

THE COMPREHENSIVE GUIDE TO THE
wild flowers
OF THE UNITED ARAB EMIRATES

M.V.D. Jongbloed

with

G.R. Feulner, B. Böer, A.R. Western



Grasses after spring rains in Wadi Ashwani



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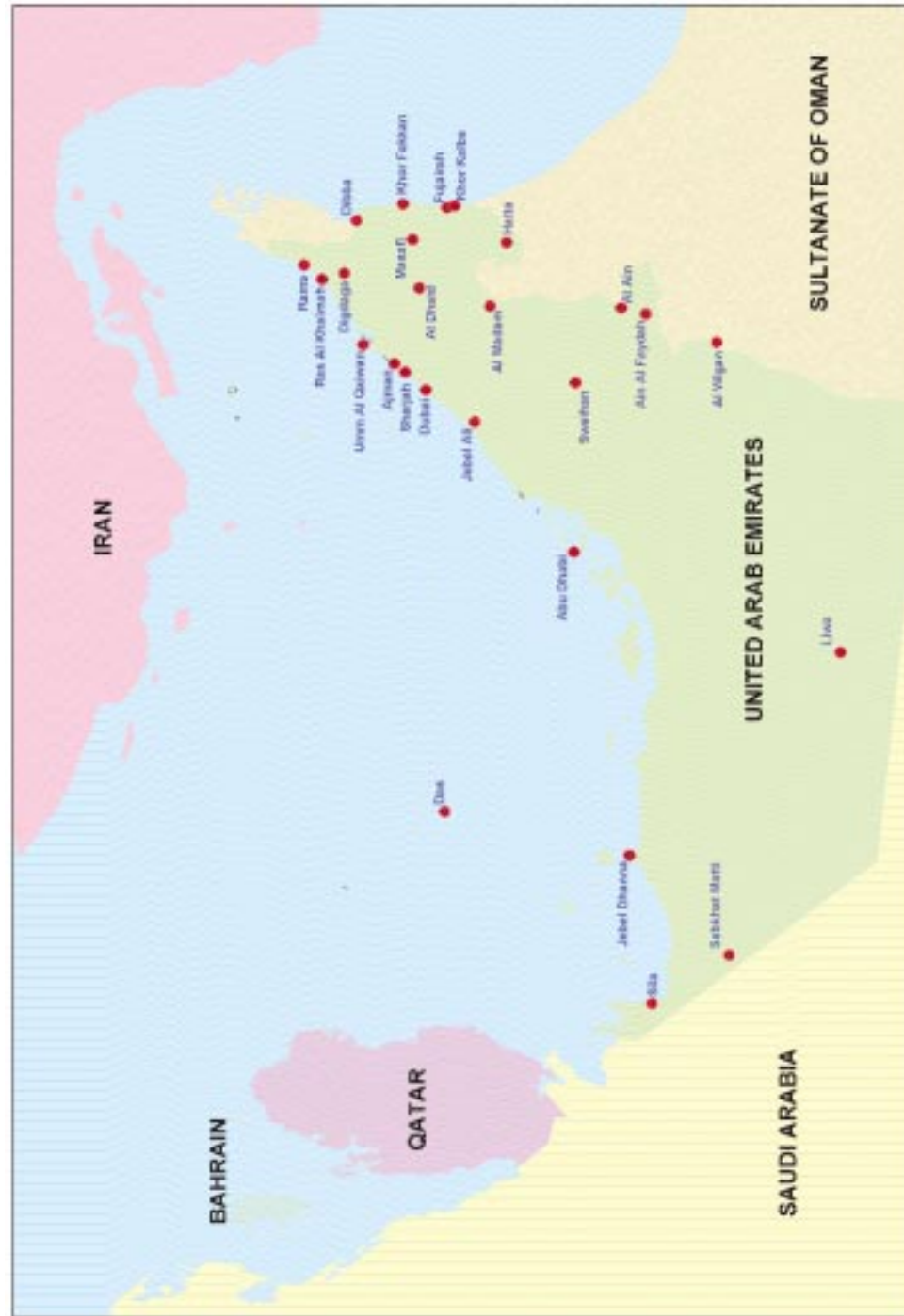
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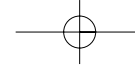
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Map of the United Arab Emirates with main cities and towns

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FOREWORD

Dedicated
to the memory of
my mother
Maria Carolina Antoinette

She loved plants, animals and people,
music, gardening and home making.
She taught me how to share.

Established in 1996, the Environmental Research and Wildlife Development Agency (ERWDA) assists the Abu Dhabi Government in the conservation and management of the Emirate's natural environment, resources, wildlife and biological diversity. This is done through scientific research, proactive planning and coordination, environmental awareness promotion, policy formulation, and enforcement that balances sustainable economic development with the protection of the environment for this and future generations.

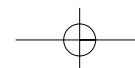
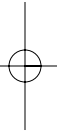
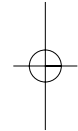
ERWDA developed the Environmental Strategy for the Emirate of Abu Dhabi in December 1999 to identify and address the environmental needs over five years (2003 to 2007). The six strategic goals identified are: environmental and natural resources regulatory and monitoring systems, management regimes for fisheries and for fresh water resources, a regime for management and rehabilitation of wildlife and a society with increased environmental awareness and education.

This book is one of ERWDA's initiatives to preserve and protect the environment. It presents and explores the wild flowers in the UAE. During the last 20 years specialists and professionals in the field of botany have collected and authenticated a number of plants growing in the UAE. The book describes more than 700 species of plants including various new records.

First Gulf Bank supports ERWDA and appreciates the cause of identification and documentation of the wild flora and fauna in the UAE. This publication introduces readers to the wild plants of the UAE and is a useful reference for many research biologists, botanists and other scientists.

First Gulf Bank continues its commitment to the community and its support for the conservation of nature and the protection of the environment.

Mansour Bin Zayed Al Nahyan
Chairman of First Gulf Bank



ACKNOWLEDGEMENTS

It took almost twenty years to gather the data that resulted in this book. It is obvious that during such a long time many people became involved one way or another.

First and foremost my grateful thanks go to Professor Loutfy Boulos, who took my enthusiasm for plants and showed me how to convert it into knowledge. Nineteen years ago he gave me a plant press, a notebook and an order: "Collect! Collect specimens with flowers and fruits on them." The press was used a lot, but until the very last he still had to tell me to make more notes! Besides being a wonderful and patient teacher, he has also become a dear friend.

Another dear friend who contributed much to this book is Minie van der Weg, a long-time resident of the UAE and a nature enthusiast who introduced me to many new places and new plants. Quite a few of the plants that turned out to be new records for the UAE were first encountered on trips with Minie. Even though she never could remember the names of plants and was not too good at describing plants, she knew the ones I knew. If she called: "Come have a look, I don't think you know this one. It is a plant like the common large one, only smaller!", it paid to check out what she had found. In the final days of preparing this book this resulted in the discovery of a Lotus species new to me (a pea like Tephrosia, only smaller!).

In the early days Dr. Claus Müller, then curator of mammals and reptiles at Al Ain Zoo, was my partner on many desert trips, teaching me to observe and finding new plants for me to photograph.

Other plant-collecting/photography trips made in the course of preparing this book were with Gary Feulner, Dr. Brigitte Howarth, John Martin and members of the Natural History Group of Al Ain. Benno Böer worked in the UAE as a professional ecologist and shared freely of his acquired knowledge and infectious enthusiasm. Pam Cole and I shared a wonderful plant photography trip to Salalah in the Dhofar region of Oman.

Most plant identifications during the almost twenty years of collecting were made or confirmed by Prof. Loutfy Boulos. Dr. T.A. Cope was extremely helpful and responsive in identifying grasses. I also consulted the herbarium of the University of Al Ain with the kind assistance of Nael Fawzi. At the herbarium of the Seikh Zayed Complex for Herbal Research and Traditional Medicine both Dr. Abdunasser al-Gifri and Salwa Abdulwahab Noureldayem were very hospitable and helpful. The latter also provided me with a number of the Arabic vernacular names and local traditional uses. Several visits were made to the herbarium at the Oman Natural History Museum in Muscat. I thank all these institutions for their hospitality and assistance.

The Natural History Groups of Abu Dhabi, Al Ain and Dubai funded the publication of the first checklist of UAE plants in 2001. That booklet formed the basis for this book, but continuing study and new data have rendered it obsolete in many particulars. Quite a few new plants were added, while others have been deleted from the list for being either uncertain records or listed under two or more names or misidentified in the past.

For the writing of the book I am indebted to the authors of the many floras and wildflower guides that I consulted. I would like to make specific mention of a few of these that were particularly helpful to me: *Introduction to the Flora of the United Arab Emirates* by A.R. Western, the three volumes of the *Flora of Egypt* by L. Boulos, *Flora of the Arabian Peninsula and Socotra* by A.G. Miller and T.A. Cope, *Flora of Eastern Saudi Arabia* by

J.P. Mandaville, *Wildflowers of Saudi Arabia* by S. Collette, and *Grasses of Saudi Arabia* by S.A. Chaudhary. I thank Loutfy Boulos, Shahina Ghazanfar and Tony Miller for allowing me to use the information on traditional and medicinal uses from their books (*Medicinal plants of Northern Africa*, *Handbook of Arabian Medicinal Plants* and *Plants of Dhofar* respectively). I am also indebted to Mr. Abraham Jacob, meteorological Officer at the Department of Civil Aviation in Sharjah, for giving me access to the Department's excellent meteorological reports.

For photographs of the plants of the higher and more inaccessible mountain regions of the UAE and adjoining areas of Oman I relied almost entirely on Gary Feulner, who likes to do his walks 'vertically'. He also keeps impeccable notes and provided many of the data on distributions and flowering/fruitlet times. My thanks go also to Loutfy Boulos, Gary Brown, Sheila Collette, Shahina Ghazanfar, John Martin and Carolyn Lehmann for providing photographs. All are credited alongside their photographs used in this book.

The distribution maps were reviewed and annotated by Dr. Abdunasser al-Gifri, Dr. Reza Khan, Dr. Benno Böer and Gary Feulner. The maps published many years ago by Rob Western in his *Introduction to the Flora of the UAE* served as a basis for the ones in this book, although much of the new information extended the known ranges (or in some cases, decreased them).

Throughout the year of writing of this book I had lively e-mail discussions with Rob Western, Benno Böer and Gary Feulner about the plant descriptions. Remarks such as: "Are you sure?" and "Where did you get that?" or "Oh no!" reverberated through cyberspace. I owe them a debt of gratitude for their instructive criticism as well as their unabated interest and enthusiasm. Gary was also a diligent copy reader, pointing out inconsistencies and errors in the text at several phases during the production of the book. He gave generously of his spare time, which is already so precious in the life of a busy lawyer. He took me seriously and tried to make sure I did my very best at all times.

Loutfy Boulos spent four days of his valuable time to go over the penultimate draft of the manuscript, a time during which I learned much! Dr. Gary Brown, botanist at the Terrestrial Environmental Research Centre (TERC) reviewed the final draft - a time-consuming but worthwhile exercise that was much appreciated.

I also thank Nadia Jones for teaching me about the publishing process and Geri Macario for helping me with the design of the cover.

Last but not least I want to thank the Environmental Research and Wildlife Development Agency in Abu Dhabi, and specifically Mr. Mohammed al Bowardi and Mr. Ahmed al Sayegh, for giving me a chance to fulfill a dream: to compile the plant information that I gathered as a labour of love during the past twenty years and to create this book. It made this last year before I leave the UAE a wonderful time of learning and remembering.

To the sponsors of this publication, First Gulf Bank of Abu Dhabi, I owe thanks for providing the means to make this a high quality book with hundreds of illustrations.

Often during the year I paused to marvel at a piece of interesting information about a plant or admire a particularly nice specimen, either in the field or in a photograph. And hundreds of times before that I enjoyed being afoot in the desert and discovering its wonderful flora and fauna. I count myself lucky to be able to agree with the poet William Wordsworth:

“Nature never doth betray the heart that loves her.”



Haloxylon salicornicum in fruit along the Dubai-Hatta road

HOW TO USE THIS GUIDE FOR BEST RESULTS

This guide is aimed at anyone interested in knowing more about the wild flora of the United Arab Emirates. In order to make the information more accessible to non-specialists, technical botanical terms have been avoided as far as possible and a glossary has been provided. Reading the following explanation of the guide will allow the user to better understand the information provided and the limitations that are inherent in a guide like this.

Species names - The current scientific name is used. Synonyms are given only if the current name has been changed recently and the plant may be better known by its previous name. Identifications were confirmed mainly by experts at the Royal Botanical Gardens at Kew and Edinburgh, with the majority of determinations having been made over the past twenty years by Prof. Loutfy Boulous. A list of collectors is given below.

The plants included in this guide are all those plants that occur in the UAE without irrigation (and a few that need regular water such as the date palm and the henna tree). In some cases this includes plants that started as introduced agricultural plants but have escaped and are now spreading by themselves in the natural environment. There are also several species of native wild plants that have become a feature of local horticulture and are now common in gardens and planted roadsides (e.g. *Salvadora persica*, *Sesuvium verrucosum*, *Leptadenia pyrotechnica*).

Arabic vernacular names: The names given are those that are used around the Gulf (UAE, Oman, Qatar, Bahrain, Saudi Arabia, Kuwait) and sometimes in Egypt and Northern Africa. The local (UAE) Arabic name is given first, where known. If vernacular names were not known, the space has been left blank so that names can be noted if and when they become available. None of the vernacular names (Arabic or English) have been capitalised.

English vernacular names: These were gleaned from various floras and plant guides.

Descriptions: Various floras were consulted (see bibliography) and the descriptions are based on specimens collected in the Emirates. The plants are described according to what can be observed casually, and this can be different from what is described after detailed examination by experts (for instance, a spike can be a contracted panicle).

Size: Sizes given for the plant, the leaves, the flower and the fruit are the **most usual sizes** for a mature plant. However, in desert situations size can vary greatly depending on the prevailing environmental conditions. In areas with enough moisture or in times of rain and favourable temperatures or where there is no grazing, plants will thrive and grow larger and more luxuriously than in very dry, overgrazed areas or during times of drought or extreme temperatures.



Giant *Calotropis procera* with a height of 4 m

Many of the trees can grow to sizes much larger than the ones given, but these "giants" are few and far between.

Flowering time: The times given are times of the year when it is **most likely** to find the plant in **flower and/or fruit**. Again, these times can vary with prevailing conditions. It is quite possible to see flowering and fruiting outside the given times, although it is unlikely to not see flowering or fruiting within the given times. For many of the annual plants, however, flowering may depend on the occurrence of rain as much as on the season.



Forsskaolia tenacissima on the roof of Bidiyah Mosque

Habitat: Plants have preferred habitats, which are described in the text. But within each larger habitat micro-habitats can occur that allow occasional "odd" occurrences at times. For instance, the author first found *Glossonema edule* on sand in Al Ain zoo and recorded it as a sand plant until it was later observed that the rocky wadi habitat was a much more usual place for this plant. The zoo plant possibly grew from a seed dropped by a bird. A luxurious specimen of *Forsskaolia tenacissima* growing on the roof of the famous Bidiyah Mosque was certainly in an extraordinary habitat.

Distributions:

In many cases it proved very difficult to be certain about the distribution of species. Both the maps and the descriptions of plant distributions are based on published and unpublished records gathered from literature and from personal communications by local collectors. Especially in the case of the uncommon or rare plants this left many questions. The absence of records for a plant does not necessarily mean that the plant does not grow in a given area. If only one record exists, this location is indicated by a point and mentioned by name in the text. If two or more records exist for an uncommon plant and these locations are far apart, it is possible that the plant occurs in the area between the recorded locations. The rarity or abundance of a plant is reflected in the intensity of the colour of the distribution area on the map (light blue = rare or uncommon, dark blue = common or abundant). The areas where local wild plants have been used in afforestations and horticulture have not been taken into account.

Where distribution is limited by elevation, this is mentioned in the text and the map must be interpreted accordingly. In the case of *Euphorbia larica*, for instance, the map shows that the plant occurs throughout the Hajar Mountains, but the text indicates that it will normally not be found at the highest elevations, since its range does not exceed 1200 m.

Due to the small size of the maps, these can only give a general indication of the areas where the illustrated plants have been found and could be encountered again. The distributions shown include many localities that are outside the UAE borders in neighbouring parts of Oman. Since wild flora and fauna are not restricted in their distribution by man-made borders, the Musandam province and other areas of Oman that UAE residents can reach without obtaining a visa or passing a border post were included. The areas of the maps that extend into Oman relate to the records for this book, but this does not, of course, mean that

the plants do not occur beyond the areas indicated by these maps.

While preparing the distribution maps, comparison was made with the maps included in A.R. Western's *Introduction to the Flora of the United Arab Emirates*, published in 1989. With the additional data that were available for this book many of the distributions seem more extended, but there are also some plants that may have disappeared since the late eighties (e.g. *Prosopis farcta*, *Carthamus* sp.). Even some plants recorded by the author have only been seen once and never again (*Gymnarrhena micrantha*, *Ononis reclinata*). One plant that graced the plain at the foot of Jebel Hafeet, *Anvillea garcinii*, will certainly disappear from the UAE if the intrusion into its habitat by heavy construction vehicles is not stopped immediately. Another, *Limonium carnosum*, appears threatened by coastal development in Ras al Khaimah and may not be seen for much longer.

Traditional uses: Whenever information was available from literature (specifically the books on medicinal plants by S.A. Ghazanfar and L. Boulos, as well as sections from J. M. Mandaville's *Flora of Eastern Saudi Arabia*) this has been included in the text. In addition, interviews with local ladies provided some traditional UAE uses. Much more research could and should be done on traditional herbal medicine, before the knowledge disappears with the older generation of local people. If no information about traditional uses was available, the space has been left blank so that the user of the guide can add information if and when it becomes available.

Remarks: This section includes distinguishing characteristics of plants that are otherwise very similar as well as anecdotal information. Also listed under remarks are the names of other species in the same genus that have not been given a full page treatment but just a brief description, generally without illustrations. These listings make the guide a relatively comprehensive checklist of UAE plants as well.

Collectors in alphabetical order

Mrs. R. Ash collected around 1982. Her specimens were identified at the Herbarium of the Royal Botanical Garden in Edinburgh, with duplicates at the National Herbarium at the Oman Natural History Museum in Muscat. The National Museum of Ras al Khaimah holds a list of her collections as well as a number of herbarium sheets, some with specimens and others with just a label.

Benno Böer collected between 1989 and 2000. His specimens deposited in the Herbarium of TERC/ERWDA could not be traced. Duplicates exist in the herbaria of Riyadh, Sultan Qaboos University, Cairo, Osnabrück, Helsinki, Kassel and Berlin.

Loutfy Boulos collected on several occasions between 1984 and 2000 and identified virtually all plants collected by Jongbloed between 1984 and 2003. The specimens are with several herbaria in Egypt and the United Kingdom.

T. A. Cope collected during a visit in the 1980s. The specimens are with the Herbarium of the Royal Botanical Gardens at Kew.

Ian Curtis collected in the spring of 1998. His specimens are in the Sharjah Desert Park Herbarium, with duplicates in the Herbarium of the Royal Botanical Gardens at Edinburgh.

Ulrich Deil collected in the UAE in March 1987. His specimens are mainly in the Herbarium of the University of Bayreuth.

Gary Feulner has collected since 1995 to the present day. His early specimens are either in the Sharjah Desert Park Herbarium or in the Herbarium of the Royal Botanical Gardens at Edinburgh (through Martin and Curtis). His later specimens are included in the ERWDA/TERC Herbarium.

Ali Al-Ghonemy collected between 1982 and 1995. His specimens are mainly at the Herbarium of the UAE University in Al Ain.

I. C. Hedge and R. A. King published a checklist of Cruciferae for the Arabian Peninsula (1983) from which several records have been gleaned. Since their publication several new species of Cruciferae have been identified from within the UAE.

Marijcke Jongbloed has collected since 1983 to the present day. The collections are at the Sharjah Desert Park Herbarium and at the ERWDA/TERC Herbarium. All identifications were done by Prof. Loutfy Boulos, initially in Kuwait, later in Cairo and Kew. Grasses were identified mainly by T. A. Cope and duplicates are kept in the Herbarium of the Royal Botanical Gardens at Kew.

Fawzi Karim collected between 1990 and 1998. His specimens are included in the Herbarium of the UAE University in Al Ain. Duplicates, where they exist, are in the herbaria of the Royal Botanical Gardens at Kew and Edinburgh.

John Martin has collected on numerous occasions from the late 1980s until the present day. His collection is with the Herbarium of the Royal Botanical Gardens at Edinburgh, while duplicate specimens are mostly with the Sharjah Desert Park Herbarium.

The Herbarium of the Zayed Complex for Herbal Research and Traditional Medicine contains many specimens. Collections and determinations were done by **Li Mingguang, Salwa Noureldayem** and **Abdulnasser al Gifri**.

The Herbarium of **TERC/ERWDA** in Abu Dhabi includes many of the plants collected for the research for this book and can be accessed on request by anyone interested to study the specimens.

During the preparation of this book and the discussions with colleagues about difficulties in the identification of certain local plants, it became apparent that considerable scope exists for further study both in the recognition and identification of additional plants that may be present in the UAE, the reconciliation of possibly erroneous and duplicative identifications made to date and the ecology of individual plants and plant communities in the varied environments of the UAE. It is hoped that this book may inspire UAE students or scholars to take up this challenge and look into these matters in more detail.

BRIEF DESCRIPTION OF GEOLOGY, HABITATS, CLIMATE AND PLANT ADAPTATIONS

The United Arab Emirates is located along the southeast coast of the Arabian Gulf and extends eastward across the Hajar Mountains to the Gulf of Oman. between 20° 50' and 25° N latitude and 51° and 56° E longitude. Its total area is about 78,000 km² and includes a number of small islands in the Arabian Gulf, situated from a few hundred meters to more than 150 km offshore. About 80% of UAE territory consists of the coastal sabkhas (salt flats) and interior sand deserts of the Emirate of Abu Dhabi, which borders the Empty Quarter (Osborne, 1996)

The climate of the United Arab Emirates is characterised by low rainfall and high summer temperatures. There are no frosts.

Even though it is a relatively small country, the UAE has a number of different ecological zones.

For the purpose of this book the following ecological zones are distinguished:

Coastal areas

There are two separate coastal areas - the sandy and low Arabian Gulf coast, 600 km long, and the rocky and sometimes steep Gulf of Oman (Indian Ocean) coast, 75 km long.

The Arabian Gulf coast in the west is characterized by narrow raised beaches of calcareous sand, with saline flats (sabkhas) extending up to 30 kms inland, bordered by a low escarpment of Tertiary rocks. In the far west lies the Sabkha Matti, reaching as far as 100 km inland. These sabkhas support no visible vegetation due to their extremely high salt concentrations and often impermeable layers of gypsums and anhydrites.

The sandy coastal strip supports *Zygophyllum qatarense* and *Salsola imbricata* as dominant species, with *Heliotropium kotschy*, *Fagonia ovalifolia*, *Suaeda vermiculata* and *Panicum turgidum* mixed in.

Near Abu Dhabi there are many inshore islands with tidal lagoons where the mangrove *Avicennia marina* is present and *Arthrocnemum macrostachyum* dominates the tideline, together with various saltbushes such as *Halopeplis perfoliata*, *Suaeda* spp., *Anabasis setifera* and *Salsola imbricata*. Where sand has accumulated *Cornulaca monacantha*, *Heliotropium kotschy* and *Convolvulus deserti* are frequent.

Further north the beaches are punctuated by creeks and lagoons, while the low dunes along the seashore are covered with the sand-fixing *Halopyrum mucronatum* grass as well as *Salsola imbricata*. Further inland there are mixed stands of *Cornulaca monacantha* and *Atriplex leucoclada*, while on higher ground *Crotalaria persica* and *Sphaerocoma aucheri*



Salt flats in the Western region.



Tirmania nivea, an underground fungus that is a popular food item for UAE nationals.

can be found.

Inland of the coast road the perennials *Helianthemum lippii* and *Echiochilon kotschyi* and the annuals *Arnebia hispidissima*, *Silene villosa* and *Senecio glaucum* occur.

Between Ajman and Umm al Quwain the last stretch of relatively undeveloped coast still supports the locally popular, underground fungus *Tirmania nivea*, which lives in association with *Helianthemum lippii*. The low dunes inland here are densely covered with the grasses *Pennisetum divisum*, *Panicum turgidum*

and *Sporobolus iocladius*.

Near Ras al Khaimah some high dunes reach the coast, many supporting dense growth of *Acacia tortilis* and *Prosopis cineraria* trees, together with *Cenchrus ciliaris*, *Coelachyrum piercii* and *Pennisetum divisum* grasses. In spring various *Launaea* species and the small mallow *Malva parviflora* can be found here.

The narrow gravel plain that separates the coast from the high mountains of the Ru'us al-Jibal in the far north is dominated by *Acacia tortilis* trees, together with *Tephrosia purpurea* and *Fagonia indica*. Many *Phoenix dactylifera* (date palm) groves are tended here. The coastline has long narrow lagoons with the mangrove *Avicennia marina* and some *Phragmites australis* in areas where fresh water comes near the surface.

The East Coast consists of a narrow gravel plain between the sea and the mountains that in places extend rocky spurs all the way to the sea.

In the south is the large mangrove forest of *Avicennia marina* at Khor Kalba with inland a coarse gravel plain dotted with *Acacia tortilis*. North of Kalba urban development has all but covered the entire plain, but just north of Fujeirah some marshes remain with *Arthrocnemum macrostachyum*, *Halocnemum strobilaceum* and *Limonium axillare*.

Around the rocky spurs further north *Tephrosia purpurea* dominates with conspicuous stands of *Boerhavia elegans* and *Haplophyllum tuberculatum* along the road in spring. In the many extensive palm plantations *Abutilon pannosum*, *Pergularia tomentosa* and *Suaeda aegyptiaca* grow along the fences, while *Vernonia cinerea*, *Boerhavia diffusa* and *Boerhavia repens* can be found beneath the palm trees.

The sand desert

Most of the land surface of the UAE is sand desert. This in turn consists of a mixture of low dunes, high dunes and intervening sand flats. In the south and south east of the country major dunes ridges may reach heights of up to 100 meters or more and the flats between them are not sand flats but salt flats (sabkha).

In the west there are mobile dunes with *Cyperus conglomeratus* and *Calligonum comosum* that can reach the height of small trees here. On the sandy plains between the dunes *Tribulus omanense* grows along with a sparse *Zygophyllum qatarense* and *Halopeplis perfoliata* and in deep sand *Heliotropium digynum* and *Limeum arabicum* occur.

The central desert has calcareous sand near the coast and quartz sand further inland. The

dunes are low and the water table is deep. It is dominated by *Haloxylon salicornicum* with *Cornulaca monacantha*, *Cyperus conglomeratus*, *Zygophyllum madavillei* and *Haloxylon salicornicum* as co-dominant species. Many grasses also grow here such as *Setaria verticillata*, *Stipagrostis plumosa* and *Centropodium forskahlii*.

In wet springs the annuals *Cleome amblyocarpa*, *Eremobium aegyptiacum* and *Silene villosa* are numerous, while areas that are protected from grazing support *Crotalaria aegyptiaca*, *Indigofera argentea*, *Tribulus macropterus* and *Heliotropium digynum*. East of Dubai *Leptadenia comosum* thrives between the fences along the Sharjah-Dhaid road.

In badly overgrazed areas between Dubai and Al Faqah and outside the fences along the Sharjah-Dhaid road *Calotropis procera* is often the only conspicuous plant.

The alluvial plains

The alluvial plains along the western edge of the Hajar Mountain range consist of pebbles and coarse rock detritus near the mountains and sand and finer gravel further west, plus interstitial alluvium.

East of Al Ain the gravel plain is dominated by *Rhazya stricta* and *Haloxylon salicornicum*. The absence of other plants is probably due to over-grazing since in fenced off areas *Fagonia ovalifolia*, *Indigofera argentea* and *Astragalus* spp. can be found, with *Cleome amblyocarpa* in areas of deeper sand.

On gravel plains further north around Madam and Dhaid *Acacia tortilis* and *Haloxylon salicornicum* dominate, interspersed with some *Rhazya stricta*. The limestone hills of Jebel Faiya and Jebel Mileiha support *Capparis sinaica* and *Ochradenus arabica*, while the mountain foothills to the east have *Tephrosia purpurea* and *Salvadore persica* stands.

To the west of Digdaga and Khatt on the fertile Jiri plain there is a large *Prosopis cineraria* forest, which in wet springs has a

luxurious ground cover of annuals such as *Malva parviflora*, *Sisymbrium* and *Geranium* spp. Elsewhere the plain supports *Calotropis procera* and *Acacia tortilis*, often intertwined with *Lycium shawii*. In fallow fields *Pulicaria crispa* flowers in spring, together with the annuals *Ammi majus*, *Emex spinosa* and *Malva parviflora*.



Ghaf forest near Digdaga

The Hajar Mountains

Most of the mountain backbone of the country consists of igneous rocks representing former oceanic crust and mantle that was pushed onto the Arabian platform during Cretaceous times. The Hajar Mountains of the UAE and neighbouring Oman constitute the world's finest and most extensive surface exposure of ocean crust rocks, collectively called ophiolites. The Hajar range is about 20-50 kms wide and the mountains reach elevations of more than 1000 m.

Throughout the Hajar Mountains except on the summits *Euphorbia larica* and *Tephrosia purpurea* are common. On the lower hills and plains the perennial bushes *Gaillonia*

aucheri, *Pteropyrum scoparium* and *Pulicaria glutinosa* dominate together with *Physorhynchus chaemarapistrum* and *Fagonia indica*, while *Ochradenus aucheri* is more frequent in the northern Hajar. There is a great diversity of plants in the wadis, especially in years with good rainfall. A frequently encountered shrub is *Dodonea viscosa*. Wadi trees include *Prosopis cineraria* (in wider wadis) and *Ficus cordata* subsp. *salicifolia*. In spring numerous annuals appear, including *Viola cinerea*, *Erodium neuradifolium*, *Cometes suratensis* and *Argyrolobum roseum*. On rocky hillsides *Moringa peregrina* grows. Dominant grasses are *Cymbopogon commutatus* and *Aristida adscensionis* while composites such as *Launaea spinosa*, *L. massauensis*, *Filago desertorum*, *Reichardia tingitana* and *Urospermum picroides* can be found. Where water flows in the wadis *Nerium mascatense*, *Saccharum ravennae* and *Arundo donax* occur, while in shady damp places *Bacopa monnieri* and *Adiantum capillus-veneris* are found, the latter often in association with the UAE's only orchid *Epipactus veratrifolia*. In mountain plantations *Oxalis corniculata*, *Centaurium pulchellum*, *Convolvulus arvensis* and *Corchorus trilocularis* abound.



Fenced fields protect a number of flowering plants.

The Ru'us al-Jibal

The mountains north of Dibba are geologically distinct from the Hajar Mountains to the south. They consist of sedimentary rocks, mostly carbonates (limestones and dolomites). Peaks in this Ru'us al-Jibal range reach up to 2000 m., while the summit plateaux average almost 1500 m. The Arabian almond *Amygdalus arabicus* grows in these mountains, as well as *Ficus johannis*, while high plateaux are covered with bushes of *Seriphidium herba-alba*, *Convolvulus acanthocladus* and *Cymbopogon* spp. In fenced fields bulbs such as *Gladiolus italicus* and *Muscari longipes* can thrive, as well as the flamboyant *Iris sisyrynchum* and *Ixiolirion tataricum*, and small annuals like *Vicia sativa* and *Galium* spp. On silt among the rocks spring annuals like *Geranium mascatense*, *Campanula erinus*, *Pentanema divaricata* are numerous.

Rainfall pattern and plant growth

The climate of the UAE seems inhospitable to modern man, with its high summer temperatures and low annual rainfall, but plants have learned to adapt to and even thrive in these conditions.

The Meteorological Office of Sharjah International Airport has been recording weather conditions since 1934. From the chart that records rainfall in Sharjah (at the airport) it appears that winters with good rainfall (200 mm or more) occur approximately every 7 to 10 years with periods of drought (100 mm or less) in between.

Extraordinary rainfalls were recorded in 1957 (340 mm), 1982 (275 mm) and from 1995 through 1998 (resp. 290, 230, 320 and 180 mm). From 1998 through to Jan 2003 the country experienced drought conditions with only occasional and very localised rainfall.

During the rainy years of the mid-nineties the vegetation cover of the country was profoundly affected. Grasses and annuals appeared in numbers not seen for thirty years. Perennials thrived also and were able to spread and establish themselves in good numbers.



Shawka oasis with dying palms

During the subsequent drought the damage to the perennial vegetation has become obvious while annuals have barely been seen at all in the first few years of the third millennium. Continuing extraction of ground water caused salinity to rise in the erstwhile fertile areas around Digdaga and Dhaid, and it became less feasible to conduct extensive agriculture in these areas. Entire palm groves both on these plains and in the lower montane wadis showed signs of stress or died.

Desert plant adaptations

Native plants have developed various adaptations to cope with prevailing extreme conditions.

A few of these are:

- Reduction of leaves and branches during droughts (woody perennials).
- Storing of moisture in enlarged leaves or stems (succulents).
- Dying back of above-ground parts to allow underground parts to survive until better times (plants with bulbs and corms).
- Covering with a waxy layer to prevent evaporation as well as provide extra support.
- Covering with fine white hair to reflect sunlight and to reduce evaporation.
- Long central root systems to reach deep aquifers.
- Extended superficial root systems to profit from dew. In the coastal areas and on the sand sheets dewfall is a more regular source of moisture for than rainfall. It is a feature of a large number of nights each month and in the summer it is the only source of surface moisture over much of the desert.
- Shallow root systems combined with a short growing and reproductive season (ephemerals).
- Sharp spines or impenetrability to protect themselves from being grazed or browsed.



Malva parviflora flowering and fruiting while still a tiny plant shortly after the seedling stage