

## Desert

### Introduction

Deserts occupy one third of the surfaces above the water level, and are present in all the continents. In these environments rain is very scarce: at times for a few drops of water to fall from the sky it may even take years. The temperature at day time reaches very high values, while at night it drops greatly because a large amount of heat present on the surface disperses in the atmosphere. However life does not stop even in the desert, and even though there are thousands of difficulties, it successfully can resist a climate that is so unfavourable, by resorting to very effective expedients.

### Desert Biome

#### A habitat with strong contrasts

The desert (from the Latin *deserere*, to abandon) is a habitat with poor rainfalls. In many deserts, the annual rainfall is below 50 mm, but it can even be zero. In this ecosystem, the shortage of water is the main ecological factor affecting vegetal and animal life.

As well as the shortage of rains, it is also its variability over the year that strongly affects life: for comparison, just think that rainfalls in Europe vary by 20% over the year, while in Sahara this variability reaches 80-150%. This involves occasional violent downpours during which it can rain more than over several consecutive years.

Deserts may be either cold or hot. Cold deserts are at high altitudes, where winter temperatures can be below zero, such as the Gobi Desert, protected by the air masses bringing rain from high mountain ridges.

In hot deserts, the atmospheric temperature during the day can reach 50°C, while the surface temperature of the sand can rise to 90°C. At night, the ground and the air quickly cool down, with temperature differences of over 20°C.

In such a inhospitable environment, all the living beings must adapt themselves: to make up for the shortage of water, the most varied forms of adaptation have developed, even if biodiversity is still low, since between 20 to 400 plant species can be found in 150,000 square kilometres (one half of Italy).

#### World deserts

Deserts extend from the 20th northern parallel to the 20th southern parallel. 15% of all lands above sea level are considered medium dry, another 15% dry and 4% extremely dry. Extremely dry deserts have no rainfalls at all for periods of over one year. This is typical of real deserts, such as the Sahara, part of the Arabic desert; the Mojave desert in North America; the Namibian desert and part of the Kalahari; the Atacama desert in Latin America; the Gobi desert in Asia and part of the Australian desert. Dry and medium dry deserts, with comparatively more abundant rainfalls and shorter droughts, include part of the Kalahari and the Karoo desert in South-Africa; in Asia, the Arabic and Middle Eastern desert, the Iranian desert, the Turan, the Indian, Tibetan and Mongolian desert; in North America, the Mexican Chihuahua desert; the Patagonian desert in Latin America and a large part of the Australian desert.

#### Oases

An oasis generally forms where a water table is closer to the earth's surface so that the water that can let life develop comes to the surface. Occasionally, oases are artificially made by digging wells, even to a depth of a few kilometres, to reach the water table from which water can be taken later with a pump or bucket.

The vegetation of these habitats generally consists of date palms and small vegetable, fruit and cereal plantations. They need water, which is channelled and brought to the vegetable gardens of the oasis. Oases need man to take care of it, since it risks disappearing buried in the sand that slowly settles on them during sandstorms. Protective belts have been

put in place at present, even if only in the richest areas, while elsewhere the oases are protected by barriers made of palm branches.

## Plants of the desert

The vegetal life of the desert comprises annual, ephemeral and perennial species.

### **Annual plants**

Annual plants are all those plants, mostly herbaceous, having a life cycle of less than a year, such as, for instance, the *Panicum turgidum* which is an evergreen plant in moister alluvial soils, while in dry areas it becomes a deciduous plant, i.e. a plant that loses its leaves.

### **Ephemeral plants**

Ephemeral plants are those plants that are born only after occasional rains and reproduce and die before a new drought comes, and they typically have therefore an extremely short life cycle, for instance the *Alyssum alyssoides*.

### **Perennial plants**

Perennial plants must instead be able to survive in dry conditions, by minimising the loss of water during the hottest periods. These plants are normally xerophytic, which means they have leathery leaves coated in a waxy film and closed stomas to reduce transpiration and evaporation. Many plants have a reduced foliar surface or have turned their leaves into thorns, especially to avoid losing fluids, as well as to protect themselves from herbivores. These plants can trap great amounts of fluids within their tissues. This is the case of the succulents, such as the American cactus (Cactaceae) and the African and Asian euphorbia (Euphorbiaceae), which are ecological homologous species. In both cases, these plants have turned their leaves into thorns and the photosynthesis has been moved to the trunk tissue which, for this reason, always looks green because of the presence of the photosynthetic pigment.

In the desert, perennial plants generally grow very slowly because of the unfavourable environment in which they live and live very long to make up for regenerative problems. An impressive example is the *Welwitschia mirabilis*, a primitive plant related to the conifers, **endemic** of the Namibian desert, which has an extremely slow growth rate and lives to a ripe old age: the oldest specimen ever found is 1,500 years old. This plant has a small, woody trunk from which only two ribbon-like leaves sprout and grow slowly and relentlessly along the sandy ground. At ten years of age, the leaves measure just a few centimetres. Both ends of the plant come undone, so that it looks like it has a lot of leaves. Green female flowers and red male flowers grow in the middle. Plants growing in oases are different and are called **phreatophytic** because they have extremely long roots that absorb moisture from the water table. This is the case of the date palm (*Phoenix dactylifera*) growing in the Saharan and Middle Eastern oases.

## Animals of the desert

Impressive cases of adaptation to this inhospitable habitat, where heat and drought are the main limitations to the development of life and also to the availability of food, can also be found in the animal kingdom.

During the summer or particularly long drought periods, some desert animals "**aestivate**", i.e. they reduce their activity by hiding under the rocks or underground, just as, in milder climates, many living beings hibernate in winter. Aestivating animals include, for instance, some species of reptiles and the desert snails which come to life only after rains: when moisture decreases, they hole up in their shells waiting for new rains in a dormant state that can last up to five years. Butterflies, coleopters and desert cockroaches also adjust their life cycles to rainy times: the larvae come out of their eggs only when there is more food around after the rains.

Reduced activities can also be found during the day, especially at the hottest mid-day hours when all animals take refuge in the shadow.

Some large animals, such as ungulate mammals, carnivores, birds and flying insects, wander away or migrate to move from hotter and drier areas to more hospitable ones. For instance, the sand-grouses, partridge-like birds, move every day to go and drink in the oases or wherever they may find water. These birds can even drink brackish water.

## Desert formation

A desert forms when there has been a shortage of rain for a long time. It may have different geological conformations - mainly due to the effect of the wind (wind erosion). There are sand deserts, called **erg**, rock deserts, called **hammada**, and pebble deserts, the **serir**.

The history of a desert can be studied through palaeontology. During the Pleistocene (1 million years ago), where there are deserts now, rainy periods followed each other during the glaciations, while dry periods followed each other in warmer times. This is proven by the stratigraphical sequence of the land and the variations of the level of the waters of some lakes that still exist today. For instance, Lake Chad in the Sahara desert used to be much larger and 120 m deeper than it is today.

In more recent times, at the end of the last glaciations, the climate of some areas which were constantly submitted to high pressures determined the spreading of the deserts.

In other instances (the Patagonian medium desert in the Andes), it was the presence of mountain ridges that acted as a barrier against the wet currents coming from the oceans and that determined the conditions that favoured the development of the desert. Clouds are actually stopped by mountains and therefore they let rain fall on the first side they bump into, while "at the back" it rains very little.

The cold oceanic currents have also originated some dry areas: they generate cool and constant winds carrying little humidity which can at most condense into fog without causing any real rain. For instance, the coastal desert of Peru and northern Chile washed by the cold Antarctic current of the Hudson and the Namib desert, washed by the Antarctic current of the Benguela.

In addition, winds are responsible for the ongoing reshaping of the landscape: they play a key role in that there's virtually no vegetation at all and the ground is easy to attack. In addition, their erosive effect is enhanced by the sand acting as an abrasive agent. The most spectacular results of the action of the winds are eroded and polished rocks in the most bizarre shapes.

Dunes are also generated by the wind that builds and "moves" these sandy mountains around; the draughts lift the grains and settle them down again when friction increases. The shape of the dunes mostly depends on the direction and variability of the wind; there may be parabolic, dome-shaped, boat-shaped, crosswise, straight, opposing or star-shaped.

## The long history of the Sahara

The origins of the Sahara desert, the largest hot desert and the largest desert in the world, date back to approximately 600 million years ago. The sea submerged the region over and over again, depositing its sediments; whenever it resurfaced, it was alternately covered by forests, savannahs and even marshlands. During that time, trees, such as oaks, cypresses, olive trees and Aleppo pines, grew in the area. Approximately 50-55 million years ago, these lands surfaced once and for all and the land started to get dry, as many finds still attest: shells, trunks now turned into stone after a long silicification process, wall paintings and graffiti portraying the typical fauna of the savannah.

## The dinosaurs of the Gobi

The Gobi desert, at the south-western tip of Mongolia, is now one of the most inhospitable areas in the world, but between 130 and 65 million years ago it was a region brimming with life, with large lakes and rivers. It's here that, since the early twentieth century, the palaeontologists have been finding extremely rich deposits of fossils from the Cretaceous Period, when dinosaurs got to the height of their development before disappearing. In order to understand how important the finds of this area are, let's just say that, of the seven systematic groups in which dinosaurs have been classed, as many as five are present in the fossils of the Gobi desert, and among them most of their carnivore species. It's not just the variety of the species found that makes the Gobi desert unique, but rather the extremely precious fossils showing every stage of the dinosaurs' life, such as still unopened eggs, remains of young dinosaurs just out of their eggs and even, in one case only, a predator and its prey together.

## Man and desert

### The desert peoples

Despite the desert being so inhospitable, there are ethnic groups living in these places; they are groups of people that have to keep moving in caravans in search of places with water and food, defying the greatest risks: sandstorms, silted up wells and loss of bearings due to the lack of points of references. Some of these peoples are the Berbers of North Africa, that include the Kabilis and the Tuaregs, the Bedouins of the Arabic deserts, the Bejas in Namibia, the Sans in the Kalahari desert and the Australian Aborigines.

#### *The Tuaregs*

The epitome of life in the desert are the Tuaregs, who for centuries have spent their lives riding their dromedaries along the Saharan tracks. Also called the "blue men" for the typical veils they wear to protect themselves from the sand and the heat, these people live in camps of tents built of dozens of goatskins painted in red ochre and skilfully sown together by their women to guard all the items and tools of everyday life.

The Tuaregs mainly live on products derived from their animals. Their foods are curdled milk, fermented butter, dates and cereals (millet in particular) from which they make flour. They rarely eat meat, but when they have guests they just have to honour them so they kill a goat according to Muslim traditions. Water is carried in scooped-out and sun-dried pumpkins, whose decorated surfaces hint at the groups who produced them.

Originally, the Tuaregs were a nomadic people, but later on many conflicts and French colonisation pushed many of them to lead a sedentary life and the few nomadic ones that have been left live on the products of their animals and other foodstuffs they obtain through trade and breed horses and dromedaries. They produce handicrafts, for instance engraved silverware, they tan hides, make mats and produce rugs and textiles out of dromedary wool. Farming as well as high-level handicrafts are produced by lower castes, who live sedentarily in the oases. Today, some Tuaregs have found employment in the service sector, especially tourism: since they know the desert so well, they work as tour guides.

#### *The Bejas*

If the Tuaregs can be regarded as the "undisputed masters of the Sahara", the Bejas have always inhabited the large expanses of the Nubian desert. Most Bejas (approximately 1.5 million overall) live in the north-east of Sudan. They are called "Fuzzy-Wuzzies" because of their frizzy hair. For over 4,000 years, the Bejas have been running through this hot country and the bleak hills of the Red Sea in search of pastures for their camels, cattle, sheep and goats. They were feared for the quick raids they made into the rich towns along the Nile. After sacking the town, they hid in the desert of which they knew every nook and cranny and the wells where they could find water, even the most secluded ones. They are valiant and strong people, so much so that they did not only resist the pressures of the Egyptians, Greeks and Romans, but in the 19th century they even won a battle against the British army, which were much better equipped and trained. Their only weapons have always been: silver-inlaid swords, bent knives, elephant-skin round shields and a very old weapon, the "throw stick", which had already been used by the Egyptians for hunting at the time of the Pharaohs.

### Farming in the oases

In desert areas farming develops in oases. In the beginning there may be one palm only, planted in a dug-out area and surrounded by dead branches to protect it from the sand. Large crops develop over time, but the water needed for the vegetation to grow does not flow out freely. A tiring and rigorous work must be carried out by man to take water from underground. With time, man has built underwater tanks to collect water and long channels to carry it. They need constant maintenance to remove the sand or stones that could settle there and obstruct them. Every oasis has its typical irrigation system: for instance in Ghardaya (in the Mozab valley), in the Sahara, water flows underneath the dry bed of an old river. Over one million date palms are irrigated by a sophisticated system that controls the underground flow. It is a widespread system made up of dams, weirs and wells, that channel, select and dispense water, so that all gardens receive the right amount of it.

In other oases, such as those of the Souf region, where the water table is very close to the surface, the farmers have

found out another clever method to water the palm groves: instead of irrigating the surface with wells and channels, they dig out real craters for the palms, so the palms can reach the water with their roots: a clever trick that avoids waste due to evaporation and offers the plantations effective protection against the wind and sand.

## The gold of the desert

The economic importance of the desert is also related to the exploitation of its mining resources, an activity which dates back to the antiquity. In Egypt, for instance, during the Roman rule, red porphyry was quarried to decorate great public buildings and the emperor's houses. The importance of red porphyry was probably not only related to its beauty, but also to the fact that the colour purple was chosen as the royal or imperial colour: its name, "*porphyrites*", actually comes from "*porphyr*", purple. Purple quarries were located in the Eastern Egyptian desert, on a mountain 1,660 metres asl, named after the colour of the rocks: "*Mons Porphyrites*" or "*Mons Igneus*", i.e. mountain of fire, and were completely deserted by the first half of the 5th century.

In some deserts, there are gold and granite fields, also exploited from time immemorial.

The main economic resource of the deserts is in any case oil, with the richest fields being located in the Persian Gulf (Saudi Arabia, Iraq, United Arab Emirates, Kuwait and Iran). This rather small area contains 65% of the world's oil resources; Saudi Arabia alone contains 25% and is therefore the country possessing the largest amounts of crude oil.

## Diamonds in the desert

Another human settlement in this hostile ecosystem has to do with its mineral resources: from gold to diamonds, from oil to many minerals.

As early as the Ptolemaic era in ancient Egypt, the slaves toiled all through their lives to extract gold from quartz using primitive stone tools. Even now, a large part of the Namibian and South-African desert is exploited for its diamonds. Evidence of this activity is the old mining village of Kolmanskop, now a real ghost town neighbouring on this forbidden town. It was founded around 1920 after finding diamonds in the area, it quickly expanded into a local work and residential centre and was completely deserted by 1956. Today the sand has invaded some of the houses, getting in through the windows, blocking the doors and making the roofs cave in, and only a few houses are in a good state of repair and perfectly furnished, to tell how man lived there.

South-Africa is the most important diamond producer in Africa. In this area, diamonds are mainly contained in igneous rocks, such as **kimberlite** vents, which were first discovered in 1869. The biggest diamond ever found, the Cullinan (3,106 carats), and many other extremely valuable gems are from South-Africa. For more information on oil, see the specific secti

## The desert for the tourists

Another economic resource of the desert concerns tourism: it's hard to resist its charms. Many people are attracted by the silence and width of these picturesque, unique places. This is why camps have been fitted out to accommodate tourists from all over the world all through the year and as a basis for guided tours. Another tourist attraction that has to do with the desert is the "Paris-Dakar" car and bike race along a 10,000 km track from France to Senegal, through Spain, Morocco, Mauritania, Mali. The real race is amidst the dunes and the deserts, which are one of the attractions of this race with the myriad dangers it hides.

## Desertification

### What is desertification

According to the figures reported by the United Nations Environment Programme (UNEP), 25% of the earth's land is threatened by desertification. The lives of over one billion people in over 100 countries are at risk since farming and

cattle breeding become less productive.

Desertification does not mean the deserts are still expanding or taking over the neighbouring lands. As defined by the UN Conference on "Environment and Development" held in Rio de Janeiro in 1992, desertification is a process of "deterioration of the arable land into dry, medium dry and sub-humid dry areas as a consequence of many factors, including climatic changes and human activities". A common element shared by the areas threatened by desertification is the relentless reduction of the surface layer of the soil and its productive capacity. This is a serious phenomenon since it determines other ecological disasters, such as the loss of biodiversity and the increase of the temperature all over the world.

Areas of degraded land may be found hundred of kilometres from the closest desert. But they can expand and join each other into something that may resemble a desert. The most serious reasons underlying this phenomenon are drought and human activities: intensive farming exhausts the soil; cattle breeding removes the vegetation, which would otherwise.

## Fighting against desertification

The 1992 Rio conference produced the Agenda 21, an agreement containing a set of measures for the 21st century, locally applicable and aiming at addressing a global issue that could only be solved by combining economic development, the protection of the environment and social growth.

On December 26th 1996, a UN Agreement came into effect, proposing a partnership-based approach to be implemented through initiatives involving international co-operation; the common purpose is to improve the productivity of the farmland, to reclaim and preserve it and to manage water and soil in a sustainable manner. The measures taken tend to give priority to those projects that have been expressly developed for specific areas, by emphasising the involvement of the local communities, the restoration of precious traditional customs and the reappraisal of the role played by the rural communities to prevent the deterioration of the land. In addition, while in the past more emphasis was laid on technical solutions, now problems are addressed as global issues, in view of the relentless population increase and a number of political and socio-economic factors.

A number of UN organisations are addressing the desertification issue world-wide, such as the FAO (Food and Agriculture Organisation), the IFAD (International Fund for Agricultural Development), the UN Development Program (UNDP), the World Meteorological Organisation, the UNEP (United Nations Environment Programme) and the UNESCO (United Nations Educational, Scientific and Cultural Organisation).