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National UNESCO Commission
National MAB Committee**

**IDENTIFICATION OF
POTENTIAL NATURAL HERITAGE SITES
IN ARAB COUNTRIES**

**Report to
the World Heritage Center
UNESCO**

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EXECUTIVE SUMMARY

After 25 years of the initiation of the World Heritage Convention, that is managed by the World Heritage Center (WHC) at UNESCO, Paris, it has been found in recent meetings that Arab countries did not yet fully benefit from the provisions of this Convention. Of the 22 Arab countries, only 16 have so far adhered to the Convention. Of these, 12 have declared 41 sites as Cultural World Heritage Sites and only 4 have declared 4 World Natural Heritage Sites (one of them also Cultural), while 4 countries have not requested the declaration of any site, whether cultural or natural. Although the area of the Arab World is quite large and its natural heritage is quite important as well as quite fascinating, no movement has yet been started to rectify this situation. These gaps were recently pointed out in regional Arab meetings and from the contrast shown by the manifest interest of Arab countries shown in recent years in the fields of environmental protection, with focus on nature conservation and enhancement of the value of biodiversity.

The Egyptian National MAB Committee and the World Heritage Center agreed therefore to conduct a survey of for the identification of potential natural heritage sites in Arab countries that are worthy of being declared within the terms of the Convention. The purpose of this report is to primarily to facilitate access to knowledge about potential natural heritage sites in Arab countries, whether members of the Convention, or not. A number of national experts from 8 Arab countries were asked to prepare statements about the physical and biological characteristics of their respective countries and to make a selection of some sites that they perceive as important and in need of being declared by their own countries in this context. Information about three other countries was also obtained either from the literature or from field visits by Egyptian experts, members of the MAB Committee. These countries, from west to east and from north to south, are: Mauritania, Morocco, Algeria, Tunisia, Egypt, Sudan, Lebanon, Syria, Jordan, Kingdom of Saudi Arabia, and Yemen. Six are thus from the African wing of the Arab World and 5 from its Asian wing.

A total of about 55 sites have been selected as a result of this survey. Criteria for short-listing of these sites, if need be, are given on the basis of the attributes of the sites (regarding infrastructure, touristic value, possibility of bi-national trans-frontier cooperation with neighbouring countries, presence of cultural heritage, presence of ecotones, etc.). These criteria, totalling 10 in number, are shown in tabular form at the end of the report, followed by the names and addresses of the national experts.

INTRODUCTION

1 - Why This Report?

During the Third Training Course on Conservation and Management of Natural Heritage in Arab Countries that was held in Cairo, Egypt, in May 1995, Dr. M. Rössler, of the World Heritage Center (WHC) at UNESCO, pointed out that very few Arab countries had made full use of the benefits of the World Heritage Convention that was initiated in 1972 (Rössler 1996). It was revealed in a recent (Jan. 1997) survey of records kept at the WHC that Arab countries have between them 41 Cultural Heritage Sites officially declared since 1972, but only 4 Natural Heritage Sites. Moreover, these sites are in only 12 Arab countries, and 4 countries have not proposed any sites, whether cultural or natural, while 6 Arab countries did not adhere to the Convention. The Egyptian MAB Committee and the WHC therefore felt that some effort should be done so that Arab countries could fully gain benefit from the Convention, especially in its Natural Heritage component, and so agreed to have a report prepared on the identification of potential Natural Heritage Sites in Arab countries, to be considered a UNESCO publication to all Arab countries and elsewhere.

The purpose of this report is:

- 1 - to make the natural heritage aspect of the Convention more widely known in Arab countries, particularly to the scientific community and to decision makers in the fields of nature protection,
- 2 - to facilitate the access to knowledge about some prominent natural heritage sites in Arab countries that could be worthy of being declared as World Natural Heritage Sites, within the requirements of the Convention,
- 3 - to encourage Arab countries which did not yet adhere to the Convention and to make full use of their potential natural heritage sites, and
- 4 - to help in dissipating the disinterest that many Arab intellectuals show about the value of natural heritage, particularly biodiversity, in the Arab World, and to raise awareness about the necessity of its conservation..

It is not in the purpose of this report in any way to inform countries about their natural heritage or to indicate to them which sites to propose for declaration within the Convention. These aspects of conservation and management of natural heritage that fall within the jurisdiction of national authorities are naturally fully left to the countries concerned.

2 - Implementation of the Report

The report was planned and implemented in the following steps:

- The present writer paid a visit to the WHC Office in Paris in February 1997 to discuss the details of the mission and to consult a number of libraries and data bases (WHC, UNESCO, OECD, Inst. du Monde Arabe, Inst. National de Géographie, etc.).
- Relevant WHC documents were translated into Arabic.
- Eleven focal national experts from eleven Arab countries were selected on the basis of personal merit.
- These experts were requested to prepare reports about the natural heritage sites in their own countries that they would identify as worthy of being declared as World Natural Heritage Sites, with the help of the documents that were translated into Arabic.
- Complete inputs were obtained from eight national experts: Morocco, Algeria, Tunisia, Egypt, Sudan, Syria, Jordan, and Yemen (see Annex I).
- A preliminary report about the early findings of the survey was presented by the present writer at the Fourth Training Course on Conservation and Management of Natural Heritage in Arab Countries, that was held in Rabat, Morocco, in May 1997.
- Information about Mauritania was provided from the literature by the present writer and for the Kingdom of Saudi Arabia by Prof. M. A. Ayyad (President of National Egyptian MAB Committee).
- Further information was obtained from field visits to Morocco (Merja Zerga), Tunisia (El-Faidja and Bou Kornine), in May 1997, as well as from Jordan (Dana Reserve) by the present writer and from Lebanon (Horsh Ehden and Chouf), by Prof. M. A. Ayyad, in June 1997.

We take this opportunity to thank with pleasure and gratitude all the colleagues who have kindly and unreservedly helped us in all the steps of preparing this report.

In the following pages details are given about sites worthy of being declared as World Natural Heritage Sites in Arab countries, according to the views of the national experts and/or of the present writer.

Remark

The words Gebel, Djabal, or Djebel recur often in the Arab World for "Mountain", they are given in this report according to the spelling of the respective countries.

Reference

Rössler, M. (1996) Definition and acquaintance with natural heritage in the international and Arab contexts. The Third Regional Training Course on Conservation and Management of Natural Heritage in Arab Countries, Egyptian National UNESCO Commission, National MAB Committee, *MAB Bull.-Egypt*, 13 (3/4): 4-9.

IDENTIFICATION OF POTENTIAL NATURAL HERITAGE SITES IN ARAB COUNTRIES

CHAPTER I

General Features of the Natural Environment in the Arab World

1 - Land Forms

The Arab World occupies an area of about 14 M km², which is generally flat and desertic, from the Atlantic ocean to the Arabian gulf, separating the Mediterranean World from Tropical Africa. It is thus the hinge of temperate and tropical environments, and the heart of the Old World. It may be useless to repeat that the Arab World is dominated by the flat desert, but it is useful to note that this flat desert occupies only 80% of the area of the Arab World (Ayyad 1995). The rest is marked by a number of mountain chains or massifs, such as the Hoggar (3300 m) in Algeria, the Tibesti (3265 m) in Libya, the Oweinat (1892 m) further east, the Djebel Marra massif (3071 m) and Kordofan (1460 m) in Sudan. At the edges of this more or less flat desert, we have the Atlas mountain chains (4165 m) in the Maghreb, Mount Lebanon (3088 m) in the Levant, the Taurus (3734 m), and Kurdistan (3607 m) in the NE part of the Arab World. The Red Sea, which bisects the Arab World, is flanked along its two sides by two long mountain chains: beginning at its northern end in by St. Catherine (2641 m), then Elba (2217 m) in the west, and in the east Assir (3050 m) and Yemen (3700 m). The Arabian Gulf, likewise, is situated within two massifs, in Oman (3100 m), and in Zagros (3460 m). By contrast, level plains are found in river basins, wadis, depressions, oases, and coastal zones.

2 - Phytogeographic Regions

Plant life in the Arab World belongs to four main phytogeographical regions (Ayyad 1995):

The Mediterranean:

This is found in the coastal plains bordering the Mediterranean sea and the mountains overlooking them. Parts of this region are covered by evergreen forests, so that plant life is active all year round, particularly where rainfall is above 400 mm/yr. (till 1000 mm/yr.). Below this amount, land is dominated by evergreen short shrubs, while grasses and herbs dominate the areas of mountain shadows. Plant diversity is particularly rich in such areas, including oak, cypress, pistachio, pine, carob, and olive. Succeeding cultivators over many centuries have added citrus, mulberry, bananas, apricots, and acacias. This is a fruit-tree region *par excellence*.

The Irano Turanian Region

This includes parts of Jordan, most of Syria, northern Iraq, and some parts of the Maghreb, and is interrupted by the excessively dry coasts of Egypt and Libya (Ayyad and Ghabbour 1993). This region is almost limited to the highlands, with a great variety in altitudes, rainfall, temperature, and with a rather long dry period. It is characterized by short grasses and small shrubs generally in dense or open associations. It is particularly suitable for grazing.

The Saharo-Sindian Region

It extends from the Atlantic coast to the deserts of Sind and Punjab in the Indian sub-continent. It reaches the Mediterranean coast in Egypt and Libya. It includes most of the Maghreb countries, as well as northern Sudan, north and central Arabia, and parts of Yemen and Oman. Rainfall is scarce and irregular, temperature is high with great fluctuations, evaporation is high, soil is poor, and mobile sand dunes are an important feature. Plant life is consequently remarkably poor and plant density is also very low. Vegetation is either short shrubs or ephemeral herbs. The date-palm is the characteristic species in the oases which intersperse this region. In spite of these features, the region is able to support an important herding activity, because of its immense area.

The Sudano-Deccanean Region

This region extends from the Atlantic coast to the Indian sub-continent, south of the Saharo-Sindian region. It covers southern Mauritania, most of Sudan, and Somalia and Djibouti, as well as the southern parts of Arabia (southern Hedjaz, Assir, parts of Yemen and United Emirates). Temperature is high all year round and rainfall is relatively high (summer regime). It includes a variety of habitats and is relatively rich in both native and cultivated plants. It is characterized by tall grasses (savanna) which merge southwards into woodlands, with tropical dense forests in the extreme south of the Sudan. This region is also particularly suitable for herding livestock.

3 - Zoogeographic Regions

The characteristics of zoogeographical regions in the Arab World, follow those of climate, landforms, and vegetation. The geographical position of Arab countries has had an important role in the intermediate nature of their animal biodiversity (Ghabbour 1997). The Old World's biogeographic regions are four, but only three of them are represented in the Arab World:

- 1- The Palaearctic Region, extending from the Iberian Peninsula to the Far East from west to east, and from the Arctic to southern Europe, but also the Atlas Mountains in the Maghreb, a narrow strip along the Afro-Mediterranean coast from southern Tunisia to the Palestinian coast, and the western parts of Lebanon and Syria, as well as northern Iraq.
- 2- The Ethiopian Region, constituted of Africa south of the Sahara, plus Yemen and Madagascar.
- 3- The Oriental Region, extending from Oman to South East Asia, and separated from the Palaearctic Region by the Caucasus and Himalayan Mountain chains.

Arab countries are bordered by the Palaearctic from the north, the Ethiopian from the south, and the Oriental from the east. The Oriental Region has limited extensions into the inner lands of Iraq, Syria, Palestine, and Jordan. The Ethiopian Region also has some obvious extensions into the Tibesti and Hoggar Mountains in the middle parts of the Great Sahara Desert, in southern Libya and in southern Algeria, as well as in southern Morocco, besides its extension into northern Sudan. Naturally, Mauritania, the Sudan, Djibouti, Somalia, and the Comores, belong to the Ethiopian Region. The lands of eastern Yemen and western Oman represent the separation between the Ethiopian and the Oriental Regions.

The Sahara Desert, and its extension into the Arabian Peninsula, is a meeting place of elements from the Ethiopian and the Palaearctic Regions, with some rare intrusive elements from the Oriental Region, in varying combinations. It can thus be considered a transitional region, where elements may mix together, but it is considered neither a distinct biogeographic region nor a region divided among all three neighbouring regions.

If the Arabian desert is not a distinct biogeographic region, its biodiversity is certainly distinct just because it combines biotic elements from three different and distinct biogeographic regions. This is a unique phenomenon not met with elsewhere at the frontiers of other biogeographic regions. The Palaearctic Region is more or less sharply separated from the Oriental Region in Middle and East Asia. Likewise, the Oriental Region is also more or less sharply separated from the Australasian Region by the famous Wallacean line, and the Nearctic Region is sharply separated from the Neotropical Region in North America. Only in the Arab region do we find a very large region of mixing of co-existing elements from three highly spacious biogeographic regions. This is why the biodiversity of Arab countries is so important, and why it is rich and varied in spite of the small absolute numbers of species, relative to other regions in the north (in Europe), in the south (in tropical Africa), or in the East (in the Indian sub-continent). It is from this unique varied mixture of plants and animals that Neolithic man in the Arab World drew the plants and animals which he domesticated, and which were spread from the Arab World to all other parts in the neighbouring biogeographic regions, and also to the New World.

Species living in the Arabian deserts are species that have been naturally selected from the pool of species of the three neighbouring biogeographical regions, that occupied these lands in earlier times, and that have become adapted over millions of years to the prevailing harsh desert conditions. There are also many species that have become isolated for such a long time that they have evolved into new species that have remained in the very small spots where they evolved, i.e. they have evolved into unique endemic species of very limited distribution. The longer the isolation of these spots is, the more likely we should expect to find endemic species therein, provided of course that they survive till we find them.

It has been found from earlier biogeographic studies that certain Palaearctic species exist in North African oases, away from the Mediterranean coast, such as in some oases of northern Libya and northern Egypt, and even as far south as Bilma Oasis in Chad, and in the Tibesti and Hoggar. Some Ethiopian species, on the other hand, are also found in the oases of northern Egypt and northern Libya, very near to the Mediterranean coast. It is noteworthy that most of the Palaearctic species that

succeeded in reaching the middle of the Sahara are terrestrial. The possible exception may be the amphibians of Morocco, which are all Palaearctic, and a few semi-aquatic oligochaetes. By contrast, most Ethiopian species that succeeded in penetrating the Sahara and in reaching the Mediterranean coast are aquatic, such as in the case of oligochaetes and dragonflies. This success was due to the use of the Nile stream as a migration route from south to north, as well as the occurrence of long periods of high rainfall during the Pluvial Periods of earlier geologic times, such as in the case of the dwarf crocodiles of the Hoggar. But Ethiopian terrestrial animals also did migrate far into the north, such as the African cheetah which was discovered a few decades ago in the Qattara Depression in northern Egypt, and is also found in Libya, Algeria, and Morocco, but now extinct in Tunisia. North African cheetah populations are completely isolated from those in Central or East Africa.

The Arab World is on the way of four important fly routes of migratory birds of the Western Palaearctic: along the Atlantic coast, from Sicily to Tunisia, from northern and eastern Europe along the Levant and the Red Sea, and from eastern Europe and Central Asia along the western coast of the Arabian Gulf.

4 - Land Use Patterns

The little rain that falls on the peripheries of the Arab World in the north or south are edge rains and not bulk rains (Ghabbour 1995). They are the edge of the bulk rains that fall in regions adjacent to the Arab World, the substantial rain zones in Europe or in Central Africa. Without this marginal rainfall in the north and south of the Arab World, the whole Arab World would have been barren desert, from the Mediterranean to the Indian Ocean and from the Atlantic Ocean to the Arabian Gulf.

The inhabited areas of the Arab World closely occupy these marginal rain belts: the northern fringes on the Mediterranean coasts, the western fringe on the Atlantic coast, the southern fringes in the Sahelo-Sudanian belt, or the eastern fringe at the Mesopotamian highland. Besides these inhabited outer fringes, some inner zones are also inhabited: river basins, oases, and some island mountains such as the Red Sea mountains, the Tibesti, and the Hoggar. Nevertheless, being situated in the fully arid heartland, these inland mountains are unable to catch enough rain to support population densities comparable to the fringe mountains such as the Atlas, Mount Lebanon, Kurdistan, or Yemen.

We can say therefore that the Arab World is characterized by being a ring of inhabited lands around a large space of an uninhabited void, except in the Nile Valley, which acts as an axis linking the Mediterranean World to the African savanna, and allows limited crossing between the eastern and western wings of the Arab World (Ayyad & Ghabbour 1986).

The desert is then the environment of the Arabs and the source of their life-support resources. It is from it that they obtain their food, drink, clothing, housing, and from it that they molded their culture and their identity. The Arab homeland is basically a desert homeland. The Arabs are the only people adapted to live in it and it is the most suitable for their living. Arabs have today to adopt a new approach towards their desert homeland at the same level of the intense relationship which marked their mutual attachment since the dawn of history. Arabs today have to understand the

desert and love it and care for it as did their ancestors who loved it, sang its virtues, defended its territories, and conserved its resources.

The Arab homeland is not merely the land inhabited by the Arabs, and the desert environment is not merely the environment surrounding the Arabs. The Arab homeland is in reality the homeland that was initiated and evolved and developed at the hands of the Arabs and thanks to their continuous efforts at its nurturing. The Arab people are not just the people inhabiting this homeland - a mere area of land on the planet's surface - but they are the people who were initiated, evolved, and developed in it, and the people who drew their strength, their values, and their institutions from the very harsh nature of this homeland.

The desert of the Arab homeland is one of the principal great and harsh environments of this planet where grew such an intricate relationship, physically, socially, and culturally, between the land and its inhabitants. Similar close relationships have grown between the Eskimos and their icy desert, between the British or Japanese and their isolated islands, but the relationships between Arabs and their desert homeland surpasses all these, because the Arabs have added to it their unsurpassed literary talent which they employed in describing all the characteristics of their environment, in spite of its harshness.

None of the other harsh environments of the world, such as cold deserts or high mountains, has had such an intimate relationship grown between a people and a barren land. The Arab people fill their desert from end to end in a large and extended area that is astonishingly homogeneous in spite of its large area. The Arab people are also astonishingly homogeneous on the land of this desert, from the Gulf to the Ocean. When we say the Arab world we do not contradict reality if we also say that it is the Arab desert. And when we say the Arab desert we simultaneously say the Arab Nation. The Arab Nation and the Arab desert environment are one and the same, man and his home. No separation of one from the other, and no life of one without the other.

Today, the Arab environment is unable to support the basic needs of the Arab Nation for the first time in its long history. Natural resources of the Arab homeland are in a state of rapid change. With the continuous efforts since several decades to increase land productivity and to expand agriculture horizontally and vertically, with intensive veterinary services, resettlement schemes for Bedouins, etc., desertification is becoming a serious threat: forests disappear, soil is salinized and eroded, rangelands diminish, underground water either rises or escapes. Whatever success is achieved by national efforts in achieving to raise food production, is negated by the disappearance of basic resources, and so the food gap is ever widening (Tawfik et al. 1992). It is to be deplored that in spite of this fact being acknowledged by Arab intellectuals, when the matter of nature conservation, and particularly the conservation of biodiversity, is brought up, it is often said: "What biodiversity is there in the poor desert that we have? And what is worth saving in them? Our deserts must be made green by land reclamation and irrigated agriculture in order to feed our people and to close the gap of our food deficits!" (Ghabbour 1997). Admittedly, no one can argue against the need to increase agricultural production through large and modern irrigation projects, and to establish favourable conditions (sea-side resorts, safari rallies, etc.), for attracting tourists, but the fact remains that biodiversity is also a much precious treasure that must be kept and enhanced. It is the stuff of biotechnology, which should hold great promises in the near future just for increasing food production. It should not be

allowed to disappear in the wake of ill-advised development projects. The only way to make use of biodiversity for increasing food production (together with its multiple other benefits), is first to preserve it, and then to conserve it, and third to develop it. We will never be able to develop a resource that has already vanished. And vanished because of apathy or of neglect.

5 - Basic Principles for the Management of Natural Resources

In order to deal with land degradation in the Arab world, we have to consider that the factors leading to it are multiple and interacting. Ayyad (1995) proposed five basic guiding principles in this respect:

- (1) collection of information about ecological systems,
- (2) management of water utilization,
- (3) environmental monitoring to anticipate risks,
- (4) integration of production systems, and
- (5) conservation of biological diversity.

Conservation of natural heritage can help to achieve most of these principles, if not all. We shall give here details about three of them that can be achieved through a system of natural heritage sites:

(1) Collection of information about ecological systems.

It is often said that there is enough scientific information, and that all what we need is to apply it. There is really a lot of information but it is either not available for application, or in need of adequate analysis, or much of it irrelevant, or collected by an inaccurate method. We still need much information about plants and animals and abiotic components of ecological systems, especially in what are called marginal environments of the Arab countries.

(2) Environmental monitoring to anticipate risks

The anticipation of natural hazards and annual variations in environmental conditions in order to mitigate their risk should be a main objective of development and conservation in marginal environments in Arab countries. Highly efficient units for environmental monitoring should be established at three levels: ground monitoring, climate monitoring, and remote sensing.

(3) Conservation of biological diversity

The over-exploitation of the resources of marginal lands in Arab countries has led to serious deterioration in their ecological systems. A large number of biotic communities have lost their regenerative capacities, and many species have disappeared or are on the brink of extinction. A natural heritage site plays an important role in the conservation of unique biodiversity hot spots by fulfilling the objectives of conservation objective, concerned with the conservation of genetic resources, ecological systems, and biodiversity.

6 - The Hot Spots Concept

The concept of "hot spots" is of utmost importance in the context of Arab countries for the protection and management of their natural heritage. In a discussion of the issue, Ghabbour (1997) showed that there are several definitions for the term "hot spots" depending on what is needed by the person (or organization) using it. Here, we shall adopt the simple working early definition given by Myers (1990), which he assumed could serve as a key contribution to conservation strategies. This definition is as follows:

Hot Spots are areas that

- (a) feature exceptional concentrations of species with high levels of endemism, and
- (b) face exceptional threats of destruction.

It would be preferable to add, in the case of Arab countries, every spot where there are threatened habitats or species. In fact, every spot with greenery in Arab countries, is practically a hot spot, and an endangered hot spot for that matter.

Identification of areas to be protected within the context of the World Heritage Convention, as applied to natural heritage, requires setting priorities and listing areas of high and not so high biodiversity, as long as biodiversity areas. These biodiversity "hot spots" are to be arranged in an order of urgency, showing which are to be earmarked for immediate protection and which can be left to wait for a while. After completion, or near completion, of literature surveys, of museum specimens, and of exploratory field excursions, GIS systems will provide opportunities to manage the large amounts of data that are necessary, and that are stored and manipulated in a suitably structured data base. Through a series of overlay maps, data can be manipulated to show:

1. areas of high species concentration,
2. of endemism,
3. rare species,
4. unique habitats, and
5. risks, their locations, their types, their intensities, and their imminence.

One recently suggested methodology is through GAP analysis (Scott et al. 1993), whereby areas can be identified that can serve as preserves for biological diversity. A series of smaller preserves are thought of as to be maintaining biodiversity in one large preserve, especially if they are connected by corridors. Preserves must be selected to protect biodiversity for long periods in the future (Anderson et al., 1993). Preserving maximum biological diversity in a given biological domain will require a reserve network which includes every possible threatened species for the longest period of time. This is called "permanent protection". In this methodology algorithms are used that define the smallest number of sites which would include all the species to be preserved (Margules et al., 1988).

From the viewpoint of conservation of the natural biodiversity heritage in Arab countries, a few remarks may be added to this approach. It is need less to emphasize or to repeat that the Saharo-Arabian desert is an immense hot and dry arid area, the

largest of its kind in the world. This desert may be poor in absolute number of species, but they have two remarkable features:

1. Those species that are present and which have survived for thousands, perhaps millions, of years, are certainly very hardy and tolerate extremes of temperature, from below zero to more than 50°C., and water availability from complete desiccation to inundation. Such extremes are not met with by other species in other biogeographic regions.
2. Desert species may be few, but they are certainly of an exceptional quality. They produce many substances of secondary metabolism that help them in their adaptations. They were the pool of most of the domesticated plants and animals upon which the world economy now, and the wild relatives still exist in some hot spots. Because of their economic value, it is popularly said that medicine (if they are).

Species in the Saharo-Arabian desert may be fewer than elsewhere, but they are not of an exceptional quality. Therefore, the *problématique* of biodiversity conservation in Arab countries should be formulated as one of quality rather than of sheer numbers, as usually done for other regions of the world. We should think of numbers of species threatened as related to total number of species present and of their quality, and number of habitats threatened as related to number and quality of habitats suitable for life. The loss of say 10 species in a desert habitat with 100 species is 10%, equivalent to the loss of 400 species in a tropical forest with 4,000 species. Unfortunately, international organizations may be quite alarmed at the loss of 400 species in the Amazon forest, but not at the loss of 10 desert species in the Sahara, although the two cases are equivalent. The sudden loss of 400 species in the Amazon forest, out 4,000 (10%), may be unlikely, and even if it happens, it may not be destructive to the forest ecosystem, but the irreversible loss of 10 desert species, out of 100 (also 10%), is highly likely, and is also very destructive, sometimes certainly fatal, if they happen to be "keynote" or "edificator" species. Desert species are already too few and too precious for us to let them disappear.

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CHAPTER II

Sites Suggested for Being Declared as World Natural Heritage Sites in Arab Countries

1 - Mauritania

Mauritania is the westernmost bridge between the desert environment of the Arab World and its extension into the typical tropical environment. Mauritania already has an important World Natural Heritage Site, the Banc d'Arguin, extending for 176 km south of Nouadhibou and north of Nouakchott. Of the three West African countries along the Atlantic seaboard, Morocco, Mauritania, and Senegal, a series of coastal wetlands and "sebkhas" constitute stopover stations for migratory water birds of the extreme western flyways of the Western Palearctic from western and northern Europe to West Africa. Apparently the Banc d'Arguin, although quite large, is only a stopover station but not a main wintering area, which appears to be the Djoudj National Birds Park in Senegal, which has an area of 170 km². The River Senegal has a pseudo-delta of nearly 4000 km² consisting of a vast system of alluvial plains and basins watered by the river and its affluents. Its root is in the Richard-Toll region, 80 km from the Ocean. On its right bank, in Mauritania, basins stretch northwards in a string of depressions and sebkhas parallel to the coast. Since 1963 all of the Senegalese part of this delta was the object of important modifications. An important network of dikes suppressed the flooding of vast surfaces. This makes the coastal series of depressions and sebkhas in Mauritania and Morocco much the more vital for the survival of migratory birds on their way to the Djoudj, which is the only depression that it is at present plentifully filled at flood time and keeps water till Spring, with the working of dikes and floodgates. The management of migratory birds being of necessity an international concern, the Banc d'Arguin in Mauritania should be a focal point within a series of coastal wetlands in both Mauritania and Morocco, not just one singular station.

1 - The Diawling National Park

This area is located on the right bank of the River Senegal's lower delta. Hydraulic works radically modified the character of both the River Senegal and the Diawling area. The former flood plain is now divided into a permanently flooded one and another area which can be flooded with the help of hydraulic works. The Diawling National Park was established in 1991 on 16000 ha of former land liable to flooding and is separated from the Djoudj in Senegal by the River Senegal. The objectives of the Park are conservation and sustainable development of the natural resources of a sample of the lower delta ecosystem. The soil consists mainly of alluvial layers of clay and sandy deposits.

The very acid and salty soil of the Mauritanian lower delta was at the start unsuitable for irrigated agriculture, yet the Senegal River Authority decided to construct hydraulic works for this purpose, which will permit the restoration of flooding liability and create an artificial estuary to be fed with fresh water.

Early in the 1960's, three types of vegetation could be distinguished in the Diawling plain:

1. the low land from 0 to 0.60 m, no vegetation at all (4000 ha).
2. clay plain surfaces between 0.60 and 0.90 m, dominated by thick beds of *Sporobolus robustus* (3000 ha).
3. alluvium relief above 0.90 m, scattered *Salsola* and *Arthrocnemum* (8000 ha).

At present, *S. robustus* is represented by only some rare specimens. In the Gambar basin they are now replaced by *Typha*. The bottom flood basins were dominated by wild rice *Oryza barthii*, but are now dominated by *Scirpus maritimus* and *S. brachyceros*. In some streaming water banks *Cressa cretica* has been replaced by *Echinochloa colona*. Only some rare individuals of *Acacia nilotica* remain on the border of the flood liable plains. *Acacia tortilis*, *A. albida*, *A. nilotica* var. *adansonia* and *Balanites aegyptiaca*, together with a lot of other woody species, have almost disappeared either from the drought of the seventies or from later flooding. In the coastal basins *Avicennia africana* and *Rhizophora racemosa* have almost disappeared from overcutting or overgrazing. *Tamarix senegalensis* is also suffering the same fate.

No data exists now on the lower delta's invertebrates, fishes, amphibians, reptiles, or small mammals. The area is known for its waterfowl population and is listed as a Ramsar site. For the African birds flamingo (2 species) and white pelican (2 species), are the most outstanding. Important colonies of cormorants and herons exist in the mangrove and in the *Acacia nilotica* forests. The Sudan bustard (*Oris arabs*) is very rare now due to poaching. As for the North West European birds, waders and ducks predominate.

Drought and poaching are the main threats to the larger fauna. The last lion was killed in 1970, and the red-fronted gazelle disappeared in 1991. Only remain a few jackals, warthogs, wild cats, hares, and patas monkeys. There is no recent observation of manatees.

Other threats to biodiversity in this National Park are:

1. use of pesticides in rice fields.
2. Possibility of a de-salinization dam upstream and hence loss of estuarine organisms and functions.

A survey carried out in January 1996 confirmed the role of the Diawling National Park as complementary to the Djoudj, and that it accommodates large numbers of internationally important species: white pelican, flamingo, spoonbill, shoveler, avocet, slender-billed gull. The splendid wetlands north of the park would shortly become military bases, and thus reinforce by their inaccessibility complementarity with the Djoudj.

2 - Lake Aleg

This is an evaporation basin fed by water from a vast hydraulic system. The stretch of water can reach 5000 ha after the rainy season, to shrink to 2500 ha in January. Water plants are lush, used for grazing only on the dried up areas. Total number of waterfowl reached 75000 in January 1996, including the glossy ibis, garganey, black-tailed godwit, ruff, black-winged stilt, as well as spur-winged goose, knob-billed goose, and purple gallinule. It appears that Lake Aleg plays a far more important role for African bird species than the River Senegal's delta, because birds are leaving the artificialized delta environment for the natural conditions of Lake Aleg.

However, the future of Lake Aleg is threatened in the short term by an agricultural management project supported by the European Union, the Lake is to be used for release of agricultural polluted waters. The example of Rkiz, another Mauritanian lake where the same pattern is at work, shows that such schemes are incompatible with the conservation of the environment's biological value. The environmental impact study asked for by the European Union may not be sufficient to rule out the risk of disappearance of this natural environment of a rare type in the Sahel.

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2 - Morocco

The country is divided into three regions: the mountainous region (Atlas and Rif), the Atlantic region (plateaus and plains), and the Saharan region (a vast complex of plains and small hills in the east of the country). The mountain chains reach 4000 m in altitude. The climate is Mediterranean over almost the whole of Moroccan territory, but is very much under the Atlantic influence. There is a large spectrum of bioclimates, because rainfall varies from 30 mm/yr in the Saharan region to 2000 mm/yr in the central and western Rif. All bioclimates, from Saharan to hyperhumid, and all their variants, from hot to glacial, are represented. All Mediterranean vegetation types are also represented in Morocco. They follow the oro-Mediterranean altitudes on mountain tops of the Atlas. Other vegetation types inserted between the two extremes are from down up, the meso-Mediterranean, the supra-Mediterranean, and the montane Mediterranean. Moreover, a particular type special to Morocco is the infra-Mediterranean, confined to the SW of the country. Permanent lakes are found mainly in the middle Atlas (4), and the High Atlas (3 at least). Merjas and dayas are frequent enough in the NW of the country, but rare elsewhere. Sebkhias and maader are found mainly in the arid and Saharan regions.

Ecosystem diversity in Morocco is very large as a result of the diversity of its topography and climate. Forest ecosystems are built around a large number of trees of various species: *Abies*, *Cedrus*, oak (4 species), thuya, juniper (2 species), *Pinus* (3 species), cypress, and *Acacia*. Other arborescent or suffrutescent species build around themselves other ecosystems of more limited distribution, such as carob, oak (2 species), pine, juniper, *Dracaena*, *Pistacia*, wild olive, *Acacia* (3 species), *Retama*, and *Adenocarpus*. Steppic ecosystems are, on the contrary, more widespread, either on mountain tops (xerophytic spiny steppe), or in the desert of the eastern and southern parts of the country. Here the most important species are halfa (*Stipa*) and *Artemisia* (several species). Particular ecosystems, such as riverine and other wetland ecosystems, halophytic and littoral dune ecosystems, are also quite common.

Regarding the fauna, the steppe has a larger biodiversity of vertebrates than the forest, thanks to the dominance of reptiles in the former. The humid zones are especially important for the rare and endemic species. The steppe has 34% of the total vertebrate fauna of Morocco, while rocky and sandy regions have between them 19% of this fauna. Nineteen vertebrate species have already disappeared and 34 are seriously threatened in the short term, while 120 species are rare, of limited distribution, or vulnerable. Two of the threatened vertebrates are endemic: the bald ibis (*Geronticus eremita*), and Ebner's seps (*Chalcides ebneri*). Two other internationally threatened species are in Morocco, the monk seal and the curlew. Ten breeding bird species have disappeared from Morocco in the last decades, mainly because of wetland drainage and overhunting.

The following four sites are proposed by the national expert for Morocco, Prof. Abdel-Malik Benabid, while the fifth is proposed by the present writer as a result of a field visit. The first four sites comprise both natural and cultural heritage.

1 - Chafchaun-Talassemtane

The Talassemtane National Park is one of the most beautiful and richest Mediterranean regions as regards plant and ecosystem diversity, most important of which are the Moroccan abies forests characterized by their rich biological diversity. At the foot of the Park's mountain is the Andalusian city of Chafchaun which still retains its old cultural traditions in literature, poetry, music, and traditional industries. This park is south of Tetouan.

2 - Anzi and Sidi Moussa Aligh

This is a region in the Little Atlas, east of the city of Tiznit, near Agadir. It represents an example of the Argania Biosphere Reserve which is under study. The region is characterized by its plants: *Argania spinosa*, *Dracaena draco* ssp. *ajzal* which has been lately discovered in an area that surpasses its area in the Azores, in addition to other species. The area is also characterized by its mammals: gazelles, hyaenas, etc. It has also Prehistoric rock drawings and Islamic monuments (Zawyet Sidi Ahmad Moussa and Aligh), attesting to a long and continuous distinguished culture.

3 - Tissinit Oasis

Characterized by *Acacia raddiana* forests, with other tree species and several rare animal species. It lies east of Tata city and south of Ouarzazat, on the Dra'a River. The most important feature of this Oasis, however, is a famous knowledge of its people about herbal medicine. Its inhabitants used to travel to all countries of North and West Africa, before the closure of frontiers. They still travel to all parts of Morocco for their profession of healing with herbal medicine.

4 - The Oriental High Atlas National Park

It is situated between Ifran and Errachidia. It is characterized by *Cedrus* forests, many mammals, particularly the Barbary sheep, and cultural festivities in the area within the boundaries of the Park.

5 - Merja Zerga Wetland

Merja Zerga (= the blue lagoon), is an estuarine lagoon characterized by an ecosystem of great importance, offering a suitable habitat for a great many species of birds and fish. It lies at 211 km NE of Casablanca and 160 km SW of Tangier, on the Atlantic coast. It was declared a biological reserve in 1978 as another name for Moulay Bouselham Lagoon. It is one of the most important coastal wetlands of Morocco for migratory birds. It harbours a number of rare and threatened bird species such as the African marsh owl *Asio capensis*, the curlew *Numenius tenuirostris*, the spoonbill, the Caspian and the royal terns *Hydropogon tschergrava* and *Sterna maxima*, and the warbler *Fulica cristata*.

There are about 10,000 inhabitants living at the proximity of the lagoon on its resources: fishing, pastoralism, agriculture, and tourism services, as well as artisanal industries based on the lagoon's resources (mat-making). An all-weather road passes at the Reserve, which has hotels and camping sites.

The value of Merja Zerga to migratory birds is indispensable, as it forms with other coastal wetlands along the Atlantic sea front a series of stopover stations for these birds during their flight routes. Merja Zerga is the largest (7300 ha) of these stations in Morocco (about 4) and its serious and effective protection will certainly enhance the effective the Banc d'Arguin in Mauritania, which itself an important stopover station on the way to Djoudj in Senegal. The declaration of Merja Zerga as a World Natural Heritage Site will greatly promote tripartite trans-frontier international cooperation to manage the Atlantic route of migration of western Palaearctic birds. There is need therefore to study the other Moroccan coastal wetlands, in addition to our suggestion for the Diawling Basin in Mauritania, and to eventually declare them as a chain of stopover stations, in order to develop a cohesive management plan for their entirety.

Merja Zerga, it must be noted, suffers from an uncertain land ownership system, from pollution by agro-chemicals, and from mosquito infestation. One important measure that will help it overcome these difficulties is declaring it a World Natural Heritage Site, and to elaborate a comprehensive management plan for its resources.

3 - Algeria

Algeria is the second largest country of Africa, and of the Arab World, after the Sudan. It has a great variety of climates and soils, from sub-humid Mediterranean to Sahelian, across a vast stretch of the Sahara desert. Two large mountain massifs characterize its relief, the Atlas block which runs from west to east in the north, just adjacent and parallel to the coast, and the Hoggar block in the center. The two sites proposed here represent the habitats of these two prominent features. Algeria, however, has already two reserves declared within the UNESCO-MAB network of Biosphere Reserves: El-Kala in the northeast, near the Tunisian border, and Tassili-n-Hajjer, east of the Hoggar mountain massif, which also happens to be one of the four World Natural Heritage Site in the the Arab World, and also the only one that is simultaneously a World Cultural Heritage Site. The first of the two has been proposed as one of the two sites identified as potential sites to be declared as World Natural Heritage Sites. The other one is the Hoggar mountain massif itself.

1 - The El-Kala National Parc

The El-Kala National Parc was declared in 1983 with an area of 80,000 ha. It has a population of 87 000 people. It was declared a UNESCO-MAB Biosphere Reserve in 1990. It lies only 12 km away from the Tunisian border, and 84 km east of Annaba, and is bisected by the international coastal road of North Africa. It is a coastal reserve and is bounded from the south by the Medjerda mountains. Two of its lakes, Lake Oubeira and Lake Tonga, are declared Ramsar sites. The Parc is divided into the following ecosystems.

1. The continental shelf to a depth of 120 m, rich in natural sites and coral reefs.
2. The coastal plain, about 60 km long, very much appreciated by holiday makers.
3. A vast dune complex 60 km long and 1-4 km wide interspersed with lacustrine depressions 1/2 to 4 ha in area, rich in a flora of rare and endangered species (Lake Tonga, Blue Lake, etc.).
4. A forest complex dominated by cork oak and Zeen oak and a dense understorey generally well preserved.
5. Three lakes: Lake Oubeira, 22,000 ha; Lake Tonga, 2600 ha; and Lake Mellah, 860 ha.
6. A vast marshy depression of 1200 ha (Lake Mekhada), unique in Algeria for its rich resident and migrant avifauna.
7. The Park harbours the last flocks of the Barabary (or Atlas) deer (on the brink of extinction) and a large assemblage of rare and endangered plants and animals. There are also 110 archaeological sites from the Neolithic to our times.

The flora of El-Kala can be distinguished into three main groups:

1. The marine and littoral ecosystem, with *Posidonia oceanica* and red coral formations, Aleppo pine, maritime pine and kermes oak.

2. The lake ecosystem, with salty, brackish, and fresh water lakes (Mellah, Tonga, and Oubeida, respectively), and the Bourd'Him marsh, with a highly diverse flora, including white and black poplar, *Alnus glutinosa*, cypress, white and yellow nenuphars, water chestnut, etc.
3. The forest ecosystem, made up mainly of cork oak and green oak with all their floristic associates.

The marine fauna consists of a multitude of Crustacea and fish. There are also colonies of the monk seal, a threatened species, along the coast. At least 77 species of birds frequent the shores, lakes and marshes, and 17 species of mammals, including four felids, inhabit the dunes and forests. Eighty one species of birds inhabit the forest, in addition to 25 raptors, including three eagles, 6 falcons, and 7 owl species.

The objectives of the Park are:

1. Preservation of natural resources.
2. Promotion of touristic activities of cultural and explorative character.
3. Promotion of scientific research, awareness, cultural and recreational activities related to nature.

This Parc is highly suitable for a programme of bi-national trans-frontier cooperation with El-Faidja Parc in Tunisia, especially for the conservation of the two last Atlas deer flocks that they both possess.

2 - The Ahaggar National Park

The Ahaggar mountain massif has an area of 450,000 km². It is bounded from the east by the Tassili-n-Ajjer and the Tanezrouft desert in the west, and extends from In-Salah in the north to the frontiers of Mali and Niger in the south. It was declared a National Park in 1987. Its main objectives are:

1. Protection.
2. Conservation.
3. Enhancing the value of the cultural and natural heritage of the Ahaggar.

The multiple geomorphology of the Ahaggar, which reaches to almost 3000 m of altitude (Mount Tahat, 2908 m), includes regs, plateaus, ergs, dune desert, lacustrine deposits, old craters, wadi beds, and gueltas of different aspects. The climate is typical Saharan with irregular rainfall. Wind speed is an average 35-45 km/hr, and may reach 100 km/hr.

The Ahaggar harbours a unique cultural heritage of archaeological sites that date more than 600,000-1000,000 years ago, with artefacts of proto-human and human cultures. It seems that it harboured the highest density of humans in Prehistory. There exist several thousand rock paintings and engravings to as late as 12000 years ago (hunting scenes, humans, big games) and surface lithic tools. There are also hundreds of funerary monuments, tumuli, ksours, sites of historic battles, caravan routs denoting ancient exchanges, etc.

There are more than three hundred plant species, many of them endemic. At higher levels are found Mediterranean species, olive, myrtus, lavender. In the lower plains are found palm trees, tamarisks, acacias, Sodom's apple, *Balanites*, etc., of typical desert vegetation. The long isolation and severe climate have produced a number of endemic species such as *Lavandula antineae*, *Olea laperrini*, *Myrtus nivelli*, *Silene hoggariensis*, and *Artemisia judaica* ssp. *sahariensis*. At the gueltas are found aquatic or moisture loving plants such as mosses, algae, lichens, wild mint, reeds, rushes, and the rosy laurel.

The fauna is a typical desert fauna with insectivores, bats, gerbils, cheetah, addax, oryx, gazelles (3 species), rock damans, Barbary sheep, fennec, etc., most of them either extinct or on the brink of extinction.

Among the birds noteworthy are the ostrich (threatened), the rare *Aquila rapax*, small desert Oenanthes, the sooty crane (*Grus grus*) threatened worldwide, the white sparrow (*Passer simplex*) and a number of other desert birds rarely found together in one site. The Ahaggar represents a refuge for a large number of reptiles and amphibians, which are more numerous in the highlands and ergs than in the hamadas. But the most remarkable feature is that there are also fish: the barbel, *Tilapia*, and catfish. Insects dominate animal life, mostly beetles and ants, dragonflies, and scorpions.

This Park, like El-Kala, provides an opportunity of bi-national (or even tri-national) trans-frontier cooperation with both Mali and Niger.

4 - Tunisia

Tunisia has already one very important World Natural Heritage Site, the Ichkeul National Parc, a wetland on the Mediterranean coast, about 75 km NW of the capital Tunis, and has an area of 12600 ha. The only elevation is Gebel Ichkeul (511 m). It was declared a National Park in 1980.

1 - El-Faidja National Park

The EL-Faidja National Park (also written El-Feidja), lies at the north western corner of Tunisia, at 100 km south of the Mediterranean, and close to the frontiers with Algeria. It is part of the Atlas Tell mountain chain in the shape of a plate, with 3 peaks of elevations reading 1024 m, 1106 m, and 1152 m. Its area is 2632 ha from the Algerian frontier to Oued Batn-Chad. Only the deer reserve descends to 550 m in the Oued. Above the 800 m contour an asphalt road connects it to the nearest town of Ghardimaou, 20 km away in the valley, which is connected to the capital Tunis by an all-weather road and a railway line. One small town (Ain Sultan) and three villages near the periphery of the Park constitute the local communities most intimately associated with the Park. The administration of the Park is taken care of by the Direction des Forêts of the Ministry of Agriculture, at Jendouba, the provincial capital of the area. The Park has been declared in 1963 and no exploitation of its resources has taken place ever since.

The most important plant is *Quercaes faginea* (chêne zéen) and the most important animal is the Barbary (Atlas) deer *Cervus elaphus atlantica*.

The following plant species are rare, endemic, or threatened:

Ilex aquifolium

Laurus nobilis

Celtis australis

Salix pedicellata

Prunus avium

Ficus carica

Populus alba

Cedrus libanotica ssp. *Atlantica*

The fauna is characterized by the Barbary deer, the boar, chacal, mongoose, the porcupine, and serval. Only the boar is reproducing successfully.

There does not exist any specific documentation of the fauna of the park. The insect fauna, and soil fauna, in particular, which are said to be specially rich in the Park and are known to be a highly diverse component of the biological diversity structure of any ecosystem, are completely unknown in this Park. This is a situation unfortunately very

ecosystem, are completely unknown in this Park. This is a situation unfortunately very frequently encountered in all other sites that were visited or about which scientific literature on biodiversity is available.

The bioclimate is humid Mediterranean temperate winter with several days of snowfall. The meteorological station of the Park (730 m alt.) recorded a mean annual rainfall of 1217 mm (over 76 years) and mean temperatures 6.2°C for January and 23.9°C for August (1902-1960).

The soil is leached forest mull on sandstone with sandy deposits and loamy continental plateau of the Oligocene. It is rich in humus and slightly acidic.

Climax vegetation is "Chêne zéen", *Quercus faginea* subsp. *boetica* (= *Q. mirbecki*) and cork oak (*Q. suber*). The fauna is diverse with three conspicuous mammal species: the Barbary (atlas) deer, the boar, and the jackal. 25 mammals, 70 birds, 22 reptiles and amphibians have been recorded.

Seven vegetation types have been recognized:

- *Quercus faginea* formation
- *Quercus suber* formation, of two sub-types
 - Q.f./ *Q. s.* formation
 - Q.s./ *Q. f.* formation
- Mixed forest formation
- Tall maquis
- Short maquis
- Meadows
- Wetlands

Two fires broke out in the park, one in 1951 and the other in 1994.

The Barbary (Atlas) deer

This is a subspecies endemic to the Atlas mountains marking the sole presence of deer in the whole of Africa. It has disappeared from Morocco and is all but one or two spots in Algeria and Tunisia. The EL-Faidja N.P. holds a well-kept small population protected since 1963. Their number has reached 3000 in the P. and the surrounding Kroumirie forest. The proximity of EL-Faidja N.P. to the Beni-Salah Reserve in the Algeria side of the frontiers, about 20 km away, and the EL-Kala N.P. a little further away, where the Barbary deer is also under protection, makes this triad of reserves ideal for a transfrontier tri-partite reserve for the protection of the only remaining naturally inhabited area of Barbary deer. [This species exists now in Morocco as it has been re-introduced there from EL-Faidja stock.] It is interesting to note in this respect that the Barbary deer needs an area of 500-1000 ha for the roaming of roes, and more than 5000 ha for the males, depending on age and season. Free-roaming deer limit their movements to the large forests which constitute their natural habitat.

Conclusion

The people responsible for the management of EL-Faidja N.P. are very enthusiastic about its declaration as a World Natural Heritage Site. The personal view of the present writer is that it has all the prerequisites for such a potentiality. It harbours a unique assemblage of the characteristic flora and fauna of the Atlas mountains, one of the very few of its type in the whole of Africa. It is well kept and well managed. It has all the necessary infrastructure. Tourist visitation is adequate and under control. It has a cooperating and motivated local population. It is well connected with a nearly toure which is in turn well connected with the capital (3 hrs by train, 6 times a day, very comfortable). The town has a nice hotel, a market, and a number of nice cafés and restaurants. Its people are friendly and pleasant to foreign visitors.

The number of visitors varied from 55 in 1992 to 368 in 1995. Highest numbers are usually in spring, especilly in May, with a record of 246 visitors in May 1995. There are also some Roman remains, and probably some prehistoric remains too.

The Park has an eco-museum which should open within a year, fully equipped for environmental education about the N.P. It also has a nursery and a meteorological station, apart from the administrative office and a reception.

2 - Bou-Kornine National Parc

This was established as a National Parc in 1987, with an area of about 2000 ha. The interesting feature about this National Parc is that in spite of its proximity to the capital Tunis (only 18 km), it is exceptionally rich in highly interesting biodiversity and is also very well kept and very well protected. The parent rock is Triassic limestone, forming a little double peaked mountain (576 m), with deep cliffs. The name Bou-Kornine means in Arabic two horns, thought to refer to this shape, but it is really a modification of the Punic name Baal Karnain, the god to whom a temple was dedicated. The Romans called the site Balkarensis, in homage to the temple of Baal Saturn, who also had two horns.

The Barbary thuya is the dominant tree of the Bon-Kornine forest. This tree was used for building Phoenician, Roman and Arab fleets, and for construction of homes and palaces in ancient Carthage and Mediaeval Tunis, as well as for fine carpentry. The Persian cyclamen is very abundant in the Park. Wild tulips grow on the north facing slopes of the mountain. The understorey is made up of *Cistus*, *Genista*, wild *Asparagus*, *Romarinus* and dwarf palms. Together with *Thuya*, there are also oaks and the Aleppo pine, with neighbouring typical maquis vegetation. Most interesting is that there are 12 species of wild orchids on the north facing humid slopes. The total number of plant species is about 600.

During the Roman period three animal species existed in the Park but have now disappeared: the Barabary (Atlas) deer, the mouflon, and the mountain gazelle (last seen in the area in 1936). The wild boar is now the only large mammal in the park. The jackal, the fox, the wild cat, and the genet chase small mammals, birds, and insects under cover of night. The mongoose lives in humid habitats, and feeds mainly on reptiles. Bats live in caves and in the galleries of old mines. But the most interesting mammal at Bon-Kornine is the smallest mammal in the world, the elephant mouse, whose adult weighs only 2 gm and is 4 cm long. The porcupine is also another endangered mammal of the Park. A large number of raptors lives on the cliffs or on top

of large trees, as well as many partridges and migratory birds. Among reptiles are the chameleon and the spotted lizard (50 cm long) and land tortoises exist. One species of scorpion at least is found, but mention should also be made of beautiful large gliding butterflies.

Archaeological remains include Punic cemeteries and a Jewish synagogue of the early Roman period. An eco-museum has been built as a visitor center for education and training. The administration is serious and effective.

Other sites of special interest include:

3 - Zembra and Zembretta Islands National Parc

The Island of Zembra has an area of 389 ha and Zembretta 2 ha only. The highest point in Zembra is 435 masl, while the sea floor around it is 120 m deep. The two Islands are situated at Cap Bon, in the north of Tunisia. They were declared a National Park in 1977. Wild mammals are the European hare, some rodents, bats and the monk seal. The Island is the only site in Africa where the European hare lives in the wild state. In 1964, some Corsican mouflons were successfully released in the Island. The avifauna is well represented by millions of migratory birds, including the very rare Audouin's gull and the sooty puffin. There are Neolithic obsidians and mosaics, cisterns, and tombs of Phoenician and Roman times. Silver gulls rest in great numbers in Spring in the Island of Zembretta.

4 - Shaanbi National Parc

The Park is situated at the latitude of Soussa near the Algerian border. Its area is 6723 ha and the highest point is gebel Shaanbi at 1544 masl, while the plateau around it is about 700 masl. The Park was declared in 1980. Rainfall varies from 400 to 500 mm in the highlands, and does not exceed 250 mm in the plains. Vegetation varies according to elevation, slope, and soil type. On the top are found oak trees with *Cistus*, Junipers, and *Ampelodesma*. The slopes are covered by Aleppo pine, juniper, and halfa, typical of desert plains. The mountain harbours *Gazella cuvieri* and hyenas. There is a multitude of resident and migrant birds. Roads and an eco-museum have been built. A number of old settlements are also found.

5 - Bouhedma National Parc

This Park is situated at 85 km east of Gafsa, midway between it and the coast. It has an area of about 16500 ha and is made up of three parts. The highest point is Gebel Bouhedma (840 m), while the forest is only 90 m high. It was established in 1980. The plains have a tropical *Acacia* forest similar to the Sahel vegetation. Climate is arid Mediterranean and Saharan Continental. Rainfall has no fixed season and does not exceed 100 mm. The fauna is desertic or semi-desertic with the Barbary sheep, the gundi, *Gazella dorcas*, the fox, the *Jaculus*, eagles, and other typical desert birds. Early in the 20th century there existed the oryx, the addax, and the cheetah. According to historical records, this acacia forest may have been the last refuge for Hannibal's elephants. Oryx, addax, and ostriches have been re-introduced in the Parc. There have been built an eco-museum, a research center, and a visitor center surrounded by a eucalyptus forest.

5 - Egypt

Egypt is the hinge and heart of the Arab World, linking its two wings, the Maghreb and Mashrek, and the tropical with the Mediterranean. The Nile bisects Egypt while the Mediterranean coast crosses from west to east. Three main geographic blocks characterize Egypt, the Sinai Peninsula, the Eastern Desert and the Western Desert. Sinai is in turn divided into the flat Isthmic Desert in the north and the very rugged mountainous block wedged between the Suez and Aqaba Gulfs. The Eastern Desert is characterized by a long mountain chain from Suez to the Sudanese border, with very short wadis running to the Red Sea and longer ones running into the Nile Valley. The Western Desert is gently sloping from the higher elevations in the south, towards the Mediterranean Sea, flat and without noteworthy elevations except in the SW corner (Gebel Oweinat and the Gilf Kebir Plateau). By contrast, it is marked by a number of large and small depressions: Qattara, Wadi Natroun, Fayoum, Siwa, Kharga and Dakhla, Bahriya, and Farafra.

The Nile Valley and Delta have been so much humanized for the last 7000 years, and especially since the mid-19th century, that the original flora and fauna have become almost wiped out, except in wetlands: Lakes Mariut, Idku, Borollos, and Manzala in the north, and Lake Qaroun in Fayoum. Two artificial lakes have lately been created: Lake Nasser in the south (fresh water) and Lake Wadi El-Rayyan SW of Fayoum (brackish water). Lake Bardawil is another lake in northern Sinai that has been isolated for centuries but has become heavily exploited in the last two decades. All these lakes and the oases as well are very important stopover stations for migratory birds.

Rainfall in Egypt is practically confined to a narrow strip along the Mediterranean coast, reaching a maximum of 200 mm/yr, and only 30 mm at the level of Cairo. Orographic rainfall in Sinai and the Red Sea mountains feeds the wadis sporadically. Elsewhere, there is almost no rain. Therefore, at least four systems can be distinguished: coastal vegetation in the northern strip, no more than 80 km wide, wadi vegetation in Sinai and the Eastern Desert, diffuse vegetation in the Western Desert, and oasis vegetation. To these can be added wetlands vegetation in the lakes and pools of the oasis, as well as rare spots of mountain vegetation in Sinai and the Red Sea mountains, and in Oweinat, without forgetting the weed vegetation in the fields of the Valley and Delta.

In spite of this scanty rainfall, by virtue of its central geographical position Egypt combines floristic and faunistic elements from Asia, from Europe, and from tropical Africa, particularly from the Ethiopian Plateau, the Lakes Plateau, and even from West Africa. It is a curious fact that European and Asiatic elements predominate on land and extend to the south of the country, while tropical elements predominate in the Nile waters and the northern lakes and extend towards the Mediterranean coast, even to Libya. There are species in the northern lakes and oases (Siwa) which have their relatives only in southern Sudan, in Uganda, Kenya and Tanzania. Their presence in these far cut-off situations gives a lot of information about past climates and the geological history of the Nile. But some land animals show the same phenomenon. The cheetah, for example, lives, or used to live, in the Qattara Depression in the north of

the Western Desert, near the Mediterranean coast. Reptiles of the northern half of the Eastern Desert are mostly Asiatic, but those of the southern half are mostly African. However, mosses of Nubia and Gebel Elba are all Mediterranean. Most of the plants and animals of Asian and of Eastern European provenance stop at the eastern fringe of the Nile Delta, while most of those of Western European origin stop at the western fringe of the Nile Delta, and may extend south to the Oasis of Fayoum. This is how the Nile and its Delta form a biogeographic barrier between east and west. When speaking about the biota of Egypt, we should not forget the 1200 km long coral reefs along the coasts of Sinai and those of the Eastern Desert, together with their rich and varied reef fauna, including the dugong. We must also remember that the Suez Canal, which runs through Egyptian territory, is responsible for a considerable mixing of Red Sea and Mediterranean biota.

Egypt has scores upon scores of sites to which the criteria for World Natural Heritage Sites are applicable: oases, wadis, mountains, lakes, etc. But to make a long story short, we shall concentrate only on the following:

1 - Lake Bardawil Sebkhah

The Sebkhah of lake Bardawil is situated from the east of lake Bardawil and extends for 17 km along the coast to 25 km west of El-Arish, capital of the North Sinai governorate. It is bounded from the north by the Mediterranean Sea and from the south by the El-Arish-El-Qantara road. Several biotopes meet in this Reserve: (1) Mediterranean littoral dunes, (2) salt sebkhah (shallow marsh), (3) wetlands, and (4) dry island consolidated dunes. Rainfall is about 80 mm/yr, in winter. Hundreds of thousands of migratory birds rest here in Spring and Autumn each year as it is the first land stopover from northern and eastern Europe, and some parts of NW and central Asia. Five hundred plant species have been recorded, of which about one hundred are endangered. Birds recorded in this Reserve, declared in 1985, are 244 species from 14 Families, in quite large numbers. For example, more than 6000 white storks were recorded in Spring 1991, and 133,000 raptors were also recorded in that same season. Marine turtles use the beach for egg-laying but no quantitative information is yet available. It is suggested to establish an open zoo in the scrub nearby the sebkhah.

2 - The St. Catherine Reserve

The St. Catherine area lies in the centre of the highlands of Southern Sinai, at 1500-1600 masl, and is surrounded by a number of high mountains: Gebel St. Catherine (2641 m, the highest in Egypt), Gebel Moussa (2285 m), Gebel Safsafa (2145 m), Gebel Sanna (1969 m), Gebel Ahmar (2027 m), and Gebel Kasr Abbas (2341 m). The area is centered around the Monastery of St. Catherine, built by the Byzantine Emperor Justinian in the sixth century A.D., at the place of two earlier towers built by the Empress Helen, mother of the Emperor Constantin in the fourth century A.D. The library of the Monastery harbours a great many number of icons and manuscripts, including a document allegedly in the hand-writing of the Prophet Mohammad. Inside the Monastery is the supposed Burning Bush and the well of Moses. Outside are the supposed tombs of Aaron and the Prophet Saleh, as well as the wadis of the Israelite wanderings. Several wells and springs at inaccessible heights are used to irrigate small orchards, each of no more than a few hundred square meters, where excellent fruit trees, of endemic varieties, are cultivated. These springs provide survival for a

multitude of plants and animals, including 27 species of mosses of Alpine origin and many birds, reptiles, and insects. These mountains were the last refuges for the Barbary sheep and the Sinai leopard. Tourism is very thriving, and the city of St. Catherine, at 5 km from the Monastery, was established only a few decades ago, with its many hotels, to accommodate for this emerging tourist industry. The city has a biological research center affiliated to Suez Canal University. Local folk medicine is also a very important tourist attraction, as well as the sale of fossils and wildlife products (skins, trophies). The Reserve enjoys a cooperation agreement with the European Union for the period 1995-1999. It was also suggested as a combined World Natural and Cultural Heritage Site.

3 - Ras Mohamed Marine Reserve

This area was the first area declared by the Egyptian government as a nature reserve in 1983, just a few months after the promulgation of the law organizing this process (Law 102/1983). It has been proposed from very early times as a World Natural Heritage Site, but no serious action was taken. It is situated at the southern tip of the Sinai Peninsula where the Gulfs of Suez and Aqaba meet, at 12 km from Sharm El-Sheikh, the flourishing tourist resort, and 70 km from El-Tor, the capital of south Sinai Governorate. It extends for 10 to 15 km into territorial waters, and includes the nearby Tiran and Sanafir Islands, at the entrance to the gulf of Aqaba. The area of the Reserve is about 200 km², of which about 125 km² is offshore. The Mangrove Canal extends from the shore to Baira Island (0.5 km²) for 250 m. The Reserve is famous for its rich and varied coral reefs with all the marine life that depends on it, or is associated with it. Besides corals, the Islands harbour what may be the largest colony of ospreys in the world (26 pairs in 1983). Moreover, the rocks enclose fossils as old as 20 million years, where the succession of corals and their species (150 species), can be observed and studied to detect past climates and sea levels. The Reserve is also frequented by migratory birds. A multitude of demersal and pelagic fish peacefully frequent the waters of the Reserve. From 1989 to 1994 the Reserve has been upgraded thanks to cooperation with the European Union. A solid and well-conceived management plan is being seriously implemented. The area of the Reserve does not suffer irreversible damage from tourist visitation, while environmental cleanliness regulations are strictly observed in the nearby areas nearby.

4 - Gebel Elba Natural Area Reserve

The Gebel Elba Reserve (declared in 1986), is situated at the South East of Egypt. It represents the northernmost extension of the tropical African biogeographic region, and harbours the only natural forest (Acacias) in the country. It is made up of basement complex granitic rocks. It is also the largest nature reserve in Egypt (4800 km²). Gebel Elba (1435 m) and its outlying wadi systems, off-shore islands, and mangrove swamps form the core units of the conservation area. Other mountains are: Gebel Asoteriba (2217 m), Gebel Shellal (1409 m), Gebel Shendib (1911 m), and Gebel Shandodai (1526 m). For a desert region, it is unusual in that it receives no less than 50 mm of Winter rain. Throughout the year the mountain is moreover often covered with mist (mist oasis). Dew continues in Summer months. This moisture is sufficient to allow the growth of a rich flora (350 species) including several tree species (*Dracaena*) growing at high elevations (Wadi Akwamtra). Islands off the coast are important

breeding sites for sea birds and turtles. There are 22 species of land reptiles and amphibians recorded in the area, and 36-40 breeding birds, of which 31 in only one Wadi. W. Aideib. Little systematic work was done on the migrants because of isolation and inaccessibility. A total of 21 land mammals are known and another 2 are suspected. The Bisharin, a tribe related to the Hamitic Beja of Sudan, have been leading their traditional lifestyle there for many centuries, but their life is now being "modernized". The Conservation Area is supposed to ensure effective measures for protection and rational management of its biological, mineral, and touristic resources. A management plan is available but is not put at present into practice because of the political situation. Yet, this Reserve can provide an excellent opportunity for bi-national trans-frontier cooperation with the Sudan. The immense area also requires a sound landscaping design that is presently difficult to envisage.

6 - Sudan

Sudan is the largest country of Africa and in the Arab World. With habitats ranging from hyper-arid desert in the north to tropical rainforest in the south. Most of it is flat, with the exception of the Red Sea hills in the east and the Gebel Marra massif in the west, and the semi-circular highlands surrounding the Upper Nile basin. Such contrasts in rainfall, geology, and soils have had a remarkable influence on the vegetation which shows a text-book example of gradation in almost regular consecutive belts from desert to savanna to forest, with islands of montane vegetation in the east, west, and south.

There are three types of protected areas in Sudan: Federal General Reserves, equivalent to national parks, Game Sanctuaries, and Game Reserves. The first type is decreed by the Head of State, while the other two are decreed by the Minister of Environment and Tourism. Up till now, there are no comprehensive management plans for these protected areas, which are run in the classical method of administration without much interference. The Federal Reserves are 8 and constitute 2.2% of the area of the country, while the Game Sanctuaries (3 in number) and the Game Reserves (11 in number) constitute respectively 1.3% and 0.04% of the area of the country.

Two of the eight Federal Reserves have been declared Biosphere Reserves under the UNESCO-MAB Programme. These are Dinder, in the east, at the origin of the Blue Nile as it enters the Sudan (890,000 ha) and Radom, in the west, at the origin of Bahr El-Arab (1250,000 ha). Four areas are suggested as potential natural heritage sites in the Sudan.

1 - Wadi Howar

In spite of the fact that the desert occupies more than a quarter of the area of Sudan, there is no reserve of desert habitats. The area proposed is Wadi Howar in the NW of the country. The Wadi was an important source of the Nile 9500-3000 B.P. (before present). It represents a unique geological formation of the volcanic gebel Meidob, Gebel Rahib and other mountains. There are considerable underground water resources and a number of oases and lakes (Lake Nukheila). These are also Prehistoric remains and rock paintings. It is proposed because of the typical desert flora and fauna it harbours and its potential for re-introducing oryx, addax and dama gazelle.

2 - Sanganib Marine Reserve

This is the only circular coral island in the area, enclosing three lakes, which differ in depth and thus give beautiful and varied reflections of sunlight. It was declared a marine reserve in 1990. It has 124 species of corals, 282 of mollusea and 10 to 30 species of fish.

3 - Mountain sites

There is a number of remarkable mountain sites in Sudan such as Gebel Marra in the west, Erkoweit (or Arkawit) in the east and Imatong in the south. They constitute quite different habitats from the surrounding lowlands and possess distinct floras and

faunas which make them protection worthy. Gebel Marra is also the haven of the Fur tribe and their cultural heritage. Erkoweit is an important vacationing area and is characterized by *Dracaena* and the Nubian ibex. The Imatong has a wonderful gradation of tropical vegetation from the bottom up to the top.

4 - Natural heritage sites in southern Sudan

The Portacos Game Reserve in the extreme SW of Sudan, with an area of 3500 ha is an equatorial forest with elephants, warthogs, wild buffalo, bongo, water kob, chimpanzee, and red-tailed baboons. It can serve for bi-national cooperation with Congo-Kinshasa. On the other hand, the Buma Federal Reserve, with an area of 2280,000 ha, between the Sobat River and the Ethiopian border, is a migration territory for hundreds of thousands of white-eared kobs. It too can serve for bi-national trans-frontier cooperation with Ethiopia.

7 - Lebanon

Lebanon may be the only Arab country devoid of a desert. Its diverse topography with a number of mountain chains alternating with valleys, and its position on the Mediterranean Sea front, make it a highly convenient environment for speciation and endemism of plants and animals. For example, four thousand species of insects have been identified, and six thousand more are expected to be discovered. Moreover, diversity among plants, even cultivated ones, is quite remarkable. More than a hundred species of plants related to cereals, vegetables, and fruit trees, have been identified in Lebanon. High endemism of insects, mollusks, and other small animals has been observed in the Lebanon rivers. Mountain tops also harbour endemic plant species. Ecosystems that are characteristic of Lebanon are river banks and waters, mountain tops, and deep isolated ravines. Plans are at present designed to extend protected areas to sites threatened by urbanization, such as valleys, mountain tops, and river banks, after urbanization has practically obliterated the coastal environment and made hopeless all efforts for its rehabilitation. Lebanese biologists are working towards the declaration of some springs, marshes and pools, especially in the sandy areas of the country, as protected areas.

A reconnaissance survey by Prof. M. A. Ayyad revealed that the following sites are worthy of declaration as World Natural Heritage Sites in Lebanon.

1 - Palm Island Reserve

Palm Islands, also known as Iles des Lapins, lie off the northern coast of Lebanon, 13 km offshore. They are a group of three flat rocky islands of eroded limestone pavement, rising to 6 m. Palm Island (Jazirat al-Nakhl) is the largest (20 ha). Parts of it are flooded during storms. There is some very stunted maquis-type vegetation in clefts, but otherwise the Island is bare, except in Spring when carpeted with wild flowers. The Islands are commonly visited for recreation and hunting or fishing. There are some ruins from antiquity (a Crusader church). The Islands regularly hold a significant number of globally threatened bird species. They are considered rare, threatened, and unique habitats, associated with a characteristic assemblage of bird species. Currently no species of birds breeds there, except possibly *Larus cachinnans*, due to disturbance. This species has been declining for a long time (no birds seen in 1993), and may be extinct. However, the site would make an excellent observatory for monitoring waterbird migration along the coast and for ringing them. Over 300 species of migrants were recorded by 1973, including vagrants such as *Heliaetus albicilla*, *Falco eleonora*, *F. peregrinoides*, and *Vanellus gregarius*. *Larus audouini* is a globally threatened species that is occasionally present in the Island.

There are also old records of the monk seal till the 1960's, and of the sea turtles *Chelonia mydas* and *Caretta caretta*. Some of the wildflower species are nationally endangered or extinct along the mainland coast such as *Euphorbia pithyusa* and *Cressa cretica*.

The Islands were declared a Marine Reserve in 1992, but without real protection. The site was also listed as a wetland of international importance and was designated as a

Mediterranean Specially Protected Area. Tourism is the greatest threat, followed by oil and garbage pollution, dynamite fishing, and introduction of alien species.

2 - Horsh Ehden Reserve

The Ehden Forest is a mountainous ecosystem of the northern Mount Lebanon Chain (1300-1950 m), 35 km away from the summer resort of Ehden, 35 km from the city of Tripoli, and 100 km NE of Beirut. It has one of the larger stands of the native Lebanon Cedar with thousands of trees of elegant stature. Mixed with the cedars are conifers such as the high juniper, and broadleaves such as the maple *Acer tauricum*, and the endemic wild apple *Malus trilobata*. The arborescent flora is made up of about 35 species and numerous rare and endemic shrubs such as the milkvetch *Astragalus cedreti*, *A. sofarensis*, and the Lebanon vetchling *Lathyrus libani*. Thirty of the more than 500 species of the flora are named after Lebanon. A large number is threatened and 57 are highly endemic. One species, the Ehden milkvetch *Astragalus ehdenensis*, is endemic solely in this Forest, while several species are endemic in Lebanon and in neighbouring countries, such as the Koch crocus *Crocus kotschyanus cappadocicus*. The total reserve area is 1000 ha, of which 350 ha is forested area. It was declared a Nature Reserve in 1992, but protective measures are not enforced.

Horsh Ehden is a sanctuary for resident and migratory birds. Many are endangered, such as the Imperial, booted, and golden eagles, the lesser kestrel, buzzards, sparrow hawks, two owls, and many others (at least 11). The Forest has also many threatened mammals such as the hedgehog, squirrel, porcupine, etc. (at least 15), and reptiles and amphibians (7 groups). The systematics of all the animal and plant species in this Forest, and especially of lower plants and animals, should, in the opinion of Lebanese scientists, be examined closely.

Threats come from over-cutting of the larger trees for timber and hacking down the younger ones to give goats easy access to leaves. Over-grazing the remaining vegetative cover does not allow regeneration.

3 - Chouf Cedar Reserve

The Chouf Reserve was declared in 1996. It has an area of 550 km² (2% of Lebanon) and extends from Beirut to the Bekaa Valley. It has the largest number of Lebanon Cedar, probably 3 million trees aged from 1 to more than 2000 years, in four forests, the largest being Barouk, 1750 masl, covered in snow from December to March. The forest is relatively open, with much scrub. About 10% of the area is under cultivation. Currently the area is primarily used for hunting, tourism, and recreation and secondarily for forestry, as rangeland, and for wildlife conservation. Birds include two globally threatened species, five regionally threatened species, and three species restricted wholly or largely to the Middle East. There are about 30 species of mammals of which two are threatened/endemic, as well as many endemic plants. It has the only arboreal species of ants in Lebanon. There was a reforestation programme in Barouk Mountain since 1965.

The forest suffers from a fungal disease attacking the Cedars. Major conservation problems are excessive hunting and disturbance of birds, neglect of traditional management systems, soil erosion, drought, fire, logging, and overgrazing. The area has already been nominated as a World Natural Heritage Site by the Lebanese

Government, but it still lacks a management plan. A national nature education center is planned.

The bust of an Egyptian Pharaoh, hewn in the rock, was recently discovered in Barouk. There is also a chapel and a cave which attracts visitors from all over the country for the relicts it contains.

4 - Ammiq Swamp

This is the largest remaining freshwater wetland in Lebanon, at 865 m on the western side of the Bekaa Valley, fed by El-Rhabe streams from Mount Lebanon, and overlooked by Gebel (or Jabal) Barouk (Ammiq = deep). It is bordered from the south by the canalized Riachi River, and to the north by the Houjier River. The main area is 280 ha flooded in February, March due to late Winter rain and melting snow, but dries out from August to November. There are extensive reed beds, interspersed with open fields of coarse pasture, and there are trees along the Litani and Riachi Rivers (gallery forests, corridors). Native *Salix* has almost died out, but *Populus* and *Cupressus* have been introduced. The swamp is a water reservoir for people nearby, and an important pasture for sheep and goats. Hunters come in Autumn and Spring. There is also cultivation and fishing. Breeding birds include at least 17, wintering species at least 5, and common passage migrants at least 4. Due to the site's position on the Rift Valley migration route, large numbers of pelicans, raptors, and swifts pass overhead both ways. The site was listed of international importance. It has one globally threatened species, five regionally threatened, and one species restricted wholly or largely to the Middle East. The otter, *Lutra lutra* has recently become extinct there. The total number of bird species is 217. The soft-shelled turtle, and some other rare reptiles, amphibians, and fish are also threatened/endemic there.

There are many critical conservation problems in the Ammiq Swamp. It is reduced to one tenth of its former area due to drainage. The vegetation is overgrazed, while it also suffers from drought and fire. Trees are deliberately burnt off by farmers. Overhunting of birds is occurring at excessive levels. Other major problems are garbage dumping and introduction of alien species, while toxic pollution and damming also occur locally. The land is privately owned but access is unrestricted. Negotiations are underway to protect the remaining habitat as a bird sanctuary.

8 - Syria

The territory of Syria, with an area of 185680 km² and a population of 15 million people, is divided into four bioclimatic regions:

- *forests*, formerly of an area of 4500 km², but now only 3790 km².
- *grasslands*, formerly of an area of 55,000 km², but now only 82270 km².
- *arable lands*, of an area of 60,000 km².
- *desert lands*, of an area of 67,000 km².

The climate is principally Mediterranean, distinguished into three types: typical Mediterranean, sub-steppic Mediterranean, and steppic Mediterranean.

The typical Mediterranean is distinguished into five ranges:

1. *Eu-Mediterranean*: areas directly affected by maritime influence, from the coast (183 km long) to 1100 masl. It suffers no frost, narrow temperature variations, and high rainfall (800 mm). It has carob, olive, cypress, oak, and pine.
2. *Oro-Mediterranean*: in Mounts Matta (1562 m) and Qadmoos (1385 m), temperate and rainy, as well as in the inner mountains which are cooler and with less rainfall. It has cypress, thuya, and cedars (on the eastern slopes).
3. *Sub-alpine Mediterranean*: between 1900 and 2300 m, severe winter, in the inner mountains, Hermon (2814 m), Sanir, Wadi Hager summit (2629 m), Talat Moussa summit (2616 m), Halima Qara summit (2465 m). It has *Phlomis*, *Berberis*, and *Astragalus*.
4. *Alpine Mediterranean*: at elevations of 2300-2800 m, long severe winter, at Gebel Sanbar, with *Ranunculus*.
5. *Nival Mediterranean*: Permanent ice caps from 2500 to 3000 m, the western slopes of Mount Hermon and Qurna Soda (3088 m), with *Bromus*, *Geraniodes*, and *Rhamnus*.

The sub-steppic Mediterranean is characterized by the continentality of steppes together with the temperate Mediterranean. Rainfall varies from 200 to 600 mm, in the plains and inland areas where rainfed agriculture predominates. It is distinguishable into:

1. *The Eastern Range*: includes the eastern plateau between 1200 and 1700 m of altitude, in the western Lebanese range, with cypress (3 species).
2. *The Western Range*: includes the plateaus between 1000 and 1200 m, with thorny scrub.

The steppic Mediterranean includes the desert (*badia*) with hot summer and severe winter, and low rainfall (100-200 mm), distinguishable into:

1. *Northern Steppic*: near the border with Iraq, includes gebel Sangar (1460 m), Qassioun (1154 m), Al-Mane' (1089 m), Abdel-Aziz (920 m), and Bushra (852 m).
2. *Southern Steppic*: near the Jordanian border with 50-100 mm rainfall, mostly flat country dissected by wadis.

In Syria, there are 14 national parks, ten "water protected areas" (wetlands), ten national monument or national landmark reserves, and five scientific reserves, while there are plans to propose one of the national parks as a UNESCO-MAB Biosphere Reserve.

The sites proposed as World Natural Heritage Sites are:

1 - The Cedar and Thuya National Park at Salanfa

Lying east of Lataqia, which can be the focus of bi-national trans-frontier cooperation with Lebanon in a similar site.

2 - Sanir Mountains National Park

In the eastern Lebanon mountains, also with potential for cooperation with Lebanon.

3 - Gebel Belaas component of the Central Mountains National Park

This is wrongly known as the northern Tadmor Mountains. It has a relict of Mediterranean fruit trees, including peaches and a number of endemic species.

9 - Jordan

The area of Jordan is about 90000 km² and is divided into 3 main topographic regions:

1- Hofrat Al-Inhidam: which includes the Jordan River valley, the Dead Sea, and Wadi Araba. Altitude varies from 400 m below sea level to 200 masl. This unique feature is manifested by a unique plant and animal diversity.

2- The Mountain Chain area: extending from Irbid in the north to Ras El-Nagab Ramm in the south. Altitudes vary from 500 to 1875 m. This highland is dissected by wadis and small rivers.

3- The Eastern Desert area: extending from the mountain chain area to the eastern borders. Mean elevation is 550-600 m.

Rainfall in Jordan is variable from year to year. It starts from end of July to end of April, and is classified as Mediterranean. It varies from 50 to 500 mm/year, with most of it in the mountain chain area, especially in the north.

Soils of the highlands is black clay. Under oak forests soil is Mediterranean terra rossa, and under Aleppo pine is yellow basic. In some areas soil is pure sandy as in Petra and Gebel Ramm, and in Dana Reserve. Soils of granitic origin are deposited in wadi beds and in the lowlands at Aqaba.

The territory of Jordan can be divided into four biogeographic regions:

1- The Mediterranean Region:

This is found in the mountain regions and is the region of natural forests with pine, oak, and junipers. Large areas have been cleared for agriculture. The forest area left is now only 0.8% of the area of Jordan, while the original was 10%. The reason for this degradation is that land is suitable for agriculture so that 95% of the population of Jordan lives here. Non-sustainable use of natural resources and their exhaustion is the outcome of this population condensation. With the disappearance of forests many wild animal species have also suffered, such as the deer, gazelles, and many other mammals, birds, and invertebrates.

2- The Steppe or Irano - Tiranian Region:

This Region surrounds the Mediterranean Region except in the north, where the latter extends into Syria and Lebanon. This Region is of altitudes from 200 to 700 m, and lower rainfall, 100-250 mm, with poor clay or loess soils. The key species is the *Retama* shrub and there are no natural forests. Other characteristic shrublets are *Artemisia*, *Achillea*, *Salsola*, *Atriplex*, and *Ziziphus*, all good for pasture.

3- The Saharo - Arabian Region:

This constitutes most of the area of Jordan (80%). Rainfall is low (50-100 mm). Soil deposits are coarse, with some saline, sandy, or clay playas. Plant cover is low although diversity is somewhat high. Land use is mainly for pasture. Animal life is characterized by the Arabian oryx, gazelles, the Syrian ass, ostriches, houbaras, and various birds, rodents, reptiles, and insects.

4- The Sudanian or Tropical Region:

This is found in the Rift of the Jordan Valley and the Dead Sea, Wadi Araba, and Wadi Ramm area. Here tropical trees grow, like *Calotropis*, *Balanites*, *Maerua*, *Acacia*, *Salvadora*, and *Ziziphus*. Rainfall does not exceed 50 mm, except near Lake Tiberias where it reaches 300 mm. Irrigated agriculture is widely practiced. The sandy loess soil is fixed by plants like *Haloxylon*. Saline soil is occupied by succulent plants. Characteristic animals are the Barbary sheep and the leopard, confined to inaccessible mountains. The Valley is traversed by large flocks of migratory birds, such as the white stork.

Threats to wildlife in Jordan come from a multitude of sources: overpopulation, land reclamation for agriculture, for building, for roads and industrial parks, overgrazing, charcoal production, fire, overhunting, habitat destruction, coral reef destruction, port construction, marine pollution, phosphate transport, oil pollution, thermal pollution, and chemical pollution.

Nature Protection in Jordan

Efforts for nature protection in Jordan started in the late forties and early fifties by the establishment of grazing reserves. At present there are 7 nature reserves, national parks, and 18 grazing reserves. The nature reserves are: Shaumari, Azraq Wetland, Azraq Desert, Wadi Al-Moujib, Zubia, Dana, and Wadi Ramm. Four other areas are worthy of being declared as protected nature reserves. These are: Borqo, Bayer, Wadi Araba, and the Jordan Valley area. In addition, it is suggested to declare the Petra area as a Cultural Heritage Site, and to extend the area of the Wadi Ramm Nature Reserve. But following a field visit to Dana Nature Reserve, it is suggested to pinpoint it as a potential World Natural Heritage Site.

1 - Dana Nature Reserve

Dana Nature Reserve was established in 1989 with an area of 120 km². Altitudes vary from 100 to 1640 masl. It is rich in biodiversity as it combines wild Cypress trees, juniper, and oak. It has 550-600 plant species, many of them rare and/or endemic. Animals include the Barbary sheep, wild cat, hyrax, foxes, several reptiles and a number of rare birds. The spotted leopard existed here but appears to have become extinct in the sixties.

A detailed management plan has recently been elaborated by the Royal Society for Conservation of Nature, which is the body responsible for its management, in collaboration with the UNDP and the World Bank GEF project. According to this plan, the area of Dana Nature Reserve is to become 308 km². It will thus contain an outstanding variety of habitats and includes a system of wadis and mountains which extend from the top of the Eastern Rift Valley down to the lowlands of Wadi Araba, so that altitudes range from -100 to 1500 masl. Four distinctively different but closely contiguous habitats are found within the reserve boundary: Mediterranean semi-arid, Irano-Turanian mid-altitude steppe, Acacia subtropical savanna, and sand dune desert. There are also four geological rock formations: limestone, white sandstone, red sandstone, and granit.

The reserve has a unique biodiversity with the last and the oldest known population of cypress (*Cupressus sempervirens* var. *horizontalis*) in Jordan. It hosts a wide variety of

plants (555 species), 93 of which are rare, 4 not recorded elsewhere in Jordan, 75 restricted to Shaubak area, and 8 endemic. The site also supports a significant number of rare animal species many of which are of global conservation importance. These includes 12 mammals, such as the sand cat (*Felis margarita*) and Blandford's fox (*Vulpes cana*), 4 reptiles and 9 birds: such as the spotted eagle, the Imperial eagle, the lesser kestrel, Tristram's serin, and the Cyprus warbler. The reserve contains the largest breeding population of the rare Tristram's serin ever recorded in the world. With a total of 182 bird species, the reserve is one of the most important non-wetland sites for bird conservation in the Middle East. A total of 565 animal species have been recorded in the reserve as of 1995. As elsewhere in the Arab World, the multitudes of soil animal species have not been surveyed, however.

The reserve is also of particular importance as regards cultural heritage. It has 98 sites of archaeological interest, ranging from the Epi-Palaeolithic (20,000 years ago) to the Nabatean, Roman, Byzantine, and Early Islamic Age. The most significant of these sites is the Nabatean copper mining center of Feinan, considered the second most important archaeological site of southern Jordan after Petra. Other visibly important sites include a series of military remains from the Hellenistic to the Early Islamic periods.

Regarding population and land use, four distinct social groups of pastoral Bedouins (total population 524) have varying degrees of dependency on the grazing resources of the reserve. A recent survey indicates that the maximum livestock population has already been attained, resulting in loss of biodiversity and disturbance to endangered wildlife populations. An important feature of the reserve, although not physically located within its boundaries, is the Dana village, founded in the 15th century and at present inhabited by 200 resident Bedouins who cultivate nearby terraces. The people are employed by the Dana Reserve administration, and they have strong socioeconomic links with the neighbouring village of Quadessya, which gives them access to the modernities of life.

The Dana Nature Reserve is the largest in Jordan, has high tourism profile (due to nearness to Petra with its 70 hotels), and is suitable as a demonstration and training site. It has all the necessary infrastructure (administration offices, hostel, museum, showrooms, lecture room, shops, etc.), to become a successful World Natural Heritage Site.

Other sites of interest are:

2 - Shaumari Reserve

Founded in 1975, of 22 km² area in the Eastern Desert, and at 10 km south of Azraq Wetland Reserve. Its objective is the re-introduction of the Arabian oryx, desert gazelle, and ostrich, to wildlife status after their disappearance from the Jordanian desert. Other birds and insects are also protected. It may have now the largest Arabian oryx herd in the world.

3 - Zubia Reserve

Situated in the north of Jordan within the natural oak forests, having an area of 10 km², and established in 1988. Its objective is the re-introduction of the mountain gazelle.

4 - Al-Moujib Reserve

Established in 1987 with an area of 212 km². It includes three biogeographic regions: the Mediterranean, the steppe, and the Sudanian. Altitudes vary from -400 to 700 masl, giving a wide variety of contiguous flora and fauna of all three regions, and has a number of hot springs. Its main objective is the propagation of the Barbary sheep which has become almost extinct.

5 - Wadi Ramm

This is a sandy area with the highest mountain peak in the Kingdom, near Aqaba. Altitudes vary from -400 to 1750 m. Although rainfall does not exceed 50 mm, its biodiversity is particularly high, with rare and endemic plant species, together with beautiful scenery. It is associated with the great Arab Revolution of World War I and Lawrence of Arabia.

6 - Borqo

This area is situated at the NE border and declared a Biosphere Reserve in 1993, with an area of 950 km². It is of sandy deposits interspersed with stones and gravels. Due to its difficult terrain, it is still rich in desert plants, gazelles, and houbaras.

7 - Bayer area

Situated in the Eastern Desert near Shaumari and Azraq, rich in plant and animal life in Wadi Bayer. Being near the Saudi border it could serve as a bi-national reserve, as the Wadi flows in both countries.

8 - Wadi Araba

Part of the Rift Valley, with very little rain but with tropical African plants and animals, extending into Syria. It is 200 km long between the Dead Sea and the Gulf of Aqaba. Dana Reserve may be extended to include parts of Wadi Araba, but not the parts of special interest in this Wadi. Besides tropical trees mentioned earlier, it is the habitat of the endemic poisonous Palestine viper.

9 - Jordan Valley area

Territories adjacent to the River Jordan are similar to Wadi Araba in their biodiversity. Characteristic plants such as *Asparagus palaestinus* and *Nicotiana glauca* grow only here.

10 - Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia occupies the main part of the Arabian Peninsula, with a long coast on the Red Sea and a shorter one on the Arabian Gulf. The north of the country is under the influence of the Winter regime Mediterranean rainfall, while the south is under the Summer regime. Again, the western part is made up of the Red Sea mountain chain with high peaks and dissected by wadis, while the eastern part is low and flat, and almost rainless. The large area of the country and its varied terrain contributed to the presence of a wide variety of habitats: mountains, oases, islands, etc. Nature conservation is an age-old concept applied in the "hema" (=reserve) system whereby tribes agree to prevent grazing and hunting in certain areas for certain periods to allow the regeneration of the vegetation and of the game animals. This traditional system has been rediscovered a few decades ago and is being revived by the present government. Nature reserves and breeding stations for wildlife, in the modern sense, are also being established and encouraged by the authorities. The conservation authority is highly effective and well equipped, and enjoys the technical support of IUCN and other conservation organizations. In spite of this remarkable activity, the authorities feel that there is still need for more reserves to protect sites of important biodiversity hot spots and of exceptional scenic beauty. Ten sites were proposed by the National Commission for Wildlife Conservation and Development (NCWCD), in collaboration with IUCN. The data were kindly provided by Prof. MA Ayyad. The personal view of the present writer is that the first two are to be identified as a priority, at least for the time being.

1 - Raydah (as-Sahab)

This is situated in the SW of the country in the Assir Emirate (Province) north of Yemen. Elevation is 1900 to 3000 m and the nearest town is the capital of the Province, Abha. Its size is only 9 km². It is a small steeply sloping catchment with dense mixed forest of junipers, *Nuxia*, *Aloe*, orchids, *Asplenium*, and *Adiantum*. The fauna includes leopard, caracal, baboons and mongoose, but the most important feature is the presence of all nine endemic birds of Saudi Arabia in one site. It is also a virtually pristine woodland, possibly the most intact remaining in Saudi Arabia. Threats come from grazing and wood cutting, road building, and visitor pressure. It offers opportunities for bi-lateral trans-frontier cooperation with Yemen.

2 - Hema al-Fiqrah

This is situated in the Hijaz Mountains, 75 km W of Al-Madina Al-Munawwara (Medina) with an elevation of 500 to 1900 m. It is an old tribal hema that is still in use. It is made up of high rugged crystalline rocks with juniper, olive, and acacia shrubs. The key species is *Dracaena*, among 285 plant species described. Mammals include the ibex, hyrax, wild cat, foxes, mongooses, and possibly leopards. There are 36 recorded bird species. The site comprises two historic hemas, traditional terraced agriculture, date palms producing three annual crops, and is rich in cultural and archaeological heritage. Its area is 1240 km². Threats come from uncontrolled urbanization, hunting, and disdain of the hema customs.

Other interesting sites include:

3 - Harrat al-Harrah

Situated in the NW of the country near the Jordanian border at 850 masl, 70 km SE of Al-Jouf, with an area of 13775 km². It is an undulating plain strewn with basalt boulders, volcanic ash, aeolian sand, and sabkhas (sebkhas). The vegetation is short desert steppe shrublets. It is used for breeding houbaras and is staffed by 32 NCWCD rangers. There is a possibility of re-introducing the oryx, the Saudi dorcas gazelle, the ibex, ostrich, and cheetah. It also has the potential of cooperation with Jordan.

4 - Jabal al-Lawz

Situated in the Tabuk Emirate, 125 km WNW of Tabuk in extreme northern Hejaz mountains, and at 50 km of the nearest town, ash-Sharaf. Elevation is 700 to 2549 m and area about 300 km². It is the highest mountain in Saudi Arabia, high enough to have snow in winter, of crystalline pre-Cambrian rocks. Neither the vegetation nor the fauna seems to be of special biodiversity importance, except that the mountain may be a Pleistocene refuge of Mediterranean species.

5 - Jabal (Gebel) Uthrub

Situated in the western highlands, in the middle part, at 800-2500 m elevation and with an area of about 80 km². Neither the vegetation nor the fauna is of special interest except in that they are representative of the high Assir mountain biotope, and a likely refuge for its biodiversity.

6 - Jabal ad-Dubbagh

Situated approximately 100 km WSW of Tabuk in Hejaz mountain range, at an elevation of 250-2668 masl, and an area of 600 km². The mountain massif is largely inaccessible, with high ridges and gorges. Vegetation and fauna not of special uniqueness, except the Palestine sunbird and the Sinai rosefinch. However, it is of outstanding scenic quality with high peaks and natural arches.

7 - al-Hasani/Libanah Islands

This is an offshore Red Sea island chain extending south of Umm Lajj, at the level of Medina. The remarkable mammal is the dugong, while among birds the osprey and among reptiles the green and hawksbill turtles.

8 - al-'Uqayr/al-Hasa plain

This is in Eastern Province near al-Hafuf at sea level, with an area of about 5000 km². It is a sandy gravel plain interspersed with sabkhas and aeolian sand fields, including coastal and marine habitats, used by migrant birds.

9 - Gulf Coral Islands

In the Eastern Province of uncertain area. They are important bird and turtle nesting sites.

10 - Ghaghah Island

Also in the Eastern Province and also of uncertain area, characterized by seagrass beds and fringing reefs. Here live the dugong, sea snakes and the two turtle species. It is a most scenic and attractive section of the western coast of the Arabian Gulf.

Comment

The Arab World, being a huge desert confined between two large water bodies, the Atlantic in the west and the Arabian Gulf in the east, and traversed in the middle by two other water bodies, the Nile and the Red sea, is marked by four main routes of flight for migratory birds from north to south. The entire migratory bird fauna of the Western Palaearctic has to follow one of these four migratory routes: along the Atlantic coast of Morocco and Mauritania, from Italy to Tunisia, along the Red sea and the Nile system in Lebanon, Syria, Jordan, Egypt, and the Sudan, and along the western shores of the Arabian Gulf in the Gulf states. These birds are able to use these routes thanks to the presence of a series of wetlands along their routes, like pearls in a necklace, which allow them to rest, feed, and preen themselves for the next phase of their journey: stepping ponds rather than stepping stones.

To help these birds, mostly waterfowl, to accomplish their difficult and dangerous journeys along these four main routes, the series of wetlands along these routes must be all, or at least most of them, protected. Losing a substantial number of these wetlands will cause the collapse of the whole migration route systems. The protection of the maximum number of these wetlands, beginning by the most important, in a rational series, will guarantee the sustainability of these migration routes, which are undoubtedly of world importance, as they involve scores of countries in Europe, the Middle East, North Africa, and the rest of Africa, in addition to certain countries in eastern Europe and in Central Asia. This is why we have indicated as potential natural heritage sites some wetlands in Morocco and Mauritania, in Lebanon, Syria, Jordan, Egypt, and Sudan, and have given information about the above mentioned wetlands in eastern Saudi Arabia. These four series will serve to protect the four main migratory bird routes in the western fringe of the Arab World along the Atlantic coast, in its middle across Tunisia and along the Red Sea and the Nile, and along its eastern fringe in the Arabian gulf. Cooperation for the declaration of the proposed wetland sites in these four "necklaces" will require the consent of the countries concerned first, and technical support from the WHC, IUCN, and other international organizations preoccupied with the study and protection of birds.

11 - Yemen

The area of Yemen is about 555000 km² and the population is about 15 million. Five natural regions can be distinguished, depending principally on topography:

- 1- **Mountain regions:** at 1000-3600 masl, mostly of igneous and metamorphic rocks, with cultivated terraces and flat depressions that allow agriculture. Rainfall varies from 100 to 1000 mm/yr. producing flash floods. Hot summers and very cold winters.
- 2- **Plateau regions:** parallel to the mountain regions and extending towards Saudi Arabia, mostly of limestone, of 1000 m maximum elevation. Rainfall 60-100 mm/yr. Hot and dry in summer and cold in winter.
- 3- **Coastal regions:** extending from the Omani border to Bab El-Mandeb, to the Saudi border, forming a coastal strip 2000 km long and 30-60 km wide. Hot and humid in summer and warm in winter, with 70-100 mm rainfall.
- 4- **Desert regions:** including the northern parts of the country, with some grazing lands and oases and rainfall from 5 to 10 mm. Very hot and dry in summer and rather cool in winter.
- 5- **Sea islands:** mostly along the Red Sea coast and Socotra in the Sea of Arabs. Socotra is famous for its unique biodiversity. These islands have hot and humid summers and warm winters.

Wildlife in Yemen

Yemen combines the characteristics of the African Sudanese, the Indo-Asiatic, and the Mediterranean environments, so that it is particularly varied in biodiversity. There are 3000 plant species in Yemen. It may be that 10% of the flora is endemic, while several species are rare. Socotra has 30% of its flora endemic. There are also in Yemen 370 bird species (25 endemic) and 115 species of reptiles and amphibia, some of which endemic, together with several endemic insects and mites. Marine life is also rich and varied in fish and corals. Agriculture, wood-cutting, drainage of wetlands, etc., are causing the quick disappearance of many important trees and birds, as well as felines and ungulates.

1 - Socotra Island

This Island has priority for its unique features. It has an area of 3625 km² and a population of 40-80 thousand people. Together with the Islands of Abdel-Kuri, Samha, and Darsa, it forms the Socotra Archipelago. The Island has 3 topographic units: 1- Coastal plains, 2- limestone plateau, and 3- the highlands. Its climate is warm marine. Rainfall is 150-170 mm but may reach 1000 mm in some mountains. There are two rainy seasons: Winter rain from October to December and Summer rain from March to June. Wind speed from June to August may reach 17 km/hr. Temperatures are in the range of 27 to 37°C. Relative humidity varies from 55 to 75%. The World Conservation Monitoring Center of the IUCN considers it one of the few remaining jewels of the global environment, and the tenth richest island in endemic plant species.

There are about 850 plant species in Socotra, with 277 of them and 4 subspecies endemic. In March 1996 fifteen more species were discovered, including some belonging to the olibanum group. Many more species are still to be discovered. Seven are in the Red Data Book, but the threatened species are more than this. Most conspicuous plants in Socotra are:

Dracaena cinnabari (brothers' blood)

Adenium obesum ssp. *sokotranum* (desert rose)

Dendrosicyos socotrana (tree cucumber)

Punica protopunica (wild pomegranates)

Begonia socotrana (flowery begonia)

Aloe spp.

Boswellia spp. (olibanum)

There are about 112 bird species of which 31 are resident. Six of them are endemic (the first three are threatened):

Emberiza socotrana

Incana incana

Orycognathus frater

Cisticola haesitatus

Nectarina balfouri

Passer insularis

About lizards, it can be said that they are all endemic. There are 35 insect species named after the island, either in the generic or the specific name. They constitute about 10% of the island's insect fauna (without counting the unknown soil fauna). The proportion of spider species named after the island is 20% of its spider fauna. There is also a substantial number of natural enemies of agricultural pests. The Island is also famous for the musk cat which is hunted to extract its musk, and a local variety of cows which give a high yield of milk.

Two important factors threaten terrestrial biodiversity in the island: wood cutting and overgrazing, which threaten the flora directly and the fauna indirectly.

Regarding marine biodiversity, Socotra is rich in fishes and other marine organisms. Coral reefs cover between 5 and 80% of its offshore. The Island is also rich in Algae and mangroves which may reach a height of 10 m. There are four species of sea turtles all mentioned in the Red Data Book.

Threats to marine biodiversity emanate from overfishing especially by illegal non-national boats.

However, local people have conservation customs that regulate their relationship with the environment, as for example the prohibition of felling live trees and organization of grazing rights among tribes. But rapid socio-economic changes in recent years have led to a disequilibrium between man and the environment. Basic principles regulating land ownership and rights to water, to grazing, and to agriculture are being eroded. The Island is now overtaken by a fever for purchase of land and building for settlements or

for profit. People do not distinguish in their building schemes between barren land and forest land. Many foreign scientists and collectors hurry to take whatever they like without any control. Legislation remains dead in the drawers and many specimens are taken away by air and sea to everywhere in the world.

Several attempts have been made to declare the Island or parts thereof under protection, to conserve whole ecosystems or its biodiversity. The latest suggestion is that four key areas containing representative ecosystems are to be declared protected. These are:

1. Dixehm-Haghar area, 4/5 km²
2. Shoab area, 342 km²
3. Ras Moumi, 26 km²
4. Hamadirou area, 16 km²

These four areas constitute together about 21.5% of the area of the Island. A transition zone of about 136 km² is also suggested, but the whole idea has been criticized and it seems that it needs to be revised.

Other potential natural heritage sites in Yemen are:

2 - Jazeb area

This is situated in the easternmost part of Yemen and reaches from the coast to 1500 m of altitude. It is characterized by a dense forest in the Hof area. Its area is about 30000 ha. Main trees are *Anogeissus dhofarica* (Masht) and *Dodonaea* spp. This forest is considered an extension of the Gebel Akhdar forests of Oman. Natural pastureland is available, and it is considered the most important pastureland in Yemen. During Autumn, leaves are covered by mist and dew and remain damp for 3-4 months, so much so that visibility is very low in that period. A transhumance between the coast and the highland is practiced by local herders. The area is suitable for a bi-national project of nature conservation with Oman. Up to 25-30% of the area can be declared a reserve because of the low population density, to be surrounded by a transition zone of 60-65% of the area.

3 - Gebel Araf

This is a highland in the middle of the country that is affected by rain clouds passing north in Summer and in Autumn. A number of endemic plants grow there, notably *Juniperus* spp., the only conifer in Yemen, at 1200-1400 m altitude. Although junipers grow elsewhere in Yemen, they are protected here because of inaccessibility and the private ownership of the forests. Hence these trees are felled only according to local customs. With close cooperation of the local inhabitants, it will be possible to protect the large number of endemic and rare plant species of this area.

4 - Gebel El-Arais

This highland is 1000-1500 m a sl, on the pathway of rain clouds passing to the Lodar plain, and remains for certain periods under the influence of these clouds. It has a

special flora of succulents and wild olive, with a number of endemic species. It remains virtually intact because of a low population density and of local customs. Declaring it a reserve site is most likely to succeed, with the help of local people and the local authorities.

5 - Mentag Area

This is situated at an altitude of 1000-2220 m on Gebel Khor Siban north of Al-Mokalla, capital of Hadramaut. There is a number of running permanent springs which allow the growth of some endemic plant species such as the palm *Lwistonia carinensis* which is a rare endemic found only in this part of Yemen, as well as in limited spots in Djibouti and Somalia.

6 - Gebel Bor'

This mountain is situated in Tihama, reaching an elevation of about 2000 m. It has the last vestiges of dense forests in the whole of Arabia, with an area of 900 ha, at 50 km east of Hodeida, and at 300-800 m altitude. These forests are rich in wild animals. The woody vegetation comprises 22 species of trees and shrubs, and animals comprise baboons, hyenas, many snakes and other reptiles. The area is proposed for protection.

7 - Gebel Al-Loz

This mountain is situated 50 km east of Sanaa. Its summit is at 3344 m elevation, topped by the rare junipers. The slopes are covered with junipers and acacias. Junipers cover an area of about 900 ha and this constitutes the largest spot of this species of Yemen. Wood cutting is prohibited by local tribal custom, and fines are paid for contraventions. Only grazing is allowed. There is therefore a degradation of the understorey vegetation which needs protection and restoration.

CHAPTER III

Criteria for Identification of Potential Natural Heritage Sites in Arab Countries

The present report, it can be seen, deals with 11 Arab countries out of the 22 countries members of the Arab League (50%). We have arranged them from west to east, and from north to south, beginning with Mauritania, and ending with Yemen. Information about Mauritania was obtained from reports of a recent (1996) reconnaissance survey (see references at end of that country's section). Information about Morocco, Tunisia, and Jordan was obtained by the present writer during excursions carried out in May and June 1997, in addition to reports by the respective national experts. Information about Lebanon was obtained from an excursion by Prof. M. A. Ayyad carried out in June 1997. Information about the Kingdom of Saudi Arabia was obtained from IUCN documents provided by Prof. Ayyad. Information in all other cases was provided solely by the respective national experts.

Some countries may possess declaration worthy sites but may not be particularly interested in declaring them for various political, administrative, or other reasons. Some other countries may have sites not particularly declaration worthy, but may be especially enthusiastic about declaring them as World Natural Heritage Sites, again for certain reasons.

The latter category of countries should be encouraged to improve the status of their sites so that they can become declaration worthy.

To make it easy for Arab countries to choose and designate certain areas as World Natural Heritage Sites within the regulations set by the World Heritage Convention, the following criteria (or attributes), were adopted for the identification of potential sites worthy of being declared as World Natural Heritage Sites. It will be noticed that the main feature for the selection is having special biodiversity attributes. Admittedly this is one only of the four criteria specified by the Convention, but it has a particular importance in Arab countries, whose biodiversity is characterized by five capital aspects:

1. Biodiversity in Arab countries may be lowest in the world, because of unusually harsh environmental factors, and hence is already vulnerable.
2. Plants and animals of Arab countries are marvelously adapted to the harsh conditions of their environment, and hence their value lies in their quality rather than in sheer numbers.
3. Plant and animal biodiversity in the Arab World contains a very high percentage of the wild relatives of plants and animals that were domesticated in the region several millenia ago and are now widely used as highly valuable commodities all over the world (sheep, goats, wheat, barley, etc.).

4. Plants and animals of Arab countries are found in the very few spots where some life support conditions are available, and hence human pressure is intensified in these spots in particular, which makes biodiversity under great threats of virtual extinction.
5. Biodiversity in Arab countries is unjustly neglected by international organizations which have their eyes turned on species-rich areas like the Amazon forest, but also by a low level of awareness about its importance for development, by Arab intellectuals.

Based on this approach, the potential Natural Heritage Sites to be identified should pre-eminently be those that will already permit a certain protection of representative or endangered examples of this threatened unique and valuable biodiversity, as quickly as possible. This will not be feasible, as a first step at least, except in areas where there is already a certain degree of protection, viz., in nature reserves. But to narrow down the choice, additional criteria are applied:

1. availability of serious management, preferably according to a well-conceived plan.
2. availability of a suitable infrastructure for both management and benefit by the general public (labs, eco-museum, hostel, roads, souvenir shops, etc.).
3. availability of effective legal protection.
4. availability of research facilities.
5. availability of sufficient interest by the authorities and visibility in the public eye, especially among the national scientific community.
6. availability of convincing cooperation with and participation of the local population in the management and sharing of benefits of the natural resources of the site.
7. availability of well studied and internationally recognized information about the biodiversity of the site and other relevant aspects.
8. Possibility of bi-lateral trans-frontier cooperation with a similar natural heritage site across the border.
9. Presence of archaeological vestiges and historic remains, and cultural features, that add to the interest of the site as a cultural heritage site as well.
10. Presence of a diversity of contiguous habitats that allow the manifestation of phenomena associated with ecotones, corridors, and migration routes, thereby enhancing the value of biodiversity.

These criteria are not to be necessarily taken as strict rules of thumb for short-listing of sites, if need be, but rather as attributes of the sites mentioned for relativizing their interest to the scientist, the decision maker, and the general public. These criteria are again not equal in importance, and their relative importance may vary from one site to another. A certain site may be seen as unimportant for possessing only one of these attributes, but other considerations may make it imperative to have it proposed as a World Natural Heritage Site, for example, for being under heavy pressures and exposed to serious threats endangering its very existence. Conversely, a site may

possess many positive criteria in its favour, and yet the country may not wish to have it declared as a World Natural Heritage Site, again for certain reasons of its own. Recognizing that every country has full and absolute sovereignty over its natural resources, according to international law, it is left to every country, in the final analysis, to make its own decisions regarding such criteria and the management of its own natural heritage sites.

**Table 1- Summary of sites identified
and applicability of criteria (1-10) as given above.**

Country and Site	1	2	3	4	5	6	7	8	9	10
I - Mauritania										
1. Diawling National Park	●		●				●	●		●
2. Lake Aleg	●						●	●		●
II - Morocco										
1. Chafchaun-Talassemtane		●	●				●		●	
2. Anzi and Sidi Moussa Aligh							●		●	
3. Tissinit Oasis		●					●		●	
4. Oriental High Atlas Nat'l Park		●					●		●	
5. Merja Zarga Wetland	●	●	●				●	●		●
III - Algeria										
1. El-Kala National Park		●	●				●	●	●	●
2. Ahaggar National Park			●		●		●	●	●	●
IV - Tunisia										
1. El-Faidja National Park	●	●	●	●	●	●	●	●	●	●
2. Bou-Kornine Nat'l Park	●	●	●	●	●	●	●		●	
3. Zembra & Zambretta Nat'l Park			●	●	●		●		●	●
4. Shaanbi National Park	●	●	●	●	●		●		●	
5. Bouhedma National Park	●	●	●	●	●		●			
V - Egypt										
1. Lake Bardawil Sebkh			●	●	●		●			●
2. St. Catherine Reserve	●	●	●	●	●	●	●		●	●
3. Ras Mohamed Marine Park	●	●	●	●	●	●	●			●
4. Gebel Elba Natural Area Reserve			●	●	●	●	●	●	●	●
VI - Sudan										
1. Wadi Howar					●		●	●	●	
2. Sanganiib Marine Reserve			●		●		●	●		
3. Mountain sites										
Gebel Marra							●		●	

Country and Site	1	2	3	4	5	6	7	8	9	10
Erkoweit							•			
Imatong							•			•
4. Portacos Game Reserve							•	•		
Buma Federal Reserve							•	•		
VII - Lebanon										
1. Palm Island Reserve		•	•		•		•		•	•
2. Horsh Ehden Reserve			•				•			•
3. Chouf Cedar Reserve			•				•		•	•
4. Ammiq Swamp							•			•
VIII - Syria										
1. Salanfa National Park								•		
2. Sanir Mountains National Park								•		
3. Gebel Belaas Nat'l Park										
IX - Jordan										
1. Dana Nature Reserve	•	•	•	•	•	•	•		•	•
2. Shaumari Reserve			•	•			•			•
3. Zobia Reserve			•							
4. Al-Moujib Reserve			•							•
5. Wadi Ramm									•	•
6. Borqo'			•					•		
7. Bayer Area										•
8. Wadi Araba										•
9. Jordan Valley Area										•
X - Saudi Arabia										
1. Raydah (as-Sahab)		•					•	•		
2. Hema al-Fiqrah							•		•	
3. Harrat al-Harrah			•				•	•		
4. Jabal al Lawz		•					•	•		
5. Jabal Uthrub										
6. Jabal ad- Dubbagh										
7. al- Hasani/Libanah Islands					•		•	•		•
8. al-'Uqayr/al-Hasa plain					•		•	•		•

Country and Site	1	2	3	4	5	6	7	8	9	10
9. Gulf Coral Islands					●		●	●		●
10. Ghaghah Island					●		●	●		●
XI - Yemen										
1. Socotra Island					●		●			●
2. Jazeb area							●	●		
3. Gebel Araf					●	●				
4. Gebel El-Arais					●	●				
5. Mentaq area							●	●		●
6. Gebel Bor'							●	●		
7. Gebel El- Loz					●	●				

ANNEX I

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