coastal Area Management Project – CAMP, 2004); and a study conducted by the American University of Beirut aiming at surveying coastal flora (Darwin initiative, 2002).

4. **Agro-biodiversity:**

**Ecological processes:**
Biological diversity also occurs among agricultural crops and livestock. Even though imported and genetically modified crops generate higher yields, traditional crops are indisputably hardier since they exhibit higher drought resistance, higher salt and heat resistance, and lower susceptibility to pests and diseases. Consequently, traditional crops and wild cultivars, while less productive, require less water and agro-chemicals. Basic ecological processes affecting agrobiodiversity may be the same as those affecting biodiversity in terrestrial systems.
**Status of biodiversity:**
The diversity of traditional landraces is strongly declining and at a major risk due to the introduction of new, more profitable crop varieties; monoculture; and the effect of overgrazing, natural hazards and human activities such as quarries. Livestock biodiversity which includes wild types and local breeds, such as the Awassi breed, is quickly disappearing from rural areas since they are not considered as economically significant anymore; they are being replaced with higher yielding and more efficient breeds.

**Problems facing biodiversity:**
Many factors have led to the erosion of genetic resources and loss of agro-biodiversity in Lebanon and these include: the increase in population growth, the conversion of agricultural and wild lands to urban areas, soil erosion, desertification and deforestation, indiscriminate use of agrochemicals, pollution of water resources and disposal of solid wastes and sewage, changes in farm animal production systems from large and extensive to small and intensive, abandonment of many traditional native plants and animals.

**Actions:**
The NBSAP goal related to general measures for the conservation of agro-biodiversity is to protect Lebanon’s agricultural diversity from degradation and to maintain agricultural resources availability while maximizing both environmental and economic benefits. The objectives are to protect the agricultural ecosystems and to maintain native biological diversity; to protect agrobiodiversity from deleterious agricultural practices; and to develop and implement policies and practices to minimize loss in genetic diversity. Other objectives include the establishment of a national biodiversity database for documentation and monitoring of biodiversity and developing partnerships with the environmental community at the national, regional and international level.

These objectives can be achieved by conducting environmental/economic assessments for new construction projects, buildings, roads, etc., in agricultural areas, establishing traditional farms to maintain and propagate the traditional or "heritage" varieties or breeds that are being replaced by "modern" varieties, establishing a central gene bank, reducing excessive use of agrochemicals, issuing guidelines for the conservation of agrobiodiversity, establishing a national database for crops, weeds and livestock...
**Biodiversity Functions & Values**

At many times biodiversity is underestimated for what it can offer, although many functions and values can be derived from biodiversity. Directly-derived functions from biodiversity can be from the use flora and fauna. Indirectly-derived functions from biodiversity can be from services provided by ecosystems, as another example (Decision VI/7, CBD). Other functions include production, carrying, processing and regulation, air-related processing and regulation, biodiversity-related regulation, and signification functions. Processing deals with the natural or man-made transformation of natural resources. Regulation deals with prevention, control, and protection of natural resources (for a non-exhaustive list of examples of functions of the natural environment refer to Appendix 1). Some typical functions and services of biological resources (The World Bank Environment Department, 2000) are listed below.

**Ecosystem Services**

- Protection of water resources (maintenance of hydrological cycles, regulation and stabilizing water runoff and underground water tables, acting as a buffer against extreme events such as flood and drought)
- Purification of water (e.g. by wetlands and forests)
- Soils formation and protection (maintenance of soil structure and retention of moisture and nutrient levels helping to preserve soil’s productive capacity)
- Nutrient storage and recycling (of atmospheric as well as soil-borne nutrients both necessary for the maintenance of life)
- Pollution breakdown and absorption (by components of ecosystems ranging from bacteria to higher life forms, and ecological processes)
- Contribution to climate stability (vegetation influences the climate at the macro and micro level)
- Maintenance of ecosystems (maintaining a balance between living things and the resources - such as food and shelter - they need to survive)
- Recovery from unpredictable events (such as fire, flood, cyclones and disasters initiated by humans)

SPNL: Shouf Cedar Nature Reserve – Mist is a natural phenomenon. Resulting from evaportranspiration, it contributes to climate regulation. Urban sprawl along the coast and eastern hills of Beirut, have lead mist formation to occur at higher altitudes, as witnessed by the inhabitants of Aley area.
Biological Functions - Supplier of:
- Food (animals, fish, plants)
- Genes (a huge resource which is being used for example to improve the quality and quantity of food supplies and the range and depth of medicines)
- Medicinal resources (one of the oldest uses of biological resources, the current supplier of many current medicines, such as antibiotics and the potential supplier of many future medicines, such as cancer treatment drugs)
- Biological control agents (natural pesticides and herbicides)
- Materials (fibers, coatings such as Shellac, keratins, adhesives, biopolymers, oils, enzymes)
- Wood products (including wood for fuel, construction and paper production)
- Breeding stocks, population reservoirs (providing support systems for commercially valuable environmental benefits and resources)
- Future resources (a huge "bank" for discovered and not-yet discovered resources developed to increase human welfare)

Social Functions - Supplier of:
- Research, education and monitoring facilities (living laboratories for studies on how to get better use from biological resources, how to maintain the genetic base of harvested biological resources and how to rehabilitate degraded resources)
- Recreation and tourism facilities
- Cultural values (since human cultures co-evolve with their environment, the natural environment provides for many of the inspirational, aesthetic, spiritual and educational needs of people)
- Warning signs (biological resources provide "indicators" of, for example, environmental degradation which can help humans mitigate against shortages, disasters)
Ecosystem services include provisioning, regulating, and cultural services; the benefits from these directly affect people and supporting services needed to maintain the other services.

**Provisioning Services:**
Products obtained from ecosystems
- Food
- Freshwater
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

**Regulating Services:**
Benefits obtained from regulation of ecosystem processes
- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

**Cultural Services:**
Nonmaterial benefits obtained from ecosystems
- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

**Supporting Services:**
Services necessary for the production of all the other ecosystem services
- Soil formation
- Nutrient cycling
- Primary production
Human Activities Affecting Biodiversity

The interaction between humans and natural systems depend to a large extent on the direct and indirect uses of biodiversity. Biodiversity is the basis of human existence and its loss has profound implications for economic and social development. As illustrative examples, the following activities can have minor or major effects on biodiversity:

**Agriculture:** the agricultural sector is the main sector directly affected and affecting biodiversity. Agricultural development deals with crop production, fish production, rearing of animals for products such as milk, wool, eggs and meat, etc. This sector may cause a threat to biodiversity if pesticides and fertilizers are used unwisely, overharvesting and overfishing is practiced, forested areas are converted to agricultural lands, and if wild, traditional landraces are replaced by commercial crops and GMOs. The neglect of terraces also leads to soil erosion with the subsequent loss in vegetation cover.

**Industry:** this sector is varied and includes among others food processing, tobacco, metal, chemical, mineral and construction material industry, wood manufacturing, tanneries, sand and and stone quarries and artisanal work. Industrial operations may cause a big threat to the environment, biodiversity in particular, in the absence of laws and regulations with regards to air and water pollution, land degradation, and solid waste and wastewater dumping without management and treatment.

- Lebanon's mountain tops are protected by law as they constitute the major source of freshwater. The increase in numbers of ski resorts and tourism projects on these sensitive areas calls for the development of rules and regulations that need to be backed by proper IA implementation and monitoring.

**ADVERSE IMPACTS OF TRADE AGREEMENTS**

The lack of assessment of bilateral economic agreements including the trade of agricultural products, in addition to the calendar of imports being highly competitive over Lebanese production, have lead Lebanese farmers to adopt intensive practices and to shift from one crop to another without any long-term planning. Thus agricultural entrants are being used intensively to ensure the highest yield, without any consideration for the impacts on the pollution of water-tables, health factors and impacts on beneficial insects and wildlife.
Tourism: tourism can have both negative and positive effects on biodiversity. Negative effects on sensitive habitats may result from development projects such as coastal and mountain resorts during their construction and operation. Problems also arise in the absence of studies dealing with the carrying capacity of tourists in important touristic areas. However, positive effects may arise from touristic activities that rely on protected and conserved environments, such as eco-tourism.

Urbanization: urban sprawl significantly impacts the environment through the expansion and conversion of more lands to urban areas at the expense of sensitive and valuable ecosystems. In Lebanon, it typically occurs in a linear form along roads and highways, thus increasing the cost of solid waste and wastewater management.

Transport: the building of roads or highways has a huge impact on biodiversity due to habitat fragmentation and habitat loss. In addition during the construction phases, improper processes may lead to the loss of vegetation cover in a significant area surrounding the construction zone.

Poverty and lack of awareness: meager social conditions such as poverty and lack of awareness can also aggravate the degradation of biodiversity in all its productive aspects, through excessive, overgrazing on degraded lands, unsustainable collection of edible and medicinal plants and the overharvesting of wildlife through hunting.

EFFECT OF MOUNTAIN RESORTS ON BIODIVERSITY
During the winter season, snow compactors compress the soil and damage underlying plant species. In summer, more degradation results from uncontrolled offroading on the sensitive slopes. This sector requires operation standards and norms to be set and enforced.

SPNL: Bentael – If proper practices are not adopted during road construction, they can result in significant habitat fragmentation and erosion of the vegetation cover.

SPNL – Hermel: During the winter of 2005, the decision taken by the GoL to increase fuel prices resulted in a drastic surge in wood felling in most of Lebanon’s rural areas.
Integrating Biodiversity into EIA and SEA

When it comes to integrating biodiversity issues into EIAs and SEAs studies, complications arise. Consultants, NGOs, or any group undertaking such studies have difficulty including biodiversity in each stage of the process. For this reason, it becomes easier to explain to stakeholders how to deal with biodiversity-related issues by going one stage at a time. The guidelines and method of biodiversity assessment below are applicable to both EIAs and SEAs, nevertheless, biodiversity concerns in SEAs should be addressed from the early stages of the drafting process of any new legislative and regulatory framework (CBD decision V/18, paras. 1(c) and 2(a)), plan, policy, or program, and at the early levels of decision-making and/or environmental planning (decision V/18, para. 2(a)).

1. SCREENING
In order for projects with potentially detrimental effects on biodiversity to be subject to EIA, screening procedures should include biodiversity criteria. Projects include those that are likely to have impacts on biodiversity at genetic, species, or ecosystems level (refer to Appendices 2 and 3). The project’s spatial context is also important during screening since any proposed project, programme, or policy to be implemented in or adjacent to critical habitats (such as a protected area) should be subjected to full EIAs or SEAs.

The screening stage of an EIA should take into consideration the impacts on wide ranging species that rely on various habitats in case the project is in or adjacent to the critical habitat. Different types of screening mechanisms may be used in that stage. These include positive lists identifying projects requiring EIAs, expert judgment, or a combination of both. Positive lists establish a set of specific criteria that are used to determine which projects require full-scale EIA, which ones require some form of further environmental analysis, and which do not require any further environmental analysis.

2. INITIAL ENVIRONMENTAL EVALUATION
Despite the short time allocated to this part, the initial environmental evaluation should take account of impacts at the genetic, species, and ecosystem levels on a local, regional, national, and global basis. It should also take into account the general ecological, economic, and social impacts of the project through underlining potential conservation, sustainable use, and benefit-sharing impacts.

3. SCOPING
The scoping stage is vital for the identification of impacts which are to become the focus of a full assessment. In this stage, four important principles should be considered in terms of biodiversity: spatial context, cumulative effects, public participation, and biodiversity criterion (refer to Appendix 4).

- The spatial context of the study includes time and place parameters. In order to provide a regional context for the impacts and to ensure a long term viability of biodiversity it is very important to include concepts of ecological processes or components such as migratory or nesting ranges for birds and other species of animals.
With the appropriate parameters, the cumulative effects of other activities and the added effect of the project helps identify the impacts to be studied. Impacts defined in the scoping stage are often influenced by the background and experience of the assessment team. It is hence important to afford opportunities for public participation by engaging community members, regulatory authorities, decision makers, and outside experts to introduce a degree of objectivity into the study. These experts should be from a variety of disciplines including biodiversity, ecology, economics, legal, sociology and specialized experts according to the type of project.

Biodiversity criterion to be included in the scoping guidelines and legislation should encompass information on areas with high levels of biodiversity, critical habitats, endangered and keystone species, exotic and invasive species, and existing threats to biodiversity that the project may exacerbate. The economic and social dimensions of the biodiversity agenda, particularly the underlying causes of biodiversity loss, also need to be considered.

**SPATIAL SCALE OF STUDY** (Ramsar Convention, 2002)

In relation to wetlands, the spatial scale to be considered may sometimes be wider than the ecosystem itself. The river basin (water catchment), for example, is an important spatial scale at which to address aspects of wetland-related impacts. Also, an assessment of impacts should necessarily include the scale of the migratory range (flyway) of relevant migratory fish or birds populations in the area. Since migratory paths involve a chain of ecosystems (perhaps disjunctive ones), a broader perspective in the study should be taken into consideration.

**QUESTIONS FOR PRACTITIONERS TO CONSIDER WHEN DETERMINING SPATIAL/TIME PARAMETERS OF THE IA** (CEAA, 1996)

- Could any migratory species be affected in another portion of their range which would hence cumulatively affect the species/population?
- What time, spatial, or other issues need to be considered for each of the species, communities and ecological processes affected by the project?
- Do major systemic or population changes appear to be taking place?
- What historical trends or cumulative losses of species and habitat are involved?

**QUESTIONS FOR PRACTITIONERS TO CONSIDER WHEN SCOPING FOR ASPECTS OF BIODIVERSITY** (CEAA, 1996)

- Which human actions currently or potentially affect the environment?
- How degraded is the environment?
- Which resources are the most affected?
- What changes to these actions could improve the situation?
- What changes are expected in the next 5 years?
- What species, communities and ecological processes would be impacted by the project?
- Are any of these species endangered, endemic, sustainably used, new to science or special in some other way?
- How much habitat would be eliminated or degraded, including short-term use areas vital to seasonal, life-history or migratory cycles?
- Are critical thresholds or levels of capacity being reached, i.e., are the species already in severe decline?
- What values does society attribute to each species, community and ecological process?
4. THE IA STUDY

a. Identification
To adequately identify impacts on biodiversity, certain criteria must be included in methodologies applied at this stage: such criteria should identify ecosystems and habitats containing high diversity, large numbers of endemic or threatened species, threatened wilderness, habitats that are required by migratory species, those that are of social, economic, cultural, or scientific importance, and those that are representative of unique biological processes. Whether at sector or project level, this stage should identify species and communities which are threatened, species which are wild relatives of domesticated or cultivated species, others that are of medicinal, agricultural or other economic value, those that are of social, scientific, or cultural importance, and finally those that are of importance to research into biodiversity. Described genomes and genes of social, scientific or economic importance should also be identified. Last but not least this stage should recognize processes and categories of decisions/activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity. Threats to biodiversity from such decisions/activities might include:

- habitat degradation/modification due to mining, clearing, reclamation, pollution or construction (e.g. along river basins)
- direct exploitation of species such as over-collection, poaching, logging, or road-kills
- spread of invasive alien species
- natural phenomena such as forest fires, prolonged drought and floods

Different methodologies exist for predicting impacts on biodiversity resources. These include checklists, matrices, networks, overlays and computer aided methods, and other specialized biodiversity or habitat suitability models.

i. Checklists
Checklists can vary in complexity and characteristics from a very simple list to a system that also assigns significance through the scaling and weighting of impacts. Simple checklists, descriptive checklists, questionnaire checklists, and weighting-scaling checklists all share the common basis of an index of environmental factors or development activities.

Simple checklists provide the assessor with a list of factors to be considered, but no information provided on specific data needs, methods of assessing importance of impacts, and ways of measuring change to environmental factors. They can be more likely used as an ‘aide memoir’ to identify impacts and to provide structure to initial part of scoping stage. However checklists are not effective in identifying higher order impacts on the inter-relationships between impacts; therefore impacts other than those listed may be important and should be consequently considered.

SPNL – Shouf Cedar Nature Reserve; The Syrian Serin is a restricted range species classified as vulnerable on the IUCN red data list.
### SIMPLE CHECKLIST OF POTENTIAL IMPACTS OF THE CONSTRUCTION PHASE OF TRANSPORTATION PROJECTS

(Methodologies for predicting impacts on biodiversity resources, Dr. Asha Rajvanshi)

<table>
<thead>
<tr>
<th>Noise Impacts</th>
<th>Construction Phase</th>
</tr>
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<tbody>
<tr>
<td>I. Noise impacts</td>
<td>x</td>
</tr>
<tr>
<td>A. Public health</td>
<td></td>
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<tr>
<td>B. Land use</td>
<td></td>
</tr>
<tr>
<td>II. Air quality impacts</td>
<td>x</td>
</tr>
<tr>
<td>A. Public health</td>
<td></td>
</tr>
<tr>
<td>B. Land use</td>
<td></td>
</tr>
<tr>
<td>III. Water quality impacts</td>
<td>x</td>
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<tr>
<td>A. Groundwater</td>
<td></td>
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<tr>
<td>1. Flow and water-table alteration</td>
<td></td>
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<tr>
<td>2. Interaction with surface drainage</td>
<td></td>
</tr>
<tr>
<td>B. Surface water</td>
<td></td>
</tr>
<tr>
<td>1. Shoreline and bottom alteration</td>
<td></td>
</tr>
<tr>
<td>2. Effects of filling and dredging</td>
<td></td>
</tr>
<tr>
<td>3. Drainage and flood characteristics</td>
<td></td>
</tr>
<tr>
<td>C. Quality aspects</td>
<td></td>
</tr>
<tr>
<td>1. Effect of effluent loadings</td>
<td></td>
</tr>
<tr>
<td>2. Implication of other actions, such as a. Disturbance of benthic layers</td>
<td></td>
</tr>
<tr>
<td>b. Alteration of currents</td>
<td></td>
</tr>
<tr>
<td>c. Changes in flow regime</td>
<td></td>
</tr>
<tr>
<td>d. Saline intrusion in groundwater</td>
<td></td>
</tr>
<tr>
<td>3. Land use</td>
<td></td>
</tr>
<tr>
<td>4. Public health</td>
<td></td>
</tr>
</tbody>
</table>

| Soil erosion impacts | x |
| A. Economic and land use | |
| B. Pollution and siltation | |

| Ecological impacts | x |
| A. Flora | |
| B. Fauna (other than humans) | |

---

**ii. Interaction matrices**

Matrices can be considered as the two dimensional version of a checklist. They are grid-like tables that identify interactions between decisions/activities on one axis and environmental parameters on the other. They exist in a variety of forms: magnitude matrix, time dependent matrix, and weighted matrix. Impacts in the table can be identified by:

- signs, ticks or symbols to indicate the type of impact
- numbers or a range of dot sizes to indicate scale of impact
- descriptive comments to indicate the qualitative (‘good’, ‘moderate’, ‘high’, ‘positive’, ‘negative’) and quantitative traits of the impact (absolute/relative).

The Leopold matrix is the best known comprehensive interaction matrix; it has 88 environmental characteristics along the top of the table and 100 decisions/actions in the left hand column and is suitable for use in most construction projects.
The following is an example of an incomplete Leopold matrix for transportation.

<table>
<thead>
<tr>
<th>Biological</th>
<th>Physical Environment</th>
<th>Social Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>River regime</td>
<td>Public participation</td>
</tr>
<tr>
<td>Shrubland</td>
<td>Erosion/land stability</td>
<td>Employment</td>
</tr>
<tr>
<td>Grassland</td>
<td>Sedimentation</td>
<td>Settlement</td>
</tr>
<tr>
<td>Herbfield (alpine)</td>
<td>Surface water</td>
<td>Land value</td>
</tr>
<tr>
<td>Sand/shingle/rock</td>
<td>Ground water</td>
<td>Existing land uses</td>
</tr>
<tr>
<td>Cropland</td>
<td>Agricultural soil</td>
<td>Risks and anxieties</td>
</tr>
<tr>
<td>Urban land</td>
<td>Foundation materials</td>
<td>Personal and social</td>
</tr>
<tr>
<td>Lakes</td>
<td>Climate/atmosphere</td>
<td>values</td>
</tr>
<tr>
<td>Rivers</td>
<td>Nuisance (noise, dust,</td>
<td>Historical/cultural</td>
</tr>
<tr>
<td>Estuaries</td>
<td>smell)</td>
<td>Landscape/visual</td>
</tr>
<tr>
<td>Inter-tidal</td>
<td>Landform</td>
<td>Recreation</td>
</tr>
<tr>
<td>Marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetlands</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental Effects</th>
<th>Development</th>
<th>Transport - People</th>
<th>Road</th>
<th>Rail</th>
<th>Air</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transport - Materials</td>
<td>Road</td>
<td>Rail</td>
<td>Air</td>
<td>Water</td>
<td>Pipelines</td>
</tr>
<tr>
<td></td>
<td>Energy supply - Transportation to Site</td>
<td>Electricity</td>
<td>Gas</td>
<td>Oil</td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water supply</td>
<td>Source</td>
<td>Transport</td>
<td>Water disposal</td>
<td>Solid</td>
<td>Liquid</td>
</tr>
</tbody>
</table>

Source: UNEP, EIA Training Manual, 1996
iii. Networks
Networks can be used as means of establishing the causal chain of impacts. They go further than checklists and matrices to offer a three dimensional approach to identifying impacts. Simplified networks are useful in identifying second-order impacts (indirect, synergistic, etc) since they illustrate the multiple links between decisions/activities and environmental characteristics especially if used in conjunction with other methods. Computer programs can be used to help in more detailed networks which can be time-consuming and difficult to produce.

iv. Overlays
Map overlays or computer images can be used to display impacts pictorially. The original overlay technique included the superimposition of mapped data onto transparencies to gain an overall visual impression of the concentration of impacts. Nowadays computer data-based geographical information system or GIS are utilized for analysis and computer modeling purposes. The picture below represents overlays of different maps including maps of ecological sites, historic sites, visual maps, settlement maps, or water maps.
The table below lists the main advantages and disadvantages of the various impact identification methods (adapted from MoE/METAP/UPP, 2001 and Methodologies for predicting impacts on biodiversity resources, Dr. Asha Rajvanshi):

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checklists</td>
<td>• Simple to understand and use&lt;br&gt;• Good for site selection and priority setting&lt;br&gt;• Not necessarily sector/project specific&lt;br&gt;• Once established, can be used in many different situations</td>
<td>• Do not distinguish between direct and indirect impacts&lt;br&gt;• Provide no quantitative information on impacts&lt;br&gt;• Do not link action and impact&lt;br&gt;• The process of incorporating values can be controversial&lt;br&gt;• Can never be considered as definite or complete&lt;br&gt;• Tend to compartmentalise</td>
</tr>
<tr>
<td>Matrices</td>
<td>• Link action to impact&lt;br&gt;• Good method for displaying EIA/SEA results&lt;br&gt;• Relationships between development and environment made explicit&lt;br&gt;• Easily modified, so many varieties have been developed and used</td>
<td>• Difficult to distinguish direct and indirect impacts&lt;br&gt;• Significant potential for double-counting of impacts&lt;br&gt;• May not provide an objective method for comparing impact magnitudes or importance</td>
</tr>
<tr>
<td>Networks</td>
<td>• Link action to impact&lt;br&gt;• Useful in simplified form for checking for second order impacts&lt;br&gt;• Handles direct and indirect impacts</td>
<td>• Can become very complex if used beyond simplified version</td>
</tr>
<tr>
<td>Overlays</td>
<td>• Easy to understand&lt;br&gt;• Good display method&lt;br&gt;• Good siting tool (can predict geographical location of impacts)&lt;br&gt;• Conceptually simple&lt;br&gt;• Highly versatile&lt;br&gt;• Appropriate for assessing impacts occurring on large areas (impacts of hydropower project on regional hydrology, landscape level impacts)</td>
<td>• Address only direct impacts&lt;br&gt;• Do not address impact duration or probability</td>
</tr>
<tr>
<td>GIS and computer expert systems</td>
<td>• Excellent for impact identification and analysis&lt;br&gt;• Good for ‘experimenting’</td>
<td>• Heavy reliance on knowledge and data&lt;br&gt;• Often complex and expensive</td>
</tr>
</tbody>
</table>
The combination of two different techniques may be the best approach to adopt since not one single impact identification methodology is necessarily comprehensive by itself. In addition to that not one methodology is fit to use on all occasions. The choice of methodology depends on a number of factors:

- type and size of the proposal
- type of alternatives being assessed
- nature of the likely impacts
- nature and appropriateness of the impact identification method
- experience of the EIA/SEA team with the impact identification method
- resources available - cost, information, time, personnel
- nature and extent of public involvement in the process
- experience of the proponent with the project type and size
- any procedural/administrative requirements or constraints

b. Examination of Alternatives

Biodiversity issues should be included in the development of alternatives and in their analysis. When looking into alternative project designs or sites, it is then possible to design projects which inherently consider and address biodiversity issues while simultaneously addressing their other objectives. This step is particularly important for addressing the sustainability objectives of the CBD. Further on, it is critically important to know how and when alternatives are considered in the EIA and planning cycle; this can help in the effective integration of biodiversity issues at the stage of implementation. For effective and efficient initiation of alternatives, these need to be considered at the earliest possible phases of the cycle. Stakeholders should be involved in the identification of the impacts, benefits, and costs of alternatives, not least because their interests will be affected by the decisions taken.

c. Prediction

It is generally acknowledged that data and information on the state of biodiversity are scarce and insufficient. Existing baseline data can be supplemented by further studies if necessary, and the timing and budget to undertake these studies should be allocated within the Impact Assessment study. Quality data are crucial for accurate prediction and insufficient research can lead to unacceptable levels of uncertainty. Where further information is required, assessment teams could use the Clearing-House Mechanism (CHM) of the CBD and other sources of data such as the Biodiversity Conservation Information System (BCIS). The CHM and BCIS are Internet based data sources currently under development. Their addresses, respectively, are: http://biodiv.org and http://biodiversity.org. These information systems are used for exchange of information and the Biodiversity CHM for Lebanon is currently under construction.

Developers may wish to down-tune the impacts for which they are most likely to be held accountable. In all cases, the allocation of certain areas for specific purposes is well known to cause a number of ecological impacts, both direct and indirect. It is important to know the nature of the impact, its magnitude, extent/location, timing, duration, reversibility/irreversibility, likelihood, and its significance. Impact prediction draws on physical, biological and socio-economic and anthropological data and techniques.

Species may be affected in a number of ways as a result of environmental change such as air, water, and noise pollution increase. Freshwater streams and rivers, for example, may be affected both in terms of water quantity and quality. In other words, a change
in flow rate might directly promote or reduce invertebrate drift within streams, with its consequent effects on other biota. With regards to a qualitative change such as eutrophication, both plant and animal populations will be similarly affected within the water body. Physical change in the form of increased sediment load may affect fish population densities. In another context, habitat fragmentation may occur in linear projects such as roads, pipelines, canals, and airport runways. This impact is mainly addressed through the proposal of mitigation measures such as planting hedgerows to maintain the connections between fragmented patches. Other related development activities might affect biodiversity through the:

- direct loss of species
- loss of wildlife habitat with the consequent loss of unique and/or endangered species
- impacts on home ranges, territory size
- direct impact on food availability
- changes in migration patterns
- spread of invasive alien species
- habitat degradation

**d. Evaluation of significance**

Impact significance is determined by considering both of the impact characteristics (magnitude) and the impact importance (value). Impact significance can be categorized into extreme, severe, substantial, moderate or slight. Therefore certain criteria should be agreed in order to assess the significance of impacts. Such criteria include:

- duration of actions
- location of affected site(s)
- urgency and quickness with which the natural systems might deteriorate
- degree of irreversible damage to natural resource base and resource quality

The ecological importance of an impact is a crucial factor to be taken into account. This should be determined through a set of significance criteria such as:

- effect on plant and animal habitat
- rare and endangered species
- ecosystem resilience, sensitivity, biodiversity and carrying capacity
- viability of local species population

The prediction of impact characteristics can be based on professional judgment, quantitative mathematical models, experiments, indices, models and case studies.

**i. Professional judgment**

Whenever there is a lack of data or a lack of analytical methods to support predictions, specialist practitioners can be called upon to help assess impact significance. It is important to engage specialists who are very experienced in their field. Ecologists for example can directly state that emissions of gases from stacks are expected to have deleterious effects on plant life, or that water fluctuation may seriously affect nesting and feeding grounds of water birds.
ii. Quantitative mathematical models
Such models are mathematical expressions developed to stimulate some aspect of reality. The inputs into the model may be changed in order to see how the outputs are affected. Mathematical models are now increasingly being developed to analyze biological, social/demographic, and economic impacts in addition to the physical impacts.

iii. Experiments and physical methods
Both methods can be used to test and analyze the effects of project-like activities on the environment as well as the effectiveness of proposed mitigation measures. Experiments may be done under laboratory conditions or directly in the field. An example of the use of experiments includes the exposure of fish in a laboratory to pollutants to determine rates of uptake and retention. Physical models may be built to predict the behavior and effect of decisions/activities on the environment.

iv. Case studies
In some situations it is considered important to review case studies of similar proposals in similar environments; they can provide a good basis confirming the direction and findings of impact assessment.

e. Mitigation
Stakeholders provide crucial insight about options. Alternatives are reconsidered with reference to new information from the prediction and significance steps. In order to mitigate impacts, incentive measures should be used whenever possible since they are powerful methods of moving people towards lifestyles compatible with biodiversity conservation, sustainable use, and equitable benefit sharing. Incentive measures work with rather than against rational decision-making processes. Environmental Management Plans (EMP) should also be included as mitigation measures for projects with impacts in their operational phases. The principle of 'no net loss' of ecosystems, species populations, or genetic diversity can guide the design of mitigation measures in a way that degraded habitats for example can be restored in the place of those altered. Whatever the mitigation measures recommended, they are useless if not accompanied by implementation and monitoring plans to ensure they perform as planned. Mitigation measures for biodiversity impacts include avoidance, reduction, moderation, and minimization, relocation and translocation, repair, reinstatement, and restoration, compensation, enhancement and mitigation banking.

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**TYPICAL MITIGATION MEASURES**
(The World Bank Environment Department, 2000)

- Full site protection through project re-location or re-design (avoidance)
- Strategic habitat retention (minimization)
- Restricted conversion or modification (minimization)
- Measures to minimize ecological damage (minimization)
- Post-development restoration works (compensation)
- Ex-situ measures, e.g... captive breeding, plant seed banking (compensation)
- Translocation and/or re-introduction of species (compensation)
- Restoration of degraded habitats (enhancement)
- Establishment and maintenance of ecologically similar protected area of suitable size and integrity (enhancement or offset)
i. Avoidance
This mitigation option is used for sensitive designs to avoid the disturbance that might occur to key areas such as protected areas. Siting is based on least damage criteria; for example the timing of project activities such as to avoid disturbance of fauna during nesting, fawning, or breeding period. Some preventive measures may be proposed to avoid irreversible impacts on biodiversity; this may include ‘no go’ options as a precautionary approach.

ii. Reduction, moderation, minimization
Such mitigation options may include:
- the substitution of techniques using BATNEEC (Best Available Technology Not Entailing Excessive Costs) such as pollution abatement techniques to reduce emissions to the legal limits
- promoting bio-friendly technologies
- controlled or regulated access during construction or operation
- landscape and urban planning such as designing an expressway landscaping to complement natural ecology for extensions of habitats
- nature engineering solutions such as wildlife bridges, tunnels, fences and ‘ecoducts’
- modification of a proposal such as the realignment of a road sections
- alternative choices such as the use of wind power instead of thermal power

iii. Rescue (relocation, translocation)
Mitigation in this case would deal with the:
- translocation of plant/animal/habitat component
- removal and storage of top soil for restoration of wetland and terrestrial habitats
- collection of seeds to ensure a supply of locally adapted native plants which may be a useful practice in restoration of mined out areas

iv. Repair, reinstatement, restoration
Mitigation options may include activities such as the reinstatement of natural habitats, the restoration of hydrological functions which occur due to construction of check dams, stabilization of river banks by the reconstruction of riparian areas for their subsequent use by species, and the restoration of eroded areas by special measures.

v. Compensation
Compensation can be achieved through upgrading the legal status of habitats of equivalent or better biodiversity values for improving protection to offset losses due to land take elsewhere. Habitat areas may also be substituted or financial resources can be provided for ‘creative’ management such as the naturalization of managed areas.

vi. Enhancement
This option can be achieved through enhancing existing degraded habitats and creating additional habitats to partially offset the loss of those removed by the project. New habitat on alternative sites may also be created such as in the case of re-vegetating vacant lands, landfills, or exposed rocks. A third activity might deal with proposing alternative substitutes for enhancing habitat use and value such as artificial nests for improving habitat use.
vii. Mitigation banking

Mitigation banking deals with the creation or rehabilitation of wetlands in one location that can be used to replace degradation or destruction of natural wetlands in another.

Identifying alternatives as early as the planning stage might be useful in offsetting biodiversity losses. The feasibility of the mitigation options depend largely on the financial, technological, and operational resources available. In other words, the mitigation options for biodiversity impacts proposed in EIA or SEA studies are affected by:

- conservation status of species that would be most affected
- reversibility of impacts
- restoration potential of habitats
- duration of impacts
- availability of mitigation measures
- cost of mitigation

### EXAMPLES OF MITIGATION MEASURES RELATED TO BIODIVERSITY

(Compiled from Erickson, 1994 and Bennet, 2003)

**Case 1.** In an effort to mitigate the roadkills of boar in a remote area, an expensive underpass is constructed to serve as a means for animals to migrate safely from one side of the highway to the other. With the use of appropriate fencing the number of roadkills can actually be reduced however local hunters might use underpasses as a funnel to direct wildlife straight into their gunsights.

**Case 2.** A highway is constructed with a relatively wide median strip. Members of the design team decide to plant the median strip with a long-flowering berry-producing shrub which would enhance the aesthetic values, vehicular safety and wildlife values. After the project was completed and over a period of several years, the project received much praise for the beauty of the flowers and the vehicular safety. Wildlife biologists were also pleased because the berries attracted local bird populations. Overlooked, however, is the fact that, in periods of drought, the berries ferment causing the intoxicated birds to move unpredictably among traffic lanes and cause many vehicular accidents.

**Case 3.** Linkages can be used as an important mitigation measure for rectifying project impacts. Linkages and corridors are very important in securing the integrity of vital environmental processes such as periodic flooding and in connecting isolated patches of habitat thereby increasing the viability of local species populations by:

- allowing access to a larger area of habitat (e.g. for foraging, the dispersal of juveniles or the recolonization of other habitat patches)
- allowing seasonal migration
- permitting genetic exchange with other populations
- allowing local populations to move away from a degrading habitat

**Case 4.** Habitat restoration can also be used as a compensatory measure for the damage caused to the environment by development projects. It involves the reconstruction of natural and semi-natural ecosystems after development. The importance behind restoration ecology is that it produces communities that enhance the ecological resources in a particular area.
f. Documentation
The Environmental Impact Study (EIS) is all too often a weighty volume written in technical jargon, making EIA/SEA inaccessible and intimidating. EIS should be clear and concise. To add to the problem, combining the jargon of EIS with the jargon of biodiversity is likely to exacerbate the situation. This problem can be alleviated if executive summaries are considered however serious efforts need to be exerted to ensure that the EIS is accessible to groups of relevant stakeholders.

5. REVIEW
This stage is important to the credibility of the EIA process and the review team should ensure that biodiversity issues specifically have been adequately addressed. Biodiversity experts should be available for consultation by the review team or be included in the EIA team itself. The public should also be widely consulted to ensure the process is transparent, understandable and acceptable.

6. MONITORING
Monitoring methods should be established in prediction and mitigation stages of the study. Biodiversity data obtained through monitoring should be included in global data services such as the CHM Lebanon and BCIS and should be readily accessible to anyone through the MOE or other agency. Monitoring usually involves measuring trends and changes over time. Certain plant and animal taxa are sensitive to changes in their natural environment; these can be used as indicators to monitor the impacts of specific development projects. The selected indicators should be able to differentiate between natural cycles or trends and those induced by anthropogenic stress.

7. POST-PROJECT AUDIT
Concerning biodiversity, an audit could be used to establish how well the objectives of the CBD are met through existing IA processes; this would then help determine the relevance of IA as a tool for fulfilling the CBD objectives and obligations.
A study was done in the aim of describing the definitions and perceptions of biodiversity by those involved in preparing EIAs (Wegner et al. 2005). One particular hypothetical question asked to 19 practitioners in Western Australia pertained to assessing the effects of mining on the biodiversity of internationally important wetlands. The answers revealed three related but differentiated approaches among the practitioners: the elementary, conventional and extended approaches. The approaches differ in their degree of sophistication and comprehensiveness.

The first approach (fig 1) relies predominantly on biological surveys. According to this approach, genetic diversity should only be considered if rare or endemic species are found.

The conventional approach (fig 2) begins with the strategic recommendation that the proposed development should not be considered in that location due to the area’s international importance. If the development is pursued biodiversity (such as the wetland’s representativeness and uniqueness) should then be considered in its regional context. The scale of impacts is also given a regional context by examining regional and downstream consequences of the development.

The extended approach (fig 3) expands on the conventional approach to consider spatial and temporal scale, community values and net conservation benefit.

EIAs conducted in Lebanon vary in their approaches to biodiversity. However, one cannot but notice that most of the studies fall under the elementary approach. Therefore there is a need to expand and build on the current practices to include assessment on the ecosystem, species, and genetic level, national and international relevance of projects, considerations of spatial and time scale, community values...
Fig. 1. The ‘elementary’ approach

Conduct flora & fauna survey → Assess representativeness of species → Review relevant international conventions → Review national legislation → Assess if endemic/are species are present → Yes → Include genetic diversity → End of assessment

No → End of assessment

End of assessment

Fig. 2. The ‘conventional’ approach

Assess wetland type/state/function → Assess representativeness of species → Assess uniqueness of wetland → Assess scale of impacts within regional context & downstream → Assess if migratory birds are present → Assess ecosystem diversity → Assess species diversity → Assess genetic diversity → End of assessment

End of assessment

Fig. 3. The ‘extended’ approach

Assess wetland type/state/function → Assess representativeness of species → Assess uniqueness of wetland → Assess scale of impacts within regional context & downstream → Assess if migratory bird are present → Assess ecosystem diversity → Assess species diversity → Assess genetic diversity → Assess genetic parameters → Consider spatial & time scale → Include community values → Demonstrate capacity or good management → Demonstrate achievement of net conservation benefit → End of assessment

Source: Wegner et al, 2005
**Biodiversity Baseline Studies**

As part of the scoping stage of EIA or SEA study, it is desirable to carry out a baseline study. Such studies should include the collation of existing and the collection of new data from field surveys. There should be a balance between the utilization of existing secondary information - a cheap source of data - and conducting new fieldwork, invariably much more expensive and requiring specialist skills. The main criteria to be addressed during the scoping process are the species, taxa, habitats and environmental variables. It is also crucial for the study to identify abiotic aspects of the environment that may act as key factors controlling ecological system function. This may require coordination between different specialists across various disciplines. The method of surveying and assessing biodiversity is resource dependent in terms of money, time, and expertise availability. An in-depth assessment survey should include or try to include all the steps explained below.

1. **COLLECTION OF SECONDARY INFORMATION**
   Secondary information is somewhat helpful in narrowing down the scope of work to accomplish more focused studies. It comprises all relevant published and/or unpublished information such as research papers/articles, status survey reports, species checklists, resource maps, vegetation profiles, species distribution records, plant/animal population estimates. Maps and images (topography & land use maps, aerial photos, RS images) are important secondary information acting as visual aids.

2. **DEVELOPING A SURVEY PROTOCOL**
   Before undertaking the survey some points need to be made clear in order to focus on the right type of information to be gathered. The following need to be prepared, developed or identified:
   - a grid map of the site to be surveyed
   - data sheets and a draft database
   - the faunal and floral groups to be surveyed: woody and herbaceous plants, vertebrate fauna (such as fish or mammals) and other selected invertebrate fauna
   - the period and frequency of the field survey schedule: choosing an appropriate time frame over which monitoring will take place is crucial to the success of the survey. The time of year when starting and ending a sampling programme is important since organisms are responsive to these seasonal changes. It should be clear whether the primary focus of a study is spatial or temporal, or both. Spatial studies may be done at one time of year with intensive comparable sampling. Temporal studies are much more demanding. As mentioned before, animals are affected by the seasonality and seasonal patterns of organisms. Seasonality of a certain species is the stage at which it is feeding, reproducing, molting etc. Seasonal patterns on the other hand are the stages at which the species is hibernating (in winter for example) or migrating from place to place.
   - the sampling techniques for documenting fauna and flora. These methods include:
     - **Mark-recapture/resight technique** is used for various animals to assess and estimate the relative abundance and density over a given area. It is based on capturing a proportion of the population, marking them, releasing them and recapturing them. This method gives a rough
estimate of population size. It has provided some valuable information on populations of mammals, butterflies and birds. Bird ringing is one mark-recapture technique which has been very useful in establishing the migratory routes of birds.

- **Radio tracking** is a variation of the mark-recapture technique whereby captured individuals are fitted with a radio transmitter on a collar or harness. This technique is used to monitor the movements of large mammal species and some large bird species.
- **Remote sensing** of populations through fixed point or ground-based photography. Repeated photographs taken from the same point over time may allow a species to be monitored. Measurements can be made, for example, of changes in the biomass of a plant species or of the activities at a bird nest.
- **Territory mapping, point counts and transects.** Territory, or spot mapping, is useful for estimating the numbers of pairs of birds or animals present in an area during the breeding season without having to capture the species. For point counts, individuals of species are counted from fixed points during a specified time interval, whereas for transects observers are required to walk along a particular route recording all the individuals of species on either side of the line walked.
- **Quadrat sampling** is used for sampling land plants and slow-moving animals such as soil fauna (macroinvertebrates) and benthic invertebrates. The quadrat which can be a square or a rectangle is placed in the place to sample and anything inside the quadrat is counted or sampled.
- **Traps, nets and dart guns** can be used for larger terrestrial animals
- **Nets, trawls, and electric shockers** can be used to sample aquatic animals

### 3. PERSONNEL RECRUITMENT

The success of a biodiversity assessment will depend on skilled personnel who are able to work in the field. A list of experts is listed in section 14. It is also important to include community members in that group since they may have local knowledge on biodiversity and they may be familiar with the specific site.

### 4. GATHERING OF RELEVANT MATERIAL AND EQUIPMENT

Equipment that might facilitate field sampling include GPS meters, digital cameras, binoculars, as well as insect nets, fishing nets, mammals traps, pit-fall traps, dart-guns, electric shockers and measuring tapes. In case of collecting specimen polythene bags, containers, and preservation solutions such as formalene or ethyl alcohol would be very useful. As for identification of different taxa field guides or identification keys can be very helpful in the field.

### 5. RECONNAISSANCE SURVEY

Some points should be considered and noted for the reconnaissance survey:

a. Identify local contacts
   - Local people possessing a wealth of local knowledge and experience on biodiversity
- Information on potential dangers to be avoided such as areas with land mines, trap guns, disease causing agents
- Important locations for logistical issues such as rest houses, hospitals/dispensaries, shops, fuel stations etc.

b. Determine survey boundaries and access routes
- Identify priority areas/habitats for systematic survey
- Determine scope of field investigations and verify pre-planned survey techniques for fauna and flora
- Confirmation of field survey schedule

6. CLASSIFICATION OF HABITATS
Habitat classification is generally based on
- Vegetation types (plant communities)
- Edaphic factors (soil types)
- Climatic factors (rainfall, temperature)
- Hydrological factors (water regime)

7. SYSTEMIC INVENTORIZATION OF FAUNA AND FLORA
Biodiversity inventorying provides fundamental and essential biological information used by many basic scientific disciplines. Inventorying can be at different biological levels; genetic, species, and ecosystem level. The time needed to complete an inventory and how often it will be necessary to conduct monitoring surveys depend on what is measured, how the results will be applied, what resources are available to carry out the study, and political and economic stability in the subject area. Two types of surveys exist depending on the time allocated for surveying:

a. Qualitative surveys
- to document presence of species, based on opportunistic visual encounter surveys in representative habitats
- diurnal and nocturnal surveys to observe fauna
- Rapid biodiversity assessments are most commonly applied to site-based problems and seek to inventory and survey ecosystems with high levels of biodiversity facing imminent threats. In this context, rapid biodiversity assessments are commonly undertaken as part of environmental assessments made in anticipation of large-scale development projects; these assessments generally use visual encounter surveys. Rapid assessments usually involve only those groups of organisms that are relatively well known and easily identifiable in the field. Depending upon the specific development proposal, it may be necessary to make a detailed investigation of any group, such as: lower and vascular plants, invertebrates, amphibians, reptiles, fish, birds, or mammals. Birds are amongst the most widely surveyed animals in EIAs. This is because most bird species are fairly easy to identify, being distinctive both visually and by song, and surveyors need relatively little specialist training in their identification. Rapid methodologies can also be employed to inventory for local populations of threatened or large species. It is important to note that rapid biodiversity assessments cannot serve as substitutes for scientifically rigorous inventories.
- Visual encounter surveys may employ random walks, quadrats, patches or transects as the basis for sampling. For some target organisms, tape recordings or photographs can supplement visual recordings. For a successful rapid
assessment, employed field personnel should have a high degree of expertise with field surveying and identification. These scientists should record the diversity of selected indicator groups of organisms, and analyze this information in relation with social, environmental and other ecosystem information to produce recommendations in a time-frame which suits managers and decision-makers. Standardized survey methods for a particular species group should always be specified in the terms of reference for every EIA and SEA.

– Visual encounter surveys do not produce highly accurate estimates of the densities of animals such as birds and mammals unless coupled with a mark-recapture analysis. Such visual surveys have methodological limitations such as their inability to sample all biotopes or microhabitats equally. The problem with such assessments is that the reliability of the information collected will often depend on the reputation of the observer for this reason additional, relevant information on biodiversity can be taken from local sources.

b. Quantitative surveys
– to determine abundance of species, based on systematic sampling techniques
– other parameters to be determined and measured include species density, frequency, coverage, biomass, species presence/absence, dominance, and importance (check the glossary for more information on each)
– techniques for quantitative surveys are usually determined in the survey protocol prior to actual field surveying

<table>
<thead>
<tr>
<th>SCORING FOR WILDLIFE VALUES &amp; IMPACTS</th>
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<tbody>
<tr>
<td>When undertaking an ecological baseline study, scoring for wildlife values may be very useful in assessing the importance of the habitat. It may also be used as a scale for conservation significance. For example in a wetland ecosystem scoring can be as follows:</td>
</tr>
<tr>
<td>Fish:</td>
</tr>
<tr>
<td>Turtle:</td>
</tr>
<tr>
<td>Migratory water fowl:</td>
</tr>
<tr>
<td>Aquatic mammals:</td>
</tr>
<tr>
<td>Impacts can also be scored; this helps determine the dimensions of the disturbances and the impacts. The following scoring may be used:</td>
</tr>
<tr>
<td>0 = Negligible</td>
</tr>
</tbody>
</table>

8. IDENTIFICATION OF IMPORTANT ECOLOGICAL PROCESSES
During the field survey it is important to note and identify all ecological processes occurring in the field. These include:
- species migrations
- mass breeding periods
- seasonal events (ie., floods) that sustain temporal habitats and species
- sustaining diverse food webs
- ground water discharge/recharge
- water purification
9. PREPARATION OF A PHOTO CATALOGUE
Pictures are important visual aids that help in assessment, inventory building, and facilitating future monitoring. The catalogue could contain:
- photos of plant and animal species
- geo-referenced photographs of vegetation/habitat types
- photos of conservation issues/threats

10. GROUND TRUTHING AND PREPARATION OF MAPS
Similarly to photos, maps are important information
- Obtaining geo-referenced information on vegetation/land-cover/habitat types
- Interpretation of RS images/aerial photos
- Upgrading the baseline grid map with field verified information
- Preparation of accurate maps on vegetation/land-cover/habitat types using GIS techniques

Appendix 5 portrays an ideal representation of which biodiversity parameters and attributes should be assessed in EIAs and SEAs and in which time scale in particular to marine-related projects.

Appendix 6 depicts the best timing for monitoring birds and mammals in general.

INFORMATION TO BE COLLECTED FOR BASELINE STUDY
(Decision VII/16, CBD)
- **Species inventories** include identification of particular species important to the affected indigenous or local community as food, medicine, fuel, fodder, construction, artifact production, clothing, and for religious and ceremonial purposes, etc
- **Identification of endangered species, species at risk, etc**, possibly referenced to the World Conservation Union (IUCN) Red Data Book, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and national inventories
- **Identification of particularly significant habitat** as breeding/spawning grounds, remnant native vegetation, wild-life refuge areas including buffer zones and corridors, habitats and routes for migratory species and crucial breeding seasons for endangered and critical species
- **Identification of particularly significant physical features and other natural factors which provide for biodiversity and ecosystems** e.g. watercourses, springs, lakes, mines/quarries that supply local needs
- **Identification of areas of particular economic significance** as hunting areas and trapping sites, fishing grounds, gathering areas, grazing lands, timber harvesting sites and other harvesting areas
- **Identification of sites of religious, spiritual, ceremonial and sacred significance** such as sacred groves and totemic sites
Stakeholders in EIA/SEA Studies

A range of stakeholders are involved in EIA/SEA studies. The successful design, implementation, and operation of proposals, in addition to the integration of biodiversity issues cannot be achieved without the involvement of the following:

**Government agencies:** administrators and decision-makers present in ministries and governmental bodies have a crucial role in integrating biodiversity and other relevant environmental issues into laws, frameworks and regulations. The main role of governmental agencies is to ensure that the granting of implementation permissions of projects be only permitted to those in line with biodiversity-related regulations.

**Local authorities:** Municipalities are responsible for many development projects in their corresponding areas through deciding on what type of projects and on the extent of the project impact within their jurisdiction.

**Private sector:** private consultancy firms, the first type in this sector, perform EIAs and need to consider biodiversity issues in their projects. They should be transparent and accountable for their decisions and the results of their studies. The investors/clients who demand IAs are the second type. They should be involved from the early stages of IA to know the importance of the biodiversity aspect in EIAs and the importance of EIAs themselves in ensuring sound, long-term development projects.

**Academic:** institutions can contribute to EIA/SEA studies by providing expertise and scientific documents for the studies.

**Donors:** donors should ensure that their funds are granted to small, medium, and large sized projects that contribute to biodiversity conservation or to projects not having a negative impact on environment.

**NGOs:** they can provide useful broader public perspective on a proposal and they can also represent the views of local communities. NGOs can also play an important role in lobbying for accepting or refusing a project for which the EIA and SEA proved that they should not be implemented in a certain area. They can lobby for new laws and regulations that help protect the environment, and for the enforcement of existing laws. They may also raise public awareness relating to such issues.

**Local people:** Local people usually want to know what the project proposes and what the likely impacts will be. They want their values to be known, understood and taken into account and they want their suggestions and concerns to be carefully considered. It is also important to consider the local knowledge that local people which may add valuable input to the EIA/SEA studies.
Public Hearing & Public Consultation: Difference & Applications

Stakeholder involvement in IA is rooted in the principle of “Environmental Justice” that pins down the right of each and every citizen for living in a healthy and sound environment. In the U.S., EPA defines environmental justice (EJ) as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups should bear disproportionately high and adverse human health or environmental effects resulting from Federal agency programs, policies, and activities.

In addition to EJ, the increasing understanding of the transboundary nature of environmental impacts, the level of public spending involved in the development and application of policies and plans, coupled with increased democratic and decentralized procedures, have led to an enhanced acknowledgement of the value of stakeholder involvement at the early stages of project development and decision-making processes for improved ownership and reduced resilience and advocacy against such decisions.

Hence IA practices worldwide include a component of stakeholder involvement that take different forms. They can range from individual meetings and interviews to public gatherings and workshops, simple consultation of written material, internet-based opinion polls, e-discussion groups, or direct participation in the identification of impacts. The most common forms of stakeholder involvement in IA remain public participation and public hearings.

A public hearing is a special type of public meeting. The sole purpose of a public hearing is to provide an opportunity for the public to make comments on a proposed decision or project. All remarks made during the hearing should be written down, and official minutes of the proceedings prepared. Consequently a Response to Comments that contains a response to each issue raised at the public hearing or provided as a written comment during any public comment period is prepared. A public hearing is not a question and answer session, it only serves to collect the viewpoints of concerned or affected stakeholders. Public hearings are mostly used in EIA studies.

The most common form of Public participation occurs through stakeholder gatherings and reunions. There interest groups are formed and produce specific information to be used in the IA study. They can propose mitigation measures, allocate weights to impacts, or identify alternatives to the decision/project. In this case, the party undertaking the study facilitates the workshop and the work of the groups by providing all the background information and the skeleton based on which the information is to be organized. Public participation is mostly used in SEA studies.

MEASURES TO ENHANCE STAKEHOLDER INVOLVEMENT

In light of several mis-functions in IA processes in terms of involving and accounting for the concerns of affected stakeholders, the United Nations Economic Commission for Europe (UNECE) has elaborated the “Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters”, also referred to as the Aarhus Convention, done in Denmark in 1998.
Public Hearing Procedure Within the West Bengal Pollution Board

**What is Public Hearing?**
Public hearing is aimed at public scrutiny of the project and transparency in environmental clearance system.

**Notification**
State Pollution Control Board will issue notification about the project mentioning about the:
- Project
- Proposed project area
- Date
- Time and
- Venue for the public hearing

Notification will be issued in two widely circulated newspapers. One of them should be published in local vernacular. The notification will also invite Oral / Written suggestions, views, comments and objections, if any, from concerned public likely to be affected by the proposed project.

**Panel**
A panel consisting of the following representative will conduct the public hearing:
- Representative of State Pollution Control Board.
- District Collector or his nominee.
- Representative of State Govt. dealing with the subject.
- Representative of Development of Environment of the State Govt.
- Not more than three representatives of local bodies such as Municipality or Panchayet close to project area.
- Not more than three senior citizens of the area nominated by the District Collector.
- Project proposer.

**Executive Summary**
The project proponent will prepare twenty copies each of the executive summary of the project both in local language and English and submit to concerned State Pollution Control Board with NOC application.

**Information to be Furnished in the Executive Summary**
- The executive summary of project will summarize the project mentioning the
  - Socio-economic benefit from the project
  - Environmental impact of the project
  - Mitigation measures proposed to minimize the negative environmental impact, if any.

**Public Access to the Executive Summary**
The executive summary of the project subjected to public hearing will be made available in the following offices for public scrutiny:
I. District Collector’s office  
II. District Industry Centres  
III. In The office of the Chief Executive Officer of Zila Parishad or Commissioner of Municipal Corporation / Local body as the case may be,  
IV. In the head office of the concerned State Pollution Control Board and its concerned regional office.  
V. In the Department of Environment, Govt. of West Bengal.

**Who Can Participate in the Public Hearing?**
- Any person who is likely to be affected by the project.
- Any person who owns or has control over the project with respect to which application has been submitted for environment clearance.
- Any association of persons whether incorporated or not likely to be affected by the project and / or functioning in the field of environment.

**Scope of the Public Hearing**
Besides environmental issues in respect of water, air and soil pollution, hazardous wastes, threat of environment accidents from use of hazardous chemicals etc., issues related to displacement / eviction of persons / families and their rehabilitation programme can be raised in the public hearing.

**What Happens After the Public Hearing?**
The detailed minutes of the public hearing as recorded by State Pollution Control Board and approved by the panel along with ‘No Objection Certificate’ from State Pollution Control Board, if warranted, are sent to Ministry of Environment & Forest, Govt. of India for their consideration for obtaining environmental clearance for the project.
SPNL – Ebel es Saqi; Public participation for the development of a local management plan for the Hima. Participants work in groups and then expose their findings. Working groups are facilitated by technical moderators and the final document is collated in such a way as to reflect the aspirations of the stakeholders.

KEY ISSUES WHEN INVOLVING STAKEHOLDERS IN IAS RELATE TO:

1. Publicizing the project or activity being subjected to IA
2. Advertising the process of collection of stakeholder feedback (meeting, consultations, written comments)
3. Ensuring that information be made fully available in a transparent manner, and provided to each stakeholder upon request
4. Ensuring that the information, both in terms of vocabulary and language, is simple enough to be understood by all stakeholders
5. Providing enough time for stakeholders to voice their concerns
6. Officially documenting the comments and insights of stakeholders
7. Integrating the comments, concerns and insights into the IA document
8. Providing stakeholders with the opportunity to view the revised document
9. Advertising the final decision related to the project or activity of concern (e.g., rejection, approval, modification).
Who Can Carry out Biodiversity Assessments for EIA and SEA studies?

The type of expertise required for biodiversity assessment will depend upon the scope of the sector or project and the characteristics of the sector or the project’s environment. At sector level, multidisciplinary expertise is required to cover policy and sector-specific issues in addition to experts understanding linkages between the sector in question and biodiversity. At project level, dam projects, for example, will tend to require expertise in aquatic ecosystems composition, function and services. Agricultural projects require expertise in agro-ecosystems and in any ecosystems (e.g. forests) which may be transformed. Pipeline projects require expertise in those ecosystems to be traversed. Biodiversity experts in Lebanon may be present in academic institutions such as universities, ministries, in many environment-oriented private consultancy firms, Lebanese NGOs, and in national research centers in general. The table below lists all possible specialists who may be assigned to work on the team performing the EIA or SEA study.

<table>
<thead>
<tr>
<th>TYPES OF EXPERTISE FOR TREATMENT OF BIODIVERSITY IN EIA &amp; SEA</th>
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<tbody>
<tr>
<td>(World Bank Environment Department, 2000)</td>
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<tr>
<td>general expertise in animal (zoologists) or plant (botanists) ecology, taxonomy or biosociology</td>
</tr>
<tr>
<td>taxonomists, ecologists and bio-sociologists specializing in particular taxa of importance within the project area, e.g. mammalogists (mammals), ornithologists (birds), lepidopterists (butterflies), primatologists (primates), mycologists (fungi), ichthyologists (fish)</td>
</tr>
<tr>
<td>ecologists specializing in particular habitat types of importance within the project area, e.g. mountain ecologists, rainforest ecologists, wetland ecologists, marine ecologists, agricultural ecologists</td>
</tr>
<tr>
<td>specialists in ecosystem structure or function</td>
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<tr>
<td>ecological statisticians (for analysis of quantitative data), population ecologists (for studies on population dynamics, viability, etc.)</td>
</tr>
<tr>
<td>specialists in the conservation of biological diversity, including conservation biologists, protected areas planners and administrators</td>
</tr>
<tr>
<td>biogeography specialists, including those skilled in remote sensing and GIS techniques, and in the identification of biogeographic affiliations</td>
</tr>
<tr>
<td>specialists in ethnobiology, ethnobotany and ethnozoology (traditional knowledge of biodiversity)</td>
</tr>
<tr>
<td>specialists in the sustainable use of biodiversity, equity and intellectual property regime (IPR) issues</td>
</tr>
<tr>
<td>specialists in the legal, institutional and policy aspects of biodiversity conservation</td>
</tr>
<tr>
<td>specialists in stakeholder participation in biodiversity conservation</td>
</tr>
<tr>
<td>specialists in organic agriculture (offering viable biodiversity-enhancing alternatives in agricultural projects)</td>
</tr>
<tr>
<td>specialists in the economics of biodiversity</td>
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Guidelines for Practitioners & Policy-Makers

The following guidelines are provided as illustrative examples to be taken into account by practitioners. They constitute valuable and easy tools for policy-makers to build upon in the decision-making process.

<table>
<thead>
<tr>
<th>QUESTIONS FOR PRACTITIONERS TO CONSIDER WHEN ANALYZING EFFECTS ON BIODIVERSITY (CEAA, 1996)</th>
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<tbody>
<tr>
<td>What impact will the project have on the genetic composition of each species? Are different genotypes of the same species likely to be isolated from each other? To what extent will habitat or populations be fragmented?</td>
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<tr>
<td>How will the proposal affect ecosystem processes? Is this proposal likely to make the ecosystem more vulnerable or susceptible to change?</td>
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<tr>
<td>What abiotic effects will devolve - change in seasonal flows, temperature regime, soil loss, turbidity, nutrients, oxygen balance, etc.?</td>
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<tr>
<td>Does the proposal contribute to or undermine the sustainable use of biological resources?</td>
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<tr>
<td>Does it set a precedent for conversion to a more intensive level of use of the area?</td>
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<tr>
<td>Is diversity measured at the species, community and ecosystem level?</td>
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<tr>
<td>Have exotics been included in measures of diversity?</td>
</tr>
<tr>
<td>Have standardized protocols for diversity measurement been applied when available?</td>
</tr>
<tr>
<td>Is the biological resource in question at the limit of its range?</td>
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<tr>
<td>Does the species demonstrate adaptability?</td>
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<tr>
<td>Have sustainable yield calculations, including population dynamic parameters, been determined e.g., lake capacities, population thresholds?</td>
</tr>
<tr>
<td>Is the data dependable? What are the sources used?</td>
</tr>
<tr>
<td>Is the assessment based on long-term ecological monitoring, baseline surveys, reconnaissance level field observations and primary research?</td>
</tr>
<tr>
<td>Is sampling planned on a suitably spaced geographic grid pattern, two-dimensional for land, three-dimensional for lakes and oceans, etc.?</td>
</tr>
<tr>
<td>Does the sampling cover more than one or two years in order to assess annual variations and all the seasons studied?</td>
</tr>
<tr>
<td>Does the assessment include a check for gaps in the sampling data?</td>
</tr>
<tr>
<td>Are plans made throughout the assessment for meaningful input from the public, NGOs and other stakeholders?</td>
</tr>
<tr>
<td>What level of confidence or uncertainty can be assigned to interpretations of the effects?</td>
</tr>
</tbody>
</table>
GUIDING PRINCIPLES TO ALL (Adapted from CEAA,1996)

- Apply the “precautionary principle”
- Avoid negative impact on biodiversity
- No “net loss” of the ecosystem, species populations or genetic diversity
- No effect on the sustainable use of biological resources
- Maintenance of natural processes and adequate areas of different landscapes for wild flora and fauna and other wild organisms
- Define the spatial parameters that characterize ecological processes and components in order to provide a regional context for an impact analysis of the proposed project
- Identify the best practicable option (mitigation) for maintaining biological diversity
- Examine the cumulative effects of other activities in the area/region to date and evaluate the added “effect” that this project, and others likely to follow, will have on biological diversity
- Create opportunities for biodiversity enhancement
- Assess the full range of biodiversity impacts
- Assess the significance of biodiversity impacts in the context country regulations
- Base decision on full information on biodiversity
- Use inferential information, e.g., identify species that are rare or at the limit of their range and therefore a possible early warning of critical ecological change
- Where possible, use indicator species or valued ecosystem components to focus the assessment
- Ensure biodiversity monitoring is provided during and after development
Constraints & Recommendations When Assessing Biodiversity in EIA & SEA

LIMITATIONS
Since SEA was not enough experienced in Lebanon, the following limitations are based solely upon experiences of various private firms went through when conducting EIA studies. Identifying limitations related to SEA require additional years of implemented SEA studies to confirm whether the hereafter restrictions are applicable to SEA as well.

Limited time. The process of evaluating the implications of a development proposal on biodiversity interests is potentially very resource intensive in terms of time and cost. Limited time is available to conduct ecological studies since developers very often assign a period of 4 to 8 weeks to finalize the EIA study. This is mainly due to the fact that environmental considerations are only being addressed at later stages of project design and not at the earlier stages. The EIA becomes a mere administrative requirement for the developers in order to get a permit for construction. In addition to that, collection of data from the field is insignificant in most cases whenever a short period is assigned for the EIA to be completed; ecological surveys are usually carried out at the wrong time of the year and focus on a restricted range of organisms. This time interval is inappropriate for undergoing biodiversity assessments since the process is very season specific; in other words, year-round information on species and habitats should be available to properly assess the significant impacts of the project in all seasons.

Limited data. Available data is very limited due to lack of biodiversity monitoring programs. There is a considerable imbalance in the level of information about different species, for example many bird species and higher plants are well monitored and researched, whereas there is little data or information available for a large proportion of invertebrates, bryophytes, and lichens which are important environmental indicators. Limitation in data is even more striking when addressing fauna since the surveying of species is a very tedious and time-consuming activity, and can rarely be done in the current time-frames for EIA studies. In addition to that, few ecologists involved in EIAs have the ability to identify all organisms therefore specialists are needed. Furthermore, ecologists have a tendency to exhibit preference in the animals they cover since the animals may be more charismatic for example studying butterflies and disregarding moths.

Wrong focus. EIAs have traditionally focused on impacts upon protected species and habitats with much less focus on other aspects of biodiversity such as diversity between species and habitats, trends over time, species abundance and distribution, and the functional components of biodiversity. They have mostly included brief habitat surveys and species lists with no particular emphasis on species’ roles in ecosystem dynamics and processes. Few attempts have been made to assess the functional components of biodiversity.

At the present time, a major consideration in an EIA is the status of a site, particularly with respect to any conservation designation of a statutory nature that it may carry. It is true that a designation such as ‘nature reserve’ or Ramsar site indicates an area of quality, the converse however that a designation implies ‘no worth’, is certainly not the case. Unfortunately this is often perceived to be the case by developers who may
object to the allocation of resources to a site that, as far as they are concerned, is of no value.

**Weak monitoring systems.** A particular problem facing EIAs is the weakness in developing and implementing monitoring systems. This is due to constraints such as lack of time and money, perceived lack of qualified staff, little or no connection between project interventions and monitoring, difficulty in determining what specific data need to be collected, and how it should be analyzed and used. Absence of EMP application and monitoring and the absence of budgets for implementing EMPs during the life-time of the project is a major problem facing Lebanese EIAs.

**RECOMMENDATIONS**

**Better time allocation.** More time should be given to EIA/SEA studies in general depending on the sector or the size of the project or plan and on the extent of the impacts of the project or plan. EIA/SEA studies should be accounted for at early stages of project or plan design and provided appropriate time, both in terms of duration and season.

**Data collection.** The impetus behind biodiversity action plans such as the NBSAP means that significantly more data should be collected and analyzed. Reference should be made to priority species and habitats identified in the NBSAP. Targets in biodiversity action plans will help to identify the significance of the likely impacts on these habitats or species. The biodiversity action planning process should therefore provide more detailed, readily accessible information, which can be utilized in impact assessments. Since this is the case of Lebanon, action plans regarding specific biodiversity monitoring plans should be undertaken to develop a database for all biodiversity related issues. Particular attention should be made to a number of issues: species that are in relative abundance, but are rapidly declining, historic declines of species and habitats, and habitat fragmentation. A core set of biodiversity indicators can be used to trigger more detailed investigation of biodiversity impacts. When this is achieved, it would be easier then for the EIA/SEA team to collect site specific information, complement the existing database, and perform the impact assessment with relevant biodiversity experts. In addition to that it is fundamental for the study team to map areas of potential impacts within the site and in the surrounding area of the project. This can be undertaken quickly and relatively cheaply from remotely sensed imagery, in particular aerial photographs or from already existing maps. Collected data should include the diversity of species at all levels: genetic, species, and ecosystem level. In addition to that biodiversity should be addressed with respect to its compositions, its structure, and the processes taking place.

**Financial resources.** More financial considerations and resources should be given to EIA/SEA studies as early as the first stages of budget allocation. Developers should carefully allocate the appropriate amount of money according to the sector or the size of the project and to the extent of damage that it may cause. Therefore when a large-scale project is proposed, an important amount of money should be given to the study team in order to acquire the best, multidisciplinary human resources needed for the conduct of a top quality, extensive assessment.

**Ecosystem approach.** The EIA/SEA studies should have an ecosystem approach to them whereby this approach looks at potential impacts on the ecosystem as a whole,
particularly its functions for example wetlands providing a storage function to help avoid flooding. Also the potential knock-on effects of impacts in ecosystems should be studied for example the loss of species at lower levels of the food chain having implications for the food source of predators higher up the chain. An ecosystem approach could highlight opportunities of creating wildlife corridors or links between habitats and could enhance the biodiversity interest of existing features through specific management practices.

**Policies.** Specific policies in plans or programmes could be used to identify when a more detailed assessment should be carried out. Such policies could include criteria such as the presence of priority habitats or species, areas which have been subject to habitat fragmentation in the past, or areas where the local biodiversity action plan has identified opportunities for enhancement. In order for the EIA process to be effective, it should be fully incorporated into existing legal planning processes and not be seen as an "add-on" process.

**Legislative authority.** At a very early stage developers are prompted to use EIA/SEA tools to improve the development process prior to the project consent stage or prior to screening procedures. This can only happen if EIA/SEA procedures are incorporated into legislation, and consequently project/policy developers are obligated to find the most environmentally sound, efficient options that avoid, reduce, or mitigate biodiversity and other adverse impacts.

**Incentives.** The CBD incorporates biodiversity considerations into impact assessments as a step in the design and implementation of incentive measures. There is a need to expand the concept of incentives in article 20 of Law 444 with respect to biodiversity considerations. The endorsement of EIAs/SEAs and their implementation within a legislative framework can act as an incentive by itself; this can include incentives to protect, restore, and rehabilitate biodiversity. Financial or other incentives can also be part of a negotiated approval package for a project.

**Monitoring and environmental auditing.** Monitoring is a critical stage in EIA/SEA, often lacking in EIA/SEA studies, because it determines if the effects of impacts were predicted accurately. It sees that prescribed mitigation measures are carried out appropriately, and ensures that unexpected impacts are addressed. Monitoring also is a critical component of adaptive management systems since it helps communities and developers effectively obtain the information that they need to manage their local resources. Environmental audits are also practically non-existent in EIA/SEA studies. They are similar in objective to monitoring plans however, they add to the analysis by assessing to what extent the EIA process integrated environmental, economic and social considerations into the decision-making process. Both monitoring and audit stages should be fully implemented and integrated into the studies.

**Transparency and accountability.** Transparency and accountability in the overall decision-making process is crucial, so that it can be clearly seen how biodiversity impacts have been taken into consideration.

**Capacity building.** Appropriate capacity development activities should be considered in any activity aimed at the incorporation of biodiversity considerations into national EIA systems. Training workshops on biodiversity and EIA/SEA for both assessment practitioners and biodiversity specialists should be developed in order to build a common understanding of the issues; local expertise should be trained on appropriate
methodologies, techniques and procedures of assessment. Schools and university curricula should incorporate material on biodiversity conservation, sustainable development and EIA/SEA if possible. As mentioned in previous sections study teams should include ecologists with extensive knowledge on the relevant ecosystem along with other experts in taxonomy, conservation biology, ecology, and traditional knowledge.

**Participation and cooperation.** All possible relevant stakeholders, in particular indigenous and local communities, should be involved in the development of guidelines or recommendations for EIA/SEA in all of the stages of the assessment processes relevant to them, including decision-making. With regard to cooperation, practitioners of EIA/SEA and scientists working in the biodiversity domain should enhance communication between them for superior assessment outcomes. On the regional scale, collaboration between the CBD, Ramsar Convention, and the CMS resulted in listed sites and binding agreements on certain species; this can facilitate the development and implementation of any guidelines agreed upon for the integration of biodiversity-related issues in EIAs/SEAs. In other words, regional collaboration can improve on many impact assessment issues. It can develop criteria and indicators for the evaluation of impact and possibly criteria and indicators that can provide early warning of potential threats and adequately distinguish the effects of anthropogenic activities from natural processes. This collaboration can improve on the use of standardized methods of collection, assembly and exchange of information to ensure regional compatibility and accessibility of data.

**Databases and registers.** All biodiversity-relevant data collected during the study should be organized in regularly updated databases which should be accessible to anyone. Databases can easily help in identifying priority biodiversity hotspots. National registers of biodiversity experts should be developed in order for developers to choose wisely their assessment teams or to choose experts to be consulted in the review process.


UNEP/MoA (1996) *Etude de la Diversite Biologique du Liban: Faune et Flore Marines et Cotieres*


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Biodiversity Observations on the Internet (BIO) [http://www.unesco.org/mab/CBD/index.htm](http://www.unesco.org/mab/CBD/index.htm)


Center for Biological Diversity [http://www.biologicaldiversity.org/swcbd/](http://www.biologicaldiversity.org/swcbd/)

Convention on Biological Diversity (general) [http://www.biodiv.org/default.aspx](http://www.biodiv.org/default.aspx)


Energy and Biodiversity Initiative (EBI) [http://www.theebi.org/](http://www.theebi.org/)

Inter-American Biodiversity Information Network [http://www.iabin-us.org/index.html](http://www.iabin-us.org/index.html)


IUCN [http://www.iucn.org](http://www.iucn.org)


World Conservation Monitoring Centre [http://www.wcmc.org.uk](http://www.wcmc.org.uk)
Abundance is the number of individuals in a given area.

Bio-accumulation is the accumulation with time of concentrations of toxic chemicals in the living tissue of filter-feeding organisms.

Bio-magnification is the increase in concentrations of toxic materials in higher order consumers.

Biomass is the weight of the individuals of a population, expressed per unit area or volume.

Consumers are organisms that cannot transform sunlight energy into the chemical energy of organic molecules. They must consume preformed organic materials and transform these into the living substance of their own bodies. Herbivores consume plants. Carnivores consume other animal. Omnivores consume both plants and animals. Detritivores consume dead organic remains.

Coverage is the proportion of the ground covered by the species, usually plant, as the habitat is viewed from above.

Cumulative impacts are the aggregates of direct and indirect impacts resulting from two or more projects in the same area or region.

Decomposers are organisms that accomplish the disintegration and mineralization of organic materials into inorganic materials. These include bacteria, fungi, earthworms, and beetles among other.

Density is the abundance expressed per unit area or volume.

Direct impacts are changes in environmental components and processes that result immediately from a project-related activity or action.

Direct use values are economic values derived from direct use or interaction with a biological resource or resource system.

Documentation is the gathering of all information and procedures used in the study into what is commonly referred to as an environmental impact statement (EIS).

Dominance is an estimate of the comparative population size of different species.

Ecological succession includes primary and secondary succession. Primary succession begins with bare ground whereas secondary succession begins in areas that previously have been vegetated. The sequence of stages biological communities that succeed naturally one another are the pioneer stage, developmental stages, and the climax stage.

Environmental impact study is the stage which examines impacts identified in the scoping stage in further detail, determines their significance, and recommends measures to mitigate adverse impacts and maximize positive impacts.

Examination of alternatives through including options that range from taking no action, altering the design of the project, selecting a different project site, to finding an alternate means of implementation. These options are analyzed for possible impacts, benefits, and costs.

Eutrophic systems are lakes characterized by high concentrations of nutrients.

Evaluation of significance of predicted impacts depends on qualitative insights gained through examination of existing legislation, social norms, and policy objectives.

Fragmentation is the breaking up of extensive landscape features into disjunct, isolated, or semi-isolated patches as a result of land-use changes.

Frequency is the number of times a given event occurs.

Habitat is a specific place where physical, chemical, and biological factors and processes are suitable for a specific species. Physical factors include temperature, relative humidity, photoperiod, substrate type, and availability of water. Chemical factors include the concentration of oxygen, pH, and availability of mineral nutrients. Biological factors include the population density of predators, the degree of interspersion of vegetative types, and the availability of prey.

Identification determines the project’s direct and indirect impacts through checklists, matrices, overlays, models, questionnaires, and simulations. Information from screening and scoping stages guides and supplements identification work.
Importance is the value assigned to a given species with respect to a defined goal or objective.

Indirect impacts or secondary impacts are changes in environmental components and dynamics that are consequences of direct impacts. Indirect impacts result from the varied interactions of direct impacts and the physical and social environmental components, processes, and conditions that are or become dynamically linked to those direct impacts. Indirect impacts are far more numerous than direct impacts and typically account for most of the assessment effort.

Indirect use values are economic values derived from the role of resources and systems in supporting or protecting activities whose outputs have direct value in production or consumption.

Inventorying is the surveying, sorting, cataloguing, quantifying, and mapping of entities such as genes, individuals, populations, species, habitats, biotopes, ecosystems and landscapes or their components, and the synthesis of the resulting information for the analysis of processes.

Mitigation options can include not proceeding with the development, finding alternative designs or sites which avoid the impacts, incorporating safeguards in the design of the project, or providing compensation for adverse impacts. Suitable mitigation measures for negative impacts and means of maximizing positive impacts are determined.

Monitoring ensures that unpredicted impacts or failed mitigation measures are identified and addressed in a timely fashion this stage monitors and evaluates the development activities, predicted impacts and proposed mitigation measures.

Niche may be described as the organism’s profession. A niche may describe the functional role of an organism or it may describe different subdivisions of the physical environment in which the organism acts out his role. A more contemporary view would involve both the functional role of an organism in the ecosystem as well as its position in time and space.

Nutrient cycling is achieved by rooted terrestrial vegetation which takes the dissolved nutrients out of the soil, transform them into more complex organic molecules through photosynthesis, and then release detritus back into the soil which will be consequently mineralized back into the soil by decomposers such as bacteria and fungi.

Oligotrophic systems are lakes that have very sparse concentrations of nutrients.

Population dispersal includes the possible emigration, immigration or migration (nocturnal, diurnal, diel, or seasonal) phenomena.

Post-project audit provide important information for improving the EIA processes. Audits of past EIAs reveal how accurately key impacts were identified and their effects predicted, how effective mitigation measures were, and to what extent the EIA process integrated environmental, economic and social considerations into the decision-making process.

Prediction identifies and predicts the likely environmental impacts of the project taking into account inter-related consequences of the project proposal and the socio-economic impacts. It also identifies causes, predicts effects of key impacts and highlights methods of monitoring.

Preliminary assessment is done by applying methods of rapid assessment to determine key impacts, their magnitude and significance, and their importance to decision-making after finding that a project requires an EIA or if there is uncertainty about potential impacts of the project.

Primary producers are organisms that transform the radiant energy of sunlight and inorganic nutrients into living materials. These include all green plants such as pine trees and microscopic single celled plants floating in the sea.

Review determines if the assessment adequately informs decision makers about environmental consequences of the project and reviews alternatives and mitigating measures. If the EIA is inadequate, the review committee requests further information or alternative methodologies.

Scoping identifies which potential impacts are relevant to assess, and to derive terms of reference for the impact assessment.

Screening determines which projects or developments require a full or partial impact assessment study.

Species interaction or the interaction between two different species is of different types: mutualism (both species are benefited by the interaction), predation (one species is benefited while one is inhibited), competition (each species is inhibited by the other).
commensalism (one species is benefited, while the other is not affected), amensalism (one species is inhibited while the other is not affected), and neutralism (neither species is affected by the interaction).

Species presence/absence is the simple presence or absence of certain species.
Appendix 1

Indicative list (non-exhaustive) of examples of functions of the natural environment that are directly (flora and fauna) or indirectly (services provided by ecosystems such as water supply) derived from biological diversity (from Decision VI/7, CBD)

<table>
<thead>
<tr>
<th>Production functions</th>
<th>Nature-based human production</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural production</strong></td>
<td><strong>Nature-based human production</strong></td>
</tr>
<tr>
<td>• Timber production</td>
<td>• Crop productivity</td>
</tr>
<tr>
<td>• Firewood production</td>
<td>• Tree plantations productivity</td>
</tr>
<tr>
<td>• Production of harvestable grasses (construction and artisanal use)</td>
<td>• Managed forest productivity</td>
</tr>
<tr>
<td>• Naturally produced fodder &amp; manure</td>
<td>• Rangeland/livestock productivity</td>
</tr>
<tr>
<td>• Harvestable peat</td>
<td>• Aquaculture productivity (freshwater)</td>
</tr>
<tr>
<td>• Secondary (minor) products</td>
<td>• Mariculture productivity (brackish/saltwater)</td>
</tr>
<tr>
<td>• Harvestable bush meat (food)</td>
<td></td>
</tr>
<tr>
<td>• Fish and shellfish productivity</td>
<td></td>
</tr>
<tr>
<td>• Drinking water supply</td>
<td></td>
</tr>
<tr>
<td>• Supply of water for irrigation and industry</td>
<td></td>
</tr>
<tr>
<td>• Water supply for hydroelectricity</td>
<td></td>
</tr>
<tr>
<td>• Supply of surface water for other landscapes</td>
<td></td>
</tr>
<tr>
<td>• Supply of ground water for other landscapes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Carrying functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Suitability for constructions</td>
</tr>
<tr>
<td>• Suitability for indigenous settlement</td>
</tr>
<tr>
<td>• Suitability for rural settlement</td>
</tr>
<tr>
<td>• Suitability for urban settlement</td>
</tr>
<tr>
<td>• Suitability for industry</td>
</tr>
<tr>
<td>• Suitability for infrastructure</td>
</tr>
<tr>
<td>• Suitability for transport infrastructure</td>
</tr>
<tr>
<td>• Suitability for shipping / navigation</td>
</tr>
<tr>
<td>• Suitability for road transport</td>
</tr>
<tr>
<td>• Suitability for rail transport</td>
</tr>
<tr>
<td>• Suitability for air transport</td>
</tr>
<tr>
<td>• Suitability for power distribution</td>
</tr>
<tr>
<td>• Suitability for use of pipelines</td>
</tr>
<tr>
<td>• Suitability for leisure and tourism activities</td>
</tr>
<tr>
<td>• Suitability for nature conservation</td>
</tr>
</tbody>
</table>
### Processing and regulation functions

<table>
<thead>
<tr>
<th>Land-based processing and regulation functions</th>
<th>Water related processing and regulation functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Decomposition of organic material (land based)</td>
<td>• Water filtering function</td>
</tr>
<tr>
<td>• Natural desalinization of soils</td>
<td>• Dilution of pollutants function</td>
</tr>
<tr>
<td>• Development/prevention of acid sulphate soils</td>
<td>• Discharge of pollutants function</td>
</tr>
<tr>
<td>• Biological control mechanisms</td>
<td>• Flushing/cleansing function</td>
</tr>
<tr>
<td>• Seasonal cleansing of soils</td>
<td>• Bio-chemical/physical purification of water</td>
</tr>
<tr>
<td>• Soil water storage capacity</td>
<td>• Storage for pollutants function</td>
</tr>
<tr>
<td>• Coastal protection against floods</td>
<td>• Flow regulation for flood control</td>
</tr>
<tr>
<td>• Coastal stabilization (against accretion /erosion)</td>
<td>• River base flow regulation</td>
</tr>
<tr>
<td>• Soil protection</td>
<td>• Water storage capacity</td>
</tr>
<tr>
<td>• Water filtering function</td>
<td>• Ground water recharge capacity</td>
</tr>
<tr>
<td>• Dilution of pollutants function</td>
<td>• Regulation of water balance</td>
</tr>
<tr>
<td>• Discharge of pollutants function</td>
<td>• Sedimentation /retention capacity</td>
</tr>
<tr>
<td>• Flushing/cleansing function</td>
<td>• Protection against water erosion</td>
</tr>
<tr>
<td>• Bio-chemical/physical purification of water</td>
<td>• Protection against wave action</td>
</tr>
<tr>
<td>• Storage for pollutants function</td>
<td>• Prevention of saline groundwater intrusion</td>
</tr>
<tr>
<td>• Flow regulation for flood control</td>
<td>• Prevention of saline surface-water intrusion</td>
</tr>
<tr>
<td>• River base flow regulation</td>
<td>• Transmission of diseases</td>
</tr>
<tr>
<td>• Water storage capacity</td>
<td>• Carbon sequestration</td>
</tr>
<tr>
<td>• Ground water recharge capacity</td>
<td>• Transmission of diseases</td>
</tr>
<tr>
<td>• Regulation of water balance</td>
<td></td>
</tr>
<tr>
<td>• Sedimentation /retention capacity</td>
<td></td>
</tr>
<tr>
<td>• Protection against water erosion</td>
<td></td>
</tr>
<tr>
<td>• Protection against wave action</td>
<td></td>
</tr>
<tr>
<td>• Prevention of saline groundwater intrusion</td>
<td></td>
</tr>
<tr>
<td>• Prevention of saline surface-water intrusion</td>
<td></td>
</tr>
<tr>
<td>• Transmission of diseases</td>
<td></td>
</tr>
</tbody>
</table>

### Air-related processing and regulation functions

- Filtering of air
- Carry off by air to other areas
- Photo-chemical air processing (smog)
- Wind breaks
- Transmission of diseases
- Carbon sequestration

### Biodiversity-related regulation functions

- Maintenance of genetic, species and ecosystem composition
- Maintenance of horizontal and vertical spatial structure, and of temporal structure
- Maintenance of key processes for structuring or maintaining biological diversity
- Maintenance of pollinator services

### Signification functions

Cultural/religious/scientific/landscape functions
Appendix 2

Questions pertinent to screening on biological diversity impacts (from Decision VI/7, CBD)

<table>
<thead>
<tr>
<th>Level of diversity</th>
<th>Biological diversity perspective</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conservation of biological diversity (Non-use values)</td>
<td>Sustainable use of biodiversity (Use values)</td>
</tr>
<tr>
<td>Genetic diversity</td>
<td>(I) Does the intended activity cause a local loss of varieties/cultivars/breeds of cultivated plants and / or domesticated animals and their relatives, genes or genomes of social, scientific and economic importance?</td>
<td></td>
</tr>
<tr>
<td>Species diversity</td>
<td>(II) Does the intended activity cause a direct or indirect loss of a population of a species?</td>
<td>(III) Does the intended activity affect the sustainable use of a population of a species?</td>
</tr>
<tr>
<td>Ecosystem diversity</td>
<td>(IV) Does the intended activity lead to serious damage or total loss of (an) ecosystem(s) or land-use type(s), thus leading to a loss of ecosystem diversity (i.e. the loss of indirect use values and non-use values)?</td>
<td>(V) Does the intended activity affect the sustainable exploitation of (an) ecosystem(s) or land-use type(s) by humans in such manner that the exploitation becomes destructive or non-sustainable (i.e. the loss of direct use values)?</td>
</tr>
</tbody>
</table>

(1) The potential loss of natural genetic diversity (genetic erosion) is extremely difficult to determine, and does not provide any practical clues for formal screening. The issue probably only comes up when dealing with highly threatened, legally protected species which are limited in numbers and/or have highly separated populations (rhinoceros, tigers, whales, etc.), or when complete ecosystems become separated and the risk of genetic erosion applies to many species (the reason to construct so-called eco-ducts across major line infrastructure). These issues are dealt with at species or ecosystem level.

(2) Species diversity: The level at which "population" is to be defined fully depends on the screening criteria used by a country. For example, in the process of obtaining a special status, the conservation status of species can be assessed within the boundaries of a country (for legal protection), or can be assessed globally (IUCN Red Lists). Similarly, the scale at which ecosystems are defined depends on the definition of criteria in a country.
Appendix 3

The Screening Criteria (from Decision VI/7, CBD)

This is a suggested outline of a set of screening criteria, to be elaborated on country level. It only deals with biodiversity criteria and thus is an add-on to already existing screening criteria.

Category A: EIA mandatory:

Only in the case criteria can be based on formal legal backing, such as:

- National legislation, for example in case of impact on protected species and protected areas;
- International conventions such as CITES, the Convention on Biological Diversity, Ramsar Convention on Wetlands, etc.;
- Directives from supranational bodies, such as the European Union directive 92/43/EEC of 21 May 1992 on conservation of natural habitats and of wild fauna and flora and directive 79/409/EEC on the conservation of wild birds

Indicative list of activities for which an environmental impact assessment could be mandatory:

(a) At the genetic level (relates to screening question I in appendix 1 above):
   - Directly or indirectly cause a local loss of legally protected varieties/cultivars/breeds of cultivated plants and/or domesticated animals and their relatives, genes or genomes of social, scientific and economic importance e.g. by introducing living modified organisms that can transfer transgenes to legally protected varieties/cultivars/breeds of cultivated plants and/or domesticated animals and their relatives

(b) At species level (relates to screening question II and III in appendix 1 above):
   - Directly affect legally protected species, for example by extractive, polluting or other disturbing activities;
   - Indirectly affect legally protected species, for example by reducing its habitat, altering its habitat in such a manner that its survival is threatened, introducing predators, competitors or parasites of protected species, alien species or GMOs;
   - Directly or indirectly affect all of the above for cases which are important in respect of e.g. stop-over areas for migratory birds, breeding grounds of migratory fish, commercial trade in species protected by CITES.
   - Directly or indirectly affect non-legally protected, threatened species.

(c) At ecosystem level (screening questions IV and V in appendix 1 above):
   - Are located in legally protected areas;
   - Are located in the vicinity of legally protected areas;
   - Have direct influence on legally protected areas, for example by emissions into the area, diversion of surface water that flows through the area, extraction of groundwater in a shared aquifer, disturbance by noise or lights, pollution through air.
Category B: The need for, or the level of EIA, is to be determined:

In cases where there is no legal basis to require an environmental impact assessment, but one can suspect that the proposed activity may have a significant impact on biological diversity, or that a limited study is needed to solve uncertainties or design limited mitigation measures. This category covers the frequently referred to but difficult to use concept of "sensitive areas". As long as so-called sensitive areas do not have any legal protected status it is difficult to use the concept in practice, so a more practical alternative is provided.

The following categories of criteria point towards possible impacts on biological diversity, and further attention is thus required:

(a) Activities in, or in the vicinity of, or with influence on areas with legal status having a probable link to biological diversity but not legally protecting biological diversity (relates to all five screening questions in appendix 1 above). For example: a Ramsar site has the official recognition of having internationally important wetland values, but this recognition does not automatically imply legal protection of biological diversity in these wetlands). Other examples include areas allocated to indigenous and local communities, extractive reserves, landscape preservation areas, sites covered by international treaties or conventions for preservation of natural and/or cultural heritage such as the UNESCO biosphere reserves and World Heritage Sites;

(b) Impacts on biological diversity possible or likely, but the environmental impact assessment is not necessarily triggered by law:

   (i) **At the genetic level:**
   · Replacing agricultural, forestry or fishery varieties or breeds by new varieties, including the introduction of living modified organisms (LMOs) (screening questions I and II).

   (ii) **At the species level:**
   · All introductions of non-indigenous species (questions II and III);
   · All activities which directly or indirectly affect sensitive or threatened species if or in case these species are not yet protected (good reference for threatened species is provided by the IUCN Red Lists); sensitive species may be endemic, umbrella species, species at the edge of their range, or with restricted distributions, rapidly declining species (question II). Particular attention should be given to species which are important in local livelihoods and cultures;
   · All extractive activities related to the direct exploitation of species (fisheries, forestry, hunting, collecting of plants (including living botanical and zoological resources), etc.) (question III);
   · All activities leading to reproductive isolation of populations of species (such as line infrastructure) (question II);

   (iii) **At the ecosystem level:**
   · All extractive activities related to the use of resources on which biological diversity depends (exploitation of surface and groundwater, open pit mining of soil components such as clay, sand, gravel, etc.) (questions IV and V);
   · All activities involving the clearing or flooding of land (questions IV and V);
   · All activities leading to pollution of the environment (questions IV and V);
   · Activities leading to the displacement of people (questions IV and V);
· All activities leading to reproductive isolation of ecosystems (question IV);
· All activities that significantly affect ecosystem functions that represent values for society (see appendix 3 below for a list of functions provided by nature). Some of these functions depend on relatively neglected taxa;
· All activities in areas of known importance for biological diversity (questions IV and V), such as areas containing high diversity (hot spots), large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or which are representative, unique (e.g. where rare or sensitive species occur) or associated with key evolutionary or other biological processes.

**Category C: no EIA required**

Activities which are not covered by one of the categories A or B, or are designated as category C after initial environmental examination.

The generic nature of these guidelines does not allow for the positive identification of types of activities or areas where environmental impact assessment from a biodiversity perspective is not needed. At country level, however, it will be possible to indicate geographical areas where biological diversity considerations do not play a role of importance and, conversely, areas where they do play an important role (biodiversity-sensitive areas).
## Appendix 4

Biodiversity checklist on scoping for the identification of the impacts of proposed projects on components of biodiversity (from Decision VI/7, CBD)

<table>
<thead>
<tr>
<th>Levels of Biological Diversity</th>
<th>COMPONENTS OF BIOLOGICAL DIVERSITY</th>
<th>Key processes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Composition</td>
<td>Structure (temporal)</td>
</tr>
<tr>
<td>Genomic diversity</td>
<td>Minimal viable population (avoid destruction by inbreeding/ gene erosion)</td>
<td>Cycles with high and low genetic diversity within a population</td>
</tr>
<tr>
<td></td>
<td>Local cultivars</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Living modified organisms</td>
<td></td>
</tr>
<tr>
<td>Species diversity</td>
<td>Species composition, genera, families etc, rarity/ abundance, endemism/ exotics</td>
<td>Seasonal, lunar, tidal, diurnal rhythms (migration, breeding, flowering, leaf development, etc)</td>
</tr>
<tr>
<td></td>
<td>Population size and trends.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Known key species (essential role)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conservation status</td>
<td></td>
</tr>
<tr>
<td>Ecosystem diversity</td>
<td>Types and surface area of ecosystems</td>
<td>Adaptations to/dependency on regular rhythms: seasonal</td>
</tr>
<tr>
<td></td>
<td>Uniqueness/ abundance</td>
<td>Adaptations to/ dependency of on irregular events: droughts, floods, frost, fire, wind</td>
</tr>
<tr>
<td></td>
<td>Succession stage, existing disturbances and trends (autonomous development)</td>
<td>Succession (rate)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Appendix 5

Biodiversity Assessment in EIAs/SEAs of Marine-related Projects

The following tables give a comprehensive idea on what data should be collected and when it is best to be collected in relation to marine projects. This table was compiled based on a questionnaire sent out by SPNL, and mainly on feedback received from Fadi Sharayha, JREDS/Jordan.
### Requirements for EIA/SEA studies in the context of marine-related projects (Source: JREDS)

<table>
<thead>
<tr>
<th>Category</th>
<th>Scientific requirements</th>
<th>Length/frequency of collecting/analyzing biodiversity context</th>
<th>Human resources required</th>
</tr>
</thead>
</table>
| **Marine and coastal biodiversity** | - Identifying baseline data requirement  
These are detailed below | Affected by the nature of the project and by the type of the EIA and the time needed for its implementation, and could be very variable. The frequency of collecting/analyzing data is dependent on the nature of the attribute itself and could by ranging from daily to monthly to even yearly. | The involvement of professional with experience in: 1. Environmental sciences/process design 2. Coastal engineering (marine structures, foundations, dredging etc.) when available 3. Chemical/ mechanical engineering (Hazardous material handling/operations) 4. Oceanography 5. Water resources 6. Marine biology 7. Socio/Environmental/Natural resources-economics 8. Sociology  
This is in an ideal EIA team with some modifications in the structure of the team according to the nature of the project. But 1, 2,4,6,7 are a must in nearly all cases concerning marine related projects. |
Environmental parameters and their corresponding attributes to be measured in the context of marine-related project (according to the fact that most of these projects include both offshore and onshore components)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Attributes to be measured</th>
</tr>
</thead>
</table>
| • Air                      | • Diffusion factor-atmospheric (wind speed and direction, temperature, temperature gradient, humidity, rainfall, frequency on inversion, stability) and topographic (hills, valley, buildings).  
                           | • Quality factors-particulates, SOx and NOx. Hydrocarbons, carbon monoxide etc.                                                                                                                                              |
| • Noise                    | • Attenuation factors-atmospheric and topographic factors.                                                                                                                                                                   |
| • Marine environment       | • Diffusion factors-hydrodynamics (this include tidal ranges, waves current, velocity) especially when taking in consideration the semi enclosed nature of gulfs  
                           | • Marine soil characteristics  
                           | • Water quality factors-physical (pH, salinity, temperature, oil and grease, TSS, turbidity), chemical (DO/BOD, nutrients, heavy metals/toxic compounds), biological (fecal coliforms)  
                           | • Sediment quality (Benthos, toxicity, SOD, phytoplankton, zooplankton)                                                                                                                                                     |
| • Land                     | • Soil characteristics, hydrology, land-use patterns, waste management practices, topography including geomorphology, coastal stability, archaeological monuments (if there is any) etc.                                                                 |
| • Ecology                  | • Natural vegetation (offshore and onshore)  
                           | • Endangered species (these are nearly always neglected)  
                           | • Marine organisms including benthic fauna and fisheries  
                           | • Ecologically sensitive species (corals, sea grass etc.)  
                           | • Identify critical habitats                                                                                                                                                                                            |
| Note: the study should be conducted even in fishing, breeding and polluted zones. The study should include analysis at various trophic levels with intertidal sampling. |
| • Socio-economic           | • The attributes of this parameter are well known mostly                                                                                                                                                                     |
| • Resources                | • Same as above                                                                                                                                                                                                            |
The type of EIA determines the time of its implementation:

<table>
<thead>
<tr>
<th>Type of EIA</th>
<th>Time of EIA implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapid or comprehensive EIA</strong> (concerning projects with simple environmental issues only e.g. captive jetties, resettlement issues, induced developments and projects located in non-critical habitats and projects likely to cause a range of significant adverse impacts (affecting a number of environmental parameters) whose extent and magnitude cannot be determined without a detailed study such as: breakwater projects, ports and harbors initiated for the sake of industry, projects involving resettlement and rehabilitation issues, projects located in critical habitats etc.)</td>
<td>• Ranging from one season up to more than three seasons (Seasonal wind, when involving attributes depending on this factor)</td>
</tr>
<tr>
<td><strong>Regional EIA and sectoral EIA</strong></td>
<td></td>
</tr>
<tr>
<td>• Regional EIA for projects in an entire region in terms of industry or induced developments</td>
<td>• Varies a lot according to the nature of the project and could be ranging from one-three years in the ideal situations if not even more.</td>
</tr>
<tr>
<td>• Sectoral EIA for projects in a particular sector, where it involves multiple sub-projects. This involves evaluating cumulative effects of a project on a long-term basis.</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 6

Best timing for monitoring birds and mammals in Lebanon

<table>
<thead>
<tr>
<th>Birds</th>
<th>Mammals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Migration</strong> occurs from mid August till mid November and from the end of February till the end of May.</td>
<td>Monitoring by night relies on the visual sighting of the mammal.</td>
</tr>
<tr>
<td><strong>Wintering season</strong> is between November and February.</td>
<td>Monitoring by day relies on detecting mammal tracks and refuse.</td>
</tr>
<tr>
<td><strong>Breeding season</strong> is from mid-May till August.</td>
<td></td>
</tr>
<tr>
<td>Best timing to watch birds:</td>
<td></td>
</tr>
<tr>
<td>• For passerines: from 5 am till 10 am then from 5:30 pm till 8:30</td>
<td></td>
</tr>
<tr>
<td>• For soaring birds: from 9 am till 4-5 pm</td>
<td></td>
</tr>
</tbody>
</table>
CONTACTS

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