

Chapter 2

The Desert of Egypt

Abstract Egypt is part of Sahara of North Africa in the hyperarid regions, with a hot and almost rainless climate. The Egyptian deserts are among the most arid parts of the world. Therefore, desert vegetation covers vast areas formed mainly of xerophytic shrubs and subshrubs. Egypt includes three deserts: (1) the Eastern, (2) the Western, and (3) Sinai. The Nile land, with its valley and delta, forms the fertile arable lands. Five major habitats can be distinguished: (1) the aquatic habitat, (2) the swampy habitat, (3) the canal bank habitat, (4) the cultivated lands, (5) the northern lakes, (6) the artificial lakes, and (7) the Nile islands. The Mediterranean coastal land of Egypt extends for about 970 km between Sallum on the Egyptian–Libyan border eastwards and Rafah on the Egyptian–Palestinian border. The Red Sea coastal lands include series of high mountains; the highest peak is of Gebel Elba in its southern part.

2.1 Location and Physiographic Features

Egypt is part of Sahara of North Africa and occupies the northeastern corner of Africa and the Sinai Peninsula, covering a total area of over 1 million km² (about 1,019,600 km²) in the hyperarid regions. The Mediterranean Sea bound it to the north, Sudan to the south, Libya to the west, and the Gulf of Aqaba and the Red Sea to the east (Said 1962). It is situated between latitudes 22° and 32° north and lies for the most part in the temperate zone with less than a quarter of its area south of the Tropic of Cancer. Most of landmass is below 500 m above sea level, which limits potential diversity. About 95% of Egypt land is desert; the Western Desert constitutes one of the most extreme arid desert habitats in the world (Fig. 2.1). Generally, the Nile Valley divides Egypt into two geomorphological regions: the eastern dissected plateau and the western flat expanse which form an extension of the Libyan Desert. Although the land to the east of the Nile forms one geomorphological region, it is divided geographically into the Eastern Desert and the Peninsula of Sinai, separated by the Gulf of Suez. Three areas of Egyptian desert may therefore be distinguished: the Eastern Desert, the Western Desert, and the Sinai Peninsula. The whole country forms part of the great desert belt that stretches from the Atlantic across the whole of North Africa through Arabia. It is a cross-road territory with its Mediterranean front connecting it with Europe with which it has had biotic

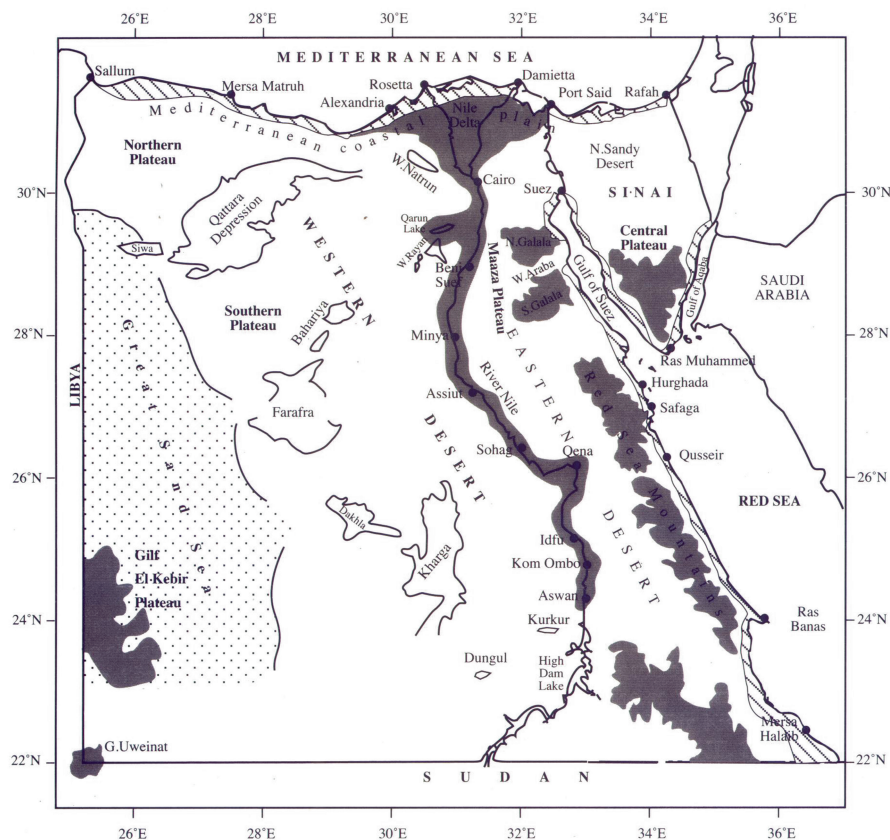


Fig. 2.1 Map of Egypt

exchanges during the glacials and the interglacials, and today we know that routes of migratory birds converge through Egypt. Two highway corridors join Egypt with tropical Africa and beyond: the Nile Valley and the basin of the Red Sea. The Sinai Peninsula is the bridge between Africa and Asia.

Egypt is characterized by a hot and almost rainless climate. The average annual rainfall over the whole country is only about 10 mm. Even along the narrow northern strip of the Mediterranean coastal land where most of the rain occurs, the average annual rainfall is usually less than 200 mm, and the amount decreases very rapidly inland (southwards). The scanty rainfall accounts for the fact that the greater part of the country is barren and desolate desert.

The Egyptian deserts are among the most arid parts of the world. The rainfall does not exceed 10 mm/annum in most parts of the country. The highest rainfall is that along the Mediterranean coast with an average of 150 mm/annum. This amount decreases rapidly as one proceeds southwards till it reaches 30 mm at Cairo. Further to the south, rain decreases reaching 3 mm or even less.

In Egypt, desert vegetation is by far the most important and characteristic type of the natural plant life. It covers vast areas and is formed mainly of xerophytic shrubs and subshrubs. Monod (1954) recognized two types of desert vegetation, namely contracted and diffuse. Both types refer to permanent vegetation which can be accompanied by ephemeral (or annual) plant growth depending on the amount of precipitation in a given year. Kassas (1966, 1971) added a third type as “accidental vegetation” where precipitation is so low and falls so irregularly that no permanent vegetation exists. It occurs mainly as contracted patches in runnels, shallow depressions, hollows, wadis, and on old dunes with coarse sand. Accidental vegetation consists of species which are able to perform an annual life cycle: potential annuals (Haines 1951), or potential perennials (Bornkamm 1987), but can likewise continue growing as long as water persists in the soil. Thomas (1988) identified these plants as those with episodic growth strategies linked to immediate water availability. Recently, Springuel (1997) classified the accidental vegetation in south-eastern Egypt into three groups: (i) runoff-dependent vegetation in the main *wadi* channels, (ii) run-on-dependent vegetation of playa formation, and (iii) rain-dependent vegetation on levelled plains of sand sheets.

2.2 General Features of Phytogeographical Divisions

2.2.1 *The Western Desert*

The Western Desert covers two-thirds of Egypt (about 681,000 km²) as it extends from the Mediterranean coast to the Sudanese border for about 1,073 km and from the Libyan border to the Nile Valley for about 600–850 km. Precipitation decreases from 150 mm at the coast to practically zero in the south, and southwest Egypt is known as the driest part of the globe. Well-marked drainage systems (wadis) comparable to those of the Eastern Desert are not found (Zahran and Willis 2009). Another salient feature, resulting from arid conditions, is the uniformity of the surface as compared with other parts of North Africa.

2.2.2 *The Eastern Desert*

The Eastern Desert of Egypt occupies about 223,000 km², i.e. 21% of the total area of Egypt. It is characterized by two main ecological units, the Red Sea coastal land and the inland desert with its wadis. According to Zahran and Willis (2009), the latter can be divided into four main geomorphological and ecological regions: (1) Cairo–Suez Desert, (2) Limestone Desert, (3) Sandstone Desert, and (4) Nubian Desert.

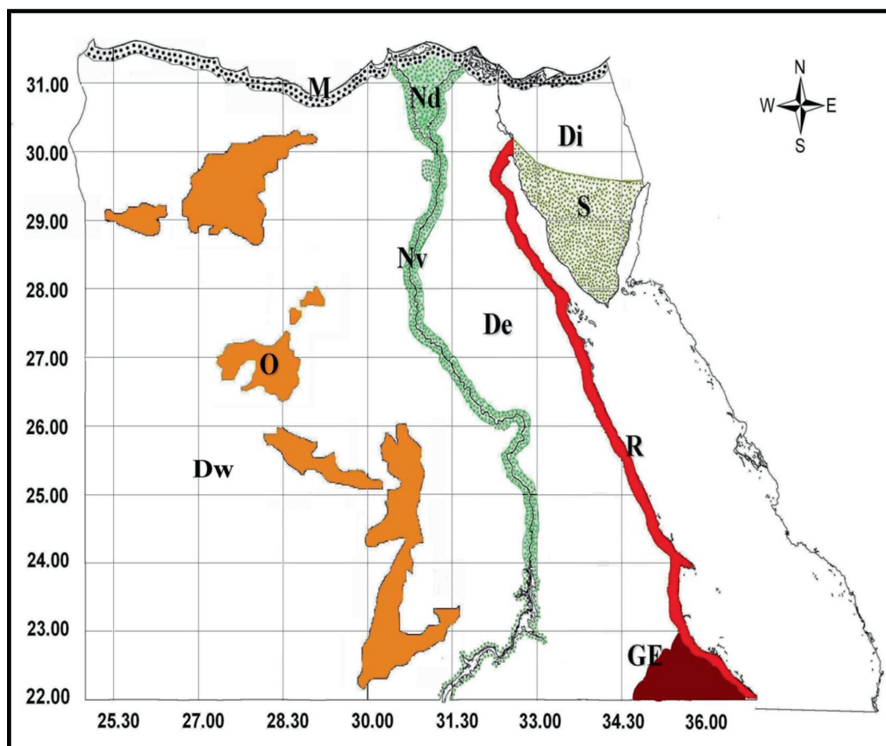


Fig. 2.2 Phytogeographical divisions of Egypt (after Wickens 1977). *M* Mediterranean, *Nd* Nile Delta, *Nv* Nile Valley, *De* Eastern Desert, *Dw* Western Desert, *Di* Isthmic Desert, *S* Sinai Peninsula, *R* Red Sea, *O* Oases, and *GE* Gebel Elba

The inland part of the Eastern Desert of Egypt lies between the Red Sea coastal mountains in the east and the Nile Valley in the west, an area of about 223,000 km² (Fig. 2.2). It is a rocky plateau dissected by a number of wadis. Each wadi has a channel with numerous tributaries, and the whole desert is divided piecemeal into the catchment areas of these drainage systems. Most of the wadis drain westwards into the Nile.

The coastal mountain ranges of the Red Sea represent a conspicuous habitat type of special interest for their complex patterns of natural communities interrelating the floras and faunas of Egypt, Sudan, and Ethiopia. One of these ranges is the Gebel Elba Mountains of south-eastern Egypt. This mountain range is considered as a continuation of the granitic formation of the Red Sea highland complex between Egypt and Sudan, situated between 36° and 37° of the eastern longitudes and about 22° of the northern latitude. The flora and fauna of this area comprise hundreds of species of plants and animals; these include a number of endemics and a number of species that represent the northern outpost of the biota of the Ethiopian highlands. The floristic richness of Gebel Elba area is noticeable, compared to the rest of

Egypt, that this is considered as one of the main phytogeographical territories of the country (El Hadidi 2000) as it borders the Saharo–Arabian and Sudanian floristic regions. The flora and vegetation of Gebel Elba group is much richer than that of the other coastal mountain groups (Drar 1936; Hassib 1951), where the Palaearctic and Afrotropical regions meet. It comprises elements of the Sahelian regional transition zone (*sensu* White and Léonard 1991) and represents the northern limit of this geoelement in Africa. Within its massive, the vegetation on the north and northeast flanks is much richer than that on the south and southwest (Kassas and Zahran 1971). Its ecological features, together with its particular geographic position, seem to have promoted plant diversity, singularity, and endemism in this area and favoured the persistence of extensive woodland landscape dominated with thickets of *A. tortilis* (Forssk.) Hayne subsp. *tortilis*, which is not known elsewhere in the Eastern Desert of Egypt (Zahran and Willis 2009).

In spite of the biogeographical and botanical interests of Gebel Elba mountain range, it has been overlooked in most global biodiversity assessments (Heywood and Watson 1995). Of the 142 woody perennial threatened plant species that are included in the Plant Red Data Book of Egypt (El Hadidi et al. 1992), 56 or 39.4% were known from Gebel Elba district. Therefore, this area was protected in 1986 as Gebel Elba National Park (Prime Ministerial Decrees 450/1986, 1185/1986, and 642/1995), covering 35,600 km², aimed to promote the sustainable management of natural resources and maintain its biodiversity. Biodiversity conservation in Egypt is supported by a number of important protected areas network (21 representing 8% of the country's land surface, and further 19 area are recently proposed for protection), based on natural region classification of the land, and having for mandate to preserve a representative sample of ecosystem characteristic of each region.

2.2.3 The Sinai Peninsula

The Sinai Desert covers approximately 6% of the total land area of Egypt and is a desert of the “Saharan type” (McGinnies et al. 1968) linking Asia with Africa. The Sinai Peninsula constitutes a transition between the Egyptian deserts and those of the Middle East. It is an interesting phytogeographic region as it borders the Mediterranean, Irano–Turanian, Saharo–Arabian, and Sudanian regions (Zohary 1973). Besides, the great diversity of climate (mean annual precipitation decreases from about 100 mm in the north, near the Mediterranean, to 5–30 mm in the south; Danin 1978), rock and soil types make the existence of some 900 species and 200–300 associations possible (Danin 1986). The northern part of the peninsula is covered with sand; in the central part, limestone hills and gravel plains predominate. The landscape of the southern region is characterized by a variety of landforms which display varied environmental and vegetational spectra. The major landforms include plains, wadis, oases and springs, salt marshes, and sand dunes. Southern Sinai, however, has an intricate complex of high, very rugged igneous and metamorphic mountains that represent the highest peaks in Egypt, among others, Gebel

Katherina (2,641 m), Gebel Musa (2,285 m), and Gebel Serbal (2,070 m). The western coastal plain, known as El-Qaa, borders the Gulf of Suez. These mountains are highly rich in their flora and fauna (Moustafa et al. 1998) and support mainly Irano-Turanian steppe vegetation dominated by *Seriphidium herba-album* accompanied by *Gymnocarpus decanter*. The vegetation is characterized by sparseness of plant cover of semishrubs, restricted to wadis or growing on slopes of rocky hills and in sand fields, and paucity of trees (Danin 1986).

South Sinai Mountains represent a great harbour of endemism (Moustafa 1990) where the area has wetter climate than most of Sinai and characterized by having large outcrops of smooth-faced rocks which support rare species (Danin 1972, 1978, 1983). The mountainous region of southern Sinai probably contains a greater biodiversity than in the rest of Egypt. A large section of the area was declared a Protectorate in 1996, centred upon the town of St. Catherine (1,600 m a.s.l.) with its world-famous sixth-century Monastery built on the traditional site of the “burning bush” of the Bible, at the foot of Mt. Catherine. From the mountain of St. Catherine, at 2,641 m, the highest point in Egypt and marking the watershed of the peninsula, wadi systems drain eastwards towards the Gulf of Aqaba and westwards towards the Gulf of Suez.

Although southern Sinai is classified as “very arid” (Zahran and Willis 2009), there is in fact a great deal of water draining down the wadis, sometimes as violent and destructive flash floods, but under normal circumstances, most of the water is underground, occasionally surfacing to produce short sections of freely flowing permanent water. Sparse vegetation occurs everywhere, but the wet areas are particularly rich with plants and consequently with insects and other animals.

2.2.4 The Nile Land

In Egypt, the River Nile is the primary source of fresh water. It also provides Egypt with a very fertile and productive land along both the Nile Valley and Delta regions (Fig. 2.1). Of the total course of the River Nile, only the terminal 1,530 km lie within the borders of the country. It consists of a complex system of various units of water bodies (lakes, marshes, streams, canals, drains, etc.) and landforms (plains and valleys). Within these units, a great variety of climate, vegetation structure, and land use and also a number of biogeographical regions exist. The Nile land, with its valley and delta, had attained most of its present and prominent features during the Ne Nile phase (30,000 years BP) of the Pleistocene period. The Nile Valley flows in elongated S-shaped pattern for a distance of about 900 km long from Aswan to Cairo. The Nile Delta, with an area of about 22,000 km², comprises about 63% of Egypt’s fertile land. It has strong geological similarities with the desert to the west and the Nile Valley to the south. The total length of the canals and drains is approximately 47,000 km (Van der Bleik et al. 1982).

The Nile system had been subjected to a series of large-scale schemes of river control, using a series of barrages and dams that had been built across the river and

its tributaries. These dams and barrages had segmented the natural hydrobiological system with undoubted impact on the biota (Kassas 1971). The construction of dams and barrages in the River Nile had caused great environmental changes, including the destruction of many natural habitats and the formation of artificial ones like cultivated fields on river island and aquaculture plots. Khattab and El-Gharably (1984) reported that among the serious problems is the vast spread of aquatic weeds in the Egyptian water bodies, particularly the net of the canals and drains in the Nile Valley region. The degree of infestation is affected by environmental factors, including water transparency, depth of water, physico-chemical water quality, water current, and air temperature. According to Zahran and Willis (2009), the Nile system of Egypt includes a number of habitats formed and/or greatly influenced by the water of the River Nile. These are (1) the aquatic habitat, (2) the swampy habitat, (3) the canal bank habitat, (4) the cultivated lands, (5) the northern lakes, (6) the artificial lakes, and (7) the Nile islands.

In a country like Egypt, where a warm climate prevails most of the year, the hydrophytes of the River Nile and its irrigation and drainage systems are greatly developed. The establishment of the Aswan High Dam in the most extreme south of Egypt controls to great extent the flow of water in the Nile and its Damietta and Rosetta branches. This control has led to numerous ecological changes in the Nile system, the effect of damming on downstream reaches being marked. Changes due to damming include silt-free water running downstream which results in the extensive use of fertilizers to compensate for the lack of the silt. Side effects also include changes in the chemical and physical characteristics of irrigation water, the presence of water in the canals all the year around, and the level of water in the Nile system particularly in Lower Egypt being noticeably lower and the current being of decreased velocity. The absence of silt in the Nile below the High Dam has made it no longer necessary to dredge the canals. Dredging removes large quantities of seeds and perennating organs of water plants; such factors are causing a noticeable and considerable increase in the growth rate and densities of the fresh water hydrophytes of the Nile system. Also the introduction of a new-water weed (*Myriophyllum spicatum*) to the Delta has appeared and started to spread during the last 20 years. The distribution of *M. spicatum* is restricted to the Nile system in Upper Egypt, but it is not yet present northwards in the Nile Delta.

Usually a 3-year crop rotation is applied in the croplands of the Nile land (including Nile Delta, Nile Valley). The crop succession during this period is (1) temporary Egyptian clover (or fallow fields)—cotton; (2) wheat—maize (or rice in the northern Delta); and (3) permanent Egyptian clover (or broad beans)—maize. So, an area is usually divided into three parts in order to have all the crops in the same year (El-Khshin et al. 1980). Planting time for the winter crops is September–November, February–March for cotton, and April–May for maize and rice. The crop longevity is 5–6 months for all crops, except cotton (7–8 months). Hand pulling and manual hoeing are the most frequent methods of all the crops, except rice.

2.2.5 The Western Mediterranean Coast

The Mediterranean coastal land of Egypt extends for about 970 km between Sallum on the Egyptian–Libyan border eastwards and Rafah on the Egyptian–Palestinian border (Fig. 2.1), with an average width ranging from 15 to 20 km in N–S direction. It lies within the Mediterranean/Sahara regional transition zone, where the vegetation comprises floristic elements for both of the Mediterranean and Saharo–Arabian regions (White 1993). Floristically, it remains one of the less known territories of the country. El Hadidi (2000) distinguished between a Mareotis sector which extends between Sallum eastwards to Alexandria, where Cyrenaican elements are prominent, and a Sinaitic sector extending from Port Said eastwards to Rafah, where East Mediterranean taxa prevail. Ecologically, it represents the narrow less arid belt of Egypt that can be divided into three sections: western, middle, and eastern (Zahrán et al. 1990). The western section extends from Sallum eastwards to Abu Qir, near Alexandria, for about 550 km.

2.3 Concluding Remarks

1. Floristically, the Mediterranean coastal land of Egypt represents one of the richest phytogeographical territories of the country. El Hadidi and Hosni (2000) reported that 1,060 species or 51% of the total flora of Egypt are recorded from this territory. Three hundred twenty-one species were confined in their distribution to a specific habitat and only known from this territory, of which more than two-thirds are typical Mediterranean chorotype. Four plant species are known to be endemic to this territory and not recorded elsewhere in the country; these include *Allium mareoticum* Bornm. & Gauba, *Echinops taeckholmianus* Amin, *Fumaria microstachys* Hausskn., and *Helianthemum sphaerocalyx* Gauba & Spach (Boulos 1995).
2. Physiographically, the western section of the Mediterranean coastal land can be distinguished into two main provinces: an eastern province between Alexandria and Ras El-Hikma and a western province between Ras El-Hikma and Sallum (Selim 1969). One of the salient features of the latter province is the dissection of its landscape into an extensive system of shallow wadis (gullies; sensu El Hadidi 2000). They drain from the southern limestone plateau which lies parallel to the west Mediterranean coast and reaches a maximum elevation of about 200 m above sea level at Sallum. The phytosociology and vegetation analyses of these wadis were the subject of El Hadidi and Ayyad (1975), El Hadidi et al. (1986), El-Kady and Sadek (1992), Kamal and El-Kady (1993), and El Garf (2003).
3. Since the 1950s, much attention has been paid to the western section of the Mediterranean coastal land. Till the recent, less attention has been paid to the distant part of the western Mediterranean coast from Sidi Barrani to Sallum on

the Egyptian–Libyan frontier. The latter represents the distant part of the western Mediterranean coastal land of Egypt, where the human activities through cultivation, grazing, and urbanization were much less pronounced than in the other parts of the region.

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