First Saudi Arabian National Report on the Convention on Biological Diversity

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The National Commission for Wildlife Conservation and Development

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Foreword

His Royal Highness Prince Sultan bin Abdulaziz
Second Deputy Premier, Minister of Defence and Inspector General

Conservation of biological diversity and the sustainable use of the resources of the Earth are enshrined in Islamic law and principles. It is therefore fitting that in 2001 the Kingdom of Saudi Arabia became a signatory to the Convention on Biological Diversity that seeks to ensure the conservation of species and their habitats for all time.

Biodiversity is itself a complex resource, but it differs from many other natural resources in that it is managed at local levels, but is subject to claims and influences that may operate on a global scale. Consequently, successful conservation of biodiversity requires involvement of all stakeholders, from the smallest local communities to the global community. It is this that makes the Convention on Biological Diversity so important. Despite a general acknowledgement that biodiversity is important; its very complexity makes it difficult to identify exactly what we gain from it. Benefits are both direct and indirect. Direct benefits include the use of the whole range of biological resources, whereas indirect benefits include stability of ecosystems, prevention of disease and psychological well-being of people.

As with any resource, management has to find a compromise between among outcomes that fulfil different values of biodiversity. This compromise can only be achieved when the managers have adequate information and effective monitoring and evaluation of the effects of actions. Therefore national reporting within the framework of the Convention on Biological Diversity forms a key component of assessment of biodiversity. Assessment involves measuring biological variety and variability, as well as the impacts on and the outcomes of this diversity.

The conservation of biodiversity is also particularly important as it provides the option to use biological resources in the future. Therefore, with this First Saudi Arabian National Report on Biodiversity that provides both information on the status of biodiversity and presents the overall plan for implementing the Convention on Biological Diversity, the Kingdom has taken an important step in ensuring its natural heritage.

I thank those Ministries that have been involved in preparing this report and urge them to continue diligently to fulfil the requirements of the Convention of Biological Diversity.

Contents

Chapter 1. Executive Summary

Saudi Arabia became a signatory of the Convention on Biodiversity in 2001. This has had consequences for the structure of this report. In particular, the First National Report both describes the status of biodiversity and also the measures that the Kingdom is taking to meet its obligations.

Maintaining biodiversity through protection and sustainable use of resources is both a responsibility and a necessity for any country. In Saudi Arabia, where many terrestrial ecosystems have small numbers of species and little inbuilt redundancy, it is particularly critical that no more species or functional groups of species are lost. Furthermore, the long history of human occupancy means that the country has a wealth of locally adapted races of plants and breeds of domestic animals. Changes in farming practises, influx of breeds and cultivars from elsewhere and introduction of parasites and pathogens could result in loss of priceless genetic material.

Appropriate legislation that is effectively implemented and enforced is a key element in maintaining biodiversity. Saudi Arabia has, since the mid 1970s introduced and implemented legislation that provides a sound basis for conservation and sustainable use of natural resources in a framework that allows the benefits to be shared by all citizens. The Report provides readers with an overview by briefly describing the major laws dealing with biodiversity issues, the organisations responsible for their enforcement and the consequences of breaking the laws.

The current status of biodiversity in the Kingdom is presented in Chapter 3. In order to set the scene, a brief description of the geography of the Kingdom is given, followed by sections on each of the major components of biodiversity.

Within its almost two million square kilometre land area, Saudi Arabia has a wide diversity of terrestrial habitats, from mesic, cool, high mountains through arid desert steppes to hot, semi-arid coastal plains. Despite this large area, the flora, of about 2,250 species, is comparatively modest in number of species, but it is biogeographically very interesting in containing elements of three major elements. Although well-known at a broad taxonomic level, details of the distribution and population status of many species is poorly documented. Consequently, local perceptions of the numbers of threatened species do not match well with the IUCN Red List of Threatened Species. This underlines one of the major concerns of the Global Taxonomy Initiative – more taxonomists need to do much more work on the flora in order for meaningful progress to be made on meeting the target of decreasing biodiversity loss by 2010. This is particularly important, since the severe droughts, low and unpredictable rainfall even under normal conditions, increasing human pressures and poor grazing management are severe threats to many plant species. As noted earlier, agro-biodiversity, especially in relation to land races and wild relatives of important crop plants is being lost very rapidly. To counter this, some important restoration projects in mountain woodlands and mangrove swamps have been very successful.

Diversity of large animals and birds is also modest. Species, such as Arabian oryx, Nubian ibex, Dugong and Arabian leopard, for example, are restricted in distribution whereas many migratory birds cross the Arabian Peninsular. Many of the larger mammals were either extirpated (oryx, Saudi gazelle) or exist as fragmented, small populations (ibex, Mountain gazelle). As with plants, the invertebrate fauna is poorly

known. All elements of the fauna are under threat from changes in land use practises that alter habitats (especially mountains, wetlands and coastal areas) as well as through unsustainable hunting practices. The Kingdom has undertaken major re-introduction programmes to restore Sand and Mountain gazelles and Arabian oryx to protected areas.

The marine and coastal environments differ from the terrestrial environment in that the coral reefs and seagrass beds, especially in the Red Sea, are amongst the most species-rich in the world. Apart from species diversity, these areas have great functional importance for the Red Sea, Arabian Gulf and adjacent parts of the Indian Ocean as refuges and breeding grounds for many species. Marine mammals, fishes and turtles are also well represented in the seas around Saudi Arabia, and some of the island in the Red Sea and Arabian Gulf are key breeding sites for turtles. Here too, development, pollution and increasing pressures of commercial and recreational use of resources pose serious threats.

Growth in the human population has been rapid in the past decades, resulting in many and varied socio-economic challenges to maintenance of biodiversity. Traditional demands – such a need for food, pasturage for animals and the like - for all kinds of resources has obviously increased. This has both put more pressure on harvesting of natural resources, increased the use of commercial crops and animal breeds, increased use of underground water and changed farming practices. Simultaneously, livestock owners have become more independent of rainfall through easy access to financial support for supplementary feed and water tankers. In addition, the need for outdoor recreation has increased as more and more people spend their lives in cities. These changes have resulted in increasingly unsustainable use of natural resources and consequently, decrease in biodiversity.

In the same way that the effective achievement of the objectives of CBD depends on legislation, there have to be organisations that are specifically charged with carrying out the necessary activities. The institutions in Saudi Arabia that deal with issues related to the CBD are listed and their major functions described. In addition, the sources of funding and the ongoing programmes on biodiversity-related work are briefly presented.

Saudi Arabia is in the final stages of preparing the National Biodiversity Strategy and Action Plan. In addition, the National Commission for Wildlife Conservation and Development has a detailed, scientifically based strategy for *in*- and *ex-situ* conservation that is regularly updated. Similarly, the Presidency for Meteorology and the Environment has developed strategies for coastal zone management and for dealing with oil spills and other forms of chemical pollution. As a result, Chapters 4 (dealing with the strategy the country will take in implementing the recommendations of CBD) and 5 (in which recommended measures are described) present a large body of detailed information on how biodiversity will be preserved and enhanced and how resources can be more sustainably used.

Chapter 6 continues the detailed explanation of the way that the Kingdom will meet its obligations by presenting descriptions of actions that are being taken and will be further developed to meet Articles 7 to 19 of the Convention. Articles 8, 9, 10, 12 and 13 are covered in greatest detail, since these are the areas to which most attention is focussed at present and which have the greatest potential to provide most return for effort expended.

In Chapter 7 a list of partner organisations is given to show the range of organisations that will be major players in the near future.

At this stage of development of the National Biodiversity Strategy and Action Plan, it is not possible to present any details of the schedule of activities (Chapter 8) that will be undertaken. Obviously, considerable progress needs to be made by 2010. The intermediate deadlines for activities that have to be met by 2006 are likely to prove arduous to meet, but they will also clearly show the progress that the Kingdom of Saudi Arabia is making.

A considerable body of information has been gathered in the Annexes. These comprise the following:

1 Selected Bibliography
2. Endangered plant taxa
3. List of Saudi Arabian Mammals
4. List of Saudi Arabian Birds
5. List of Saudi Arabian Reptiles
6. List of Saudi Arabian Amphibians
7. List of Taxa of High Conservation Priority

Chapter 2. Introduction

2.1. National reporting and the scope of the report.

National Reporting

Article 26 of the Convention on Biological Diversity (CBD) call on Parties to the Convention to carry out a variety of reporting activities. The major objective of such reporting is to provide information on measures that have been taken to implement the Convention and the effectiveness of these measures. Information on status and trends of biological diversity is not of primary importance; rather, it should be presented in such a way as to show how the measures taken by a particular country have been implemented.

National reporting both assists the Conference of the Parties (CoP) in assessing the overall progress made in implementing the Convention as well as helping individual countries to monitor the status of implementation of the commitments it has taken on as a Contracting Party to the Convention on Biological Diversity. National reporting therefore assists the country to identify those commitments that are being successfully met, those that have not been implemented and the constraints being experienced in meeting commitments.

First National Reports

At the second meeting of the Conference of the Parties held in Jakarta (November 1995) it was agreed that First National Reports should '*focus as far as possible on the measures taken for implementation of Article 6 ("General Measures for Conservation and Sustainable Use") of the Convention, as well as the information available in national country studies on biological diversity*'. At the third CoP (Buenos Aires, November 1996), it was decided that first national reports should be submitted no later than 1st January 1998.

First National Report for Saudi Arabia

On 3rd October 2001 Saudi Arabia became a signatory to the Convention on Biological Diversity. In part because the first deadline for submission of the First National Report was already past by this time, the Kingdom immediately embarked on developing the National Strategy and Action Plan, followed by preparation of the present report. As a consequence of this, the guidelines for national reporting (Annex to Decision II/17, CoP 2, 1995) are not fully appropriate for the First National Report for Saudi Arabia. Accordingly, the present report provides more information on the status of biological diversity in the Kingdom than is found in some other First Country Reports while broadly keeping to the guidelines.

2.2. What is biodiversity and how is it measured?

Definition

Biodiversity (or *biological diversity*) is used to refer to the variability among living organisms. By the definition used by the Convention, 'biological diversity' means:

> The variability among living organisms from all sources, including, *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and ecosystems.

The most obvious differences are often those to be found between different *species*. A species is a group of organisms that are sufficiently similar to one another to be able to interbreed in nature and produce fertile offspring. Each species has its own particular specialisations to fit it to its own *niche* or place in the environment. Through external changes (such as alterations in climate or decimation of populations through predation or disease) or internal ones (such as changes in genetic composition), many species have become extinct. There are therefore far fewer species alive today that there were in the past, and this loss of species (and therefore of biodiversity) has accelerated in the past few hundred years through the increasing impacts man has on the environment.

As indicated in the definition above, variation is also found within species: each individual plant or animal has its own unique set of genes and therefore its own unique characteristics. This uniqueness allows each individual to interact with its environment in slightly different ways from other individuals – it may need slightly more or slightly less of some mineral, be more or less susceptible to disease or poisons and so on.

When the numbers of individuals (i.e. the abundance) of a species decreases, the total genetic variation within a species is also usually reduced. The species is then less well able to cope with changes in the environment and hence is more likely to become extinct when a change occurs.

In addition to the two levels just mentioned, life on earth shows great diversity within and between different *ecosystems*. Different external conditions, habitats within each ecosystem and different kinds of interactions between species in ecosystems mean that the functioning, nature of resources provided, resilience to change and the sustainability of exploitation of ecosystems all vary widely even within broadly similar climatic regions. This provides the third level of biological diversity.

Measurement

Quite obviously, in order to conserve and measure changes in biological diversity, it is necessary to be able to measure it. The fact that there are three levels of diversity that are important, it is evident that no single kind of measurement will serve to cover all aspects. Furthermore, no country has the resources available to make a complete inventory of the variation existing in the natural environment. In any event, for large, diverse and poorly-known groups such as insects or micro-organisms, the rate at which humankind is changing the environment makes it likely that vast numbers of species will become extinct long before we can even discover and name them.

ECOSYSTEMS

Inventories of ecosystem-level diversity increasingly depend on the use of different techniques of remote sensing. Different types of ecosystems can be rapidly identified (i.e. the composition of the landscape can be determined) and quantitative measures of the structure can be determined. In addition, some indication of functions and processes taking place can also be obtained through the use of remote sensing techniques. However, no matter how detailed the remotely sensed imagery is, ground surveys are still necessary.

SPECIES

Species diversity requires far more detailed study that can be provided by ecosystem inventories and identification of indicator species. Three measures are needed to record species-level diversity, namely, *species richness, species structure and species uniqueness*.

Species richness is the simplest measure, and is just the numbers of species in an area. The methods used to compute and report species richness differ and usually only easily-recorded organisms such as higher plants, larger reptiles, mammals and birds are included in inventories. This means that it is often difficult to compare between different inventories (which is critically important for monitoring the effectiveness of conservation measures or to determine changes taking place over time) and entire categories of organisms – many of which play key roles in human welfare – are ignored.

Species structure refers to the distribution of different species. This requires measurement of the abundance and other measures of the distribution of a species within the environment.

Richness and structure are measures of quantity of species, not the particular kinds of species and their importance in the environment. Not all species of equally important to the functioning of ecosystems and nor are all species of equal perceived value to humankind. Species such as *Acacia tortilis* are central to sustained functioning of some rangeland systems. The loss of such a species would result in the collapse of the grazing system and with it many people's livelihoods. Other species are found only in Saudi Arabia in the entire world. Such *endemic* plants and animals have a special conservation value attached to them and require detailed monitoring and management. Particularly where endemic or other species are under threat of extinction (i.e. the species listed in the *Red Data lists*), reporting of status and the actions taken by countries to conserve these species and their habitats is an important element of the national reporting process for achieving the objectives of the CBD.

GENETIC DIVERSITY

Measurement of genetic diversity is especially difficult because the genetic variation within a species can seldom be defined unambiguously in terms of a definite number of different types.

In many cases, it is best to measure genetic diversity on the basis of the *structure* of the diversity. For example, in some species, most of the variation between individuals is found within a single population. In such a species, conservation of one or a few large populations will suffice to maintain the genetic diversity of the whole species. Another species may show little variation within each population, but populations at different

locations may be widely different. Here, the only way to conserve the genetic diversity of the species will be by safeguarding each individual population.

In light of the increasing realisation that humankind's very existence may depend on finding and using genes for wild species for the improvement and strengthening of economically important organisms, documentation and conservation of genetic resources (i.e. genetic diversity) is a matter of critical importance. The numbers of wild relatives of domestic crops and medicinal plants that are found in Saudi Arabia attest to the responsibility that is placed on the Kingdom to protect these God-given resources.

2.3 Importance of Biodiversity to Saudi Arabia

The term biological diversity often conjures images of particular landscapes with their plants and animals – the richness of coral reefs or the majesty of Arabian oryx in the dunes of the Rub al Khali. This aesthetic value is very important for the health and well-being of people and the increasing willingness of people to pay (sometimes to pay very high prices) for nature-based tourism, these natural habitats are by no means the only aesthetic values of diversity. Diversity in the local environment – especially for city dwellers – may be even more important. When nature is impoverished or suppressed, we suffer deprivation of physical, mental and spiritual well-being. Maintenance of biodiversity is an essential part of meeting deeper-seated needs of humankind and a nation that neglects this aspect of planning and management will ultimately suffer for its lack.

There are also practical, tangible benefits of biodiversity: it provides a wide range of useful biological resources. Fishing, and gathering of foods and medicines from natural communities are still important to the economy of the country. Sustainable use of such resources depends on conservation of the species used, their habitats and the maintenance of the functioning ecosystems of which they are an integral part.

Apart from individual species that we use, the very existence of life on the planet depends on biological processes. In all likelihood, loss of an appreciable proportion of biological diversity will result in the demise of humankind. The balances of oxygen and carbon dioxide in the atmosphere are maintained by plant life, whereas in diverse and rich communities, microbes maintain soil formation and the balances of fertility of soils. It is likely that fewer organisms than are now present could sustain all the processes that go to make the earth a functioning system. However, we do not have any idea of just what is the limit to impoverishment of fauna an flora before function ceases. What we do know is that if the global ecosystems became dependent on only a few key species (in other words, they came to resemble crop mono-cultures), an epidemic of some kind could render the entire system non-functional. Biological diversity is therefore essential to the survival of humankind and its preservation is the responsibility of every society on earth. This is especially relevant in Saudi Arabia, where many of the ecosystems have small numbers of species and hence little in-built redundancy.

Chapter 3. Background

3.1 Legal framework

3.1.1 Enabling Laws

Laws within the Kingdom that relate to elements of biodiversity naturally pre-date the Convention on Biological Diversity. Consequently, as is fully appropriate for a sovereign state, most do not explicitly address the contents of the CBD. However, as the descriptions that follow show, existing laws of Saudi Arabia provide a comprehensive framework of legislation under which the Kingdom can fully meet its obligations as a signatory to the CBD.

In the Table 3.1 below, laws are presented in the chronological order in which they were promulgated.

Table 3.1
Legislation regulating use and conservation of biodiversity within Saud Arabia.

TITLE	DATE OF PROMULGATION
1. Agricultural and Veterinary Quarantine Regulations	1975
2. The Uncultivated Land Act	1978
3. The Forests and Rangelands Act	1979
4. The Water Resource Conservation Act	1980
5. The National Commission for Wildlife Conservation and Development Act	1986
6. The Fishing Exploitation and Protection of Live Aquatic Resources in the Territorial Waters of Saudi Arabia Act	1987
7. The Wildlife Protected Areas Act	1995
8. The Wild Animals and Birds Hunting Act	1999
9. The Act on Trade in Endangered Wildlife Species and their Products	2000
10. Environmental Code	2002

3.1.2 Descriptions of Legislation

3.1.2.1 Agricultural and Veterinary Quarantine Regulations

Objectives
To regulate the introduction of plant and animal species into Saudi Arabia and the issuing of health certificates for any importation.

Authority responsible for enforcement
Ministry of Agriculture.

3.1.2.2 The Uncultivated Land Act

Objectives
To control and regulate land development activities.

Provisions
Interested people are given the right to invest in agricultural land according to cost/benefit analysis programmes. The act places a limit on the maximum number of years that interested and eligible individuals can utilise the allocated lands. It also places a limit on the maximum acreage of land that can be utilised for these purposes.

Authority responsible for enforcement
The Ministry of Agriculture

Punishment for contravention
No punishments are stated.

3.1.2.3 The Forests and Rangelands Act

Objectives
To ensure the conservation and rational exploitation of the forests and rangelands.

Provisions
a) Definitions (Article 1) clarify the terms in the Act.
b) Afforestation in public and village forest lands (Articles 6, 7 and 8).
c) Rational exploitation of the forest products (Articles 9, 10 and 11).
d) Acts prohibited in the forests (Article 12).

Authorities responsible for enforcement
The Ministry of Agriculture
The Ministry of the Interior.

Punishment for contravention
Financial penalty (maximum): SAR 1,000 (approximately USD 266).
Custodial penalty: Four months maximum detention.

3.1.2.4 THE WATER RESOURCES CONSERVATION ACT

Objectives
To control and regulate the use of water resources.

Provisions
Priorities have been given to the use of water for human and animal needs and for agricultural and industrial purposes. The Ministry of Water has been given the responsibility of supervising drilling activities to find water.

Authority responsible for enforcement
The Ministry of Electricity and Water

Punishment for contravention
Financial penalty (maximum): SAR 100,000 (approximately USD 26,000).

3.1.2.5 THE NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT ACT

Objectives
To establish the National Commission for Wildlife Conservation and Development.

Provisions
a) Establishment of the National Commission for Wildlife Conservation and Development (Article 1).
b) The Commission to encourage and conduct wildlife research and to use the information thus obtained for promoting conservation and sustainable development; to undertake the protection of the natural heritage of the Kingdom; to undertake the restoration and protection of endangered native fauna and flora; to change the public attitude and practises by promoting an ethical approach for sustainable living; and, to co-ordinate its work with other relevant national agencies (Article 2).
c) The composition of the Commission's Board of Directors, tasks and meetings (Articles 4, 5, 6 and 7).
d) The Commission's Administration; tasks, employees and budget (Articles 8 to 15).

Authority responsible for enforcement
The National Commission for Wildlife Conservation and Development.

Punishment for contravention
No penalties included.

3.1.2.6 THE FISHING EXPLOITATION AND PROTECTION OF LIVE AQUATIC RESOURCES IN THE TERRITORIAL WATERS OF SAUDI ARABIA ACT

Objectives
To ensure the rational utilisation of the live aquatic resources in the territorial waters of Saudi Arabia.

Provisions

a) Fishing and diving practises (Articles 1, 2, 3 and 4).
b) Preservation of living resources (Article 5).
c) Acts prohibited in the Kingdom's coastal zone (Article 6).

Authorities responsible for enforcement

The Ministry of Agriculture
The Ministry of the Interior
The National Commission for Wildlife Conservation and Development

Punishment for contravention

Financial penalty (maximum): SAR 10,000 (approximately USD 2,667).

3.1.2.7 THE WILDLIFE PROTECTED AREAS ACT

Objectives

To conserve and develop wildlife in the Kingdom of Saudi Arabia.

Provisions

a) Definitions (Article 2).
b) Protected areas declaration procedures (Articles 3, 4 and 5).
c) Protected areas management (Articles 6 and 7).
d) Establishment of the guard force (rangers) (Article 8)
e) Acts prohibited in the protected areas (Article 13).

Authorities responsible for enforcement

The National Commission for Wildlife Conservation and Development
The Ministry of Agriculture
The Ministry of the Interior

Punishment for contravention

Financial penalty (maximum): SAR 10,000 (approximately USD 2,667).
Custodial penalty: 30 days maximum detention.

3.1.2.8 THE WILD ANIMALS AND BIRDS HUNTING ACT

Objectives

To regulate hunting of wild animals and birds; and to ensure the preservation of the nation's fauna by providing opportunities for wild animals and birds to breed.

Provisions

a) Definitions (Article 1)
b) Issuing of hunting permits (Article 2)
c) Acts prohibited by the Act (Article 4).
d) Species that are protected from hunting (Article 5).

Authorities responsible for enforcement

The National Commission for Wildlife Conservation and Development.
The Ministry of the Interior

Punishment for contravention

Financial penalty (maximum): SAR 20,000 (approximately USD 5,333).
Custodial penalty: No custodial penalty is included.

3.1.2.9 The Act on Trade in Endangered Wildlife Species and their Products

Objectives

To regulate the trade in wildlife and wildlife products by the system of import/export permits according to the rules of the Convention on International Trade of Species (CITES)

Provisions

a) Definitions (Article 2).
b) Trade in wildlife and its products is prohibited without the appropriate permit from the National Commission for Wildlife Conservation and Development (NCWCD) (Article 3).
c) The NCWCD should issue a list of endangered species with the agreement of the Ministry of Agricultures (Article 4).
d) A fee of SAR 50 should be collected, for the Treasury, for each permit issued (Article 5).

Authorities responsible for enforcement

The National Commission for Wildlife Conservation and Development
The Ministry of Agriculture
The Ministry of the Interior

Punishment for contravention

Financial penalty (maximum): SAR 10,000 (approximately USD 2,670).
Custodial penalty: No custodial penalty included.

3.1.2.10 THE ENVIRONMENTAL CODE

Objectives
To protect the environment and conserve biodiversity in the Kingdom.

Authorities responsible for enforcement
The Presidency for Meteorology and the Environment.
The Ministry of the Interior

Punishment for contravention
Financial penalty (maximum): SAR 20,000 (approximately USD 5,333).
Custodial penalty: No custodial penalty is included.

3.2 Current status

Introduction

As noted in the introductory chapter, the First Country Report for Saudi Arabia includes a comparatively extensive overview of the current status of biodiversity in the Kingdom.

3.2.1 GEOGRAPHY AND CLIMATE OF SAUDI ARABIA

Geography

The Kingdom of Saudi Arabia is about 1,969,000 km^2 occupying four-fifths of the Arabian Peninsula. It is the tenth largest country covering 1.64% of the land area of the world, and 8% of the land area of Asia.

The Kingdom extends from 32º 12' N latitude on the Jordanian border in the north to 16º 00' N at the Yemeni border in the south. It is bounded by the Red Sea in the west and the Arabian Gulf in the east.

Western Saudi Arabia is dominated by a mountain chain running the entire length of the country, known as the Hejaz and Asir mountains. It runs parallel to the Red sea and rises to between 1300 – 3000 m. above the Tihamah coastal plain to its west. The flat coastal plain along the edge of the Red sea is hot and humid with temperature reaching 45º C in the shade during the summer months, with 90% relative humidity. The winter is considerably cooler but due to the relative warmth of the sea, it is never cold. From this fertile crest it falls towards the east as a desert plateau to the dry interior or the Najd containing the Dahna and Nafud which extends to the great sand desert of the Rub Al Khali (The Empty Quarter). From the Dahna dunes to the east coast the terrain alternate between rocky outcrops and gravel plains. The eastern region lies on the Arabian Gulf coast and contains salt flats (sabkhahs). There are many artesian wells along the coast which are used to irrigate large areas under cultivation around Hofuf and Qatif.

Saudi Arabia divides naturally into seven terrestrial physiographic regions (with 30 sub-regions) and two marine regions (Child and Grainger 1990):

1. The Tihamah
2. Western Highlands
3. Arabian Hinterland

4. The Cuesta region (Sedimentary Najd)
5. Aeolian Sands: an-Nafud, Ad-Dahna, Al-Jafurah, Ar-Rub' al-Khali
6. As-Summan and Widyan Plateaus
7. Arabian Gulf coastal region
8. The Red Sea
9. The Arabian Gulf

Climate

1. Rainfall

Saudi Arabia is an area of dry, stable, subsiding air which gives rise to hot, dry and near cloudless skies with dry days most of the year. Occasionally disturbed tropical monsoon weather may reach the Kingdom, bringing rain to the south of the country in the summer. In winter, remnants of the mid-latitude low pressure system may penetrate the north of the country giving rise to most rain in the region.

Precipitation due to high altitude and proximity to the Red Sea augments rainfall along the south-western escarpment. Daytime on-shore sea breezes force the moist air from the Red Sea to ascend, giving rise to afternoon showers and thunderstorms. Annual precipitation in the mountains south of Taif is above 125 mm and may exceed 600 mm.

Map 2.4 in Child and Granger (1990) shows the average annual precipitation in the Kingdom. It is a guide as in most areas the precipitation is highly variable and unpredictable.

2. Temperature and Humidity

Temperatures are subject to considerable diurnal and seasonal fluctuations. Winters (December to February) are cool to warm. Summers (June to September) tend to be very hot with temperatures above 40º C widespread and common and may approach 50º C. Humidity is generally low, except along the coasts where it may be quite high.

Average August temperature in Jeddah 32º C but may reach 49º C, winter temperature average 24º C, and relative humidity varies seasonally between 55% and 65%.
Summer months in Riyadh are intensely hot with a daily maximum about 45º C. Winters are cooler, with a maximum temperature of 22º C declining to 10º C or lower. Relative humidity also varies with seasons with typical summer humidity of between 15 to 20 %.

The Gulf coast is warm and humid in summer with average maximum of 42º C and winter maximum average of 22º C. Humidity varies seasonally greatly from 40% in summer to about 70% in winter.

The Arabian Gulf

The Arabian Gulf extends from the Straits of Hormuz in the south to the Shatt al-Arab in the north. It is a narrow sea, about 200 to 300 km wide and 1000 km long. It is mostly quite shallow with an average depth of 35 m. the deepest water being found closer to the Iranian coast (80m) and the Strait of Hormuz (100 m).

Twenty thousand years ago, when the world was passing through an 'ice age', much of the water now in the sea was locked up in great ice sheets and the sea level was about 120 m lower than it is today. The Gulf was dry. The Tigris and Euphrates rivers flowed along the coast of Iran and met the sea at the Strait of Hormuz. The sea only reached its present level about five thousand years ago. The plant and animal

communities living in the Gulf have therefore only been here for a relatively short period of time.

The Gulf coastline ranges from extensive tidal mud flats at the head, forming the delta of the Tigris and Euphrates, to the steep rocky Iranian coast, the rocky cliffs of the Emirates and the mountains of Oman. However, much of the west coast is relatively low lying and extensive sand beaches and flats extend along the coast of Saudi Arabia and beyond, both to the north and south. Numerous creeks or subkha break the western coastline*:* bays and small offshore islands are common.

Water enters the Arabian Gulf from the Indian Ocean through the Strait of Hormuz and flows north along the coast of Iran to Kuwait and then southerly down the coast of Saudi Arabia. As the water follows an anticlockwise passage around the Gulf it becomes saltier due to evaporation, and sinks below the less salty water.

The Red Sea

The Red Sea is a narrow body of water approximately 130 kilometres long which is a part of the Red Sea – East African Rift System, where the African and the Arabian tectonic plates diverge from each other. It lies between 30º N and 12º 30' N, and between 32º 30'E and 43º 30'E. In the south, it joins the Indian Ocean, and with construction of the Suez Canal connects with the Mediterranean Sea at the north of the Gulf of Suez. The marine biota of the Red Sea has a complex biogeography and evolutionary history, related to tectonic activity and sea level changes over the past several million years.

The maximum depth of the Red Sea is 2,850m, which is relatively deep for a body of water of its size. In the northern and central Red Sea a shallow coastal shelf may extend only a few kilometres offshore, although in the southern Red Sea it is more extensive. Excluding the coastal shallow areas, the average depth of the Red Sea is about 700m and the main trough exceeds 1,000m.

The Red Sea is a relatively young ocean, and its complex history has encompassed some major environmental upheavals (Braithwate, 1987). It had its origin in crustal sagging which occurred in the Mesozoic era, perhaps 180 million years ago, but only became established as a distinct trough in the Oligocene, about 38 million years ago. During its formation the area was periodically covered by sea but was quite often dry land. A dramatic environmental change occurred in the later part of the Miocene period (from 25-5 million years ago) when the entire Red Sea basin became a great evaporation pan, forming considerable thickness of salt and other evaporate minerals. At the time the Red Sea was separated from the Indian Ocean by a neck of dry land, in the area where in Straits of Bab al Mandab now lie, but was linked across the Isthmus of Suez to the ancient Mediterranean basin (part of the ancient Sea of Tethys).

The Red Sea has unique coastal and marine environments in the world. Among the most notable is the extraordinary system of the coral reefs and their associated animals and plants. Surrounded by arid environments, which are themselves unique, these environments support rich biological communities and representatives of several endangered species. The natural resources have support coastal populations for thousands of years, and nourished the development of a maritime and trading culture linking Arabia and Africa with Europe and Asia.

The Red Sea is one of the most important repositories of marine biodiversity in the world. Its relative isolation and physical conditions, which range from nearshore shallows to depth of over 2000 meters in the Central rift, have given rise to an extraordinary range of ecosystems and biological diversity. Its most renowned expression is the elaborate system of coral reefs. There are also mangroves, seagrass beds, reefs

constructed of algae and intertidal habitats, species endemism in the Red Sea is extremely high, particularly among some groups of reef fishes and reef associated invertebrates.

3.2.2 VEGETATION AND FLORA

The flora of Saudi Arabia reflects the geographical position of the Arabian Peninsula between Africa, Asia and Europe. Consequently, the flora has many elements of two of the eight global terrestrial realms; namely the Palaearctic (Europe and Asia) and the Afro-tropical (Africa south of the Sahara) as well as a smaller complement of elements from the Indo-Malayan terrestrial realm. It is thus an area of ecological and academic significance.

At the broadest scale, Saudi Arabia divides naturally into seven terrestrial physiographic regions:

1- Tihamah
2- Western Highlands
3- Arabian Hinterland
4- The Cuesta Region (Sedimentary Najd)
5- Aeolian Sands
6- As-Summan and Widyan Plateaus
7- Arabian Gulf Coastal Region

Saudi Arabia is generally an arid country with a few exceptional sub-humid regions on the south-western escarpments and is divided into three chorological units: the Saharo-Sindian, Somali-Masur, and Afro-Montane.

Approximately 24 different ecosystems comprise the functional elements of the major floristic units. Most of these ecosystems cover large areas and are widespread in the Kingdom. Ecosystems range from those of the saline areas along the Gulf Coast and in the inland drainage basins through the systems of the dune seas of the Nafud and Rub al Khali to the complex and species-rich woodlands of the western highlands. Most of the ecosystems are comparatively simple in structure and species diversity, reflecting the aridity and high summer temperatures experienced by most of the physiographic regions.

The vegetation of most ecosystems of the Saharo-Sindian region is generally sparse and about 60% of the vegetation, mainly in the low lying areas, is represented by annuals. Population density of these annual species varies from year to year, depending on the amount of rainfall and the amount of seed remaining from previous years. The western region is rich in vegetation when compared to the central and eastern region. The north-western mountains are rugged and floristically poorer than the south-western mountains, with affinities to the Mediterranean and North African floristic regions. The south-western region is the richest in terms of species diversity, with elements of all chorological units being found. The African element is especially noticeable, adding many species. The south-western area also contains the highest concentration of endemics, despite the fact that these high altitude areas are heavily populated with human settlements dating to ancient times.

The flora of Saudi Arabia is moderately well known at the taxonomic level (see bibliography) and species richness of the 15 Protected Areas administered by the National Commission for Wildlife Conservation and Development, as well as many of the areas under the administration of the Ministry of Agriculture is well documented. Hence the relationships of the flora to surrounding areas, as well as the numbers of endemic taxa are well established. The 2,250 species of flowering plants in Saudi Arabia belong to 132 families and 837 genera. About 105 species inhabit sand dunes, 90 are halophytes, 75 are trees and 12 are aquatic plants. No families or genera of flowering plants are endemic, but there are some 246 species that are considered regionally endemic. The influence of the floras of neighboring countries, particularly Yemen and Oman, is high on the flora of Saudi Arabia.

About 450 species (18%) of flowering plants have direct benefit to man and 45 species (1.8%) are poisonous. Some 334 species (13.4%) are used in folk medicine or are known to have medicinal value. Thirty-eight species are important palatable fodder plants, 6 are important as fuel-wood, 25 species are human food plants and 47 species are used as ornamentals or for other purposes.

Related to the modest numbers of species and levels of endemism, most families of flowering plants have only a very small proportion of their worldwide total numbers of species found in Saudi Arabia. Exceptions are two small families, the Ceratophyllaceae and Barbeyaceae, in which all known species occur in the Kingdom.

In contrast with the flowering plants, gymnosperms, pteridophytes, bryophytes, and algae are not as well known. However, as the bibliography and annexes show, some ground-breaking work has been done on some groups.

Although the species richness is quite well known, other measures of plant diversity have not been widely determined for the Kingdom. Consequently, the Red List status of plant species is very poorly known at this stage. For example, the 2000 IUCN Red List of Threatened Species did not include a single record for Saudi Arabia. Even with increased the emphasis that is being placed on improving the state of knowledge of biodiversity in the Kingdom, the 2003 Red List only contains the five species listed in the table below. Non- Red List literature sources however list 14 flowering plants as endangered, 11 vulnerable, 23 critically endangered, 1 rare and 14 extinct. Unfortunately, since these figures are often based on single collection reports and do not include any quantitative assessments of population sizes and total distribution, it is difficult to determine their significance and therefore to assess status adequately. However, it has been estimated that about 20% of the flora, including the rare and endemic species, are present in small populations in their respective niches. Given the extent of over utilization of rangelands in the Kingdom and the rapid growth of human population in the most botanically diverse regions, it is most likely that the real numbers of threatened plant species is considerably higher than the currently available figures suggest.

Threatened Plant Species Listed in the 2003 IUCN Red List of Threatened Species.

Species	**IUCN Category**
Acacia pachyceras var *najdensis*	**LR/nt**
Dracaena ombet	**EN A1cd**
Dracaena serrulata	**EN A1abcd**
Euphorbia ammak	**VU A1c**
Juniperus procera	**LR/nt**

Source: IUCN 2003: IUCN Red List of Threatened Species

AGRICULTURAL BIODIVERSITY

It is self-evident that the plants and animals used in modern agriculture originated from wild plants and animals. Wild progenitors of cultivated crops are still the major source of new genetic material that is needed for improvements and the source of genes that confer resistance to new strains of diseases. Similarly, local landrace varieties of crops and breeds of domestic animals represent varieties that have been selected over time for particular environmental conditions or because they have characteristics that are desirable for some reason. Not only is the genetic variability in landraces and local breeds of animals valuable as an element of biodiversity, it also is a national resource of genetic wealth.

Modern agricultural practises result in loss of much agricultural biodiversity through uniform practises, reduction in the importance of local and traditional methods of tillage and husbandry and widespread use of pesticides. Once Saudi Arabia loses all the local varieties and wild relatives of crops, breeds of sheep, goats and camels, or even breeds of salukis, it will be totally dependent on foreign imports for seed, plants and animals.

All plants, whether they are endemic, near endemic, threatened, vulnerable or believed to be extinct, are important in maintaining the integrity of their respective ecosystems. Unless measures are taken to safeguard all species, then some of the relict populations could face extinction in the near future.

THREATS TO TERRESTRIAL FLORA

The following points summarise the major threats to plant diversity in Saudi Arabia.

1. Overgrazing and/or poor management of rangeland resources
   - Deterioration of rangelands, primarily due to over use. This has dramatically increased unpalatable species and virtual disappearance of palatable species and increased desertification over vast areas. Most rangelands in the Kingdom are degraded and have impoverished species diversity.
   - Use of trees and shrubs as fuel wood. In most cases this is not for subsistence but rather for recreational camping use.
2. Agriculture
   - Changes in agricultural practises and expansion of areas cultivated. Especially in the south-western region, abandonment, dereliction due to neglect and enlarging of farm areas lead to loss of terraces. This in turn leads to loss of micro-habitats for plants and concomitantly, animals as well as increasing soil erosion and flash floods.
   - Changes in practises and use of "imported" varieties may results in loss of landraces of crops, and hence loss of agro-biodiversity. This results in erosion of the genetic material in the country and a loss of a national resource.
   - Absence of protected areas where natural stands of wild progenitors of domestic plants can survive.
   - Loss of traditional knowledge because of changes in practises.
   - Adoption of unsuitable agricultural practices, especially excessive use of water, which results in increase in surface soil salinity with concomitant changes in plant species composition.
   - Migration of people from rural areas to cities.
3. Pollution
   Dumping of waste (especially in wadis and pools), industrial and urban pollution and land filling of coastal and marine areas.
4. Recreation activities.
   Off-road driving and excessive, unsustainable or poorly regulated recreational use of natural areas causes direct damage and general degradation to ecosystems in already harsh environments.
5. Population growth and expansion of urban areas
   Urban development (especially rapid and extensive development in the sensitive and species-rich areas in the south-western mountains) and road building damage or reduce habitats as well as causing changes in ecosystem functioning.
6. The as yet poorly understood, widespread, dieback of *Juniperus* species woodlands. This has changed the structure of the woodlands and in some areas a community characterised by species of *Acacia* and associated under-story plants is replacing the juniper community. Faunal elements are likely to also change in concert with the changes in vegetation.
7. Exotic plants pose threats in isolated areas and habitats in Saudi Arabia, largely because of severity of the climate. However, in some ecosystems (notably aquatic systems), exotic species pose an added dimension of threat to a flora that is already under stress.

3.2.3 FAUNA

The varied biodiversity of Saudi Arabia stems from its pivotal location between Africa and Eurasia, which allows elements of both regions to intermingle. The Kingdom of Saudi Arabia lies at the crossroads of three of the world's major zoogeographical realms, that is the Palaearctic zone, the Afro-tropical and the Indo-Malayan and is itself at the centre of the Eremian zone (or Saharo-Sindian) desert region which is the vast desert belt extending from Morocco to western China. Saudi Arabia's present ecology reflects its ancient past, its current geography, and the influence of man upon its natural habitat. Progressive desiccation caused by global climatic changes since the last ice age has led to the isolation of many Arabian forms in separate ecosystems and the evolution of distinctly new and exclusively Arabian taxa - the Arabian endemics.

STATUS OF TERRESTRIAL FAUNA

VERTEBRATE ANIMALS

Mammals
Seventy-nine living species of mammals belonging to 25 families in eight orders have been recorded from Saudi Arabia. Five species became extinct within the last 200 years. The complete list is presented in the Annexes to this report

The mammalian fauna of Saudi Arabia includes terrestrial and marine species. The terrestrial species fall into eight orders as follows:

ORDER	***FAMILY***	***GENUS***	***SPECIES***
Insectivora	2	4	5
Chiroptera	8	21	30
Primates	1	1	1
Lagomorpha	1	1	1
Rodentia	5	14	22
Carnivora	6	11	15
Hyracordia	1	1	1
Artiodactyla	1	3	4
Total 8	***25***	***56***	***79***

Fourteen species of marine mammals have been recorded from the Saudi side of the Red Sea and the Arabian Gulf. They belong to three families within two orders as follows:

Sirenia	1	1	1
Cetacea	2	9	13

Seventy-nine species of living terrestrial mammals are recorded in Saudi Arabia. Large mammals are important elements in the ecosystem as their status is an indicator of the health of the system. In the recent past, large mammals have been under considerable pressure. Some vanished from the country most of the others became rare and threatened.

Four species became extinct within the last 500 years. The last Asiatic lions (*Panthera leo persica)* are known to have been killed in the late 1800's. Similarly, the last surviving Asiatic cheetah (*Acinonyx jubatus venaticus)* in the Kingdom was killed in the early 1950's in an area in the north between the Jordanian and Iraqi borders. The Saudi gazelle (Ifri) *Gazella saudiya* is believed to have vanished from the country in the early 1980s. The last record of the onager (*Equus hemionus hemippus*) in the Kingdom was recorded in the early 1900's.

The Arabian oryx *Oryx leucoryx* was present in large numbers throughout most of the peninsula during the 1800's. However, their numbers and their range continued to decrease in the 1900's and the last oryx in the wild was killed in the early 1970's. Thanks to the international efforts in the Operation Oryx and the captive breeding and reintroduction programme of the National Commission for Wildlife Conservation and Development, these beautiful endemic animals are doing real well in the Protected Areas.

The three Arabian gazelles were known to be widespread and present in large numbers up to the 1930's. Then their numbers started to decline up to the 1980's where the Saudi gazelle (Ifri) *Gazella saudiya* disappeared. The numbers of the other two species, sand gazelle (Reem) *Gazella subgutturosa marica* and mountain gazelle (Idmi) *Gazella gazella cora,* continued to decline until the NCWCD was established in 1986. Again the breeding and re-introduction programme was so successful that these two endemic subspecies are doing well in the Protected Areas.

The status of the other large mammals varies among the species. The Arabian leopard *Panthera pardus nimr* is highly endangered. The Nubian ibex *Capra nubiana* is rare and present in isolated populations. All the remaining carnivores, except the red fox *Vulpes vulpes,* are in low viable populations. The baboon *Papio hamadryas* is the only large mammal that can be considered to be over-abundant, causing problems to farmers and local people.

Most of the smaller mammals, including the insectivores, bats, hares and rodents, are either widespread or poorly known and need further study to ascertain their status.

Species and subspecies endemic to Arabian Peninsula

Endemism is apparent in the mammalian fauna of Saudi Arabia.
Twelve mammalian taxa are endemic to Saudi Arabia. These include: Two bats;
One hare; five rodents; one carnivore and three ungulates.

Order Chiroptera

Rhinopoma microphyllum asirensis Nader & Kock, 1983
Nycteris thebaica najdiya Nader & Kock, 1983

Order Lagomorpha

Lepus capensis arabicus Ehrenberg, 1833

Order Rodentia

Gerbillus cheesmani arduus Cheesman & Hinton, 1924
Meriones rex philbyi (Morrison-Scott, 1939)
Meriones libycus arimalius Cheesman & Hinton, 1924
Meriones crassus longifrons Lataste, 1884
Psammomys obesus dianae Morrison-Scott, 1939

Order Carnivora

Panthera pardus nimr (Hemprich & Ehrenberg, 1833)

Order Artiodactyla

Oryx leucoryx (Pallas, 1777)
Gazella subgutturosa marica Thomas, 1897
Gazella saudiya Carruthers & Schwarz, 1935 (extinct)

Birds

The recorded avifauna of the Kingdom of Saudi Arabia reflects the position of the Kingdom between the three distinctive biogeographical zones: the Ethiopian to the west, the west Palaearctic to the north and the Orient to the east. Also, the Kingdom is one of the most important north-south and east-west migratory pathways of millions of birds. 432 species are recorded from Saudi Arabia belonging to 67 families. About 180 species are known to breed in the Kingdom. Of the breeding species 45 are believed to be of Ethiopian origin, 30 of Asiatic origin and the reminder are of Palaearctic. Eight of the eleven endemic birds of Arabia are present in both Saudi Arabia and Yemen. These birds are predominantly temperate Palaearctic relicts. They are largely confined to the more mountainous parts of the region, and in Saudi Arabia they are confined to the Hejaz and Asir mountains south of Medina (Jennings 1981). The complete list of birds recorded from the Kingdom is presented in the Annexes at the end of this report.

Saudi Arabia, along with most of the countries in the world, is creating problems for its native birds. As Rands (1989) mentioned, inevitably, as the country develops, so industrialisation, cereal farming, wetland drainage, irrigation, land filling, use of pesticides, afforestation, construction and human population all increase, which has both positive and negative effects on the bird population. The objectives of bird conservation in Saudi Arabia must be to identify the requirements of the countries avifauna and try to insure that these requirements are met in ways compatible with the development of the country.

Endemic Birds of Arabia

There are eleven endemic and three near-endemic bird species in Arabia. Nine of the endemics occur in both southwestern Saudi Arabia and Yemen. Six of the 11 are Afro tropical; four are Palaearctic and one Indo-Malaysian.

Philby's rock partridge	*Alectoris philbyi*	Saudi Arabia & Yemen
Arabian red-legged partridge	*Alectoris melanocephala*	SW Arabia & Oman
Arabian woodpecker	*Dendrocopus dorae*	Saudi Arabia & Yemen
South Arabian wheatear	*Oenanthe lugentoides*	Saudi Arabia & Yemen
Arabian accentor	*Prunella fagani*	Yemen
Yemen thrush	*Turdus menachensis*	Saudi Arabia & Yemen
Yemen warbler	*Parisoma buryi*	Saudi Arabia & Yemen
Arabian waxbill	*Estrilda rufibarba*	Tihama (Yemen)
Yemen serin	*Serinus menachensis*	Saudi Arabia & Yemen
Arabian serin	*Serinus rothschildi*	Saudi Arabia & Yemen
Yemen linnet	*Carduelis yemensis*	Saudi Arabia & Yemen

Near-endemic species

White-eyed gull	*Larus leucophthalmus*	Both sides of the Red Sea
Arabian golden sparrow	*Passer euchloris*	Both sides of the Red Sea
Golden-winged grosbeak	*Rhynchostruthus socotranus*	SW Arabia, Socotra, Somalia

Most of the birds of Saudi Arabia have affinities with neighbouring zoogeographic regions, however it is suggested that at least five species originate in Arabia. These are: Arabian (Blanford's) warbler *Sylvia l. leucomelaena,* Abyssinian sunbird *Nectarinia habessinica,* White-breasted white eye *Zosterops abyssinica,* Ruppell's weaver *Ploceus galbula* and Golden-winged grosbeak *Rhynchostruthus socotranus.*

The birds of Saudi Arabia have not been fully studied. More records are likely to be added to the breeding birds of the Kingdom. Additional species are expected to be added to the list of Saudi birds. The Straits of Hormuz, between Oman and Iran, and Bab Al-Mandab, between Yemen and Eritrea, neither is an obstacle to the migratory birds. Some of those birds have already colonized, over-wintering and even started breeding in the Kingdom. Agricultural expansion, extensive irrigation practices and the formation of drainage ponds are helping these bids to settle down.

Reptiles and Amphibians

A total of 103 species of Reptiles and seven species of Amphibians have been recorded from Saudi Arabia. All recorded species are listed in the Annexe at the end of this report. The reptiles include 60 species of lizards belonging to 7 families, 34 species of snakes belonging to eight families and nine species of turtles belonging to five families.
The amphibians include seven species belonging to three families.

Group	*Number*		
	Fam.	Gen.	Sp.
Lizards	7	21	60
Snakes	8	24	34
Turtles	5	9	9
Amphibians	3	4	7

Reptiles: 20 Families; 54 Genera; 103 Species

Amphibians: 3 Families; 4 Genera; 7 Species

Reptiles and amphibians play an important role in the ecosystem.
Reptiles are important in the control of rodents and insects populations.
Venomous snakes are important economically and medically. Venoms of some snake species fetch a large sum of money. On the other hand, anti-venom processing is important medically and economically.

Lizards

Of the eleven Agamids, svene are widespread, five moderate in distribution and number and one needs special attention in some areas.

The two Chameleons are moderate in their distribution and number.

Of the eighteen Gekkonids, three are widespread, ten moderate in distribution and number, four limited information on distribution and number.

Of the sixteen Lacertids (True lizards), three are widespread, seven moderate in distribution and six limited information on distribution and number.

Of the ten Scincids, one is widespread, five moderate in distribution and five limited information on distribution and number.

The two Varanids are moderately widely distributed.

The single Trognophid lizard has a moderate distribution and needs special attention in some areas.

Lizards in general do not face any threat of extinction. A few need more information on their distribution and number whereas two taxa, *Uromastyx aegyptia microlepis* and *Diplometopon zarudnyi,* need special attention in some areas. An exception is the spiny tailed lizard (Dhub) *Uromastyx aegyptia.* This species is being persecuted throughout its range as its meat is regarded a delicacy and hunting it is considered a thrill by young people. Moreover, this animal is being sold in local markets in large numbers.

Snakes
The single Typhlopid is **Rare**.

The two Leptotyphlopids have limited information on their distribution and numbers.

The two Boids are widespread in their distribution.

Of the thirteen Colubrids, five are widespread, two moderate in distribution and number, 3 limited information on distribution and number and three are **Rare.**

The single Atractaspidid is **Rare** and need special attention in some areas.

Of the two Elapids, one is moderate in its distribution and needs special attention in some areas and the other is **Endangered** and needs special attention in some areas.

Of the nine Hydophiids, eight have limited information on distribution and numbers and one is moderate in distribution and number.

Of the six Viperids, one is widespread, three moderate in distribution and number, one moderate in distribution and number and needs special attention in some areas, and one has limited information on distribution and number.

Most people will kill any snake they encounter without any hesitation hence they are avoided. Most species are not in danger, but a few need special attention in some areas. The following five species are rare and need protection: *Ramphotyphlops braminus, Coluber elegantissimus, Dasypeltis scabra, Telescopus dhara, Atractaspis microlepidota* and one is endangered *Walterinnesia aegyptia.*

Turtles
All the nine turtle species are **Rare** and need protection. Eggs of marine turtles are collected and sold for human consumption.

Amphibians
The four frogs (Fam. Bufonidae) are **Rare** and need special attention in some areas.

The single tree frog (Fam. Hylidae) has a moderate distribution.

Of the two common frogs (Fam. Ranidae), one is widespread and need special attention in some areas and the other is **Rare** and need special attention in some areas.
Amphibians are indicators of the health of the ecosystem in addition to their role in the control of insect populations.

INVERTEBRATE ANIMALS

Invertebrate animals are the largest group of the faunal elements, both in number of species and number of individuals.

Phylum Arthropoda
Class Insecta
Insects are the largest group within the Phylum Arthropoda. It is better studied than the other groups of the phylum. Tentative number of the recorded species/subspecies is 3033 and of these, 557 are endemic.

	sp/ssp recorded	**new taxa sp/ssp**	**endemic (tentative)**
Orders			
Odonata	25	1	1(?)
Orthoptera	49	9	9
Mantodae	40	12	12
Isoptera	20	4	4
Embidiina	5	4	4
Psocoptera	9	7	7
Anoplura	10	0	0
Thysanoptera	22	4	4
Hemiptera	111	4	4
Homoptera	104	28	28
Psyllodea	11	4	4
Coccoidea	47	2	2
Hetroptera	> 488		
Coleoptera	1473	287	287
Strepsiptera	2	2	2
Neuroptera	126	2	2
Lepidoptera	751	132	132
Cosmopterigidae	5	4	4
Chrysopeleiidae	1	0	0
Diptera	199	19	19
Siphonoptera	23	0	0
TOTAL	3033	557	557

Class Crustacea

About 500-600 aquatic species
Few terrestrial species

Class Arachnida

Linyphiidae	2	1	1
Scorpiones	14	5(?)	(5?)
Pseudoscorpiones	7	4	4
Acari			
Sarcoptiformes	2	0	0
Nilotonidae	1	1	1
Ixodidae	40	1	1

Order Lepidoptera

It is the second largest group of insects after the beetles. More than 755 species of butterflies and moths is expected to be present in the Kingdom as more field studies will reveal. So far, 136 endemic species/subspecies have been described and recorded.

Larsen's (1984) analysis of Arabian and Middle Eastern butterflies reveals species with Palaearctic, Afro tropical and Oriental affinities. He also recorded eight Endemic species from Asir region and 23 Endemic sub species from different parts of Arabia.

OTHER INVERTEBRATE ANIMALS

	sp/ssp Recorded	**new taxa sp/ssp**	**endemic (tentative)**
Phylum Protozoa			
No information available			
Phylum Plathelminthes			
Tubifucidae	25	9	9
Hirudinea	3	1	1
Parasitic	3	0	0
Phylum Nemathelmithes			
No information available			
Phylum Mollusca			
Aquatic	> 2000		
Terrestrial	About 100	0	0

Phylum Annelida

No information available

Phylum Echinodermata

Arabian Gulf	356	0	14	Red Sea > 225

THREATS TO TERRESTRIAL FAUNA

Economic growth based on urban and agricultural development contributes to pollution of soil, surface and ground water and to a decrease in biological and landscape diversity. As a consequence of increasing development, the main threats are:

HABITAT DESTRUCTION

- Changes in agriculture practices e.g.: technology; abandonment of less favoured areas for agriculture, use of new cultivars and hybrids; promotion of monoculture.
- Range reclamation and expansion in farming in natural areas.
- Tree cutting and firewood collecting.
- Drainage of wetland: land reclamation
- Infrastructure development, opening new roads and new industrial complexes.
- Uncontrolled urbanization.
- Lack of public awareness.
- Introduction of alien and invasive species.
- Improper and indiscriminate use of pesticides in agriculture and in public health campaigns that eliminate a large number of wildlife.

OVER-GRAZING

- Overgrazing by the increasing numbers of domestic animals.

OVER-HUNTING

- Uncontrolled over-hunting: the use of four-wheel drive vehicles and firearms.

AQUATIC BIODIVERSITY

Fish

Nine species of freshwater fishes have been recorded from Saudi Arabia.

Family Cyprinidae
Acothobrame hadiyahensis Alkahem & Behnke 1983. Endemic
Barbus apoensis Banister & Clark 1977. Endemic
Barbus arabicus Trewavas 1941
Cyprinion acinaces hijazi Krupp 1983
Cyprinion mhalensis Alkahem & Behnke 1983. Endemic
Garra t. tibanica Trewavas 1941. Endemic. Widely distributed
Garra buettikeri Krupp 1983. Endemic
Garra sahilia gharbia Krupp 1983. Endemic

Family Cyprinodontidae
Aphanius d. dispar (Ruppell 1828) Widely distributed

Status of Saudi freshwater fishes
Six species are **Endemic** and two are widely distributed.

3.2.4 STATUS OF PROTECTED AREAS IN SAUDI ARABIA

Conservation of biodiversity within protected areas has received considerable attention in Saudi Arabia. The National Commission for Wildlife Conservation and Development and the Ministry of Agriculture are the organisations having the primary responsibility for establishing and managing conservation areas. Together, the area under management for the sustainable use and conservation of biodiversity in Saudi Arabia accounts for almost 10% of the land surface of the Kingdom. In addition, coastal and marine protected areas have been identified and a number in the Red Sea and the Gulf have been proclaimed.

NCWCD developed a comprehensive Protected Area System Plan in which 103 areas that are significant for conserving various elements of biodiversity are identified on the basis of rigorously applied, scientifically based, criteria. To date, 15 protected areas, covering almost 4% of the country's surface (an area twice the size of Switzerland) conserve all the major physiographic regions, half the country's biotopes, key wetlands, marine and mountain habitats and protect viable populations of endemic, endangered and key plant and animal species. These are managed with close collaboration of local communities through liaison committees. The system plan provides a scientific foundation for rational expansion of the protected area network to ultimately conserve Arabian biotopes, key habitats and species.

Areas managed by NCWCD
The following table presents key features of the areas administered by the National Commission for Wildlife Conservation and Development.

Name	Area Km^2	Date declared
Harrat al Harrah	13,775	1987
Al Khunfah	20,450	1987
At Tubayq	12,200	1989
Mahazat as Sayd	2,141	1988
Ibex Reserve	2,369	1988
Uruq Bani Ma'arid	5,500	1994
Majami al Habd	3,400	1993
Raydah Escarpment	9	1989
Al Jubail Marine Wildlife	4,262	1995
Umm al Qamari Island	1,600	1987
Farasan Islands	600	1989
Saja/Um ar Rimth	5,500	1995
Nafud al Urayq	1,900	1995
At Taysiyah	2,855	1995
Al Jandaliyah	1,160	1995

Areas managed by the Ministry of Agriculture
Asir National Park

Rangeland fenced areas:
There are 37 such areas distributed widely throughout the Kingdom.

Forest fenced areas:
A total of 23 such areas are maintained in Asir, Al Baha, Ar Riyadh, Bisha and At Taif.

The old Himas:

Shaib Huraymila
Hima Al Gatha at Unaiza
Hima Saysad
Hima Bani Saar

Arabian oryx now roam the Empty Quarter in large numbers, Sand and Mountain Gazelles and Houbara bustards have been re-established and mangrove forests restored, which represent concrete and successful efforts of environmental restoration in the Kingdom.

Endemic plant species occur in two of the protected areas. Raydah, one of the smallest areas, covering only 9 km^2 of the south-western mountains with 22 endemics tops the list, followed by the Farasan Islands with 17 species. This means that 39 species (15.9%) of endemic plants are within areas that receive formal protection and that are managed primarily for the conservation of biodiversity.

Species richness data are available for 13 of the NCWCD protected areas and monitoring of species composition and abundance has been carried on in the protected area at the King Khalid Wildlife Research Centre near Riyadh since 1990. Five of the protected areas each have more than 10% of the species recorded from Saudi Arabia within their borders. In total, the protected areas already established contain about 43% of the recorded plants of Saudi Arabia.

3.2.5 AGRICULTURE AND RANGELANDS

Agricultural practices and the state of the desert rangeland are particularly important to the state of biodiversity in the Kingdom.

Modern agricultural practices, especially widespread mechanical cultivation, use of chemical fertilizers and indiscriminate application of pesticides has dramatically changed natural habitats and reduced populations of wild animals, especially invertebrates. There can be no question that modern Saudi Arabia needs increased output from the farming sector of the economy. However, this needs to be done in ways that is sustainable, which is currently not always the case.

Use of saline water for cultivation is a particular problem in the Kingdom, since many boreholes produce highly saline water. Irrigation of the soils of many parts of the Kingdom with salty water results in changes in soil structure and chemistry. Many former fields of wheat and barley as well as some of alfalfa have been turned in *sabkhas* where only halophytes will now grow. Not only has this reduced biodiversity, but also agricultural production has suffered.

Many of the traditional *himas* as well as many terraces have been either abandoned or disappeared under fields that are suitable for mechanical cultivation. In some cases, this has replaced sustainable systems of land use with ones that require increasing inputs of water and management to maintain their productivity, but is has also markedly reduced the diversity of habitats.

Desert rangeland, which includes dwarf-shrub steppes and arid grasslands, cover about 1,700,00 km^2 (or about 76%) of Saudi Arabia. These areas would never have been in a state of equilibrium in the true sense, since they are event-driven systems whose state is determined largely by rainfall. Nonetheless, over-exploitation and disregard for the ecological processes that drive such systems has resulted in catastrophic changes in the past century.

Although most of the plant communities of these areas have comparatively small numbers of species and many of these have very large distribution ranges, because rangelands cover such a large area the total numbers of species found is high. The general aridity (average annual rainfall is less than 100 mm) and its erratic nature led to the development of nomadic pastoralism to take advantage of the highly variable availability of plants. Such traditional land use has persisted for centuries. Because the availability of forage limited livestock numbers (which in turn, regulated human populations), there was a dynamic equilibrium that checked serious environmental degradation.

The introduction of water tankers, stock trucks, widespread water boreholes, supplementary feeds and veterinary services changed resource use in the rangeland dramatically. Increasing importance placed on education has discouraged families from following a nomadic lifestyle, leading to subtle but important sociological changes. In addition, the generally higher income levels has led many livestock owners to increase the numbers of herds they own and employ herders to take care of these. Consequently, numbers of animals has dramatically increased and they stay in one place for longer periods because water and feed are supplemented no matter what the rainfall. This has resulted in livestock numbers increasing far above the natural carrying capacity of the rangelands and has caused increased desertification, replacement of palatable shrubs and grasses by unpalatable species and the extinction of species. As early as the 1970's it was estimated that 85% of Saudi Arabia's rangelands were severely degraded and the situation has certainly not improved since then.

The major threats to the rangelands of Saudi Arabia are:

- Uncontrolled grazing of sheep, goats and camels, especially where they are provided with supplementary feed.
- Excessive harvest of woody shrubs for firewood. Since most energy is supplied by portable electricity generators and liquid or gaseous fuels, firewood is no longer a necessity.
- Conversion of the most productive rangelands to more intensive agriculture. Where this is based on irrigation with water obtained from boreholes that are often more than 1 kilometre deep, this is a particularly unsustainable practice.
- Long periods of drought. Possible effects of climate change are unknown, but droughts may well increase in duration, exacerbating effects of the other threats.
- Damage through off-road driving.

The current approaches to grazing and other uses of rangelands has replaced the traditional, nomadic system which had provided sustained use of rangeland diversity for thousands of years with an unsustainable system. Effects of the current system will require the authorities to exert very considerable efforts on a number of fronts to reverse the damage that has already taken place.

3.2.6 HUNTING AND FALCONRY

Excessive hunting, especially since the widespread use of four-wheel drive vehicles made vast areas that were previously inaccessible easily accessible, seriously affected the populations of larger animals such as Arabian oryx and Sand gazelles, resulting in their extirpation from many areas of their range. Similarly, over-hunting of the houbara bustard in many of the range state has reduced populations over the past 50 years. Hunting in Saudi Arabia is regulated through implementation of the "*Wild Animals and Birds Hunting Act*" (see 3.1 above).

Traditional hunting using falcons is an integral part of the Arab culture and constitutes an important component of the cultural heritage of the people of Saudi Arabia and many other countries of the region. Apart from the impacts of unregulated hunting with falcons on the prey species, the capture of wild hawks, especially the Saker falcon, may pose a threat to the species as numbers of falconers increase with growth of the human population.

3.2.7 WATER RESOURCES AND WETLANDS

Water resources in Saudi Arabia include surface water, underground water and unconventional sources including desalinated sea water and treated sewage water.

Surface Water Resources:
Rain is a renewable water resource. Annual average rainfall in the Kingdom is around 100 mm and the southwestern region has the highest rainfall amounting 250 mm annually. To make use of the rainwater, the Kingdom has built 214 dams with 25 under construction and nine were announced for tender. The storage capacity of the largest dam, King Fahad bin Abdulaziz dam at Bisha is 325 million cubic metre and Najran Dam 86 million cubic metres. Total storage capacity of the entire kingdom's dams is 810 million cubic metres.

Underground Water Resources:
There are two types of underground water resources, Deep and Shallow. The deep underground water is found in the successive geologic layers dating back from the Cambrian age to the Present and the age of the trapped water there ranges between 15 and 35 thousand years. Average rainwater supply to these Deep Underground water resources is very little and much less than the annual water taken out of them. The depth of the water in these formations ranges from 100 to 2500 metres. The Shallow Underground Water resources are renewable and are supplied directly from rainwater. Their depth ranges from a few metres to 100 metres. These water resources make up 50% of the water designated for human consumption and about 100% of the water used for cultivation.

Desalinated Sea Water:
There are 30 desalination plants on both red Sea and the Arabian Gulf. The capacity of these plants is 994 million cubic metres. These plants also produce electricity.

Treated Sewage Water:
About 60% of the water consumed by the people is treated as sewage water. Some is tertiary treated as safe water and some is doubly treated that could be used for agricultural and industrial purposes to reduce the consumption of the other water resources. One third of the daily sewage water, which is estimated about 1.3 million cubic metres, is tertiary treated.

Wetlands
Wetlands are both an important component of the water resources of the country as well as being key areas of biodiversity. Both natural and artificial wetlands are important habitats for many species. Perennial wetlands are the only habitats in which freshwater fish can survive; perennial and ephemeral wetlands are also critical for the survival of frogs and toads, dragonflies, and freshwater molluscs; they are also nationally and internationally important breeding and resting sites for resident and migratory birds, as recognized by the Bonn Convention for migratory species, which seeks to protect and /or restore wetlands as critical habitats for wildfowl and other migratory birds.

Saudi Arabia's natural freshwater wetlands, including ponds, perennial streams, and springs, are small both in number and in extent; because water is so scarce and valuable a resource in arid lands, they are also extremely vulnerable to agricultural development through drainage, settlement, overgrazing, over hunting, and overuse by visitors. Pumping for irrigation has already drained Uyun Layla, a cluster of karstic ponds that included the Kingdom's largest perennial body of fresh water.

Artificial wetlands, such as reservoirs, irrigation drainage, and sewage outflows, are an important factor in the sudden increase in diversity of migratory birds recorded at many sites in the Kingdom. But they are largely an ephemeral by-product of municipal and agricultural projects, in which wildlife conservation will have to compete with other needs such as the re-use of waste waters for domestic and agricultural purposes. Hence the management of most artificial wetlands belongs properly with the Ministry of Electricity and Water, and the Municipalities and related commissions and the NCWCD has an advisory role. Unfortunately, many of the larger artificial wetlands are more or less severely degraded through pollution and mismanagement. It is also likely that improved efficiency of use of water by the agricultural and industrial sectors, which must be effected in the future, will inevitably reduce the extent and possibly numbers of

artificial wetlands. Such a development is entirely necessary as a part of a strategy to reduce water wastage.

3.2.8 Coastal and Marine Resources and Fisheries

The Red Sea and Arabian Gulf are centres of diversity for corals, marine invertebrate and vertebrates, turtles and birds. Equally importantly, the fishing industries are key elements of both local and the national economies. Accordingly, conservation of biodiversity and sustainable use of the resources are essential.

All organisations in Saudi Arabia that are responsible for biodiversity conservation and resource management pay considerable attention to the Red Sea and Arabian Gulf. The Ministry of Agriculture, National Commission for Wildlife Conservation and Development and The Presidency for Meteorology and the Environment have, through the years, all been involved in projects on marine conservation and all have departments that concentrate on the marine environment. In addition, the Japan International Co-operation Agency (JICA) has collaborated in and provided considerable financial and manpower resources to studies of the Red Sea and Arabian Gulf.

The following sections provide a brief overview of some of the major elements of the coastal and marine environments of the Kingdom.

Mangroves

Mangroves are not merely a group of plants but rather marine forest ecosystems of tropical and subtropical inter-tidal regions of the world.

Two species of mangrove grows along the Saudi Red Sea coast namely *Avicenia marina* and *Rizophora mucronata.* Mangrove ecosystems are of great economic and ecological importance. Besides being used as feed substance, timber, medicine and source for industrial products like pulp and tannin, they also serve as a reservoir and refuge for many characteristic animal and plant species that are not found in any other habitat. Mangrove swamps also serve as important nursing grounds for the larvae and juvenile stages of a number of commercially important fisheries species. For example, most world shrimp fisheries are related to mangrove ecosystems.

Seagrass

Seagrass beds are the meadows of the sea. The organisms which inhabit them are quite different from those found on nearby reefs. The seagrasses are flowering plants (angiosperms) that usually grow in sediment bottoms.

The Red Sea is relatively diverse (ten seagrass species), whereas only four species have been reported from the Arabian Gulf. These belong to all seven genera that are known for the tropical Indo-West Pacific region. Details of species composition within each area of the Red Sea and Arabian Gulf are summarised in the following table.

Seagrass species within different areas of the Red Sea and Arabian Gulf

Seagrass species	Red Sea	Arabian Gulf
Halodule uninervis	+	+
Cymodocea rotundata	+	
Cymodocea serrulata	+	
Syringodium isotifolium	+	+
Thalassodendron ciliatum	+	
Enhalus acoroides	+	
Thalassia hemprichii	+	
Halophila ovalis	+	+
Halophila minor (= *H. ovata*)	+	
Halophila stipulacea	+	+
Total number: 10	10	4

Seagrass in the Gulf shows a complex distribution pattern, reflecting the heterogeneous nature of the seabed and fluctuating oceanographic conditions. In Saudi Gulf waters, well-developed stands occur within a number of shallow (< 10m) coastal embayments.

Algae

About 450 species of algae have been recorded in the Red Sea most of which occur in Saudi territorial waters. A few species show cosmopolitan distributions, being found not only throughout the Red Sea and elsewhere in the Indo-pacific, but also in the Atlantic and Mediterranean. About 9% of the Red Sea algae are endemics e.g. *Cystophyllum trinode, Sargassum subrepandum* var. *rueppllii, Phormidium penicillatum, P. vaginatum, Turbinaria elatensis*, *Dichtrix eylathensis* and *Giffordia ghardaqaensis*.

The number of algae species belonging to different groups found in the Red Sea is given in the following table.

Phylum	No. of Species of Ecological Significance	No. of Species of Economic Importance	Species of less importance	TOTAL
Green algae	22	14	72	108
Brown algae	11	9	52	72
Blue-green algae	18	8	38	64
Red algae	30	70	100	200
Total	**81**	**101**	**256**	**446**

Algal species diversity in the Arabian Gulf is lower than in the Red Sea - there are only about 90 species in the Jubail Wildlife Sanctuary in the Arabian Gulf compared with the numbers reported for the Red Sea (above).

Fish

The number of species of fish recorded in the Red Sea is 1280 and 542 species in the Arabian Gulf. Additionally, 44 species of sharks have been recorded in both the Red Sea and the Gulf. Artisanal fishing has been an important socio-economical occupation for local people along the shores of both the Red Sea and the Arabian Gulf. The number of commercial fish species sold in Red Sea markets is 180 and 110 species in the Arabian Gulf markets.

Due to over-fishing, at least three commercial fish species are threatened. Butterfly fishes and other aquarium fishes are also threatened due to the high demand in the international markets. This is in addition to all shark species due to the shark fins market in the Orient.

Molluscs and Crustaceans

The Gulf had an important pearl fishing industry that has been declining since the 1930s due to the cultured pearl industry. Gulf pearls are superior to the Red Sea pearls. Small quantities of shell fishes, squids, cuttlefishes and octopuses are being sold in both Red Sea and Gulf markets.

Of the Crustaceans, seven species of lobsters, prawns, shrimps and crabs are also sold in both markets.

Marine turtles

Of the five marine turtles, the green and hawksbill turtles occur naturally in high numbers although they are regarded endangered internationally. Hawksbill turtles are associated with coral reef and green turtles with sea grass beds in the Red Sea. The population densities of green turtles nesting at Karan Island and Jana Island rank among the top twenty nesting sites in the world.

Birds
The Red Sea and Arabian Gulf coasts and their associated islands are internationally important areas for birds whether they are Palaearctic migrants, winter residents or resident breeding species. The tidal flats of the Gulf are considered among the world most important over-wintering areas. They are home to 1-2 million waders of 125 species. Additionally, the Gulf is an important stop-over for millions of passage migrants of which 113 species have been recorded.

Marine mammals
The dugong is found in good numbers in several places along both Saudi shores of the Red Sea and the Gulf.

Seven species of dolphins and six whales have been recorded in Saudi waters (see the list that is included under mammals).

Coral reefs
Red Sea coral reefs are among the richest marine environments in the world. It is the most widely distributed ecosystems in the coastal areas of the Red Sea and is regarded as the northern extension of the coral forming reefs. The diversity and evolution of these reefs are best in the central part of the Red Sea where about 150 species are found in the Yenbu area compared to 30 in the Gulf of Aqaba and less than 10 in its southern limit. Also there are about 450 species living in the Red Sea coral reef.
The Red sea coral reefs are the most beautiful and regarded as one of the wonders of the world. The Gulf coral reefs are less abundant and are present around the six offshore Saudi islands. Coral reefs provide food and shelter for marine animals, especially commercial fishes.

3.2.9 HUMAN POPULATION

According to the 1998 census, the Saudi population is 20,846,884 people, which includes 15,588,805 Saudi nationals and 5,258,079 non Saudis. Compared to the census of 1992, it shows an increase in the population of about three millions within six years. During these six years, the Saudi population has increased 2,562,751. Most of this increase is due to the high birth rate and low death rate of the Saudis due to the increased medical services and better education.

Population distribution in the Kingdom varies between regions. More than 60% of the population is concentrated in Mecca, Riyadh and the Eastern Region. By contrast, the Northern Region, Najran and Al Baha are much more sparsely populated, and together have only about 7% of the population.

3.3 Institutions dealing with issues related to the CBD

1. Government ministries

- Ministry of Agriculture; crops and rangelands; management of national parks and national *himas*.
- Ministry of Electricity and Water; water use and (in the case of desalination plants) production.

- National Commission for Wildlife Conservation and Development; conservation of wildlife in designated protected areas and biodiversity research. Lead organisation for CBD matters in the Kingdom.
- Presidency for Meteorology and Environment; investigates and evaluates the effects of pollution on the natural aquatic and terrestrial resources and on land and marine life; recommend solutions and appropriate measures to conserve natural resources and ecological balances.
- Ministry of Planning
- The Supreme Tourism Commission
- Ministry of Interior; law enforcement (including conservation and hunting laws); administers some important sites.
- Ministry of Defence and Aviation; has jurisdiction over a number of sites that are important for conservation of biodiversity.
- Ministry of Municipality and Rural Affairs

2. Government Committees related to Environment

- Ministerial Environment Committee
- National Committee for Biological Diversity
- Environmental Coordination Committee

3. Non – governmental Organizations (NGOs)

- Saudi Biological Society (Riyadh)
- Saudi Agricultural Society
- Friends of the Environment (Jeddah)

3.4 Research

A range of institutions and organisations undertakes research on the environment and ecological research comprises a substantial part of overall environmental research in the Kingdom.

Funding of environmental research is mainly provided from the Ministry of Finance as component parts of budgets for institutions that carry out research. Smaller grants from the private sector as well as from external sources – usually provided on an *ad hoc* basis supply additional funds in some instance.

National Research Institutions

Research projects undertaken at these institutions are directly related to environmental issues that fall within the remit of the particular organisation supporting the research institution.

KING ABDULAZIZ CITY FOR SCIENCE AND TECHNOLOGY (KACST)

KACST has seven research institutes that conduct applied research, and the one most directly involved in biodiversity issues is the Natural Resources and Environment Research Institute.

MINISTRY OF AGRICULTURE

The Ministry of Agriculture is responsible for:

- National Agriculture Research Centre / National Herbarium.
- Range and Animal Development Centre at Al-Jawf.

MINISTRY FOR ELECTRICITY AND WATER

Operation of the National Water Research Centre is the responsibility of the ministry.

MINISTRY OF DEFENSE

The Ministry of Defence has responsibility for research in territorial waters and the preparation of maps for all of Saudi Arabia.

PRESIDENCY FOR METEOROLOGY AND THE ENVIRONMENT (PME)

The Meteorology and Environmental Protection Agency (MEPA) was founded in 1981 to create and carry out programs to conserve, improve and protect natural resources and the environment, as well as to control air, water and land pollution to enhance "the health, safety and welfare of the people and to promote their overall economic and social well-being". In 2003 it became an independent parastatal organisation, PME. The functions of the PME remain to:

- conduct environmental surveys
- recommend regulations and other measures
- assess levels of environmental pollution
- stay abreast of regional and international developments in environmental protection, and establish standards and specifications.

NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT (NCWCD)

In addition to its own research staff, its research centres support the NCWCD:

1) National Wildlife Research Centre (NWRC) is primarily responsible for the captive breeding and release of Arabian Oryx and Houbara bustard.
2) King Khalid Wildlife Research Centre (KKWRC) is responsible for the captive breeding of gazelles and their reintroduction into NCWCD protected areas.
3) Jubail Marine Wildlife Sanctuary is responsible for undertaking comprehensive surveys of coastal and Arabian Gulf ecosystems.
4) Al-Sudairy Gazelle Centre is a satellite gazelle-breeding centre run by the King Khalid Wildlife Research Centre.

UNIVERSITIES

Individual staff members and departments within all eight of the universities carry out research projects that contribute to knowledge and understanding of biodiversity in the Kingdom.

Universities:

- King Abdulaziz University (Jeddah)
- King Saud University (Riyadh)
- King Faisal University (Dammam)
- King Khaled University (Abha)
- King Fahd University of Petroleum and Minerals (Dhahran)
- Imam Mohammad bin Saud Islamic University (Riyadh)

- Islamic University (Medina)
- Umm Al-Qora University (Mecca)

3.5 Funding

Almost all of the funds for activities supporting the Convention on Biological Diversity are derived directly from the budgets of organisations that are responsible for implementing the Convention in the Kingdom.

3.6 Ongoing programmes

Conservation of biodiversity, sustainable resource use, involvement of local communities and benefit sharing are ongoing activities of Saudi Arabia. Programmes that are already in place and that are described in other sections of this report are continuing, being elaborated, modified and updated and new ones are being developed. Specific mention can be made of the following programmes or areas of activity where work will continue or be expanded.

FINANCING BIODIVERSITY CONSERVATION AND RESEARCH

As described in section 9 below, at present the vast majority of funds for CBD activities come directly from the budgets that government allocates to organizations involved with implementing provisions of CBD. These funds are inadequate to meet the current needs, let alone the targets set for Saudi Arabia as a Party to the Convention. All of the organizations responsible for meeting Saudi Arabia's obligations will need to develop programmes to obtain additional funds if they are to achieve their own objectives for conservation of biodiversity.

TO INCREASE THE COVERAGE OF *IN SITU* CONSERVATION IN PROTECTED AREAS

As described in Section 6.2 below, the National Commission for Wildlife Conservation and Development has an explicit, long-term programme of identifying and closing gaps in the protected area system of Saudi Arabia. In addition to achieving the target of having at least 10% of the country's land surface under protection in protected areas, the Commission is working towards full representative coverage of biotopes and protection of endangered species. Marine and mountain ecosystems are of particular importance in the future programme.

IN SITU CONSERVATION OUTSIDE PROTECTED AREAS

It is increasingly evident that in order to halt or reverse loss of biodiversity, more conservation activity will be needed outside the formally proclaimed protected areas. This depends on developing partnerships with local communities. Currently, it is awareness and education programmes that most directly address this. The National Commission for Wildlife Conservation, with the active co-operation of the various education authorities and the media, has programmes for environmental awareness and education.

Similarly, the programmes that the Ministry of Agriculture has for tree planting and in supplying indigenous species of trees for planting in cities both increase awareness of conservation issues and provide a means for the public to actively participate in conservation.

However, greater numbers and a wider diversity of programmes are needed, especially programmes that will foster co-operative management of biodiversity and sustainable resource use. These need to be developed in the near future, both for conservation of wild plants and animals as well as for maintenance of agricultural biodiversity.

EXPAND, AND WHERE NECESSARY, DEVELOP *EX SITU* CONSERVATION OF BIODIVERSITY

The Ministry of Agriculture, through its plant propagation programmes, and the National Commission for Wildlife Conservation Development through its captive breeding programmes, plant and animal germplasm banks are both involved in long-term programmes to maintain and expand *ex situ* conservation of many species. These programmes are, by definition, on-going and a major challenge for the future will be to ensure adequate funding support. It is easy to get short-term funds for the re-introduction of flagship species, but much more difficult to maintain seed banks decade after decade. Programmes to secure sources of long-term funding need to be developed as a matter of high priority.

ARID LAND RESEARCH, MONITORING AND SUSTAINABLE USE

The Presidency for Meteorology and the Environment and the Ministry of Agriculture have major programmes dealing with different aspects of arid land conservation and management. In particular, a co-operative project between the Ministry of Agriculture and King Abdulaziz City for Science and technology aims at developing a long-term grazing strategy for the Kingdom. This will address both sustainable use of rangeland as well as the maintenance of biodiversity in these areas. Implementation will involve the development and operation of one or more programmes of range assessment, monitoring and management that will need to be implemented for the foreseeable future.

Similarly, the drought-monitoring programme (as well as other projects on monitoring climate change) of the Presidency for Meteorology and the Environment are long-term programmes that will continue.

ECO-TOURISM AND NATURE-BASED RECREATION ACTIVITIES

Programmes for the development of nature-based recreation and eco-tourism, both for local people and foreign tourists are being studied and developed by national organisations (such as the Supreme Tourism Commission and the National Commission for Wildlife Conservation and development) as well as at local levels (e.g. by municipalities and even private individuals. Such programmes will increase in the future as more people engage in activities such as sport fishing, diving, wildlife viewing, hiking and others.

Chapter 4. Strategy

Introduction

Despite the inherent resilience of natural systems, the increasing impacts of developments within the Kingdom as well as large-scale changes such as global warming require the development of new and flexible strategic goals. The National Biodiversity Strategy and Action Plan for the Kingdom of Saudi Arabia provides a set of strategic goals and the necessary action plans to achieve them. It is particularly noteworthy in that it presents the Islamic vision and principles that guide conservation and sustainable use of biological diversity.

In addition to the National Biodiversity Strategy and Action Plan, five other major strategy documents, the National Strategy for Environmental Protection, the National Coastal Zone Management Plan, the National Contingency Plan (prepared by the Presidency for Meteorology and the Environment), the National Startegy and Workplan to Combat Desertification and the Forests National Workplan and Strategy (developed by the Ministry of Agriculture) are important for protection of biodiversity and sustainable development.

The Kingdom of Saudi Arabia has ratified the Convention on Biological Diversity and fulfilled its obligation of preparing a National Biodiversity Strategy, as called for in Article 6(a). The Kingdom is preparing to integrate the conservation and sustainable use of biological diversity into all the relevant sectors of the government and national plans of the country, as called for in Article 6(b) of the Convention. This will require the preparation of detailed action plans by the ministries and institutions identified in the Strategy. It will also require cross-sectoral co-ordination among all parties concerned to effectively implement all the action plans. Consequently, the section of the present report that deals with Partners (Section 7) is of particular importance.

National Biodiversity Strategy and Action Plan

The National Biodiversity Strategy, which is the strategy most directly related to implementation of the Convention on Bioloical Diversity, is divided into six parts. The document comprises six parts each of which is briefly described below.

Part One introduces the purpose and scope of the Strategy which is to promote the conservation of biodiversity and the sustainable use of its resources by placing biodiversity at the centre of national planning and development. The scope of the Strategy is broad and includes the protection, restoration, sustainable use, equitable sharing, and systematic monitoring of Saudi Arabia's biodiversity. Part One also contains an introduction to the Convention on Biological Diversity

Part Two looks at the Islamic vision and basic principles guiding the conservation of biodiversity and stresses the fact that the conservation of the natural environment is an imperative commanded by Allah. The protection of the natural environment from abuse by man leads to the welfare of man himself together with the welfare of all other beings.

Part Three reviews the status of terrestrial biodiversity with its 2,250 species of flora, 76 species of mammals, 444 species of birds, amphibians, reptiles and insects. The status of marine and freshwater biodiversity is also covered. The major threats for each of those sectors are discussed.

Part Four contains seventeen strategic goals for the conservation and sustainable use of biodiversity that include i*n-situ* conservation both inside and outside protected areas; e*x-situ* conservation; conserving and developing forests and woodlands, desert rangelands, living marine resources and agricultural biodiversity; regulating access to genetic resources and introducing national biosafety standards; enacting environmental legislation, supporting scientific research, enhancing environmental education, and achieving socio-economic development; encouraging collaborative management and promoting cooperation for biodiversity; generating income from wildlife resources and developing nature based tourism.

Part Five contains seventeen sets of preliminary action plans to serve as a guide for the implementation of the above strategic goals. The final detailed working action plans for each strategic goal will need to be individually prepared and implemented by those ministries, organizations or institutions that have been identified in the Strategy, as well as cross-sectoral coordination among all parties concerned, as highlighted in the foreword by HRH Prince Saud Al-Faisal.

Part Six deals with the mechanism for implementing and monitoring the Strategy and stresses the fact that all the government agencies, non-governmental organizations, scientific institutions, and local stakeholders in Saudi Arabia will need to participate. The mechanism for implementing the strategy includes an organizational chart and a description of its components.

Saudi Arabia has ratified the Convention on Biological Diversity and fulfilled its obligation of preparing a National Biodiversity Strategy [Article 6(a)]. The next step is to integrate the conservation and sustainable use of biological diversity into all the relevant sectors of the government and national plans of the country [Article 6(b)].

National Biodiversity Strategies are designed and implemented through partnerships - where the different parties work together as partners and not as competitors. The roles and responsibilities of all stakeholders, as well as their agreement on modes of collaboration, must be properly defined to avoid conflict.

In order to implement the National Biodiversity Strategy all concerned ministries, organizations and institutions in Saudi Arabia need to prepare detailed Action Plans. These plans will reflect the level of experience, human resources and budgets those institutions are prepared to commit to conserve and sustainably use biodiversity.

The National Biodiversity Strategy has proposed a set of seventeen action plans to guide the implementation of the Strategy. The proposed action plans list priority activities, projects and programmes that require immediate attention.

However, the preparation of detailed action plans is the next step in the process and is an integral part of the mechanism for implementing the Strategy. It will require the combined effort of a National Coordinator (representing the National Commission for Wildlife Conservation and Development) and Sectoral Coordinators (representing the National Committee for Biological Diversity).

The National Co-ordinator will manage the functions of a Secretariat for Biological Diversity (see Part Six) where he will be assisted by technical experts, technical working groups and consultants to advise him and the Sectoral Coordinators on how to most effectively prepare and implement detailed action plans.

The Sectoral Co-ordinators will also be assisted by the staff and experts within each of their concerned ministries, organizations and institutions on how to prepare and implement detailed action plans that are within the scope and budget of their agency.

The success of the National Biodiversity Strategy will depend on the level of budget allocations set aside by concerned ministries, organizations and institutions for the preparation and implementation of detailed action plans. It will also depend on the development of detailed action plans that will address specific issues. These action plans also need time-bound targets and clear indicators that will be used to monitor progress towards their completion.

National Strategy for Environmental Protection

This strategy consists of objectives, general policies and sectoral strategies including protection of wildlife, marine and coastal areas, agriculture, tourism and environmental education and public awareness. The broad aim is to protect the environment and achieve sustainable development of all ecosystems.

National Contingency Plan

This plan provides guidelines for response to oil spillage and chemical spill accidents in the Kingdom. It is implemented through the National Oil Spill Centre of the Presidency for Meteorology and the Environment and is designed to provide effective and co-ordinated response to oil and chemical spills in the Arabian Gulf and Red Sea. The ultimate aim of the strategy is to protect the marine ecosystems from the effects of oil pollution and chemical contamination.

National Coastal Zone Management Plan

The National Coastal Zone Management Plan has been developed by the Presidency for Meteorology and the Environment as a mechanism for protecting the coastal environment through sustainable development. It was submitted for approval by the government in 2003.

National Strategy & Workplan to Combat Desertification

This strategy, developed by a team co-ordinated by the Ministry of Agriculture, has been completed and is awaiting final formal approval before being implemented. The general goals are to conserve all natural resources, to prepare for drought and the amelioration of its effects, to reduce loss of vegetation cover, and to increase manpower, build capacity

and increase environmental awareness to combat desertification. A detailed workplan has been developed for implementation of the strategy.

Forests National Workplan and Strategy.

The Forests National Workplan and Strategy for the Kingdom of Saudi Arabia was completed in 2002. After presenting an overview of forests in the Arabian Peninsula, their status and threats, the strategy provides a general framework and specific targets to achieve the general objectives. Although the targets are not tightly timebound, they still provide clear directions and actions that organisations that are responsible for forest management can follow.

Of particular importance is the provision of three categories of measures (mandatory, voluntary and complimentary) that will be followed in implementing the strategy. Education, capacity building and the involvement of a range of stakeholders are important components of these measures. Furthermore, the need to ensure wide sharing of the benefits of forest conservation is explicitly built into the strategy.

Chapter 5. Recommended Measures

In the following sections, some of the actions that are required for implementing the Convention on Biological Diversity are listed and briefly described. There measures provide the context in which specific actions will be developed by responsible organisations.

5.1 Provide adequate resources for conservation of biodiversity

It is essential that the ministries, agencies and other organisations charged with responsibility of conserving biodiversity have adequate resources to meet their obligations. Trained and motivated manpower and adequate funds to carry out necessary work are in very short supply in all the responsible organisations and there is urgent need to redress this deficit. Biodiversity needs to be viewed as important for the future development of the Kingdom as any other major socio-economic activities. In addition to making specific budgetary allocations for CBD activities, means need to be found to provide increased funding for biodiversity research.

5.2 In-situ *Conservation within protected areas*

In order to strengthen and improve conservation within protected areas the following activities are needed:

1. Expand the existing network of protected areas in order to fill gaps (especially in the marine environment), protect key biological sites and species and achieve as near complete coverage of biotopes as possible.
2. Improve knowledge about populations of organisms to establish and refine conservation priorities, identify viable populations and habitats and evaluate the success of conservation management actions and impacts of changing socio-economic pressures. Where necessary, further re-introductions of species should be carried out.
3. Increase stakeholder involvement in planning, implementation of management plans as well as sharing of benefits, responsibility and authority.
4. Strengthen and increase local and/or traditional conservation initiatives.
5. Increase education and awareness activities.
6. Ensure that regulations and management plans are effectively enforced and implemented.
7 Recruit and train staff, including members of local communities who become involved in co-operative management ventures, for protected areas
8. Develop and regularly update management plans for all protected areas
9. Utilise Zoned Areas for Resource Use Projects
10. Encourage private sector funding and develop means of increasing revenue generation (e.g. eco-tourism) from protected areas where this is possible.

5.3 In-situ *Conservation outside protected areas*

In light of the much greater area of land that is, will and should be outside formally protected areas and the much greater threats that exists to biodiversity here, measures are

even more urgently needed for conservation beyond protected area boundaries. This is even more true for the marine and coastal areas than for terrestrial ecosystems.

Forests, woodlands and wetlands are terrestrial systems that are of particular significance for protection outside the protected areas. Marine areas that lie outside designated protected areas need specific and effective measures to be taken for their conservation.

The following are some of the most immediate measures that need to be taken:

1. Promote bioregional planning that explicitly takes account of biodiversity as one of the central factors.
2. Control building developments, especially in mountainous areas
3. Introduce and make mandatory Environmental Impact Assessments (EIAs)
4. Introduce mechanisms for rehabilitation and/or restoration of damaged through extractive industries such as mining and quarrying
5. Limit construction of roads, dredging and land filling and limit sand and stone quarrying
6. Identify local hotspots of biodiversity and encourage their conservation by local communities
7. Encourage sustainable agriculture and use of species and practises that conserve water.
8. Introduce integrated pest management procedures and minimise use of pesticides
9. Expand reforestation programmes and involve local communities in forest management and conservation programmes
10. Determine the causes of forest die-back
11. Increase monitoring (especially through remote sensing techniques) of forests
12. Encourage and promote maintenance and conservation of genetic agro-biodiversity existing as landraces of plants and local breeds of animals
13. Control pollution in all areas of the Kingdom and apply existing penalties for contravention
14. Enforce hunting laws and control wood cutting
15. Continue and increase education and awareness programmes with specific objectives of increasing co-operation, building capacity for managing biodiversity amongst local people and instituting systems of collaborative management of resources.

5.4 Ex-situ *Conservation*

Existing initiatives in establishing *ex-situ* collections of plants and animals need to be strengthened and expanded. There is a particularly urgent need to develop botanic gardens that have conservation goals explicitly built into their management plans. In addition, municipalities need to be encouraged and assisted in making municipal parks and zoos more useful as repositories of biological material as well as centres of environmental education.

Support is also needed for existing gene banks and new ones should be created. It is especially important that planning for such *ex-situ* conservation activities recognises the long-term and labour-intensive nature of maintaining repositories of germplasm. However, such gene banks are a source of genetic material and they need to be considered an integral part of the Kingdom's protection and use of its genetic resources.

5.5 Desert Rangelands

The serious condition of desert rangelands and the importance they have for the livestock industry as well as biodiversity means that more effective measures than have been implemented in the past are imperative to ensure that the resources of the rangelands are used more sustainably. Some of the measures that are needed to achieve this include:

1. Determine ecological carrying capacities and develop grazing systems that maintain use within the limits of the carrying capacity. It is essential that all elements of biodiversity be taken into account when determining the carrying capacity, not just production of edible herbage.
2. Develop and effectively implement appropriate incentives and penalties so that it is not worth the while of livestock owners to use only short-term gains as the measure of viability of their operations. Subsidy policies that promote sustainable use and conservation of biodiversity need to replace subsidy policies that favour inefficient and unsustainable methods of range management.
3. Investigate different methods of rangeland management, including systems based on nomadic pastoral as well as traditional *hima* systems.
4. Develop and implement collaborative management programmes that involve all stakeholders.

The Presidency for Meteorology and the Environment has established a new department of Drought Monitoring. The responsibility of this department is to undertake drought monitoring and its impacts on desertification and biodiversity. These responsibilities tie in with the large project on Environmental Support of Nomads (ESON) that was carried out to determine the distribution of plant species and the development of vegetation in the north and north-east of the Kingdom.

5.6 Conservation of marine resources

The growing population of Saudi Arabia as well as the need for protein supplements for animal feeding will require increased use of marine resources. In addition, coastal areas, especially coral reefs will become increasingly important for ecotourism. Saudi Arabia is extremely fortunate in that many of the best coastal regions have been protected from over-exploitation because they are of strategic importance. However, this "incidental conservation" needs to be under-pinned by well-developed action plans for conserving and sustainably using marine resources.

5.7 Conserve genetic resources

The genetic material of plant and animal species, sub-species, varieties, breeds and landraces that occur only in Saudi Arabia are national assets and need to be protected. In the future decades, biotechnological developments will make sources of genetic material increasingly valuable and material will be increasingly sought-after. Saudi Arabia needs to develop policies and institute necessary legal processes to determine access to genetic resources, co-operate with other countries that share the distributions of taxa and formalise agreements on reciprocal access to genetic resources.

Recognising the rights of indigenous communities to genetic resources that have been conserved by these communities is of equal importance as guarding the national resources.

5.8 Biosafety

Although "low tech" methods of genetic modification of plants and animals is as old as humankind's selection of particular strains of plants or breeds of animals or the use of micro-organisms to produce cheese, modern biotechnological tools have brought about a revolution in the extent to which organisms can be modified. Genetic material from a single cell of a micro-organism, a plant, or an animal can be taken and "inserted" into another organism, thereby conferring resistance to disease or pesticide. The resulting genetically modified organism (GMO) or living modified organism (LMO) has the potential to increase yields, grow in marginal habitats or reduce the need for fertiliser. However, there is widespread concern that GMO's and LMO's might pose severe threats to natural ecosystems (and hence biodiversity) if they "escape" and are "super-invaders."

In January 2000, governments adopted the Cartagena Protocol on Biosafety in an attempt to ensure safer transfer, handling and use of genetically modified or living modified organisms. The Kingdom needs to take action in line with the Cartagena Protocol. Amongst others, these will include:

- Enactment of new legislation for GMO's and LMO's in Saudi Arabia
- Support for international protocols on biosafety
- Appointment of expert committees
- Use of modern screening methods and require adequate certification of origin of all genetic material
- Taking precautionary measures against GMO's.
- Encourage use and further development of native plants and local breeds of animals.

5.9 Update and enforce environmental legislation

The increasing importance of the environment for the well-being of humankind and the current state of biodiversity in the Kingdom means that there is a continual need to update existing legislation and to enact new legislation to deal with emerging issues. In particular, existing laws need to be reviewed to ensure that they provide mechanisms to conserve all elements of biodiversity and prevent degradation of the environment by misuse, overuse or introduction of undesirable organisms. It is also extremely important that legislation is updated or developed that will directly link human well-being with biodiversity and that will ensure equitable sharing of benefits.

5.10 Support scientific research

The status of biodiversity and the monitoring of efforts to conserve it rest on good scientific information. Research is an essential component of implementing the Convention on Biological Diversity in the Kingdom. Listed below are some areas in which action is needed.

1. Implement the recommendations of the Global Taxonomy Initiative. Before biodiversity is conserved it is necessary to know just what is present in the country. As has been noted in many parts of the status report above, knowledge is deficient about even the basic taxonomy of many groups of organisms present in the Kingdom. Just as serious is the lack of modern, accurate, tested data on the status of many plant and animal species. It therefore is essential that steps be taken to redress this situation. The Global Taxonomy Initiative sets out a number

of actions that can and should be taken as a matter of very high priority so that the overall objective of the CBD can be met. In particular, organisational and manpower capacity building are needed.

2. Adopt a co-ordinated plan of research that focuses on biodiversity issues in order to prevent waste of effort and to avoid gaps in knowledge persisting.
3. University curricula and studies need to be oriented towards biodiversity.
4. Computerised data bases need to be developed and all organisations working with CBD issues need to be linked to then databases.

5.11 Education

Environmental education is a pre-requisite for successful implementation of the Convention on Biological Diversity. Curricula and programmes need to be developed at all levels in the formal education sector. Just as important as formal education, there need to be programmes of informal education developed that reach to all sectors of society and to people of all ages. Capture and conservation of local and traditional knowledge about fauna and flora and their sustainable use need to be incorporated into formal and informal education curricula.

5.12 Link Socio-economic development to biodiversity conservation

Saudi Arabia has a rapidly growing population in which increasing numbers of young people need to be productively absorbed into the economy. Clearly, the people of the country are the major factor around which conservation of and sustainable use of natural resources must operate. Structural changes are needed in society to produce lasting solutions to the increasing environmental problems that are developing. Such changes need to be developed through appropriate nature and environmental policies.

To develop such policies, information is needed on the costs of environmental degradation, the benefits of conservation of biodiversity and the costs and benefits of implementing biodiversity conservation policies. In addition, appropriate legislation and implementation of laws that link socio-economic progress with conservation of biodiversity are needed.

For conservation of biodiversity to benefit society at large, it is necessary that actions are taken to generate income from wildlife and biodiversity in general. Some areas that can be developed in Saudi Arabia include:

- Income generated from nature-based tourism.
- Increase the income generated from wild plants through finding and propagating new commercially valuable plants
- Determine the most effective marketing methods for natural products and institute them
- Continue and increase wildlife captive breeding
- Promote efficient and sustainable production of wild honey
- License hunting and recreational fishing, ensuring that suitable codes of conduct and enforcement of their provisions are in place.
- Find and market genetic and pharmaceutical products.

5.13 Regional and international co-operation

Many issues pertaining to implementation of the CBD require collaboration at regional or even international levels. These include regional and international agreements and treaties, regional research and monitoring activities and (possibly as important as any activities) communication through regional and international forums.

There are a number of regional agreements in existence and some regional research and capacity-building organisations have been established. It is important, however, that the Kingdom continues to engage in regional and international organisations, complies with – and most importantly, implements – signed treaties and actively participates in developing new treaties and agreements. Similarly, regional and international collaborative research needs to be maintained as a means of redressing manpower and other shortages in local capacity.

Major regional agreements directly related to conservation of biodiversity include:

- Regional Agreement on the Protection of the Marine Environment (ROPME) that was signed in 1972. This agreement is concerned with the Arabian Gulf, and all coastal states of the Gulf are parties to it. The Ministry of Agriculture (MoA) and The Presidency for Meteorology and the Environment (PME) are the organisations most closely involved in ROPME, although the National Commission for Wildlife Conservation and development is a member.
- Regional Agreement on the Protection of the Marine Environment of the Red Sea and Gulf of Aden (PERSGA) was signed in 1982. PME and MoA are the lead organisations in Saudi Arabia that are involved in PERSGA activities.
- Proposed GCC Agreement on Wildlife Protection: a draft agreement consisting of 43 Articles was proposed by NCWCD which seeks to promote regional programmes for wildlife conservation, protected areas and wildlife trade.
- Oryx Agreement

The National Commission for Wildlife Conservation and Development hosts the Protected Areas Thematic Centre of the West and Central Asia and North Africa (WESCANA) Region of the IUCN. In addition, through its central role in the Arabian Plant Specialist Group of the Species Survival Commission of IUCN, NCWCD plays a pivotal role in regional plant conservation.

The Presidency for Meteorology and the Environment has been the national focal point and has participated in international cruises of NOAA, the United Sates of America and Japan to study the marine resources of the Arabian Gulf and the Red Sea.

Chapter 6. Actions

The Kingdom is already active in meeting many of the objectives identified under the Convention. These and other actions that will be taken in future to implement the CBD are concisely described in the following sections. For increased clarity, actions are presented under the headings of specific Articles of the Convention on Biological Diversity.

6.1 Article 7: Identification and monitoring of biological diversity

The Ministry of Agriculture and the National Commission for Wildlife Conservation and Development both have on-going programmes of surveys to improve knowledge and to monitor changes in biological diversity. The lack of correspondence between information sources as to the actual status of threatened and endangered plant species (3.2.2 above) emphasises the need to effectively and urgently carry out even rather basic field studies on the flora of the Kingdom. Similar needs exist for animals, with even more urgency for poorly known groups such as the invertebrates.

The Ministry of Agriculture carries out surveys in rangelands, forests and *rawdhas* to assess the percent of plant cover and the carrying capacity in addition to document the coordinates of the area. Also, studies are done to delineate the areas that lost their plant cover in order to replant or reforest them.

The staff of the National Commission for Wildlife Conservation and Development and the staff of its two research centres, have on-going surveys in proposed protected areas and continuing research in existing areas. Such studies both provide information on the state of biodiversity as well as monitoring changes due to management and other factors.

Projects that are currently underway include:

- Staff of the National Commission for Wildlife Conservation and Development annually monitors breeding success and numbers of turtles in the Red Sea and Gulf of Arabia.
- Scientific staff of the two research centres of the National Commission for Wildlife Conservation and Research continually monitor the populations of Arabian oryx, sand gazelles, mountain gazelles and Nubian ibex in the protected areas where these animals occur.
- Houbara bustard populations are continually monitored in the Mahazat As Sayd and Saja/Umm ar Rimth Protected Areas where this species has been re-introduced.
- An extensive and intensive research project, in collaboration with the Japan International Co-operation Agency (JICA), on the juniper woodlands of the south-western mountain region. In addition to providing detailed information on the die-back of *Juniperus procera*, data are being collected on all plant species in the juniper woodland. This has produced a wealth of new data on the flora of the areas as well as baseline data on species abundance that allow changes to be monitored.
- Regular inventories are made of species occurring in all the protected areas. These lists serve to update existing knowledge as well as tracking changes in species composition in areas that are managed primarily for conservation of biodiversity.

- Long-term changes in species composition in the protected area at the King Khalid Wildlife Research Centre outside Riyadh are monitored by fixed-transect studies that are carried out annually by staff of the Centre and the King Saud University.
- Surveys of vertebrates are underway in the Ibex Reserve, documenting the species diversity of this area as well as establishing the baseline for monitoring changes in diversity.
- The National Wildlife Research Centre in Taif regularly carries out population monitoring studies on small carnivores and rodents in two very large protected areas where houbara bustard have been re-introduced.
- Studies that are co-ordinated within the *Fauna of Arabia* and *Arabian Bird Atlas* projects serve as on-going sources of high-quality information on the taxonomy and status of elements of the biodiversity of the Kingdom.
- In collaboration with other members of the Arabian Plant Specialist Group of IUCN and local universities, the Red Species List for plants is being prepared.

The Presidency for Meteorology and the Environment will undertake a joint study with UNEP's West Asia Office (ROWA) on the Asir National Park ecosystems. This study aims to assess the degradation of the area by natural and anthropogenic activity and to develop guidelines to maintain the Park and protect its ecosystems. The recommendations of the study will, as appropriate, be applied to other parts of Saudi Arabia.

6.2 Article 8: In situ *conservation*

As shown in the description of the status of fauna and flora and the extent of gaps in coverage of species and habitats in protected areas, it is clear that despite almost 10% of the Kingdom's land surface falling within protected areas, much still needs to be done. The fact that 103 areas were identified within the original System Plan for Protected Areas (Child & Grainger, 1990) as being of conservation priority, it is evident that establishment of new terrestrial and marine protected areas is on-going in the Kingdom. Currently, the System Plan is being updated and revised in light of experience gained since the National Commission for Wildlife Conservation and Development was established in 1986. The revision also takes account of new developments in the international community such as the provisions of the CBD (and in particular the *National Strategy for Biodiversity in Saudi Arabia"*) and the IUCN's (The World Conservation Union) World Commission for Protected Areas (WPC). The following section provides an overview of actions underway and being planned to ensure that future developments of *in situ* conservation improve the state of biodiversity, increase sustainable use and increase equitability of access to resources while protecting traditional knowledge and value systems.

6.2.1 Identify, evaluate and establish new terrestrial and marine protected areas for *in situ* conservation

The overall objective is to protect terrestrial, marine and freshwater ecosystems by means of establishing a comprehensive system of protected areas for *in-situ* conservation of biodiversity in Saudi Arabia. The following are actions needed to achieve this:

- Select new protected areas

- Fill gaps in the existing Protected Areas System Plan
- Protect key biological sites
- Achieve representative coverage of biotopes
- Identify viable populations of rare and endemic animals and plants
- Develop and strengthen traditional and local conservation initiatives
- Implement the existing ban on hunting in protected areas
- Continue with programmes to re-introduce key species to suitable areas
- Collaboratively prepare management plans with stakeholders
- Recruit and train staff to manage protected areas and to monitor changes
- Promote co-operation between organisations responsible for conserving biodiversity
- Establish and/or enhance benefit sharing with local communities.
- Increase education and public awareness through establishment of visitor centres

In order to evaluate potential additional sites for inclusion in the protected area system, NCWCD has developed a set of environmental, socio-economic and pragmatic criteria. These criteria were already used in the original system plan (Child & Grainger, 1990) and have been (and will continue to be) reviewed and refined for future application.

CRITERIA

Protected areas are generally first identified as being important for conserving populations of flagship plant and animal species and areas of special scenic beauty. Later, rare or otherwise important species or under-represented ecosystems and biotopes may be conserved by the proclamation of a protected area to encompass them. Although this approach has produced many extremely valuable and important areas for *in situ* conservation of biodiversity, The National Commission for Wildlife Conservation and Development (NCWCD) adopted a rational approach for the selection and prioritisation of potential protected areas from the outset. This aims to provide the most effective conservation of the biodiversity and to optimise the socio-economic benefits that are derived from the protected areas.

The criteria are summarised below, following (Llewellyn (*in prep*)).

Ecological:

- Representation of the country's terrestrial and marine ecosystems.
- Conservation of the country's most productive biological sites: freshwater wetlands, isolated mountain massifs, juniper woodlands, marine islands, mangroves, seagrass beds, and coral reefs, as well as natural seedbanks that are well-situated for restoration of degraded rangelands.
- Conservation of key plant and animal taxa: endangered, vulnerable, rare, endemic, and near-endemic species, Pleistocene relicts, migrants, and species of outstanding ecological and economic importance.

Socio-economic:

- Traditional and local conservation initiatives, such as *himas*, wildlife conservation initiatives, agricultural terraces and other rainwater harvesting systems.
- Value for rural development, through nature-based tourism and recreation, sustainable hunting and fishing, and gathering, and production of livestock, wood and firewood, and wild honey.
- Value for environmental education – easily accessible sites that demonstrate the benefits of conservation and restoration techniques, or where outstanding plants, animals, and landforms can easily be studied.

Pragmatic:

- urgency of action,
- ease of protection and management, and
- administrative balance.

REPRESENTATION OF ECOSYSTEMS

A basic objective of a system plan for protected areas is that it should ensure that no assemblage of ecological communities is lost to posterity. This requires comprehensive knowledge, incorporated in biotope maps, of the geology, physiography, climate, hydrology, soils and vegetation. To date, no comprehensive biotope map exists for the whole Kingdom, so a new, provisional physiographic map has been prepared (Llewellyn (in prep) for the updated System Plan. This new map corrects errors in the previous map, subdivides some units that were previously considered homogeneous but which have been found by ground surveys to be heterogeneous, and most importantly, includes marine biotopes.

KEY BIOLOGICAL SITES

The importance of these sites is often out of all proportion to their size, since they provide key habitats for plants and animals and often serve as refuges or reservoirs for re-colonisation of surrounding areas. In many instances, they do not correspond to the distribution ranges of flagship species, especially large animals, which have often been pushed to marginal habitats by disturbance resulting from human activities.

Key biological sites (which may alternatively be viewed as critical wildlife habitats) in the arid and semi-arid lands of Arabia include freshwater wetlands, isolated mountain massifs, juniper woodlands, marine islands, seagrass beds, mangrove thickets, coral reefs, and sites strategically situated for seed dispersion into surrounding rangelands and woodlands. Other kinds of biologically productive sites, which tend to be of less importance than those mentioned here, but still merit consideration in the revision of the System Plan, are saltmarshes, algal beds, woodlands of trees other than junipers, and *rawdahs*.

In such arid lands and saline waters as are found in Saudi Arabia, the importance of conserving key biological sites is enhanced by the relative biological poverty of most other biotopes. Vast areas of desert may (and should) be conserved for a balanced representation of the country's biotopes, but such sites still protect only a small fraction of the country's biological diversity. The conservation of small sites of key biological importance, however, may preserve the majority of its plant and animal species.

The protection of these key biological sites is probably the single most important action that could be taken to ensure that Saudi Arabia's biological diversity is preserved for future generations.

The updated System Plan identifies key biological sites in all categories. The following Table indicates the numbers of each type that meet the criteria for being important as protected areas.

Table 6.1
Numbers of sites in different categories that are identified as Key Biological Sites in the updated Systems Plan for Saudi Arabia.

AREA	LARGE SITES	SMALL SITES	MAJOR REASONS FOR CONSERVATION
Wetlands	16 natural; 10 artificial	22 natural; 3 artificial	Many natural wetlands have been drained by over-use of water; wetlands are important for migrating birds; play important roles in the hydrology of catchments.
Isolated mountain massifs	11	6	Critical centres of biodiversity because they provide a wide array of habitats in close juxtaposition; comparative inaccessibility provides protection; under increasing threat of urban development and recreation use.
Juniper woodlands	10	11	One of the few densely wooded ecosystems of Saudi Arabia; support rich fauna and flora; key areas of soil formation and water conservation
Marine island	13	13	Isolated areas; high productivity; important breeding sites for birds and marine turtles
Mangrove swamps	12	14	Proved a major contribution to coastal productivity; breeding and refuge sites for many marine species.
Seagrass beds	16	12	Highly productive areas; feeding grounds for fish, turtles and dugong; stabilise soft sediments and reduce coastal erosion; highly vulnerable to landfilling and other coastal developments.
Coral reefs	15	11	Extremely productive; provide breeding and feeding grounds for many marine species; Red Sea coral reefs amongst most richest in the world; Red Sea reefs of Saudi Arabia still undamaged; highly vulnerable to oil spills and other pollution, physical damage and over-exploitation.
Seed production	12	17	Provide *in situ* seedbanks that can be of crucial importance for re-colonisation of over-grazed and otherwise damaged vegetation12
Other important sites			Woodlands (other than juniper woodlands), saltmarshes, *rawdahs* and algal beds all provide refuges, seedbanks and breeding sites. Identification of sites of particular importance that are in need of conservation is an on-going activity.

KEY SPECIES

The existence of viable populations of key taxa of plants and animals is one of the primary criteria for selection, establishment and management of protected areas for the conservation of biological diversity. The updated System Plan expands on the older approach by which species were divided into two categories, 'flagship species' and 'indictor species'. The criteria now being applied (Llewellyn *in prep*) are listed below.

1) Genera, species, or subspecies that are ***critically endangered, endangered,*** or ***vulnerable*** (globally, regionally, or nationally); taxa which are locally extinct in the wild may be included, provided that there is an NCWCD policy to reintroduce them.
2) Genera, species, or subspecies that are ***endemic*** to the Arabian Peninsula, the Red Sea, or the Gulf.
3) Genera, species, or subspecies of which the conservation of populations within Saudi Arabia is essential to the conservation of the taxon (e.g. ***near-endemics*** and ***migrants*** for which Saudi Arabia represents a critical range).
4) ***Relict*** genera, species, or subspecies that are of global, regional, or national significance.
5) Genera or species of special ***ecological importance*** (i.e. fulfilling a vitally important function in an ecosystem such as providing a key habitat for other species, serving as indicator species, etc).
6) Genera of species of significant ***economic importance***.
7) Genera or species that serve a ***"flagship" function*** (i.e. high-profile species of cultural value, the protection of which will also protect large numbers of other species that share their habitats).

Application of these criteria by groups of experts has produced lists of species (see the Annexes) that will receive particular attention in future conservation planning.

Traditional and Local Conservation Issues

With over six thousand years of bio-cultural diversity in the region it is only to be expected that there is a wealth of indigenous knowledge on how to use natural resources sustainably. Local traditions for use of resources provide a basis that can be elaborated into programmes for linking the conservation of renewable natural resources with sustainable national development.

Functioning local *himas*, agricultural terraces, rainwater harvesting methods and wildlife populations that are protected by local people all provide initiatives of tremendous value for achieving the objectives of the CBD. Traditional, indigenous agricultural practises proved the best – often the only effective - means of conserving genetic diversity of landraces of crops and animals while the land-use patterns provide the habitats for diverse and rich assemblages of species. In some cases, species are found only in Saudi Arabia because of their interaction with humans. A case in point is the helmeted guineafowl (*Numida meleagris*). This species only occurs in Wadi Jawwah, where the birds feed in the small farms and roost and nest in adjacent scrubland. The local people harvest them more – or less sustainably, but use of chemical pesticides or clearing of the scrublands or changing the farming practises could threaten the species.

Value for Rural Development – Increasing Equitability of Access to Resources

The value of a site to provide tangible economic benefits to local communities is one of the most important socio-economic considerations in the planning of protected areas. In Saudi Arabia, the most important benefits include recreation and tourism, sustainable

hunting and/or fishing, gathering of wild products such as truffles and shellfish and the regulated and sustainable grazing and wood-cutting, honey production.

The existing and updated System Plans for protected areas explicitly make provision for people to enjoy the benefits of the protected areas. The Resource Use Class of protected areas is specifically designed to implement integrated, holistic systems of management of biological resources.

In order for conservation activities to make significant contributions to rural development, three perquisites must be met:

- Wildlife and other natural resources must be allowed to achieve their full economic potential. If they are under-valued their conservation is a burden on the state and on local citizens.
- Benefits from the protected areas must be directed to the right recipients. It is essential that the people who bear the costs of protecting biodiversity (usually people living in the local communities) receive the rewards for doing so.
- Local people need to be involved in all stages of conservation; planning, decision making, implementation of policy and responsibility for consequences of action or inaction.

Nature-based tourism, if properly managed, is the least consumptive form of use of resources. Saudi Arabia has great potential for nature-based tourism and is currently investigating ways of developing this industry. By definition, such tourism depends on the presence of flagship species, areas of unspoiled scenery, and of vegetation and coral reefs that are in "good" condition. These requirements provide strong incentives for many otherwise disinterested people to take and active interest in maintenance of biological diversity.

Sustainable hunting, like nature-based tourism can be modestly consumptive of natural resources, especially where mature males are hunted. As noted when discussing the status of biodiversity previously, hunting is among the most important traditional uses of wildlife in the Kingdom and as long as it is not purely for sport, hunting is permitted in Islam. Like tourism, hunting can, if properly regulated, provide far higher returns from marginal lands than can grazing of livestock. The hunting industry provides can be managed so as to directly and indirectly benefit local communities (through employment of local guides, purchase of food, remittance of part or all the fees charged for hunting licenses etc) as well as the broader economy, through the sale of equipment, for example.

Sustainable artisanal and recreational fishing (commercial fishing is incompatible with protected areas) is really a form of hunting and has the same benefits and impacts on diversity of properly managed. Major advantages of fishing are that services (for example, boat hire) provided by local communities are often essential and, at least at present, most fish populations and their habitats in Saudi Arabia are in far better condition than are terrestrial species and habitats.

Gathering of truffles, fruits and edible roots, sea birds' eggs, turtle eggs and shell fish are widely practised activities in the Kingdom. As human populations grow, such harvesting is likely to increase, and because it often involves off-road driving, there is a potential for habitat damage to increase. Restrictions on time and methods of harvesting are needed to ensure that the activities remain sustainable.

The severe degradation of rangelands in most of the Kingdom means that in many areas it is only the traditionally protected *himas* and the modern protected areas that support healthy grazing lands. Although the purposes of Special Protected Areas may be incompatible with grazing and browsing by livestock, Resource Use Reserves often provide very valuable grazing. Apart from giving opportunities for experimentation with different forms of regulated grazing, modern Resource Use Reserves may come to play an analogous role in local land management systems as did *himas* in the past. In addition, the long history of the presence of sheep, goats and especially camels in Arabia means that much of the present-day flora has been "shaped" by grazing and browsing. In at least some areas effective conservation of biological diversity may *depend* on some levels of grazing and browsing by livestock.

Wood production for construction purposes is almost completely satisfied commercially. However, there is tremendous demand for wood for fuel, especially for camp- and tea-fires. Although this is generally identified as a resource that can be provided from protected areas, considerable care is needed in regulating collection. Deadfalls are often extremely important elements of the habitat for invertebrates and small vertebrates. Decay of wood is also an essential component of nutrient cycling. As with all consumptive forms of resource use, woodcutting and collection of dead wood needs to be managed as part of the overall maintenance of the structural and functional integrity of ecosystems.

Honey production from natural areas is one of the most successful uses of natural resources. As practiced at present, it is sustainable, provides direct and tangible benefits to local communities and has a positive influence on environmental conservation. However, because it is so dependent on vegetation condition and plant species composition of ecosystems, a wide range of disturbances (pesticide use that kills bees or changes in land use practices that alter the vegetation, for example) to the environment could threaten future sustainability. One impact of natural honey production that needs some degree of regulation is the incidence of tree-felling to get to hives. Not only can this affect woody plant population structure, it is a wasteful method of harvesting that needs to be modified.

6.2.2 *In situ* conservation outside protected areas

It is neither possible nor desirable to attempt to conserve biodiversity simply in protected areas. On both the global and local basis, far more biodiversity exists outside officially proclaimed protected areas and this will continue to be the case. It therefore follows that in order to achieve the objectives of the CBD, Saudi Arabia needs to secure the safety of wild populations of flora and fauna outside the designated protected areas. In light of the growing population, all responsible ministries and agencies need to urgently put in place mechanisms that will halt and reverse the currently occurring loss of biodiversity outside the proclaimed protected areas.

In order to meet its obligations under the Convention on Biological Diversity, the Kingdom needs to take the following broadly defined actions:

- Identify biodiversity hotspots outside the protected area systems and develop management plans for them, including local community conservation activities.

- Introduce environmental impact assessments (EIA's) or Integrated Environmental Management (IEM) procedures as being mandatory prior to any development.
- Promote bio-regional planning.
- Control building developments, especially in sensitive areas such as the coast, mountaintops and sites of cultural importance.
- Limit construction of roads, dredging and land filling, especially in sensitive areas.
- Encourage sustainable agriculture (especially in relation to water use).
- Control pollution and minimise pesticide/herbicide use.

Buffers and Linkages for Protected Areas

Buffer zones around and corridors linking disjunct protected areas serve to maintain genetic diversity through increasing effective population size as well as preserving local microclimate. Similarly, even comparatively small areas of suitable habitat within otherwise hostile environments allow species refuges and provide "stepping stones" for movement between habitat patches.

Desert Rangelands

Because of the vast areas covered, economic importance and state of degradation of desert rangelands, high priority is being given to their restoration and implementation of strategies that ensure sustainable use. The National Biodiversity Strategy for the Kingdom presents detailed actions that need to be taken to improve conditions of the desert rangelands.

Restoration projects are currently underway in a number of areas. The Ministry of Agriculture replants rangelands that have lost their plant cover with the plant species that were there originally or very similar species. In addition, a network of earth ridges (*uqums*) is established for water distribution to increase ground moisture and to encourage plant growth.

The Ministry of Agriculture as well as the Presidency for Meteorology and the Environment and the National Commission for Wildlife Conservation and Management will be the main organisations responsible for implementation and monitoring sustainable use of rangelands, whereas the Ministry of the Interior will be responsible for enforcing the enabling legislation.

Agricultural Biodiversity

The Ministry of Agriculture reviews and evaluates agricultural policies and practises regularly and the concepts of sustainable development and conservation of biodiversity are being introduced. Importantly, local economic and social conditions are increasingly being incorporated into policy-making for agriculture. The National Biodiversity Strategy for Saudi Arabia proposes specific actions that need to be taken to maintain and increase agricultural biodiversity as well as the organisations responsible for implementation and monitoring of the effectiveness of the measures.

Forests

Conservation and development of forests outside protected areas need to be made priority activities in the sustainable use of biodiversity. As noted in a previous section, forests provide important resources that can be sustainably harvested. However, threats such as uncontrolled tree-cutting, excessive livestock browsing, urban expansion and

indiscriminate use of pesticides continue to reduce the forests. Furthermore, the general aridity of Saudi Arabia, high costs of afforestation and lack of trained personnel are major limiting factors in expansion of forests. Action plans to redress the deficiencies and halt the threats need to be developed and implemented urgently.

Thirty nurseries producing forest trees have been established by the Ministry of Agriculture to produce seedlings that will be used in the Ministry's projects and the annual tree week.

MARINE BIODIVERSITY

Although use of marine resources is covered by existing legislation, regulating the harvest is difficult, especially where local communities collect sea bird and turtle eggs and harvest shellfish and other animal products in comparatively restricted localities. Human population pressures on such marine resources are increasing, both because of increases in numbers of people harvesting the products and through habitat reduction as other uses of coastal land and inshore waters increase. As recreational diving and tourism increase the pressures on corals and coral reef ecosystem will increase, both through consumptive collection, fishing and harvesting as well as through physical damage.

Clearly, it is necessary to carry out detailed studies on all marine fauna and flora as a precursor to establishing harvest quotas, seasons and areas as a matter of urgency. Once this has been established through appropriate legislation and public awareness and education programmes, monitoring and enforcement of regulations will need to be set in motion and maintained.

WETLAND CONSERVATION AND MANAGEMENT

As discussed above, all the natural wetlands in Saudi Arabia are on high conservation importance and the most important of these have been identified in the updated System Plan for Protected Areas. However, as noted when describing the status of wetlands, artificial wetlands are important in providing habitats for resident species and especially for migratory bird species. Since management of these wetlands is (and should be) the responsibility of the Ministry of Electricity and Water and of the many municipalities, it is importance that the value of artificial wetlands for conservation of biological diversity is emphasised in all elements of planning for water management. Similarly, management of artificial wetlands needs to explicitly incorporate procedures that maximise biodiversity conservation and monitors its status.

URBAN DEVELOPMENT PLANNING

Bio-regional planning and enforcement of appropriate laws is needed to ensure that urban development, road building, quarrying and mining and other environmentally damaging activities do not result in reduction of biodiversity. Conversely, encouragement of sustainable agricultural practises and harvesting of natural resources, controlled use of pesticides and pollution control need to be managed through a combination of incentives and enforcement of appropriate laws.

6.3 Article 9: Ex situ *conservation*

The extent of degradation of rangelands and unsustainable hunting (resulting in extinction of some species in the wild) of larger animals that took place in the past makes *ex situ* conservation imperative for some species. The Kingdom needs to continue to support and to establish new captive breeding centres, botanic gardens, wildlife and municipal parks and gene banks as supplementary and complementary actions to conserve terrestrial, marine and freshwater biodiversity.

From the inception of the National Commission for Wildlife Conservation and Development, captive breeding programmes and establishment of germplasm banks have enjoyed high priority.

Captive breeding programmes at NCWCD's research centres led to re-introduction of Arabian oryx (with almost 1,000 animals now established) sand and mountain gazelle, houbara bustard to their native habitats, both within and outside protected areas. In 2003, a collaborative project with the Institute of Zoology of the Zoological society of London, London, was begun to establish a sperm bank at the King Khalid Wildlife Research Centre for endangered species of gazelles.

Propagation and re-planting of mangrove trees has been carried out over a number of years in both the Red Sea and Gulf coasts. Similarly, the tree *Mimusops laurifolia* has been the subject of *ex situ* propagation and re-introduction to selected sites in the wild, as has the endangered juniper, *Juniperus procera*.

In 2002, a collaborative agreement was entered into with the Royal Botanic Garden, Kew (United Kingdom) for the establishment of a seed bank of important plant species. Currently, NCWCD is developing its own seedbank facilities in Riyadh both as a means of ensuring that there is a seedbank in the Kingdom and also as insurance through having separate facilities. The Ministry of agriculture is also in the process of developing a seed bank for preservation of germplasm of agriculturally important plants.

The Ministry of Agriculture endeavours to increase the green areas of the Kingdom through reforesting the wadis, *rawdahs*, *faydhas* and the places of natural forests that lost its plant cover. In addition, three Seed Production Centres have been established to produce native range plants in different regions, to fulfil the Ministry's need of seeds for restoration projects.

Botanic gardens around the world play important roles in science, horticulture education and conservation of species and genetic resources. At present, only one botanic garden – the educational garden of the King Saud University in Riyadh - is located in Saudi Arabia. There is urgent need for more botanic gardens in different bioclimatic regions in the Kingdom where they can contribute to some or all of the following conservation goals:

- Identification and monitoring: Botanic gardens gather and preserve data and information and make it accessible for conservation activities. As such, they can play a central role in monitoring biodiversity.
- Integrating conservation: Botanic gardens play a major role in research, species recovery, ecosystem management, surveys, re-introductions, uses of wild plants, public education and others.
- *In-situ* conservation: Botanic gardens, through the botanists on their staffs, can assist in managing, maintaining and carrying out research in protected areas.
- *Ex-situ* conservation: Botanic gardens play a central role in the rescue of threatened species and as sources of seed and other material for re-introduction

programmes. Botanic gardens are also places where seed banks can be maintained through scheduled planting and harvesting of new seed to prevent loss of viability or genetic representation.

- Research: Scientific research on a range of botanical topics, including taxonomy, conservation genetics, biotechnology, ethnobotany, invasive species, producing and up-dating Threatened Species Lists and plant propagation, are undertaken in the larger botanical gardens of most countries.
- Training and capacity building: Training is provided for botanic gardens staff, students, school teachers, scholars and members of the general public.
- Public awareness and education: Botanic gardens are ideal as centres for development of public awareness and education related to the flora and biodiversity in general and in providing "outdoor classrooms" where people can come into direct contact with plants.
- Impact assessments and mitigation: The staff and facilities of botanic gardens are ideally placed to assess threats to plant diversity and to offer solutions to resolving those threats.

The National Commission for Wildlife Conservation and Development has advanced plans for establishing botanic gardens. Some seed funding has been obtained for establishing a botanic garden in Riyadh through a programme established by Botanic Gardens Conservation International (BGCI), based in the United Kingdom.

However, other organisations, especially municipalities, urgently need to become involved in developing botanic gardens and other *ex-situ* conservation initiatives. Municipalities are spread throughout Saudi Arabia. More importantly, through being in direct contact with the public, they are in touch with the needs and aspirations of citizens and can easily implement education and awareness programmes. Consequently, the municipal authorities in the Kingdom need to play a much more active role in meeting the Kingdom's obligations to implementing the Convention on Biological Diversity. Establishing effective, modern, well funded and managed botanic gardens is an excellent place for the municipalities to start with such activities.

6.4 Article 10: Sustainable use of components of biological diversity

Use of all natural renewable resources needs to be sustainable. To this end, all organisations responsible for regulating and managing natural resources must ensure that their operations do not compromise or reduce biological diversity. Since his involves all elements of society the numbers of actions that need to be taken is large and diverse and cannot be described completely in this document. However, the following brief listing presents an overview of areas in which actions are needed.

Agriculture

Intensive and extensive agriculture need to be reviewed and modified in light of how sustainably they use resources and their impacts on biodiversity. Education, coupled with incentives for maintaining biodiversity as well as penalties for causing a decline in diversity need to be developed and implemented throughout the agricultural sector.

Depletion of groundwater reserves for irrigation as well as increase in soil salinity due to poor irrigation techniques and management cannot continue. Apart from the waste of water, alteration in species composition and loss of diversity are unsustainable in the long term. Water-conserving strategies (including restoration or modification of

traditional water harvesting techniques and the use of plants that use little water) need to be restored or modernised and applied. Terrace agriculture is one very effective means of concentrating productivity by harvesting water resources collected over a wide area.

Desert rangelands require widespread and concerted action if the current state is to be redressed. Carrying capacity must be determined, difficult as this is in practice. Grazing management protocols that are based on carrying capacity must be established and effectively enforced (whether by imposition of penalties or use of incentives and/or market forces) so that the rangeland vegetation is restored to its previous levels of diversity. It is also imperative that adequate monitoring is carried out on a regular basis and that the results of such monitoring are widely disseminated.

Landraces of crops and local breeds of animals need to be identified and maintained. This will involve some or all of the following measures:

- Institute and/or upgrade collection of seed of landraces.
- Protect local varieties from being displaced by imported varieties. This need subsidisation or other incentive/protective measures to support people who are farming with local breeds of animals or varieties of plants.
- Establish special protected areas, including areas where only traditional forms of land use are permitted.
- Control the export of local breeds and varieties. (NOTE this is also a form of regulation of access to genetic material).

Marine biodiversity and fisheries

As with agricultural resources, sustainable use of marine resources is dependent on prevention of activities that degrade the environment and limiting off-take so that the resource is not depleted below its threshold of recovery. Consequently, the following are needed to ensure sustainability of use:

- Apply legislation that regulates fishing in marine and coastal waters.
- Establish and/or support adequate facilities for research and monitoring.
- Discourage intensive fishing activities and closely monitor those that are essential to national well-being.
- Propagate marine species and promote farming of commercial species.
- Reduce damage to breeding habitats and refuges such as mangrove swamps, coral reefs and seagrass beds.
- Control pollution of all kinds.
- Limit dredging and landfilling.

Hunting and Falconry

Despite the manifest negative impacts of uncontrolled, excessive hunting on biodiversity, regulated hunting will not be detrimental, and in some instances may even improve the genetic composition of prey species. At the very least, it mobilises and educates a segment of society that is otherwise disinterested in or ignorant of the needs for conservation of biodiversity. In recognition of this, the government of Kingdom of Saudi Arabia is currently considering mechanisms to allow hunting of certain species in defined areas during limited hunting seasons under closely controlled conditions. Suitable legislation, coupled with education, enforcement and monitoring will ensure that hunting can be sustainable and contribute to maintenance of biodiversity in the Kingdom.

In the same way that legislation is being prepared to regulate other forms of hunting and the means used in the hunt, Saudi Arabia is developing regulations and

guidelines, in accordance with CITES regulations, to ensure that any capture of wild falcon is not detrimental to the species. Given the fact that the practise of capturing young falcons on migration, using them for falconry for the hunting season and then releasing them back to the wild has persisted in the Middle East for around 4,000 years without reducing the populations of the Saker Falcon, there is every reason to suppose that sensible regulation can ensure that this continues. In this way, falconry will remain a sustainable "use" of resources.

6.5 Article 11: Incentive measures

[No information has been provided on incentive measures that may be in place in the Kingdom]

6.6 Article 12: Research and training

Biodiversity research is primarily the responsibility of the eight universities, the King Abdulaziz City for Science and Technology, the National Commission for Wildlife Conservation and Development and the Presidency for Meteorology and the Environment. In addition to these organisations, the Ministry of Agriculture and the Ministry of Forestry and Water carry out research programmes that provide, at least indirectly, information on biodiversity.

Of special importance are the regional research institutions (The Arab Centre for the Studies of Arid Zones and Dry Lands – ASAD- The Arab Organisation for Agricultural Development – AOAD – International Centre for Agricultural Research in Dry Areas – ICARDA – the International Plant genetic Resources Institute – IPGRI) that are involved in conservation of agricultural biodiversity. Although these are based in other countries, Saudi Arabia is a member of them and therefore shares in the information gained.

Training in biodiversity conservation is provided by universities that have appropriate curriculum programmes and the Training Centre for Conservation of Natural Resources that is run by the National Commission for Wildlife Conservation and Development in collaboration with UNDP. In this Centre, a range of courses for women, educators, specialist conservationists and rangers from Saudi Arabia and neighbouring countries are delivered.

In the past four years, PME has trained two of its senior staff in Japan in the field of "Biodiversity Information Systems". In addition, other staff members have been trained in marine ecosystems in co-operation with JICA. These and similar activities are aimed at increasing they capacity of PME in the field of natural resources and their conservation.

6.7 Article 13: Public education and awareness

Education is generally restricted to students and scholars following formal curricula, whereas awareness programmes usually focus on people outside the formal education structures. Both are central to implementation of the provisions of the Convention on Biological Diversity.

Schools throughout the Kingdom teach subjects such as biology, botany, zoology or the environment that underpin biodiversity. However, few adequately cover conservation of biodiversity, causes of its decline or the harmful consequence of loss of

biodiversity to humans. Similarly, although there are eight universities in Saudi Arabia, only a few have specific programmes that directly address biodiversity issues. There is therefore clear need to develop curricula at all levels of the education system and also to upgrade teachers at schools so that they are able to teach these curricula.

The media are crucial to development of awareness in the populace at large. Increasingly, the public media in Saudi Arabia devotes time and space to environmental issues and there is excellent co-operation between the media and government sectors in bringing about an improved level of awareness of Saudi Arabian biodiversity issues. Production of the popular wildlife journal *Al-Wudaihi*, frequent television and radio programmes and newspaper articles have effectively developed public awareness within the Kingdom and the region.

As a means of raising awareness and to contribute to greening of the country, the Ministry of Agriculture provides tree seedlings to the public for planting during tree week.

The Presidency for Meteorology and the Environment published the first volume of "Flowers of Saudi Arabia" and initially published the "Fauna of Saudi Arabia" series in collaboration with the Natural History Museum of Basel, Switzerland. The National Commission for Wildlife Conservation and Development published the second, revised edition of the "Flowers of Saudi Arabia" in 2003. In 2003, King Abdulaziz City for Science and Technology took over publication of the "Fauna of Saudi Arabia", now re-named "Fauna of Arabia". The Ministry of Agriculture published the comprehensive "Vegetation of Saudi Arabia".

Communication within and between specialist communities is equally important as developing awareness amongst the public at large. All the organisation involved in biodiversity issues regularly organise conferences, meetings and specialist workshops on matters of topical importance (such as coral bleaching), development of conservation strategy (such as the workshops on plant conservation strategies for the Arabian Peninsula) and means of achieving long-term sustainable use of resources. Staff members of the organisations actively publish in specialist journals as well as producing popular articles in Arabic and English on environmental and biodiversity issues.

6.8 Article 14: Impact assessment

Impact assessment is a key element of a nation's programme to implement the Convention on Biological Diversity. Following the Gulf Co-operation Council (GCC) Heads of State decision in 1984 making EIAs obligatory, The Presidency for Meteorology and the Environment established an EIA department. Formal assessment of environmental impacts of development activities (including pollution) is the responsibility of the Presidency for Meteorology and the Environment. The Environmental Standards produced and published by PME provide the guidelines for ambient water quality standards with the aim of protecting the marine environment.

In addition to the Presidency for Meteorology and the Environment, technical staff members of the Ministry of Agriculture conduct studies on the negative effects on the environment caused by construction projects or any development. Also, it contributes in setting the bases and specific control regulations to conserve and protect the environment.

Conservation activities, whether inside or outside protected areas, have impacts on biodiversity and like activities associated with development, these impacts must be assessed. The National Commission for Wildlife Conservation and Development, through its monitoring programmes, assesses impact of management and other activities

in protected areas. Similarly, the Ministry of Agriculture is responsible for assessing impacts of all agricultural activities on biodiversity as well as the impacts of use of marine resources.

6.9 Article 15: Access to genetic resources

Article 15 of the Convention affirms the rights of states over their genetic resources. Hence, the power and consequent authority to establish rules of access to genetic resources in Saudi Arabia is subject to (and therefore requires) national legislation.

The biogeographic situation of Saudi Arabia in the Arabian Peninsula means that genetic resources do not follow national boundaries. Consequently, a regional approach and adoption of common rules and regulations would be highly advantageous.

Notwithstanding the desirability of ultimately developing a regional approach, there is an urgent need for the Kingdom to:

- Develop a policy and determine access to genetic resources
- Recognise the rights of indigenous communities to genetic resources under their control or within their areas of influence.
- Co-operate with other states in the region in developing common or at least complementary policies and regulations.
- Promote reciprocity with other regional states.

6.10 Article 16: Access to and transfer of technology

No material is available on access to and transfer of technology. This is mainly the responsibility of King Abdulaziz City for Science and Technology and the Ministry of Agriculture.

6.11 Article 17: Exchange of information

No specific material in addition to that mentioned elsewhere in this report is available.

6.12 Article 18: Technical and Scientific co-operation

Organisations in the Kingdom co-operate in many spheres, with many organisations at all levels from local to international and constantly on a wide range of biodiversity-related issues, as shown in a number of previous sections of this report. The following list, while from exhaustive, provides some indication of the technical and scientific co-operation that is maintained.

- Organisations responsible for implementing international conservation treaties such as the UNEP Convention on Biological Diversity, the Convention on International Trade in Endangered Species (CITES), Convention on Migratory Species (the Bonn Convention), UNESCO World Heritage Convention, Convention on Combating Desertification, The Cartagena Protocol and many others.
- Direct involvement in the IUCN, The World Conservation Union. Amongst other activities, this included hosting the Protected Areas Thematic Centre, which serves as a communication centre and provides mechanisms for developing conservation initiatives throughout West and Central Asia, the Middle East and North Africa. Saudi Arabia is also closely involved in other initiatives of IUCN

in the regions, such as environmental law, water and development of regional terrestrial conservation strategies

- Playing an active role in marine research and information-sharing through active participation in organisations such as Regional Agreement on the Protection of the Marine Environment (ROPME) and the Regional Agreement on the Protection of the Marine Environment of the Red Sea and Gulf of Aden (PERSGA) amongst others.

6.13 Article 19: Handling of biotechnology and distribution of the benefits

King Abdulaziz City for Science and Technology is the primary organisation responsible for implementing the provisions of this article in the Kingdom. No details of activities are available at this time.

Chapter 7. Partners

In order to conserve biodiversity and use resources sustainably, collaboration, co-operation and regular interaction is needed amongst all stakeholders. The following lists indicate the government ministries, committees, parastatal organisations and non-governmental organisations that interact on biodiversity matters.

Government Ministries and Commissions

National Commission for Wildlife Conservation and Development (NCWCD)
Presidency for Meteorology and the Environment (PME)
Ministry of Agriculture
King Abdulaziz City for Science and Technology (KACST)
Ministry of Planning
Ministry of Electricity and Water
The High Commission for Tourism
Ministry of Interior (Ministry of Local Administration)
Ministry of Defense and Aviation / Military Survey
Ministry of Municipalities and Rural Affairs
Ministry of Industry and Electricity
Ministry of Health
Ministry of Information
Ministry of Petroleum and Minerals
Ministry of Finance and National Economy
Ministry of Higher Education
Ministry of Education
General Presidency of Education for Girls

Government Committees on the Environment

Ministerial Environment Committee
Environmental Coordination Committee
National Committee for Biological Diversity

Non-Governmental Organisations

Saudi Biological Society - Riyadh
Saudi Environmental Society (SES) - Jeddah
Jeddah Ornithology Group (JOG) – Jeddah
Saudi Diving and Water Sport Club (SDWSC) - Jubail
Society of Advocates and Volunteers for the Environment (SAVE) – Dhahran

International Organisations

Botanic Gardens Conservation International (UK)
Birdlife International
IUCN, The World Conservation Union and its specialist Commissions
Japan International Co-operation Agency (JICA)
The Royal Botanic Gardens, Kew (UK)
The Zoological Society of London (ZSL)

Chapter 8. Schedule

In order for the National Biodiversity Strategy to be implemented, it is essential that action plans that incorporate clear and measurable targets, each with a specific schedule for completion, are developed. Since the National Biodiversity Strategy has only recently been completed, the action plans still need to be developed. Accordingly, the schedule for completion of actions has not yet been developed.

Notwithstanding this, there are a number of deadlines that have been set at international meetings, which Saudi Arabia needs to meet in order to fulfil its obligations as a signatory of international agreements. Two of the most important deadlines are 2006 and 2010; dates which have been identified by the CBD as being deadlines for actions to have been taken by signatory nations. It seems likely that 2006 will be a particularly important date, since this will show what progress has been made and will give clear indications of the work and rate of work that will be needed by all those organisations that are charged with ensuring the Kingdom meets its international obligations under the Convention on Biological Diversity.

Chapter 9. Financial Resources (Article 20).

At present, most of the funding for biodiversity-related activities comes from the state in the form of the budget allocations to ministries and agencies that are responsible for implementing the provisions of CBD.

However, in establishing the Saudi Wildlife Fund, the National Commission for Wildlife Conservation and Development has made a start in providing an independent financial base for conservation activities. The Saudi Wildlife Fund primarily obtains money from public donations although some income is generated from the sale of books, art works and similar sources. The funds are to be used for projects that directly improve the conservation of biodiversity.

Chapter 10. Monitoring and Evaluation

A number of organisations (NCWCD, PME, Ministry of Agriculture, Ministry of Electricity and Water) all have responsibilities for monitoring and evaluating the state of the environment in Saudi Arabia. PME, as the organisation charged with carrying out Ecological Impact Assessments is most directly responsible for monitoring impacts of development and pollution on biodiversity outside protected areas.

The National Commission for Wildlife Conservation and Development carries out regular monitoring of the state of biodiversity as well as consequence of management activities in all of the projected areas under its jurisdiction. Monitoring activities include:

- on-going tracking of movements of re-introduced populations of Arabian oryx and gazelles in the 'Uruq Bani Ma'arid and Mahazat As Sayd Protected Areas and houbara bustard in Mahazat As Sayd
- monthly or quarterly counts of animals in Mahazat As Sayd, 'Uruq Bani Ma'arid and the Ibex Reserve Protected Areas
- annual tagging, counts monitoring of breeding of turtles in the Gulf and Red Sea
- monthly or quarterly monitoring of rangeland condition in the protected areas where oryx, gazelles and houbara bustards have been re-introduced,
- monthly monitoring of small carnivores and their prey species in Saja/ Umm ar Rimth Protected Area
- annual monitoring of birds (especially vultures)
- Monitoring of gazelle populations in the Farasan Islands and in the Harrat al Harrah Protected Areas on an approximately biennial basis.

Evaluation of the status of all the protected areas is carried regularly through reports of the departments of the NCWCD and its research centres. Such evaluations are used in developing the annual work plans for each of the protected areas, the programmes of work for the research centres and for setting schedules and priorities for management and research activities in the protected areas.

Chapter 11. Sharing National Experience

Saudi Arabia actively collaborates with countries throughout the region. The Secretary General of NCWCD has served on numerous regional and international bodies. Equally importantly, other senior staff members are also deeply involved in such bodies, which ensures continuity and builds capacity in NCWCD. The Commission has been instrumental in starting regional initiatives such as clean-up actions following the Gulf War, the Arabian Plant Specialist Group and encouragement for developing regional Plant Conservation Strategies. Of special significance is NCWCD's initiative to develop a Gulf Environmental Fund that will help to finance conservation in all the Gulf States.

In order to increase exchange of information, the Commission has organised local, regional and international conferences, symposia and workshops, publishes *The Fauna of Arabia*, and has obtained funding to produce the *Flora of Arabia* in partnership with the Royal Botanic Gardens, Edinburgh. Staff members of the Commission and researchers at the Research Centres regularly attend scientific meetings where their work is presented to the scientific community as a whole.

As part of the on-going programme of collaboration and capacity building, NCWCD supports and manages the Thematic Centre for Protected Areas of the IUCN. This, and the other thematic centres of the WESCANA Region of IUCN serves as a clearing house for information, a focal point for research and development initiatives and organises workshops, training courses and conferences for the region.

Annexes

Supporting material for the First National Biodiversity Report for Saudi Arabia is presented in the following annexes

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Endangered Plant Taxa

(After Collenette 1998)

Summary by Families

Families	Genera	Species	Endemic	Endangered	Unnamed	Extinct
ACANTHACEAE	14	35	9	18	6	
AIZOACEAE	6	12		4		
ALLIACEAE	1	9	2	6	1	
ALOEACEAE	1	25	16	15	15	
AMARANTHACEAE	9	21		8		
AMARYLLIDACEAE	3	5				
ANACARDIACEAE	2	7	2	4	2	
ANAONACEAE	1	1		1		
APOCYNACEAE	7	7	1	2		
ARACEAE	1	1		1		
ARISTOLOCHIACEAE	1	1				
ASCLEPIADACEAE	30	71	21	35	8	3
ASPARAGACEAE	1	5	1	1	1	
ASPHODELACEAE	1	4	1		1	
BARBEYACEAE	1	1				
BORAGINACEAE	22	60	6	21	5	
BURSERACEAE	1	11	3	3	5	
CACTACEAE	1	2				
CAMPANULACEAE	3	9	3	6	3	
CAPPARACEAE	6	29	2	6		
CAPRIFOLIACEAE	1	1				
CARYOPHYLLACEAE	26	74	10	33	5	
CELASTRACEAE	1	6		3		
CERATOPHYLLACEAE	1	2				
CHENOPODIACEAE	22	68	1	7	1	
CISTACEAE	2	7		1		
COLCHICACEAE	1	3		1		
COMBRETACEAE	2	3		1		
COMMELINACEAE	3	9		2	1	
COMPOSITAE	89	218	26	43	21	
CONVOLVULACEAE	11	42	6	13		
CRASSULACEAE	4	16		4		
CRUCIFERAE	49	87	3	29	3	2
CUCURBITACEAE	8	17	1	1	1	
CUPRESSACEAE	1	2				
CYNOMORIACEAE	1	1				
CHPERACEAE	12	42	1	8		
DIPSACACEAE	2	10	3	6	4	

Summary by Families: continued

Families	Genera	Species	Endemic	Endangered	Unnamed	Extinct
DRACAENACEAE	2	3				
EBENACEAE	2	2		1		
ELATINACEAE	1	2		2		
EPHEDRACEAE	1	7		2		
ERICACEAE	1	1				
EUPHORBIACEAE	15	66	8	17	8	
FLACOURTIACEAE	1	1		1		
FRANKENIACEAE	1	2				
GENTIANACEAE	4	8	1	3	1	1
GERANIACEAE	4	27		6		1
GLOBULARIACEAE	1	1		1		
GRAMINEAE	101	261	2	18	1	1
HALORAGACEAE	1	1		1		
HYCINTHACEAE	5	12	4	6	3	1
HYDNORACEAE	1	1		1		
HYPERICACEAE	1	6	1	3		
IRIDACEAE	4	7		2		
IXIOLIRIACEAE	1	1		1		
JUNCACEAE	1	4				
LABIATAE	26	76	17	27	13	2
LAURACEAE	1	1				
LEGUMINOSAE	55	212	18	63	12	2
LEMNACEAE	1	1				
LILIACEAE	2	4		3		
LINACEAE	1	4		2		
LOGANIACEAE	2	3				
LORANTHACEAE	4	6	1	1		
LYTHRACEAE	4	5		2		
MALPIGHIACEAE	1	1		1		
MALVACEAE	11	37	4	19	4	
MELIACEAE	1	1				
MENISPERMACEAE	2	3		2		
MOLLUGINACEAE	6	8	1	1		

Summary by Families: continued

Families	Genera	Species	Endemic	Endangered	Unnamed	Extinct
MORACEAE	2	10		1		
MORINGACEAE	1	1				
MYRICACEAE	1	1		1		
MYRSINACEAE	2	2		1		
MYRTACEAE	2	2		2		
NEURADACEAE	1	1				
NYCTAGINACEAE	4	12	1	5		
OCHNACEAE	1	1		1		
OLEACEAE	2	3				
ONAGRACEAE	2	2		1		
ORCHIDACEAE	5	7		4		1
OROBANCHACEAE	2	16	2	6	3	
OXALIDACEAE	1	1				
PALMAE	2	4				
PANDANACEAE	1	1				
PAPAVERACEAE	6	15		5		
PASSIFLORACEAE	1	1				
PEDALIACEAE	2	2		1		
PITTOSPORACEAE	1	1		1		
PLANTAGINACEAE	1	14		3		
PLUMBAGINACEAE	2	6	1	3	1	
POLYGALACEAE	1	11	4	3	3	
POLYGONACEAE	8	22	2	3	1	2
PORTULACACEAE	2	6		2		
POTAMOGETONACEAE	1	5		3		
PRIMULACEAE	4	6	1	1		
PTERIDOPHYTES						
ACTINIOPTERIDACEAE	1	2				
ADIANTACEAE	6	8		1		
ASPLENIACEAE	1	4				
DRYOPTERIDACEAE	1	1		1		
EQUISETACEAE	1	1				
MARSILIACEAE	1	1		1		
OPHIOGLOSSACEAE	1	1				
PARKERIACEAE	1	1		1		
POLYPODIACEAE	1	1		1		
PSILOTACEAE	1	1		1		
PTERIDACEAE	2	3		1		

Summary by Families: continued

Families	Genera	Species	Endemic	Endangered	Unnamed	Extinct
PTERIDOPHYTES (cont.)						
SELAGINELLACEAE	1	2				
WOODSIACEAE	1	1		1		
RANUNCULACEAE	4	10	1	3		
RESEDACEAE	4	11	3	3		
RHAMNACEAE	4	12	1	4	1	
RHIZOPHORACEAE	1	1				
ROSACEAE	7	9	1	4		
RUBIACEAE	15	32	4	10	3	
RUPPIACEAE	1	1		1		
RUTACEAE	3	3				
SALICACEAE	1	2		1		
SALVADORACEAE	2	2				
SANTALACEAE	2	3		3		
SAPOTACEAE	3	4		3		
SAPINDACEAE	2	3		2		
SCROPHULARIACEAE	22	77	21	31	16	1
SOLANACEAE	7	33	7	12	7	
STERCULIACEAE	4	10	1	7	1	
TAMARICACEAE	2	7				1
THYMELACEAE	3	4				
TILIACEAE	3	13	1	3		
TYPHACEAE	1	2		1		
ULMACEAE	2	2		1		
UMBELLIFERAE	25	50	12	1		
URTICEAE	4	7	1	20	10	
VAHLIACEAE	1	1		1		
VALERIANACEAE	1	6	1	6	1	
VELLOZIACEAE	1	1		1		
VERBENACEAE	8	13		1		
VIOLACEAE	2	3		3		
VISCACEAE	1	3		2		
VITACEAE	3	6		1		
ZANNICHELLIACEAE	1	1		1		
ZYGOPHYLLACEAE	7	32	6	4	1	
142	**837**	**2243**	**246**	**656**	**176**	**21**

List of Saudi Arabian Mammals

Order Insectivora

Fam. Erinaceidae

Hemiechinus auritus
Paraechinus aethiopicus
Paraechinus hypomelas

Fam. Soricidae

Crocidura suaveolens
Suncus murinus

Order Chiroptera

Fam. Pteropodidae

Rousettus aegyptiacus
Eidolon helvum
Epomophorus labiatus

Fam. Rhinopomatidae

Rhinopoma microphyllum
Rhinopoma hardwickei

Fam. Emballonuridae

Taphozous perforatus
Taphozous nudiventris

Fam. Nycteridae

Nycteris thebaica

Fam. Rhinolophidae

Rhinolophus clivosus
Rhinolophus hipposideros

Fam. Hipposideridae

Hipposideros caffer
Hipposideros megalotis
Asellia tridens
Asellia patrizii

Fam. Vespertilionidae

Myotis emarginatus
Pipistrellus kuhli
Pipistrellus bodenheimeri
Eptesicus nasutus
Eptesicus bottae
Otonycteris hemprichi
Nycticeinops schlieffeni
Scotophilus leucogaster
Barbastella leucomelas
Plecotus austriacus
Miniopterus schreibersi

Fam. Molossidae

Chaerephon nigeriae
Chaerephon pumila
Mops midas
Tadarida aegyptiaca

Tadarida teniotis

Order Primates

Fam. Cercopithecidae

Papio hamadryas

Order Lagomorpha

Fam. Leporidae

Lepus capensis

Order Rodentia

Fam. Cricetidae

Gerbillus poecilops
Gerbillus nanus
Gerbillus dasyurus
Gerbillus henleyi
Gerbillus cheesmani
Sekeetamys calurus
Meriones rex
Meriones libycus
Meriones crassus
Psammomys obesus

Fam. Muridae

Rattus rattus
R. norvegicus
Myomys yemeni [=Praomys fumatus]
Mus musculus
Acomys russatus
Acomys dimidiatus
Bandicota bengalensis
Nesokia indica

Fam. Muscardinidae

Eliomys melanurus

Fam. Dipodidae

Jaculus jaculus
Allactaga euphratica

Fam. Hystricidae

Hystrix indica

Order Carnivora

Fam. Canidae

Canis lupus
Canis aureus
Vulpes vulpes
Vulpes rueppelli
Vulpes cana

Fam. Mustelidae

Mellivora capensis
Vormela peragusna

Fam. Viverridae

Genetta felina

Fam. Herpestidae

Herpestes edwardsi

Ichneumia albicauda

Fam. Hyaenidae

Hyaena hyaena

Fam. Felidae

Felis silvestris

Felis margarita

Felis leo persica **(extinct)**

Caracal caracal

Panthera pardus

Acinonyx jubatus venaticus **(extinct)**

Order Hyracoidea

Fam. Procaviidae

Procavia capensis

Order Artiodactyla

Fam. Bovidae

Oryx leucoryx

Gazella subgutturosa

Gazella gazella

Gazella saudia **(extinct)**

Capra ibex

Order Perissodactyla

Fam. Eqidae

Equus hemionus hemippus **(extinct)**

Order Sirenia

Fam. Dugongidae

Dugong dugon

Order Cetacea

Fam. Delphinidae

Neophocaena phocaenoides

Tursiops truncates

Delphinus delphis

Sousa chinansis

Stenella longirostris

Pseudorca crassidens

Orcinus orca

Fam. Balaenopteridae

Balaenoptera edeni

Balaenoptera musculus

Balaenoptera physalus

Balaenoptera acutorostrata

Balaenoptera borealis

List of Saudi Arabian Birds

Fam. Struthionidae – Ostrich
Struthio camelus **(Extinct)**

Fam. Podicipedidae - Grebes
Tachybaptus ruficollis
Podiceps cristatus
Podiceps grisegena
Podceps nigricollis

Fam. Hydrobatidae – Storm petrels
Oceanites oceanicus

Fam. Phaethontidae - Tropicbirds
Phaethon aethereus

Fam. Sulidae – Boobies and Gannets
Sula leucogaster

Fam. Phalacrocoracidae - Cormorants
Phalacrocorax carbo
Phalacrocorax nigrogularis

Fam. Pelecanidae - Pelicans
Pelicanus onocotalus
Pelicanus rufescens

Fam. Ardeidae - Herons and allies
Botaurus stellaris
Ixobrychus minutus
Nycticorax nycticorax
Butorides striatus
Ardeola ralloides
Bubulcus ibis
Egretta gularis
Egretta garzetta
Egretta alba
Ardea cinerea
Ardea purpurea
Ardea goliath

Fam. Scopidae – Hammerkop
Scopus umbretta

Fam. Ciconiidae - Storks

Ciconia nigra
Ciconia abdimii
Ciconia ciconia

Fam. Threskiornithidae – Ibises and Spoonbills

Plegadis falcinellus
Geronticus eremita
Threskiornis aethiopicus
Platalea leucorodia

Fam. Phoenicopteridae - Flamingoes

Phoenicopterus rubber
Phoenicopterus minor

Fam. Anatidae – Swans, Geese and Ducks

Anser albifros
Anser anser
Tadorna ferruginea
Tadorna tadorna
Nettapus coromandelianus
Anas penelope
Anas strepera
Anas crecca
Anas platyrhynchos
Anas acuta
Anas querquedula
Anas clypeata
Marmaronetta angustirostris
Netta rufina
Aythya ferina
Athyna nyroca
Athyna fuligula
Mergus albellus

Fam. Accipitridae – Hawks, Eagles, vultures and allies

Pernis apivorus
Milvus migrans
Haliaeetus leucoryphus
Gypaetus barbatus
Neophron percnopterus
Gyps fulvus
Gyps rueppellii
Torgos tracheliotus
Aegypius monachus
Circaetus gallicus
Terathopius ecaudatus
Circus aeruginosus
Circus cyaneus

Circus macrourus
Circus pygargus
Melieerax metabates
Micronisus gabar
Accipiter gentiles
Accipiter nisus
Accipiter brevipes
Accipiter badius
Buteo buteo
Buteo rufinus
Buteo lagopus
Aquila clanga
Aquila rapax
Aquila nipalensis
Aquila heliaca
Aquila chrysaetos
Aquila verreauxii
Hieraaetus pennatus
Hieraaetus fasciatus

Fam. Pandionidae - osprey
Pandion haliaetus

Fam. Falconidae - Falcons
Falcon naumanni
Falco tinnunculus
Falco amurensis
Falco columbarius
Falco subbuteo
Falco concolor
Falco biarmicus
Falco cherrug
Falco peregrinus
Falco pelegrinoides

Fam. Phasianidae - Gamebirds
Alectoris chukar
Alectoris philbyi
Aleictoris melanocephala
Ammoperdix heyi
Francolinus francolinus
Coturnix coturnix
Coturnis delegorguei

Fam. Numididae – Guineafowl
Numida meleagris

Fam. Turnicidae – Button Quails
Turnix sylvatica

Fam. Rallidae - Rails and Crakes

Rallus aquaticus
Porzana porzona
Porzona parva
Porzona pusilla
Crex crex
Gallinula chloropus
Fulica atra

Fam. Gruidae - Cranes

Grus grus
Anthropoides vigro

Fam. Otidiae - Bustards

Chlamydotis undulata
Ardeotis arabs
Otis tarda

Fam. Jacanidae - Jacanas

Hydrophasianus chriurgus

Fam. Haematopodidae - Oystercatchers

Haematopus ostralegus

Fam. Recurvirostridae – Stilts and Avocets

Himantopus himantopus
Recurvirostra avosetta

Fam. Dromadidae – Crab Plover

Dromas ardeola

Fam. Burhinidae - Stone curlews

Burhinus oedicnemus
Burhinus capensis

Fam. Glareolidae - Coursers and Pratincoles

Cursorius cursor
Glareola pratincola
Glareola nordmanni

Fam. Charadriidae - Plovers

Charadrius dubius
Charadrius hiaticula
Charadrius alexandrius
Charadrius mongolus
Charadrius leschenaultia
Charadrius asiaticus
Charadrius morinellus

Pluvialis dominica
Pluvialis fulva
Pulvialis apricaria
Pluvialis squatarola
Hoplopterus spinosus
Haplopterus indicus
Chettusia gregaria
Chettusia leucura
Vanellus vanellus

Fam. Scolopacidae - Sandpipers, Snipes, Phalaropes and allies

Calidris alba
Calidris minuta
Calidris temminckii
Calidris subminuta
Calidris melanotus
Calidris ferruginea
Calidris alpina
Limicola falcinellus
Tryngites subruficollis
Philomachus pugnax
Lymnocryptes minimus
Gallinago gallinago
Gallinago media
Gallinago solitaria
Scolopax rusticola
Limosa limosa
Limosa lapponica
Numenius phaeopus
Numenius arquata
Tringa erythropus
Tringa tetanus
Tringa stagnatilis
Tringa nebularia
Tringa ochropus
Tringa glareola
Xenus cinereus
Actitis hypoleucos
Arenaria interpres
Phalaropus lobatus
Phalaropus fulicarius

Fam. Stercorariidae - Skuas

Stercorarius pomarius
Stercorarius parasiticus

Fam. Laridae - Gulls

Larus hemprichii
Larus leucophthalmus

Larus icchthyaetus
Larus melanocephalus
Larus minutus
Larus ridibundus
Larus genei
Larus canus
Larus fuscus
Larus argentatus

Fam. Sternidae - Terns

Gelocheliodon niloticcca
Sterna caspia
Sterna bergii
Sterna bengalensis
Sterna sandvicensis
Sterna hirundo
Sterna repressa
Sterna paradisaea
Sterna repressa
Sterna anaethetus
Sterna albifrons
Sterna saundersi
Chlidonias hybridus
Chlidonias niger
Chlidonias leucopterus
Anous stolidus

Fam. Pteroclidae - Sandgrouse

Pterocles lichtensteinii
Pterocles coronatus
Pterocles senegallus
Pterocles exustus
Pterocles orientalis
Pterocles alchata

Fam. Columbidae - Pigeons and Doves

Columba livia
Streptopelia roseogrisea
Streptopelia decaocto
Streptopelia semitorquata
Streptopelia turtur
Sriptopelia lugens
Striptopelia orientalis
Steptopelia senegalensis
Oena capensis
Treron waalia

Fam. Psittacidae - Parrots

Psittacula krameri

Fam. Cuculidae - Cuckoos

Clamator jacobinus
Clamator glandarius
Chrysococcyx klass
Cuculus canorus
Centropus superciliosus

Fam. Tytonidae - Barns owls

Tyto alba

Fam. Strigidae - Owls

Otus brucei
Otus scops
Otus senegalensis
Bubo bubo
Bubo africanus
Athene noctua
Strix butleri
Asio otus
Asio flammeus

Fam. Caprimulgidae - Nightjars

Caprimulgus inornatus
Caprimulgus nubicus
Caprimulgus europaeus
Caprimulgus aegyptius

Fam. Apopidae - Swifts

Apus apus
Apus pallidus
Apus melba
Apus affinis
Cypsiurus parvus

Fam. Alcedinidae - Kingfishers

Halcyon smyrnenis
Halcyon leucocephala
Alcedo atthis
Ceryle rudis

Fam. Meropidae - Bee-eaters

Merops albicollis
Merops orientalis
Merops superciliosus
Merops apiaster

Fam. Coraciidae - Rollers

Coracius garrulous
Coracias abyssinicus

Coracius benghalensis

Fam. Upupidae - hoopoes

Upupa epops

Fam. Bucerotidae – Hornbills

Tockus nasutus

Fam. Picidae - Wrynecks

Jynx torquilla
Dendrocopos dorae

Order Passeriformes

Fam. Alaudidae - Larks

Mirafa dantillans
Eremopterix nigriceps
Eremaaluda dunni
Ammomanes cincturus
Ammomanes deserti
Alaemon alaudipes
Ramphocoris clotbey
Melanocorypha sp.
Melanocorypha bimaculata
Calandrella cinerea
Calanderalla brachydactyla
Calanderella rufescens
Calerida cristata
Lullula arborea
Alauda arvensis
Eremophila bilopha

Fam. Hirundinidae - Swallows and Martins

Riparia paludicola
Ripari riparia
Ptyonoprogne fuligula
Ptyonoprogne rupestris
Hirundo rustica
Hirundo daurica
Delichon urbica

Fam. Motacillidae - Pipits and Wagtails

Anthus novaeseelandiae
Anthus campestris
Anthus similes
Anthus trivialis
Anthus pratensis
Anthus cervinus
Anthus spinoletta

Motacilla flava
Motacilla citreola
Motacilla cinerae
Motacilla alba

Fam. Pycnonotidae - Bulbuls
Pycnonotus leucogenys
Pycnonotus xanthopygos
Pycnonotus cafer

Fam. Bombycillidae - Hypocolius
Hypocolius ampelinus

Fam. Turdidae - Chats and Thrushes
Cercotrichas galactotes
Cecotichas podobe
Erithacus rubecula
Luscinia luscinia
Luscinia megarhynchos
Luscinia svecica
Irania gutturalis
Phoenicurus ochruros
Phoenicurus phoenicurus
Phoenicurus erythronotus
Cercomela melanura
Saxicola rubetra
Saxicola torquata
Oenanthe isabillina
Oenanthe bottae
Oenanthe oenanthe
Oenanthe pleschanka
Oenanthe hispanica
Oenanthe deserti
Oenanthe finschii
Oenanthe moesta
Oenenthe xanthoprymna
Oenanthe lugens
Oenanthe monacha
Oenanthe leucopyga
Monticola rufocinerea
Monticola saxatilis
Monticola solitarius
Turdus menachensis
Turdus torquatus
Turdus merula
Turdus ruficollis
Turdus pilaris
Turdus philomelos
Turdus iliacus

Turdus viscivorus

Fam. Sylviidae - Warblers

Parisoma buryi
Prinia gracilis
Scotocerca inquieta
Locustella naevia
Locustella fluviatilis
Locustella luscinoides
Acrocephalus melanopogon
Acrocephalus schoenobaenus
Acrocephalus palustris
Acrocephalus scripaceus
Acrocephalus stentoreus
Acrocephalus arundinaceus
Hippolais pallida
Hippolais caligata
Hippolais languida
Hippolais olivetorum
Hippolais icterina
Sylvia cantillans
Sylvia rueppelli
Sylvia mystacea
Sylvia nana
Sylvia leucomelaena
Sylvia hortensis
Sylvia nisoria
Sylvia curruca
Sylvia communis
Sylvia communissylvia borin
Sylvia atricapilla
Phylloscopus umbrovirens
Phylloscopus borealis
Phylloscopus inornatus
Phylloscopus bonelli
Phylloscopus sibilatrix
Phylloscopus collybita
phylloscopus trochilus

Fam. Muscicapidae - Flycatchers

Muscicapa striata
Muscicapa gambagae
Ficedula parva
Ficedula semitorquata
Ficedula albicollis
Terpsiphone viridis

Fam. Timaliidae - Babbler

Turdoides squamiceps

Fam. Remizidae - Penduline Tits
Remiz pendulinus

Fam. Nectariniidae – Sunbirds
Anthreptes metallicus
Nectarina habessinica
Nectarina osea

Fam. Zosteropidae – White-eyes
Zosterops abyssinica

Fam. Oriolidae - Orioles
Oriolus oriolus

Fam. Laniidae - Shrikes
Tchagra senegala
Lanius isabellinus
Lanius collurio
Lanius minor
Lanius excubitor
Lanius senator
Lanius nubicus

Fam. Corvidae - Crows, Magpies and Allies
Pica pica
Corvus splendens
Corvus ruficollis
Corvus rhipidurus

Fam. Sturnidae - Starlings
Onychognathus tristramii
Cinnyricinclus leucogaster
Sturnus vulgaris
Sturnus roseus
Acridotheres tristis
Acridotheres ginginianus

Fam. Passeridae - Sparrows
Passer domesticus
Passer hispaniolensis
Passer euchlorus
Petronia brachydactyla
Petronia petronia

Fam. Ploceidae - Weavers
Ploceus galbula
Ploceus philippinus
Ploceus manyar

Fam. Estrildidiae - Waxbills and Allies

Estrilda rufibarba
Euodice malabarica
Euodice cantans
Lonchura malacca
Amandava amabdava

Fam. Fringillidae - Finches

Fringilla coelebs
Serinus rothschilidi
Serinus menachensis
Rhynchostruthus socotranus
Carduelis chloris
Carduelis carduelis
Carduelis spinus
Carduelis cannabina
Carduelis yemenensis
Rhodospiza obsolete
Bucanetes githagineus
Carpodacus erythrinus
Carpodacus synoicus

Fam. Emberizidae - Buntings

Emberiza leucocephalos
Emberiza striolata
Emberiza tahapisi
Emberiza cineracea
Emberiza hortulana
Emberiza caesia
Emberiza pusilla
Emberiza aureola
Emberiza schoeniclus
Emberiza bruniceps
Emberiza melanocephala
Miliaria calandra

Total 432 species in 67 families

List of Saudi Arabian Reptiles

Order Squamata

A. Lizards

Family Agamidae

Agama adramitana
Agama blanfordi
Agama flavimaculata
Agama pallida
Agama sinaita
Agama stellio
Agama yemenensis
Phrynocephalus arabicus
Phrynocephalus maculates
Uromasty aegyptia aegyptia
U. ae. microlepis
Uromastyx ornata ornate
U. o. philbyi

Family Camaeleonidae

Chamaeleo calyptratus
Chamaeleo chamaeleon

Family Gekkonidae

Bunopus tuberculatus
Cyrtodactylus scaber
Hemidactylus flaviviridis
Hemidactylus persicus
Hemidactylus turcicus
Hemidactylus yerburii
Pristurus flavipunctatus
Pristurus gasperetti
Pristurus popovi
Pristurus rupestris
Ptyodactylus hasselquistii
Stenodactylus arabicus
Stenodactylus doriae
Stenodactylus grandiceps
Stenodactylus khobarensis
Stenodactylus slevini
Stenodactylus yemenensis
Tropiocolotes steudneri

Family Lacertidae

Acanthodactylus boskianus
Acanthodactylus gongrorhynchatus
Acanthodactylus grandis
Acanthdactylus hassi

Acanthodactylus opheodurus
Acanthodactylus robustus
Acanthodactylus schmidti
Acanthodactylus scutellatus
Acanthodactylus tilburyi
Mesalina adramitana
Mesalina brevirostris
Meselina guttulata
Meselina plivieri
Meselina sp.
Meselina sp.
Philochortus neumanni

Family Scincidae
Ablepharus pannonics
Chalcides levitoni
Chalcides ocellatus
Eumeces schneideri
Eumeces taeniolatus
Mabuya aurata
Mabuya brevicollis
Scincus hemprichii
Scincus mitranus
Scincus scincus

Family Varanidae
Varanus griseus
Varanus yemenensis

Family Trogonophidae
Diplometopon zarudnyi

B. Snakes
Family Typhlopidae
Ramphotyphlops braminus

Family Leptotyphlopidae
Leptotyphlops macrorhynchus
Leptotyphlops nursii

Family Boidae
Eryx jayarkari
Eryx jaculus

Family Colubridae
Coluber ventromaculatus
Coluber rhodorachis
Coluber elegantissimus
Coluber manseri

Dasypeltis scabra
Eirenis coronella fennelli
Lytorhynchus diadema
Lytorhynchus gaspperetti
Malpolon moilensis
Natrix tessellate
Psammophis schokari
Spalerosophis diadema
Telescopus dhara

Family Atractaspididae
Atractaspis microlepidota

Family Elapidae
Naja haje
Walterinnesia aegyptia

Family Hydrophiidae
Enhydrina schistose
Hydrophis cyanocinctus
Hydrophis lapemoides
Hydrophis ornatus
Hydrophis spiralis
Lapemis curtus
Microcephalophis gracilis
Pelamis platurus
Praescutata viperina

Family Viperidae
Bitis arietans
Cerastes cerastes
Echis pyramidum
Echis coloratus
Pseudocerastes persicus

Order Testodines

Turtles
Family Emydidae
Mauremys caspica

Family Testudinidae
Testuda graeca
Geochelone sulcata?

Familt Cheloniidae
Chelonia mydas
Eretmochelys imbricate
Caretta caretta

Lepidochelys olivacea?

Family Dermochelyidae
Dermochelys coriacea?

Family Pelomedusidae
Pelomedusa subrufa

List of Saudi Arabian Amphibians

Order Anura

Family Bufonidae
Bufo tihamicus
Bufo viridis
Bufo dhufarensis
Bufo arabicus

Family Hylidae
Hyla savignyi

Family Ranidae
Euphlyctis ehrenbergii
Rana ridibunda

List of Taxa of High Conservation Priority

The following are the key taxa that have been included in the updated Syatem Plan for Saudi Arabia (Llewellyn *in prep*). Species were selected by applying the following set of criteria and the numbers in the species lists refer to which criterion or criteria qualify particular organisms for inclusion as "key taxa".

1). Genera, species, or subspecies that are ***critically endangered, endangered,*** or ***vulnerable*** (globally, regionally, or nationally); taxa which are locally extinct in the wild may be included, provided that there is an NCWCD policy to reintroduce them.
2). Genera, species, or subspecies that are ***endemic*** to the Arabian Peninsula, the Red Sea, or the Gulf.
3). Genera, species, or subspecies of which the conservation of populations within Saudi Arabia is essential to the conservation of the taxon (e.g. ***near-endemics*** and ***migrants*** for which Saudi Arabia represents a critical range).
4). ***Relict*** genera, species, or subspecies that are of global, regional, or national significance.
5). Genera or species of special ***ecological importance*** (i.e. fulfilling a vitally important function in an ecosystem such as providing a key habitat for other species, serving as indicator species, etc).
6). Genera of species of significant ***economic importance***.
7). Genera or species that serve a ***"flagship" function*** (i.e. high-profile species of cultural value, the protection of which will also protect large numbers of other species that share their habitats).

PLANTS, ALGAE, FUNGI, and LICHENS

The list of key plant species is based on existing information available to the NCWCD. However, more research needs to be done; new species from Saudi Arabia are being discovered every year, and many of these new species are endemics. Already, some 246 endemic species have been listed by Mrs. Sheila Collenette, and many of these are rare, vulnerable, or threatened, such as a number of succulent asclepiads and aloes, or the endemic genus *Dolichorhynchus.*

Similarly many of the relict plants of Mediterranean, Eurasian, or African origin such as the almond *Prunus korshinskyii*, the tulip *Tulipa biflora*, or the heather *Erica arborea*, survive in small populations in restricted localities, which makes them especially vulnerable. During long-term climatic fluctuations, such relict populations may play a vitally important role in the conservation and re-dispersal of genetic material, as well as the evolution of new forms.

Species of special ecological importance include the brown algae, seagrasses, mangroves, and junipers, which constitute the habitats of exceptionally large numbers of other species. Species of actual or potential economic importance such as the truffles, some of the aloes, *Maerua crassifolia*, *Artemisia judaica*, the wild barleys, the wild olive, and feral date palms may be endangered by overharvesting, but at the same time represent

opportunities for conservation through sustainable use. Some of these are medicinal plants, or wild crop strains of potential agricultural importance.

Several of the plants mentioned above could serve as flagship species. So are spectacular species such as the dragon tree *Dracaena ombet,* the "desert rose" *Adenium obesum,* the one apparently native population of oleander in the Kingdom, the ban tree *Moringa peregrina,* and *Mimusops laurifolia,* the largest of Saudi Arabia's trees. A good example of a flagship species is the lote tree *Ziziphus spina-Christi*, with its many uses in Arabian culture from shade to fruit and forage, soap, timber, and honey production, its recurrence in the Qur'anic imagery of paradise, and the teachings of the Prophet Muhammad, upon whom be blessings and peace, condemning its destruction.

SCIENTIFIC NAME	CRITERIA
Fungi	
Podaxis pistillaris	
Terfezia spp.	(6)
Tirmania spp.	(6)
Algae	
Cytoseiraceae	(5)
Sargassaceae	(5)
Lichens	
Non-Vascular Plants	
Mosses:	
Pleopeltis macrocarpa	
Liverworts:	
Vascular Plants	
Acanthaceae	
Barleria proxima Lindau	(1)
Echbolium gymnostachyum (Nees) Milne-Redh.	(1)
Ruellia grandiflora (Forssk.) Blatter	(1)
Acrostichaceae (=Psilotaceae)	
Acrostichum aureum L.	(1,4)
Actiniopteridaceae	
Actiniopteris radiata (Sw.) Link	(1,5)
Adiantaceae	

Adiantum capillus-veneris L. (1,5,7)

Alliaceae

Allium asirense B. Mathew (1,2)

Aloeaceae

Aloe x abhaica Lavr. & Collen. ined. (1,2)
Aloe armatissima (1,2)
Aloe brunneodentata (1,2)
Aloe cephalophora Lavr. & Collen. ined. (1,2)
Aloe fleurentinorum Lavr. (1)
Aloe parvicapsula (1,2)
Aloe parvicoma (1,2)
Aloe pseudorubroviolacea Lavr. & Collen. ined. (1,4, 6,7)
Aloe porphyrostachys Lavr. & Collen. ined. (1,2,4,6,7)
Aloe x qaharensis (1,2)
Aloe rivierei Lavr. & Newton (1)
Aloe rubroviolacea Schweinf. (1,6,7)
Aloe sabaea (1, 2 or 3)
Aloe shadensis (1,2)
Aloe sheilae Lavr. (1,2)
Aloe vulcanica (1,2)
Aloe yemenica J.R.I. Wood (1,2)

Amaranthaceae

Nothosaerva brachiata (L.) Wight. (1,4?)

Amaryllidaceae

Crinum album (Forssk.) Herbert = *C. yemense* (1,7)
Scadoxus multiflorus (Martyn) (1,7)

Anacardiaceae

Pistacia cf. khinjuk Stocks (1,4)

Apocynaceae

Adenium obesum (Forssk.) Roem. & Schult. (2 or 3,6,7)
= *A. arabicum* Balf.
Nerium oleander L. (6,7)

Araceae

Arisaema flavum (Forssk.) Shott. (1,4)

Asclepiadaceae

Angolluma commutata (Berger) Plowes ssp. *sheilae* Plowes (1,2)
Angolluma deflersiana (Lavr.) Plowes (1)
Angolluma eremastrum (Schwartz) Plowes (1)
Caudanthera sinaica Plowes (1)
Caudanthera sinaica Plowes ssp. *baradii* (Lavr.) Plowes (1)
Ceropegia arabica Huber (1)
Ceropegia arabica Huber var. *abbreviata* Bruyns (1,2)

Ceropegia aristolochioides Decne. ssp. *deflersian*a Bruyn (2)
Ceropegia botrys K. Schum. (= *C. mansouriana*) (1)
Ceropegia bulbosa Roxb. (1)
Ceropegia rupicola Defl. (1)
Ceropegia somalensis Chiov. (1)
Ceropegia superba D.V. Field & Collen. (1)
Ceropegia tihamana Chaudhary & Lavr. (1,2)
Ceropegia variegata Decne. var. *adelaidae* Bally (1)
Ceropegia variegata Decne. var. *variegata* (1)
Ceropegia vignaldiana A. Rich. (1)
Crenulluma petraea (Lavr.) Plowes (1)
Cylindrilluma solenophora (Lavr.) Plowes (1)
Cynanchum acutum L. ssp. *sibiricum* (Willd.) Rech. f. (1)
Diplostigma canescens K. Schum. (1)
Duvalia sulcata N. E. Br. (1)
Duvalia velutina Lavr. (1,2)
Glossonema sp. aff. *boveanum* (Decne.) Decne. (1,2)
Gymnema sylvestre (Retz.) Schult. (1)
Huernia sp. nov. aff. *boleana* Gilb (2)
Huernia laevis J. R. I. Wood (1)
Huernia sp. aff. *lodarensis* Lavr. (1,2)
Huernia saudi-arabica D. V. Field (1,2)
Periploca visciformis (Vatke) K. Schum (1)
Rhytidocaulon macrolobum Lavr. (1)
Rhytidocaulon macrolobum Lavr. ssp. *minimum* Meve & Collen. (2)
Rhytidocaulon sheilae D. V. Field (1,2)
Sarcostemma arabica Bruyns & Forster (2)
Sarcostemma forskaolianum Schult. (2)
Sarcostemma vanlessenii Lavr. (1)
Sarcostemma viminale (L.) R. Br.
ssp. *stipitaceum* (Forssk.) Meve & Liede (2)
Sulcolluma shadhbana (Lavr.) Plowes (2)
Sulcolluma shadhbana (Lavr.) Plowes
var. *barhana* (Lavr.) Plowes (2)

Burseraceae
Commiphora erythraea (Ehrenb.) Engl. (1,6,7)
Commiphora gileadensis (L.) C. Christ. (6,7)
Commiphora myrrha (Nees) Engl. (7)

Capparaceae
Capparis spinosa L. (blue leafed variety) (1,7)
Cleome hanburyana Penzig (1)
Maerua crassifolia Forssk. (5,6)

Caryophyllaceae
Dianthus deserti Kotschy (1,2)
Gypsophila umbricola (J.R.I.Wood) R.A. King (1,2)
Petrorhagia cretica (L.) Ball & Heywood (1,4)

Silene asirensis D.F. Chamb. & Collen.	(1,2)
Silene corylina D.F.Chamb. & Collen.	(1,2)
Chenopodiaceae	
Arthrocnemum macrostachyum (Moric.) K. Koch	(5,7?)
Cornulaca arabica Botsch.	(1,2)
Haloxylon persicum Bung.	(5,6)
Salicornia europaea L.	(5,6)
Compositae	
Anthemis sheilae A. Ghafour	(1,2)
Anthemis zoharyana ssp. *brachyota* Eig	(1,2)
Artemisia judaica L.	(6)
Centaurothamnus maximus Wagenitz & Dittr	(2,7)
Crepis sancta (L.) Bornm. ssp. *sancta*	(1,2)
Kleinia pendula (Forssk.) Sch. Bip.	(2,7)
Convolvulaceae	
Convolvus excelsus R. Mill	(1,2)
Convolvus infantispinosus R. Mill	(1,2)
Convolvus siculus L. ssp. *siculus*	(1,4)
Cruciferae	
Dolichorhynchus arabicus Hedge & Kit Tan	(1,2)
Erysimum hedgianum Al-Shehbaz = *Arabidopsis erysimoides*	(1,2)
Cupressaceae	
Juniperus procera Hochst. ex Endl. = *J. excelsa*	(5,7)
Juniperus phoenicea L.	(5,7)
Cymodoceaceae	
Cymodocea rotundata	(5)
Cymodocea serrulata	(5)
Halodule uninervis (Forssk.) Aschers.	(5)
Syringodium isoetifolium (Aschers.) Dandy	(5)
Thalassodendron ciliatum	(5)
Cyperaceae	
Cyperus alternifolius L.ssp. *flabelliformis* Rottb.	(1,7)
Eleocharis uniglumis	(1,4)
Dipsacaceae	
Pterocephalus brevis Coult.	(1,4)
Pterocephalus sp. nov. aff. *sanctus* Decne.	(1,2)
Pterocephalus sp. 7572	(1,2?,4)
Dracaenaceae	
Dracaena ombet Ky & Peyr.	(1,3,4,7)
Sansevieria ehrenbergii Schweinf. Ex Bak.	(1)

Ebenaceae

Diospyros mespiliformis Hochst. ex. DC.	(1)

Ericaceae

Erica arborea L.	(4,7)

Euphorbiaceae

Euphorbia ammak Schweinf.	(1,7)
Euphorbia sp. aff. *Ammak* Schweinf.	(1,4?,7)
Euphorbia balsamifera Ait. ssp. *adenensis* (Defl.) Bally	(3)
Euphorbia cactus Ehrenb. ex. Boiss.	(1,6)
Euphorbia cuneata Vahl	
Euphorbia fractiflexa S. Carter & J.R.I. Wood	(1,3?6)
Euphorbia sp. aff. *fractiflexa* S. Carter & J.R.I. Wood	(1,4?,7)
Euphorbia sp. aff. *fruticosa* Forssk.	(1,2)
Euphorbia sp. aff.. *parciramulosa* Schweinf.	(1,2)
Flueggea virosa (Roxb. ex. Willd.) Voight = *Securinega virosa*	(1,4)

Flacourtiaceae

Oncoba spinosa L.	(1,4?,7)

Globulariaceae

Globularia arabica Jaub. & Spach	(1,2)

Gramineae

Avena barbata	(6)
Cymbopogon commutatus	
Cymbopogon schoenanthus	
Enteropogon macrostachyos (Hochst. ex. A. Rich) Munro ex Benth.	(4)
Hordeum murinum Huds. ssp. *glaucum* (Steud) Tzavelev	(6)
Hordeum spontaneum K. Koch.	(6)
Pogonatherum paniceum (Lamarck.) Hackel	(4,7)
Sporobolus pellucidus Hochst	(1)
Triseteria chaudharyana H. Scholz	(1,2)

Hyacinthaceae

Albuca pendula B. Mathew & Collen.	(1,2)
Leopoldia tenuiflorum (Tausch) Heldr.	(1,4)

Hydrocharitaceae

Enhalus acoroides	(5)
Halophila ovalis (R.Br.) Hook. f.	(5)
Halophila ovata	(5)
Halophila stipulacea (Forssk.) Aschers.	(5)
Thalassia hemprichii	(5)

Iridaceae

Gladiolus dalenii Van Geel	(6,7)

Gladiolus italicus Miller (4)
Gynandiris sisyrinchium (L.) Parl. (4,7)
Iris albicans Lange (1,7)
Iris postii Mouterde (1,7)

Labiatae
Ajuga arabica P. Davis (1,2)
Lallemantia royleana Benth. (1,4)
Lavandula citriodora A G Miller. (2,6)
Lavandula dentata (6)
Nepeta sheilae Hedge & King (1,2)
Origanum syriacum L. (6)
Phlomis brachyodon (Boiss.) Zohary (1)
Teucrium hijazicum I.C. Hedge & R. A. King (1,2)
Teucrium popovi R.A. King (1,2)
Thymus decussatus Benth. (1,6?)

Leguminosae
Acacia gerrardii Benth. = *A. pachyceras, A. iraqensis* (5)
Acacia gerrardii Benth. var. *najdensis* Zohary (2,5)
Acacia johnwoodii Boulos (2,5)
Acacia seyal Del. (1)
Argyrolobium sp. aff. *crotalarioides* Jaub. & Spach (1,2)
Astracantha (Astragalus) echinus (DC.) Pall.
ssp. *arabica* I.C. Hedge & Podlech (1,2)
Astragalus collenettiae Hedge & Podl. (1,2)
Delonix elata (L.) Gamble (6,7)
Faidherbia albida (Delile) A. Chev. (1,4,5,6)
Prosopis koelziana Burkhart (1,6,7)

Liliaceae
Tulipa biflora Pallas (1,4,6,7)

Malpighiaceae
Caucanthus edulis Forssk. (1,4)

Malvaceae
Alcea striata (DC) Alef (1,4)

Moraceae
Ficus palmata (6)
Ficus palmata ssp. *virgata* (1,6)
Ficus populifolia (1,6)
Ficus sycomorus (6)

Moringaceae
Moringa peregrina (Forssk.) Fiori (6,7)

Myrtaceae

Myrtus communis L. (1,4)

Nyctaginaceae
Boerhavia elegans Choisy ssp. *elegans* (1,2)

Ochnaceae
Ochna inermis (Forssk.) Schweinf. (1)

Oleaceae
Olea europaea L. ssp. *africana* (Burm.f.) P.S. Green =
O. e. ssp. *Cuspidate* incl. forma *dulcis* (6,7)

Orchidaceae
Bonatea steudneri (Rchb. f.) Th. Dur. & Sching (1,6)
Epipactis veratrifolia Boiss. & Hohen. (1,6)
Eulophia guineensis Lindl. (1,6)
Eulophia petersii (Reichb.f.) Rchb. f. (6)
Eulophia speciosa (R. Br. ex. Lindl.) Bolus (1,6)
Holothrix arachnoidea Rchb. f. (1,6)

Palmae
Hyphaene thebaica (L.) Mart. (5,6,7)
Phoenix dactylifera L. (5,6,7)

Pittosporaceae
Pittosporum viridiflorum Sims ssp. *arabicum* Chiov. (1,3,4)

Plumbaginaceae
Limonium cylindrifolium (1?,2?)

Polygonaceae
Atraphaxis spinosa L. (1)
Calligonum crinitum Boiss. ssp. *arabicum* (Sosk.) Sosk. (2,5,6,7)
Calligonum comosum L'Her (1,5,6,7)

Psilotaceae
Psilotum nudum (L.) Beauv. (1,4)

Ranunculaceae
Delphinium sheilae Kit-Tan (1,2,7?)

Resedaceae
Ochradenus arabicus Chaudhary, Hillcoat & A.G. Miller (2,7)
Reseda pentagyna Abdalla (1,2)

Rhamnaceae
Sageretia sp. aff. *thea* (Osb.) M.C. Johnst. (4,7)
Ziziphus mucronata Willd. (1)
Ziziphus spina-Christi (L.) Willd. (5,6,7)

Rhizophoraceae

Rhizophora mucronata Lam.	(5,6,7)

Rosaceae

Crataegus sinaica Boiss.	(1,4)
Prunus arabica (Oliv.) Meikl = *Amygdalus arabica*	(1,3 or 4)
Prunus korshinskyii Hand.-Mazz = *Amygdalus korshinskyii*	(1,4)
Rosa abyssinica Lindley	(7)

Rubiaceae

Breonadia salicina (Vahl) N. Hepper & J.R.I. Wood	(1,7)
Crucianella arabica Schonb.-Tem. & Ehrend.	(1,2)
Tarenna graveolens (S. Moore) Bremek. ssp. *arabica* (Cuf.) Bridson	(1,2)

Ruppiaceae

Ruppia maritima L.	(1,5)

Salvadorceae

Dobera glabra (Forssk.) Poir.	(7)
Salvadora persica L.	(6,7)

Sapotaceae

Mimusops laurifolia (Forssk.) Friis	(1,4,7)

Scrophulariaceae

Halleria lucida L.	(1,4)
Kickxia collenettiana D. Sutton	(1,2)
Verbascum decaisneanum O. Kuntze	(1,3,4)

Solanaceae

Solanum cordatum Forssk.	(1,2)

Sterculiaceae

Glossostemon bruguieri DC.	(1,4?)

Thymelaceae

Daphne linearifolia Hart	(1,4,6?)
Thymelaea mesopotamica (C. Jeffrey) Peterson	(1,3,4)

Umbelliferae

Oreoschimperella arabiae-felicis C.C. Towns var. *laevis* C.C. Towns	(1,2)
Peucedanum inaccessum C.C. Towns	(1,2)

Urticaceae

Parietaria umbricola A.G. Mill.	(1,2)

Valerianaceae

Valerianella muricata (Stev.) Baxt.	(1,4)
Valerianella cf. *sclerocarpa* Fisch. & C.A. Mey.	(1,2)
Velloziaceae	
Xerophyta arabica (Bak.) N. Menezes	(1)
Verbenaceae	
Avicennia marina (Forssk.) Vierh.	(1,5,6,7)
Zygophyllaceae	
Balanites aegyptiaca Del.	(6,7)
Tribulus macrocarpus var. *arabicus* (Hosni) Hemaid & Jacob	(2,7)
Tribulus macropterus Boiss. var. *collenettiae* Hosni	(1,2)
Zygophyllum mandevillei Hadidi	(2)
Zygophyllum qatarense Hadidi	(3?)

INVERTEBRATES

The key taxa of Saudi Arabia's invertebrate fauna are particularly difficult to define because there are so many gaps in the information available. A great many species remain to be discovered, while the ecology and conservation status of most species is unknown. Much research obviously remains to be done; in compiling future lists of key taxa, groups such as the spiders, solifugids and other arachnids and triops shrimp should be considered.

In the present report, a number of corals, molluscs, crustaceans, and insects that clearly need to be conserved have been listed. Among the endangered, vulnerable, or rare taxa are the mushroom corals, especially the Gulf endemic *Fungia tenuis*, freshwater snails, and some of the dragonflies and damselflies, several of which are relicts or endemics. Other endemics include the two S*tylophora* corals listed (both endemic to the Red Sea) and several species of crab.

Taxa of special ecological importance include the staghorn corals and horny corals. One of the latter, the whip coral *Juncuella* sp. has been found to provide habitat for an exceptional diversity of species in the Gulf, with a level of biodiversity second only to coral reefs, while the crab *Nasima dotilleforme* is a source of bioturbation in the saltmarshes and mangroves of the Gulf; it is also a species that is vulnerable to oil spills.

The distribution of earthworms in Arabia is severely restricted by the arid climate; however, they have been discovered in sites proposed for protection even in the arid interior of the peninsula; they have been included as a key taxon in view of their valuable contribution to soil formation. Honeybees play a vital ecological role in pollination and an important economic role through the provision of wild honey. Other species of economic importance include the black corals, commercial shrimps, lobsters, crabs and cuttlefish, and edible oysters and clams, all of which are vulnerable to overharvesting. Shells that are vulnerable to unrestricted collecting include the conches, cowries, tritons, and cone shells, as well as the top shell, a source of mother-of-pearl. The pearl oyster is at

present no longer exploited but remains a potential economic resource, as well an indicator species by virtue of its sensitivity to pollution.

All of the species of economic importance, as well as some of the larger butterflies and moths, may serve as flagship species for the conservation of the communities to which they belong.

COMMON NAME	SCIENTIFIC NAME	CRITERIA
	Corals (Phylum: *Coelenterata*)	
1. Black coral	*Antipathes dichotome*	(1,6)
2. Horny corals	*Order: Gorgonacea*	(1,5,7)
3.	*Stylophora mammillata*	(2)
4.	*Stylophora wellsi*	(2)
5. Staghorn corals	*Acropora* spp.	(1,2,5,7)
6. Mushroom corals	*Fungiidae*	(1,2)
Earthworms (Class: *Oligochaeta*)	(5)	
	Molluscs (Phylum: *Mollusca*)	
1. Conch shells	*Strombidae*	(1,6,7)
2. Cowries	*Cypraeidae*	(1,6,7)
3. Triton shells	*Cymatiidae*	(1,6,7)
4. Cone shells	*Conidae*	(1,6,7)
5. Top shell	*Tectus dentatus*	(1,6)
6. Freshwater snail	*Levantina* sp.	(1,2?4)
7. Freshwater snail	*Boysia* sp.	(1,3)
8. Razor pen shells	*Pinna* spp.	(1,6?7?)
9. Pearl oysters	*Pteriidae*	(1,5,6)
10. Giant clams	*Tridacna* spp.	(1,6)
11. Venus clams	*Circe* spp.	(1,6)
12. Finger oysters	*Solen* spp.	(1,6)
13. Cuttlefish	*Sepia pharaonis*	(1?,6)
	Crabs, lobsters and shrimps (Order: *Decapoda)*	
1. Shrimps	*Penaeidae*	(6)
2. Shrimps / Prawns	*Palaemonidae*	(6)
3. Spiny lobsters	*Panulirus* spp.	(1,6)
4. Slipper lobsters	*Scyllaridae*	(6)
5. Swimming crab	*Portunus pelagicus*	(6)
6. Swimming crab	*Portunus sanguinolentus*	(1,6)
7. Shore crab	*Metaplax indicus* H. Milne Edwards 1852	(3)
8. Fiddler crabs	*Uca* spp.	(2)
9. Ghost crab	*Ocypode saratan* (Forsskal 1775)	(3)
10. Ghost crab	*Ocypode rotundata* Miers 1882	(3)
11. Stalk-eyed crab	*Nasima (Cleistostoma) dotilleforme*	(1,5)

Insects (Class: *Insecta)*

1. Dragonflies & damselflies	*Order: Odonata*	(1,2,4)
2. Death's head hawkmoths	*Acherontia* spp.	(7)
3. Oleander hawkmoth	*Daphnis nerii*	(7)
4. Swallowtail butterflies	*Papilio* spp.	(7)
5. Native honeybees	*Apis* spp.	(5,6,7)

FISH

All of Saudi Arabia's endemic freshwater fish have been listed as key species, in view of their rareness and vulnerability, and their extremely limited habitats. *Acanthobrama hadiyahensis,* for example, is known from only one location, the upper reaches of Wadi Hadiyah and 'Ayn al-Jumaymah? in the northern Hijaz, while *Barbus apoensis* not only has a very restricted range, but is also increasingly harvested for food.

Among the saltwater fish, the sharks in general are threatened by the Asian shark fin market, while the humphead wrasse and bumphead parrotfish are common targets of spear fishing because of their large size. These species tend to have important ecological roles, as do the groupers, which are near the top of the food chain in the coral reef community. Three of the groupers, namely the *najil*, *hamour*, and roving grouper, are also of special economic importance, and under intense pressure from overfishing, while the butterflyfish are vulnerable to overharvesting from the growing trade in ornamental fish.

The Persian parrotfish is a Gulf endemic while the purplestreak parrotfish and three (?) of the angelfish are Red Sea endemics. A high level of endemicity (around 50%) is also found in the butterflyfishes of the Red Sea. The butterflyfishes, angelfishes, groupers, and manta ray serve as prominent flagship species, as do the whale shark and the closely allied variegated shark.

Other commercial fishes that have not been listed but might be added to future lists of key taxa if the situation warrants include the jacks, emperors, mackerels, barracudas, and additional species of parrotfish. Sharks that might need special conservation measures in view of the importance of Saudi Arabian waters to their range include the tawny nurse shark, snaggletooth shark, and slit-eye shark.

COMMON NAME	SCIENTIFIC NAME	CRITERIA
	Saltwater fish	
Variegated shark	*Stegostoma varium*	(1,7)
Whale shark	*Rhincodon typus*	(1?5?7)
Arabian bamboo shark	*Chiloscyllium arabicum*	(1,3)
Grey bamboo shark	*Chiloscyllium griseum*	(1,3)
Arabian houndshark	*Mustelus mosis*	(1,3)
Hammerhead sharks	*Sphyrna* spp.	(1,5,7)
Manta ray	*Manta birostris*	(7)

Peacock grouper	*Cephalopholis argus*	(5,7)
Coral grouper	*Cephalopholis miniatus*	(5,7)
Hamour	*Epinephelus coioides*	(5,6,7)
Lunartail grouper	*Variola louti*	(5,7)
Roving grouper	*Plectropomus maculatus*	(5,6,7)
Squaretail grouper / Najil	*Plectropomus truncatus*	(5,6,7)
Humphead wrasse	*Cheilinus undulatus? lunulatus*?	(1,5,7)
Longnose parrotfish / Harid	*Hipposcarus harid*	(7)
Purplestreak parrotfish	*Scarus genazonatus*	(1,6)
Persian parrotfish	*Scarus persicus*	(2,7)
Bumphead parrotfish	*Bolbometopon muricatum*	(1,5?7)
Butterflyfishes	*Chaetodontidae*	(2,6,7)
Emperor angelfish	*Pomacanthus imperator*	(7)
Arabian angelfish	*Pomacanthus asfur*	(2,7)
Royal angelfish	*Pygoplites diacanthus*	(7)
Zebra angelfish	*Genicanthus caudovittatus*	(2?7)
Yellow-ear angelfish	*Apolemichthys xanthotis*	(2,7)
Sohal	*Acanthurus sohal* Forsskal 1775	(2,7)

Freshwater Fish

Barbus apoensis	(1,2,6)
Barbus arabicus	(1,2)
Cyprinion acinaces	(1,2)
Cyprinion mhalensis	(1,2)
Garra buettikeri	(2)
Garra sahilia	(1,2)
Garra tibanica	(2)
Acanthobrama hadiyahensis	(1,2)

AMPHIBIANS

All of Saudi Arabia's native amphibians have been listed in view of their vulnerability, as they are restricted to freshwater wetlands, seeps and ephemeral pools, and their ecological roles within these communities. Another reason for their inclusion is the unexplained worldwide decline in amphibians that has been observed in recent years. Four of the seven species are endemic, while the other three are Palearctic relicts.

COMMON NAME	SCIENTIFIC NAME	CRITERIA
Tihamah toad	*Bufo tihamicus*	(1,2)
Dhofar toad	*Bufo dhufarensis*	(1,2)
Green toad	*Bufo viridis*	(1,4)
Arabian toad	*Bufo arabicus*	(1,2)
Savigny's tree frog	*Hyla savignyi*	(1,4)
Arabian water-frog	*Rana ridibunda*	(1,4)
Arabian skittering frog	*Euphlyctis ehrenbergii*	(1,2)

REPTILES

All of the marine and freshwater turtles native to Saudi Arabia have been included in the list in view of their various degrees of vulnerability and endangered status. The two main species of marine turtle are the green turtle and the hawksbill, both of which are threatened globally. Although records of the loggerhead, olive ridley, and leatherback turtles in Saudi Arabian waters are extremely rare, the fact that these globally threatened species have occurred at all here is significant, and suitable habitats should be protected. The Caspian pond turtle, a Palearctic relict, and the side-necked turtle, an Afrotropical relict, both have very limited distribution in freshwater wetland habitats. No confirmed observations of the terrestrial tortoises *Geochelone sulcata* or *Testudo graeca terrestris* have been made in Saudi Arabia, but if these species are recorded in the future, they should be added to the list as extremely rare relicts.

Information about the distribution and populations of Arabian lizards is very incomplete; however, the chamaeleons and the skink *Eumeces taeniolatus* appear to be relatively rare. Two of the stellios, one of the dhabbs, *Uromastyx ornatus philbyi*, and the skink *Chalcides levitoni* are endemic; two of the dhabbs and one other agamid *Trapelus blandfordi fieldi*, are near endemics, while *Stellio stellio brachydactyla* is a Palearetic relict with limited distribution. As a predator and scavenger high on the food chain the desert monitor plays distinctive ecological role, as does the newly discovered Yemen monitor, a spectacular rare endemic species. The small-scaled dhabb is of economic importance for its highly esteemed flesh, for which it is under considerable pressure from hunting. The various dhabbs could also serve as flagship species.

Endemic snakes include Jayakar's sand boa, the elegant racer and Manser's racer, the two carpet vipers(?), and the native subspecies of the cat snake, cobra, and puff adder. The black desert cobra is a near endemic. The sand boa is essential to the ecosystem of the sand seas, while large predatory snakes such as the Arabian cobra, moila snake, diadem snake, and glossy-bellied racer play important ecological roles; the later three species are important predators of rodents. The venomous borrowing asp, cobras, carpet vipers, and puff adder are all relentlessly persecuted, and are likely to come under increasing pressure from collection for their venom, which fetches a high price in the pharmaceutical market.

COMMON NAME	SCIENTIFIC NAME	CRITERIA
Caspian pond turtle	*Mauremys caspica caspica* (Gmelin, 1774)	(1,4)
Green turtle	*Chelonia mydas* (Linnaeus, 1758)	(1,6,7)
Hawksbill turtle	*Eretmochelys imbricata* (Linnaeus, 1766)	(1,6,7)
Loggerhead turtle	*Caretta caretta* (Linnaeus, 1758)	(1,7)
Olive ridley turtle	*Lepidochelys olivacea* (Eschscholtz, 1829)	(1,7)
Leatherback turtle	*Dermochelys coriacea* (Vandelli, 1761)	(1,7)
Side-necked turtle	*Pelomedusa subrufa* (Lacepede, 1788)	(1,4)
	Stellio (Agama) adramitana Anderson, 1896	(2)
Stellio	*Stellio (Agama) stellio brachydactyla* Haas, 1951	(4)
	Stellio (Agama) yemenensis Klausewitz, 1954	(2)
	Trapelus (Agama) blanfordi fieldi Haas & Y.L. Werner,1969	(3)
Small-scaled dhabb	*Uromastyx aegyptius microlepis* Blanford, 1874	(3,6,7)

Ornate dhabb	*Uromastyx ocellatus ornatus* Hayden, 1827	(3,7)
Philby's dhabb	*Uromastyx ocellatus philbyi* Parker, 1938	(2,7)
Chamaeleon	*Chamaeleo calyptratus calcarifer* Peters, 1869	(1)
	Chamaeleo chamaeleon (Linnaeus, 1758)	(1)
	Chalcides levitoni Pasteur, 1978	(2)
	Eumeces taeniolatus (Blyth, 1854)	(1,4)
Desert monitor	*Varanus griseus* (Daudin, 1802)	(5)
Yemen monitor	*Varanus yemenensis* n.sp.	(1,2,5)
Jayakar's sand boa	*Eryx jayakari* Boulenger, 1888	(2,3?5)
Glossy-bellied racer	*Coluber ventromaculatus* Gray, 1834	(5,7)
Cliff racer	*Coluber rhodorachis rhodorachis* (Jan, 1865)	(3,7)
Elegant racer	*Coluber elegantissimus* (Gunther, 1878)	(2)
Manser's racer	*Coluber manseri* Leviton, 1986	(2)
Moila snake	*Malpolon moilensis* (Reuss, 1834)	(3,5)
Diadem snake	*Spalerosophis diadema cliffordi* (Schlegel, 1837)	(5)
Arabian cat snake	*Telescopus dhara dhara* (Forsskal, 1775)	(2,7)
Burrowing asp	*Atractaspis microlepidota* Gunther, 1866	(1)
Arabian cobra	*Naja haje arabica* Scortecci, 1932	(1,2,5)
Black desert cobra	*Walterinnesia aegyptia* Lataste, 1887	(1,3)
Puff adder	*Bitis arietans arietans* Merrem, 1820	(5)
Carpet viper	*Echis pyramidum* (E.&I. Geoffroy St. Hilaire 1827)	(1,2)
Burton's carpet viper	*Echis coloratus* Gunther, 1878	(1,2)

BIRDS

The ostrich is extinct in Arabia, but since it is a species that is being reintroduced, it will be necessary to provide suitable habitat for its reintroduction within protected areas. The ferruginous duck and white-eyed gull are both endangered globally, while the houbara, Arabian bustard, lammergeier, lanner, brown noddy, and pink-backed pelican are rare or threatened within Saudi Arabia; the sandgrouses are rare and appear to be vulnerable, and the population of griffon vultures appears to be declining.

Birds endemic to the Arabian Peninsula include the Socotra cormorant, Philby's partridge, Arabian red-legged partridge, Arabian woodpecker, South Arabian wheatear, Yemen thrush, Yemen warbler, Arabian waxbill, Arabian serin, Yemen serin, Yemen linnet, and the endemic subspecies of the magpie. Near-endemics and other species with critically important populations in Saudi Arabia include the sooty falcon, crab plover, white-eyed gull, lesser crested tern, white-cheeked tern, barbary falcon, Hume's owl, Arabian golden sparrow, and golden-winged grossbeak. Migrants for which Saudi Arabia represents an important range include the demoiselle crane and houbara.

Cormorants, pelicans, vultures, and raptors occupy vital and vulnerable positions at the top of the food chain. The ostrich is a bird of high economic value; other birds of actual or potential economic importance include the hunting falcons, and gamebirds such as the partridges, guineafowl, and bustards. The ostrich, houbara and Arabian bustard, demoiselle crane, falcons, and larger raptors also serve as flagship species.

COMMON NAME SCIENTIFIC NAME CRITERIA

Ostrich	*Struthio camelus camelus*	(1,6,7)
Socotra cormorant	*Phalacrocorax nigrogularis*	(1,2)
Pink-backed pelican	*Pelecanus rufescens*	(1,5)
Northern bald ibis	*Geronticus eremita*	(1)
Spoonbill	*Platalea leucorodia*	(1)
Ferruginous duck	*Aythya nyroca*	(1,3)
Lammergeier	*Gypaetus barbatus*	(1,7)
Griffon vulture	*Gyps fulvus*	(1,3,5,7)
Lappet-faced vulture	*Torgos tracheliotos*	(1?5,7)
Bateleur	*Terathopius ecaudatus*	(1,7)
Greater spotted eagle	*Aquila clanga*	(1,5)
Imperial eagle	*Aquila heliaca*	(1,5)
Verreaux's eagle	*Aquila verrauxii*	(1,5)
Osprey	*Pandion haliaetus*	(1,5,7)
Sooty falcon	*Falco concolor*	(1,3)
Lanner Falcon	*Falco biarmicus*	(1,6,7)
Saker Falcon	*Falco cherrug*	(1,3,6,7)
Lesser kestrel	*Falco naumanni*	(1)
Peregrine Falcon	*Falco peregrinus*	(1,6,7)
Barbary falcon	*Falco pelegrinoides*	(1,3,7)
Philby's partridge	*Alectoris philbyi*	(1,2,6)
Arabian red-legged partridge	*Alectoris melanocephala*	(2,6)
Helmeted guineafowl	*Numida meleagris*	(1,6)
Demoiselle crane	*Anthropoides virgo*	(1,3,7)
Houbara	*Chlamydotis (undulata) macqueenii*	(1,3,6,7)
Arabian bustard	*Ardeotis arabs*	(1,6,7)
Crab plover	*Dromas ardeola*	(1,3)
White-eyed gull	*Larus leucophthalmus*	(1,3)
Lesser crested tern	*Sterna bengalensis*	(1,3)
White-cheeked tern	*Sterna repressa*	(1,3)
Brown noddy	*Anous stolidus*	(1)
Lichtenstein's sandgrouse	*Pterocles lichtensteinii*	(1,3)
Coronetted sandgrouse	*Pterocles coronatus*	(1,3)
Spotted sandgrouse	*Pterocles senegallus*	(1,3)
Chestnut-bellied sandgrouse	*Pterocles exustus*	(1)
Pin-tailed sandgrouse	*Pterocles alchata*	(1)
Hume's owl	*Strix butleri*	(1,3)
White-collared kingfisher	*Halcyon chloris*	(1)
Little grey hornbill	*Tockus nasutus*	(1)
Arabian woodpecker	*Picoides (Dendrocopos) dorae*	(1,2)
South Arabian wheatear	*Oenanthe lugentoides*	(2)
Yemen thrush	*Turdus menachensis*	(2)
Yemen warbler	*Parisoma buryi*	(2)
Asir magpie	*Pica pica asirensis*	(1,2)
Arabian golden sparrow	*Passer euchloris*	(3)
Arabian waxbill	*Estrilda rufibarba*	(2)
Arabian serin	*Serinus rothschildi*	(2)
Yemen serin	*Serinus menachensis*	(2)
Golden-winged grossbeak	*Rhynchostruthus socotranus*	(3)

Yemen linnet	*Carduelis yemenensis*	(2)

MAMMALS

Among the rare and endangered mammals listed are the ‘afris which appear to be extinct in the wild but should be reintroduced to suitable habitats if possible, the other native gazelles, oryx, and ibex, the dugong, Arabian leopard, caracal and other carnivores which are ruthlessly persecuted. Endemics include two species of gazelles, the Arabian oryx, and Arabian wolf, among others. Saudi Arabia also contains some of the most important populations of the dugong and hamadryas baboon. The carnivores play an important role as predators at the top of the food chain, while game species are of potential economic value. The ungulates, dolphins and whales, and to some extent the larger carnivores can serve effectively as flagship species.

The extinct cheetah and onager (to say nothing of the lion) have not been listed, because there are not at present any plans for their reintroduction, although this option remains open for the future. They should be included in future lists if the decision is taken to reintroduce them. The fennec fox and the crested rat should also be added to future lists if populations are confirmed to occur within Saudi Arabia.

Endemic rodents have not been listed in view of the paucity of available information on their distribution and the expectation that they are not in need of conservation action; however, this assumption must be tested in the future.

COMMON NAME	SCIENTIFIC NAME	CRITERIA
Bat	*Asellia patrizi*	(1)
Bat	*Rhinolophus euryale*	(1)
Straw-colored fruit bat	*Eidolon helvum* (Kerr)	(1)
Egyptian fruit bat	*Rousettus aegyptiacus* (E. Geoffroy)	(1)
Hemprich’s long-eared bat	*Otonycteris hemprichii* Peters	(1?3?)
Hamadryas baboon	*Papio hamadryas* (Linnaeus)	(3,7)
Arabian wolf	*Canis lupus arabs* Pocock	(1,2,5,7)
Asiatic jackal	C*anis aureus* Linnaeus	(1)
Rueppell’s fox	*Vulpus rueppelli sabaea* Pocock	(2 or 3)
Blanford’s fox	*Vulpus cana* Blanford	(1,4)
Ratel / Honey badger	*Mellivora capensis pumilio* Pocock	(1,2?)
	M. c. wilsoni Cheesman	(1,2?)
African small-spotted genet	*Genetta felina granti* Thomas	(1)
Striped hyaena	*Hyaena hyaena sultana* Pocock	(1)
Arabian sand cat	*Felis margarita harrisoni* Hemmer, Grubb & Groves	(1,2 or 3)
Caracal	*Caracal caracal schmitzi* Matschie	(1,5,7)
Arabian leopard	*Panthera pardus nimr* Hemprich & Ehrenberg	(1,2,5,7)
Rock hyrax	*Procavia syriaca jayacari* Thomas	(2 or 3,6)
Dugong	*Dugong dugon* Muller	(1,3,7)
Nubian ibex	*Capra ibex nubiana* F. Cuvier	(1,3,6,7)
Arabian oryx	*Oryx leucoryx* Pallas	(1,2,6,7)

Arabian mountain gazelle (idmi)	*Gazella gazella cora* H. Smith	(1,2 or 3,6,7)
Farasan gazelle (idmi)	*G. g. farasani* Thouless & Bassri	(1,2,6,7)
Saudi gazelle (‘afri)	*Gazella saudiya* Carruthers & Schwartz	(1,2,6,7)
Arabian sand gazelle (reem)	*Gazella subgutturosa marica* Thomas	(1,2 or 3,6,7)
Rub’ al-Khali hare	*Lepus capensis cheesmani* Thomas	(1,2 or 3,6)
Arabian hare	*Lepus capensis arabica* Ehrenberg	(1,2 or 3,6)
Indian crested porcupine	*Hystrix indica* Kerr	(1,4)
Bottlenose dolphin	*Tursiops truncatus* (Montagu)	(1,7)
Common dolphin	*Delphinus delphis*	(1,7)
Long-snouted spinner dolphin	*Stenelle longirostris* (Gray)	(1,7)
Humpback dolphin	*Sousa chinensis*	(1,7)
Finless porpoise	*Neophocaena phocaenoides* (G. Cuvier)	(1,7)
Bryde’s whale	*Balaenoptera edeni* Anderson	(1,7)