

## The Design and Construction of Oman Botanic Garden<sup>©</sup>

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### INTRODUCTION: OMAN BOTANIC GARDEN PROJECT

Oman Botanic Garden (OBG) is currently under construction in the Arabian Peninsula. It is located close to Oman's capital city, Muscat, and will be open to the public in a few years. The garden is a governmental project and part of the Diwan of Royal Court. The aim of the project is to conserve the biodiversity and botanical heritage of Oman for a sustainable world. The project will do this by displaying the entire flora of the country in naturalistic habitat-style plantings and will include extensive exhibitions about plants and how they are used. The 420ha site of the botanic garden was selected for its beauty, dramatic landscape and plant diversity, with 10% of Oman's native flora already naturally present.



Fig. 1. Oman Botanic Garden site.

### VISION AND MISSION OF THE PROJECT

#### **Vision**

People are inspired to conserve and cherish the biodiversity and botanical heritage of Oman to contribute towards a sustainable future.

#### **Mission**

Discover, cultivate, showcase and protect Oman's unique plant diversity and ethnobotany through innovative research, exciting displays and engaging communication.

## PROJECT HISTORY

In 2006, Oman Botanic Garden was established by Royal Decree in a rented nursery close to the current site. With few staff they started collecting native plants from the wild. In 2008, the Construction of Oman Botanic garden nursery started on the current site. Fifty-one thousand plants were transferred from rented facilities to new nursery in preparation for the official opening of the nursery by the Minister of the Diwan of Royal Court. From 2009, they started the Construction of the Orientation Centre, Field Studies Centre, Research Centre and Heritage Village (ongoing). In 2010, the team planted the first habitat of the Northern Gravel Desert. Through these years, we still work on collecting the seeds, propagating the plants either by seeds or cuttings, collecting the herbarium specimens and translocation endangered plants destined to be destroyed road construction.

## LANDSCAPE AND FLORA OF OMAN

### Landscape

Oman covers 309,500 km<sup>2</sup> and encompasses a diverse range of topography, including mountain ranges, arid deserts and fertile plains.

Oman's climate is very diverse with humid coastal areas and a hot and dry desert interior. The seasonal cloud forest of Dhofar, in the south of Oman, is lush during the summer monsoon or Khareef (July-September) and is home to most of the country's endemic flora.

The varied topography and climate of Oman, with the Dhofar range of mountains in the south and Hajar Mountains in the north also contribute to the level of plant diversity.

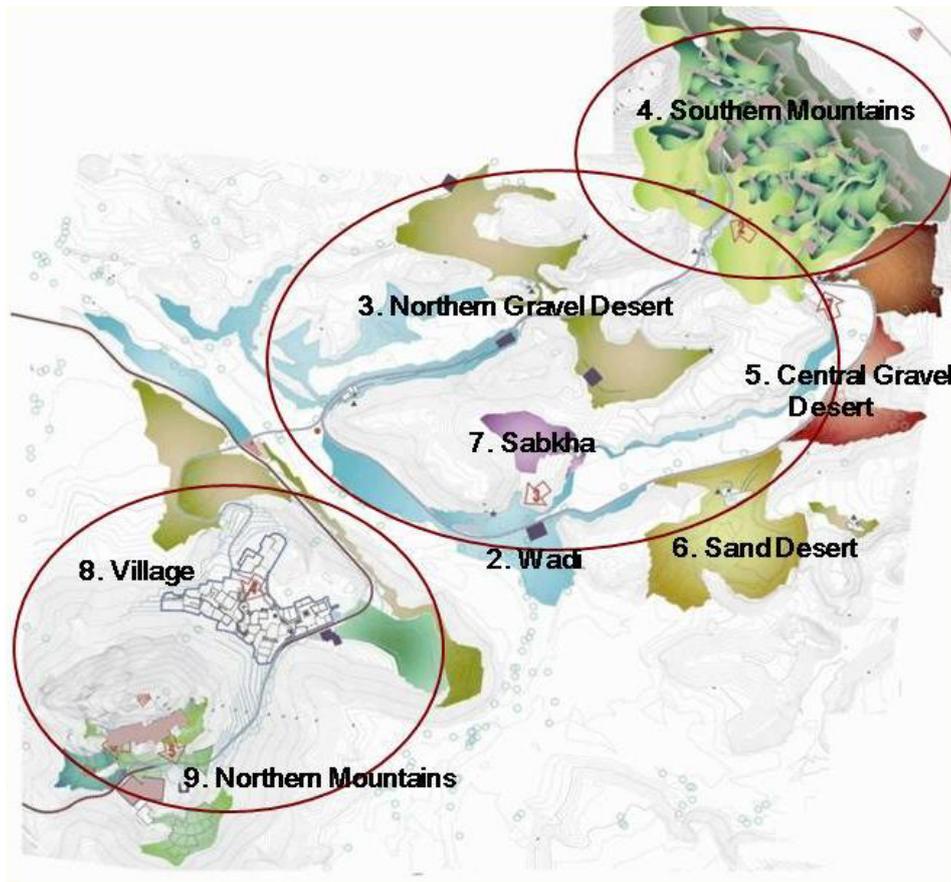


Fig. 2. Oman covers 309,500 km<sup>2</sup> and encompasses a diverse range of topography.

## Flora of Oman

Oman is home to 1,200 species of plant, of which 79 are endemic, found nowhere else in the world. About 22% of Oman's plants are range-restricted or face threats such as over-grazing, inappropriate development, off-road driving and climate change.

The Oman Botanic Garden botany team collects plants as seeds and cuttings through its regular field trips; over 250 expeditions have visited all corners of the country since 2006, each one collecting, monitoring and recording invaluable data about Oman's plants and environment. Seeds are brought back to the garden, cleaned and stored in the seed bank until they are germinated by the propagation team in the nursery

From 0 plants in 2006, the number of plants at the nursery has grown to 75,298 plants of 694 species in 2013. This is the largest documented collection of Arabian plants in the world.

The Oman Botanic Garden will form a key part of Oman's response to the Convention on Biological Diversity in particular the Global Strategy for Plant Conservation.

## THE PROJECT – WHAT ARE WE DOING?

### Master Plan-Key Components

**1. Habitats (outdoor): under Construction.** Oman's flora will be displayed within a series of naturalistic habitats. The first of these, the Northern gravel desert, was planted in March 2010 with native plants carefully positioned to reflect the natural habitat as closely as possible. Other outdoor habitats will include wadi, sabkha, central fog desert and sand desert (Figs. 3-8).



Fig. 3. Northern gravel desert habitat, planted 2010.



Fig. 4. Sabkha habitat.



Fig. 5. Central desert habitat.



Fig. 6. Wadi habitat.

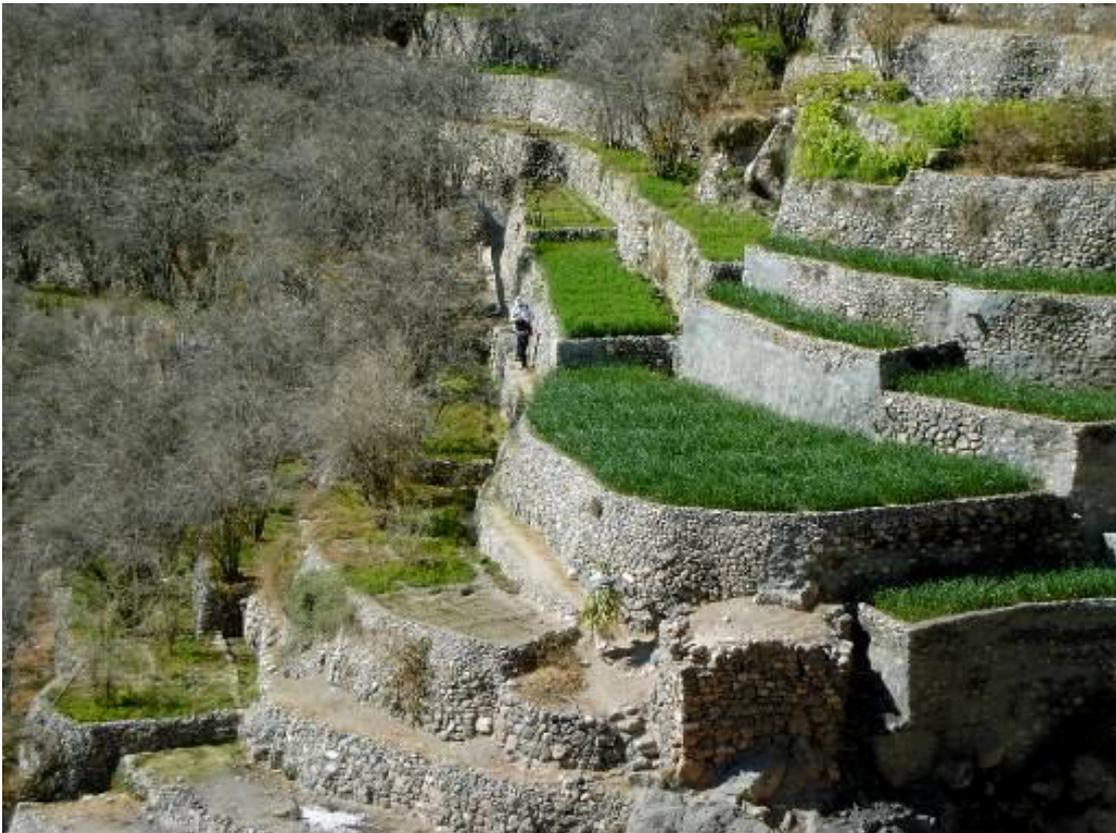


Fig. 7. Agricultural terraces in Jabal Akdar.



Fig. 8. Dhofar monsoon season.

## **2. Habitats (Indoor): Northern and Southern Biomes — Construction Not Started.**

The plants of Dhofar, Jabal Akhdar, and Musandam will be housed in “biomes” to ensure they have the controlled climate conditions they require. In the biomes of Dhofar plants the visitors will experience the Khareef (or monsoon season) at any time of year.

### **ORIENTATION CENTRE/RESEARCH CENTRE/FIELD STUDIES CENTRE**

Currently under construction, this complex includes ticketing and exhibition areas for visitors, with cafes, plant shop and gift shop, laboratories, lecture theatre, offices, library, herbarium, seed bank, classrooms, and accommodation for visiting students and researchers.

### **Sustainability**

Oman Botanic Garden will follow sustainability principles in its design, construction and operation. To protect our unique plants and precious environment, we need to live in a more environmentally-friendly, or sustainable, way so that our lives do not damage the environment that supports us.

We are aiming for international recognition through the LEED (Leadership in Energy and Environmental Design) certification process. This demonstrates that we are using water efficiently, using recycled, locally produced and safe materials, minimising energy use, investing in renewable energy sources and sharing what we learn with our visitors.

### **Existing Facilities**

**1. Nursery.** The first part of the botanic garden built on site, this state-of-the-art facility includes a shade house (3000 m<sup>2</sup>), an outside standing area (3000 m<sup>2</sup>), four polytunnels (4000 m<sup>2</sup>), seven glasshouses (2600 m<sup>2</sup>), a propagation shed, offices and meeting room.

**2. Other Facilities on Site.** Herbarium, seed bank, and extensive electronic database that keeps track of the plants, where and when they were collected, environmental conditions in the natural environment, how they are grown as well as how much water or fertilizer they need. Each plant has its own complete record — a plant ‘passport’ which links it the records of its history within the database.

## Departments

**1. Living Collections.** One of the key objectives of the garden is to collect, cultivate, and display Omani plants, the majority of these plants had never been cultivated before, which makes it very challenging. Diversity is of major importance, so collections are mainly from seeds, however cuttings and whole living plants are collected for certain species.

**2. Propagation.** The propagation team are responsible for the propagation of plants either by seeds or cuttings. Prior to germination seeds either directly sown or soaked in water for 24 h and then directly sown into standard seed trays with potting media (fine peat moss cover with vermiculite or fine sand depending on the species). Smaller seeds are broadcast into the trays, but larger seeds are spaced using a sowing template in a tray. The seed trays then labelled (each seed has a unique propagation number in the BG base programme) and kept in the propagation house. The seed trays are watered daily, being soaked in large trays, to enable water to penetrate from the bottom up. If germination occurs, young plantlets are pricked-out after reaching 50-100 mm in height. Once the seedlings have developed strong roots then they are ready to be transferred into larger pots.

Cuttings are prepared and grown in a medium (peat moss and perlite (1:3, v/v). In some cases sieved washed peat moss and wadi sand (1:2, v/v) are used. Cuttings are placed on benches in the propagation house. Mist is applied from the top to keep the cuttings fresh and heated from the bottom, (winter only) in order to enhance rooting.

**3. Production.** Once seedlings or cuttings are strong enough they are transferred into a polythene tunnel or shade structure. The standard Oman Botanic Garden potting medium, consists of peat moss, vermiculite, and loam soil (3:1:1, by vol.) and slow release fertilizer. All plants are then placed in a cooled, 70% shaded greenhouse, and watered daily. For succulents, desert perennials, and bulbs, different soil mixtures were developed. Succulent mixtures comprise of coarse gravel and vermiculite (1:1, v/v). Desert perennials — standard Oman Botanic Garden mix (1:1, v/v), and for bulbs — Oman Botanic Garden standard mix plus coarse vermiculite and good quality loam soil (1:2:1, by vol.).

Big trees are transferred in air pots until they are planted out on site. Air pots have had a positive impact on growth rates and longer term survival of large trees and shrubs. The perforations in the pots allow for air-pruning so protruding roots are effectively dried out when they come into contact with the outside environment. The air flow also allows the roots to stay cooler, which is vital when there are high summer temperatures (48°C) in the nursery.

Transplanting and rescue of mature trees from degraded or disturbed sites is ongoing. The team works in conjunction with a number of different contractors which include visits to road construction projects, water pipeline sites etc. to identify large trees for rescuing. Large trucks and construction machinery are used to excavate mature specimens that would otherwise have been destroyed. The survival rate is about 75%. Examples of rescued plants include *Olea europaea*, *Dracaena serrulata*, (endangered) *Boswellia sacra* (frankincense), *Commiphoras*, and *Adenium obesum* (desert rose). To date over 1000 mature trees have been rescued.



Fig. 9. Propagation at Oman Botanic Garden.



Fig. 10. Air pots.



Fig. 11. Transplanting and rescue of mature trees.

**4. Plant Health.** Plant health is important in the fight against pests and diseases. Chemical use is minimised and is based on low-toxicity. The use of strong organo-phosphates is not permitted on the site. Instead more environmentally friendly pesticides, like Indian neem cakes (*Azadirachta indica*) and lemon and chilli grass extracts, are used. In the future it is hoped that biological control agents will be used to effectively combat all pests and diseases. Integrated pest management helps reduce pesticide use. Good hygiene is of paramount importance to good plant health. Infestation levels are continuously monitored. Different coloured insect sticky traps help to monitor and trap insect pests.



Fig. 12. coloured insect sticky traps.

### **Botany and Conservation**

This department includes; seed bank, herbarium, ethnobotany, taxonomy, field work, and conservation.

A fundamentally important part of the botany team duties is conducting plant collection trips around Oman. They record information related to the plants, including date of collection, name(s) of collectors, location (GPS), locality, type of material, life form, soil type, associated flora, local use, herbarium specimens. All plant and habitat data are stored on the garden's extensive plant database (BG-Base).



Fig. 13. Botany team duties include conducting plant collection trips and recording information related to the plants.

The current temporary seed bank is responsible for the cleaning and storing of all accessioned seeds. The OBG seed bank currently holds a vitally important ex-situ

collection. The seed bank manages the core of the garden's living collection and is a repository of a vast amount of regional plant genetic diversity.



Fig. 14. Current temporary seed bank.

Plant identification and taxonomy form a vital part of the departments function. New collections are added all the time, in many cases new local, national, or regional records are found.

Ethnobotany team are documenting and digitising Oman's long history and vast experiences with traditional plant uses. The team conduct plant collecting field trips and audio and video interviews with traditional herbalists, crafts people and farmers. All of the information collected is being inputted on to the garden's plant database.



Fig. 15. Ethnobotany team is documenting and digitising Oman's long history.

Oman Botanic Garden's Herbarium is the third largest collection in Oman, housing approximately 2,700 specimens focusing mainly on Oman's native species. From 2006 till now they have nearly 1,500 specimens belonging to 91 family, and 691 plant species. All the specimens are accessioned in a computerized database. The collection is organized alphabetically by family, alphabetically by genus within family and alphabetically by species within genus.



Fig. 16. Oman Botanic Garden staff collecting native plants.

#### **EDUCATION AND COMMUNICATION**

To engage with the public, Oman Botanic Garden produces and distributes a regular newsletter, both hardcopy and via email, to several thousand supporters. In addition, a temporary visitor centre is used for pre-booked visiting groups and school parties.