

## Status of *in situ* and *ex situ* plant conservation in the Sultanate of Oman, Southern Arabia

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### Oman as a regional centre of plant biodiversity

Oman, southern Arabia, has a high percentage of endemics, with 79 species being strictly endemic to the country, and 46 species near-endemics. Sixty-five species are regional endemic to the Arabian Peninsula. Southern and central Oman have been identified as one of the world's key 35 biodiversity hotspots – areas that contain at least 1500 endemic species of vascular plants (> 0.5% of the world's total) (Mittermeier 2005) and the areas was added to the 'Horn of Africa' hotspot. This hotspot is estimated to contain c. 5000 vascular plants species of which 2750 (c. 55%) are endemic.

Oman has an active conservation policy and is leading conservation efforts in Arabia. A detailed study containing proposals for systems of nature conservation areas has been produced already 20 years ago (Clarke 1986). Unfortunately, until today the majority of rare and threatened plant species and their associated vegetation types are not represented with protected areas. Only few reserves for the coastal lagoons have been created for the protection of natural vegetation *per se*.

The areas included in the global biodiversity hotspot cover the monsoon-affected escarpment mountains of southern Oman and the surrounding dry gravel deserts. Isolation in space, time and climate has lead to plant communities dominated by endemics (Patzelt in review). These vegetation types are exclusively found in southern Arabia, but do not receive *in situ* conservation *per se*.

With the present incomplete protected areas system in the 'Horn of Africa' hotspot, current conservation activities are inadequate for long-term preservation of its biodiversity. The *Oman Plant Red Data Book* publication (Patzelt, in press) and the newly to be established *Oman Botanic Garden* (Diwan of Royal Court, Office of the Advisor for Conservation of the Environment) are therefore crucial contributions towards approaches that will be required to retain the country's rich botanical heritage.

Of the 261 species included in the *Oman Plant Red Data Book*, 190 species (15.8%) are range-restricted and 71 additional species (5.9%) are threatened non-endemic species. Of the total of 190 range-restricted species, 79 species (6.6%) are strictly endemic to the country, and 48 species (3.8%) are near-endemics. Sixty-five species (5.4%) are regional endemic to the Arabian Peninsula (Figure 1).

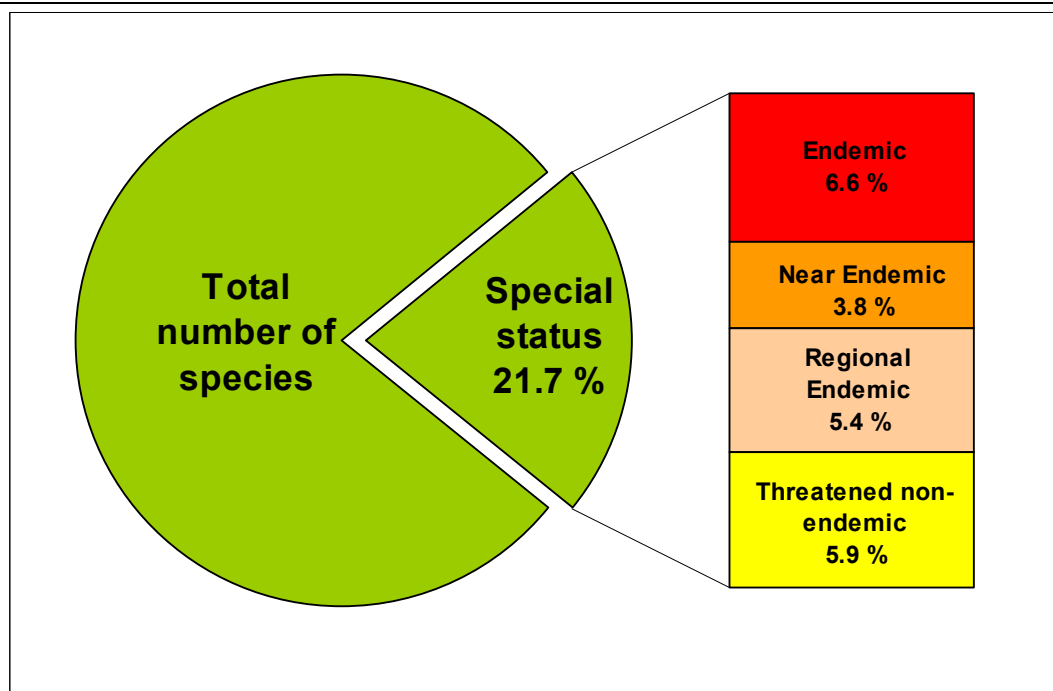


Figure 1. Proportion of plant species in Oman with special status compared to the total number of plant species

### ***In situ* Conservation**

Species management are actions directed at managing or restoring species, focused on the species of concern itself. Until today, no such actions are taking place in Oman, although there is growing recognition that the long-term persistence of protected areas, primarily for the protection of flora and vegetation, and the threatened species within them, depend on active management. It is vital to develop species management plans, e.g. for ‘flagship’ species, such as the Juniper (*Juniperus excelsa* subsp. *polycarpus*) in the northern mountains and *Dracaena serrulata* in Dhofar and for threatened and endemic species. ‘Flagship species’ can stimulate conservation awareness and should receive priority in species management programs. Monitoring of populations of species, which are evaluated in the *Oman Plant Red Data Book* as Critically Endangered, and Endangered is strongly recommended, but again is not yet implemented.

Although the country-wide overgrazing problem is addressed to some extent by active conservation policies, the problems are not yet solved (Fisher 1998). Government and conservation organisations would need to address this aspect directly by development of grazing system plans and controlling stocking densities. Land protection and land management aimed at threatened plants and fragile vegetation types are urgently needed to alleviate the causes of overgrazing.

For fragile and endangered habitats the development of management plans, strongly focusing on environmental aspects is of crucial importance for the protection of nature. Areas of special importance for flora and vegetation (Clarke 1986) should receive the status of a protected area.

As many baseline data about the distribution area of species and their population sizes are still lacking, detailed botanical surveys throughout the whole country are needed to determine estimates of critical species. All

initiatives and projects need to be underpinned by accurate data for the identification of past and present distribution of threatened species, the size and state of the remaining populations and an understanding of their genetic variability and biology. Monitoring of individual species, their populations and habitats and the sharing of this information is essential if conservation measures are to be successful. It is aimed that the *Oman Plant Red Data Book* will contribute to those targets.

Restoration programmes may involve the propagation and replanting of selected species within their original or nearby habitats. Many of such projects often require long periods of time before they can become self-maintaining. To date, only one project is undertaken in Oman, on restoration, conservation and management of mangrove, with the Ministry leading responsibility for following up the recommendations.

In order to gain an understanding of which habitats are the most important for the species on the *Oman Plant Red Data List*, the major habitats in which each species on the Red List occurred were recorded. The analysis clearly indicates that range-restricted and threatened species are not distributed randomly, but are concentrated in certain habitats (Figure 2).

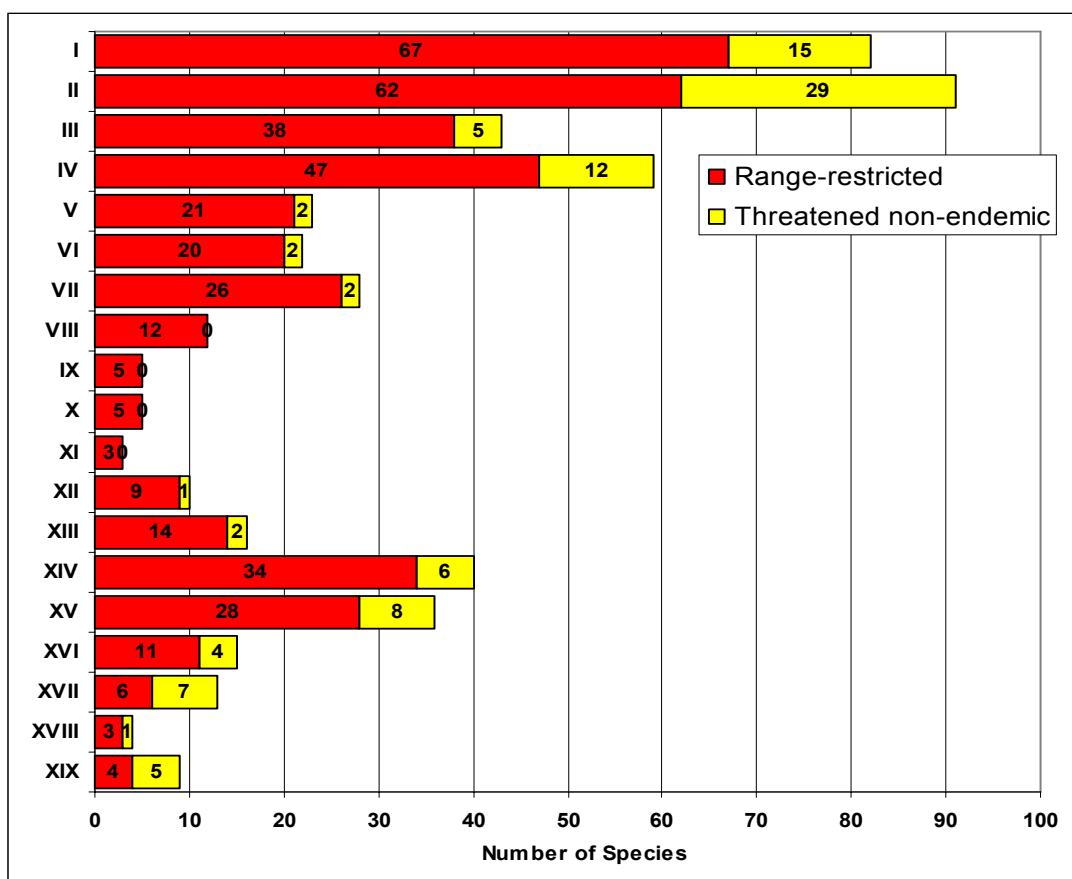


Figure 2. Distribution of range-restricted and threatened non-endemic species in habitats (absolute values indicated on each column; I coastal zone, dry hills and wadis in Dhofar; II *Anogeissus dhofarica* forest (including the *Acacia-Commiphora* woodland) in Dhofar; III *Euphorbia balsamifera* cushion scrub, Dhofar; IV *Dracaena* scrubland, Dhofar; V *Boswellia sacra* zone, Dhofar; VI Desert Plateau, Central Oman; VII Escarpment, Central Oman; VIII Plains, central Oman; IX Ar Rub Al Khali; X Eastern Sands; XI Sabkha; XII northern wadis; XIII northern plains; XIV northern foothills

and lower mountains (including *Acacia tortilis* woodland); XV= *Olea-Sideroxylon* zone, northern Oman; XVI *Juniperus excelsa* zone, northern Oman; XVII Musandam plains and mountains; XVIII coastal vegetation; XIX Oasis vegetation)

A species can occur in more than one habitat and so the values within a habitat type are non-exclusive. But many species are almost entirely dependent on one or two main habitat types. The habitat with the highest concentration of range-restricted and threatened non-endemic species is the semi-deciduous fog-affected *Anogeissus dhofarica* forest in southern Oman. This plant community is a species-rich unique palaeo-African relict association of the xerotropical tertiary Arabian vegetation. It comprises at least 300 species, 32% being range-restricted and/or threatened. Also, the *Themeda quadrivalvis* savanna revealed an endemic plant community characterised by relatively high species richness, with a moderate portion of species being endemic (10%) (Patzelt in review). The analysis indicates the richness in plant diversity of the coastal zone and dry lower hills in southern Oman, and the fog-affected *Euphorbia balsamifera* cushion shrub and *Dracaena serrulata* scrubland. All these plant communities are restricted in their worldwide distribution to the monsoon affected area of the Dhofar Fog Oasis (Miller 1994).

The analysis shows that there are some key habitats that constitute clear conservation priorities. Southern Oman is the richest region of the country in terms of floristics, and also contains the majority of range-restricted and threatened non-endemic species. *In situ* conservation of extensive areas of these globally unique habitats in the monsoon-affected fog oasis is essential if we are to prevent the loss of a large number of plants, most of which are on a global scale totally dependent on this habitat for survival.

## **Ex situ Conservation**

South West Asia and the Middle East only have a small number of botanic gardens, although the area accounts for an estimated 58,500 species ([http://www.bgci.org.uk/botanic\\_gardens/.html](http://www.bgci.org.uk/botanic_gardens/.html)). Thus, botanic gardens worldwide do not adequately reflect the Arabian plant diversity, and number of accessions is the smallest of all botanic garden living plant material ([http://www.bgci.org.uk/botanic\\_gardens/.html](http://www.bgci.org.uk/botanic_gardens/.html)). A range of logistical constraints precludes incorporation of Arabian plant species into Botanic Gardens and accordingly, reduces their direct contribution to *ex situ* conservation.

In Oman, only a limited amount of *ex situ* conservation has been undertaken. In the small Botanic Garden of Sultan Qaboos University baseline propagation data for *ex situ* conservation were gathered from propagation experience with plants that to a large extent have so far not been propagated anywhere else. The project suffered under typical restraints of a “developing” country with regards to *ex situ* conservation: no horticultural experience on propagation of native plants was available, and the garden lacked from funding and manpower (Patzelt in review)..

The main aims of this project were a) to gain knowledge on propagation of native plants using simple techniques b) to propagate threatened plants species with the long term aim of *ex situ* conservation c) to implement those aims within a limited time of three months at low financial resources and d) to raise environmental awareness in a country not having a history of Botanic Gardens. In conclusion, all four aims were reached and the project therefore can be used as an encouraging example that even under limited resources *ex situ* conservation can be obtained.

One of the most appropriate actions for safeguarding threatened species is to improve propagation techniques and to encourage cultivation. As some plants are increasingly rare, knowledge on propagation of threatened and range-restricted taxa has become essential to conserve the present phytodiversity of the country.

This project is to enhance the effective role a Botanic Garden can play, which so far is the only representative in a vast area, in the light of the convention on biological diversity. The gained experience on propagation will be useful for people working on threatened plant collections and particularly important for the development of the proposed *Oman Botanic Garden* (BGCI 2006), which is currently in the stage of detailed design.

The implementation of this iconic new *Oman Botanic Garden* is coordinated by the Diwan of Royal Court, Office of the Advisor for Conservation of the Environment. The *Oman Botanic Garden* will act as a haven for native plant species. It is intended that the *Oman Botanic Garden* will implement a conservation strategy, where threatened species and habitats can be targeted and where *ex situ* conservation can be practised. Focussing on native plants only, the *Oman Botanic Garden* is unique worldwide and will be able to contribute to *ex situ* conservation of Oman's threatened plants.

After one year, 30000 native plants have been propagated, all from material collected in the wild and for most of them no or little information on propagation information is so far available. This unique living collection already provides opportunities for research into the biology of threatened and/or endemic plant species and for environmental education. In turn, this can provide critical knowledge for the success of *in situ* programmes.

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