

## THE WADI JAWRAH MIMUSOPS GARDEN: A NEW BOTANIC GARDEN IN SAUDI ARABIA

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### ABSTRACT

The Wadi Jawrah Mimusops Garden is a new botanic garden which is under construction on a 25ha site in Jizan province, southern Saudi Arabia. The garden is being established around a stand of 14 *Mimusops laurifolia* (Forssk) Friis trees, the second largest stand of this species in the Arabian Peninsula. The major objectives of this garden are to conserve these trees, recreate the rare valley forest habitat of which they are characteristic, establish a nursery for the propagation and ecological restoration of rare species, and to provide a valuable resource for conservation education in the region. This paper covers these aims, the conservation importance of *M. laurifolia* and valley forest and some challenges and recommendations for the new garden.

### THE SITE

The Wadi Jawrah Mimusops Garden, which is currently under construction, is to be a new botanic garden for the Kingdom of Saudi Arabia. Wadi Jawrah is situated 70km from the southern city of Jizan (located at approximately 17°21'N 43°08'E) in the Jabal Fayfa area of Saudi Arabia (see Fig.1). The site is made up of 25ha of largely cleared land, which lies at an altitude of 850m next to the small hamlet of Ad-Dair. The proposed garden is adjacent to the wadi channel of Wadi Jawrah, which flows for much of the year. The garden area is protected from the flooding of the wadi by a 3m high wall which runs the length of its western and southern boundaries. This strategy of enclosed protection was initially chosen as a pragmatic

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solution to prevent the erosion of soil from the base of the *Mimusops* trees by the wadi stream (see Fig. 2), a process which is occurring in other wadi valleys in Saudi Arabia.

The locality of Wadi Jawrah is significant because it holds the largest Saudi population of the regionally rare tree species *Mimusops laurifolia*. There is a group of 14 mature trees on the wadi side and it is split into two small sub-populations; one with 10 trees next to a bankside spring (see Fig. 3), and another four trees, closer to the wadi bed, approximately 200m away. The tallest individuals in the first grove reach over 35m high, making these the tallest trees in the whole of the Arabian Peninsula. Although there is no regeneration of *Mimusops* in Wadi Jawrah, this site is of great importance for the conservation of this endangered tree species. As well as *Mimusops laurifolia* the site also holds a number of other tree species including *Ficus vasta* Forssk, *Tamarindus indica* L., *Acacia ehrenbergiana* Hayne and the Arabian endemic *Acacia johnwoodii* Boulos, all of which are species found in south west Arabian valley forest.

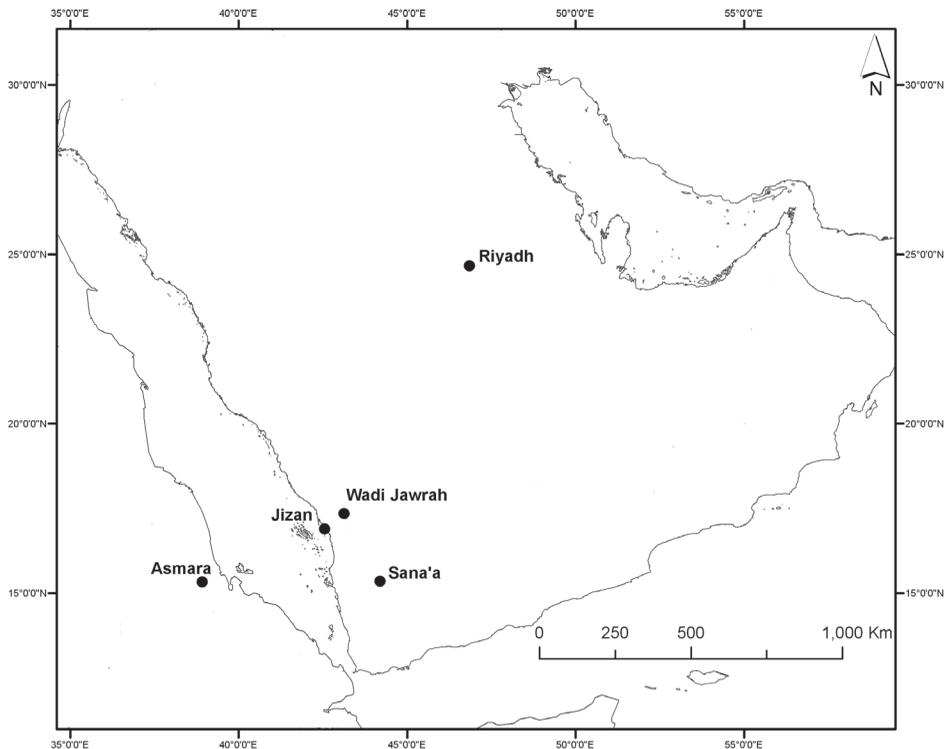


Fig. 1 Wadi Jawrah is situated within the tropical region of south west Arabia, closer to north east Africa than the central regions of the peninsula.



Fig. 2 *Mimusops laurifolia* protected from soil erosion in Wadi Jawrah. Photo: Matthew Hall.

#### THE IMPORTANCE OF *MIMUSOPS LAURIFOLIA* AND SOUTH WEST ARABIAN VALLEY FOREST

The valley forest of the south west escarpment mountains is one of the most interesting plant habitats in the whole of the Arabian Peninsula. Studies from remaining valley forest sites in Yemen describe this vegetation as being dominated by a dense evergreen canopy of mature trees reaching 30m (Hall *et al.*, 2008; 2009) (see Fig. 4). This is one of only two closed forests in Arabia, the other being the Hawf/Dhofar wet woodlands of the southern coast (Miller & Morris, 1988). Like the forest of Dhofar, the valley forest of south west Arabia is very rare. Although Hepper and Wood (1979) claim that valley forest once covered much of south west Arabia in the Miocene, only small fragments of valley forest survive. These are found in isolated valleys between 500 and 1000m



Fig. 3 A 360° photographic panorama of the largest stand of *Mimusops laurifolia* trees in Saudi Arabia, Wadi Jawrah. Photo: Oliver Collier & Matthew Hall.

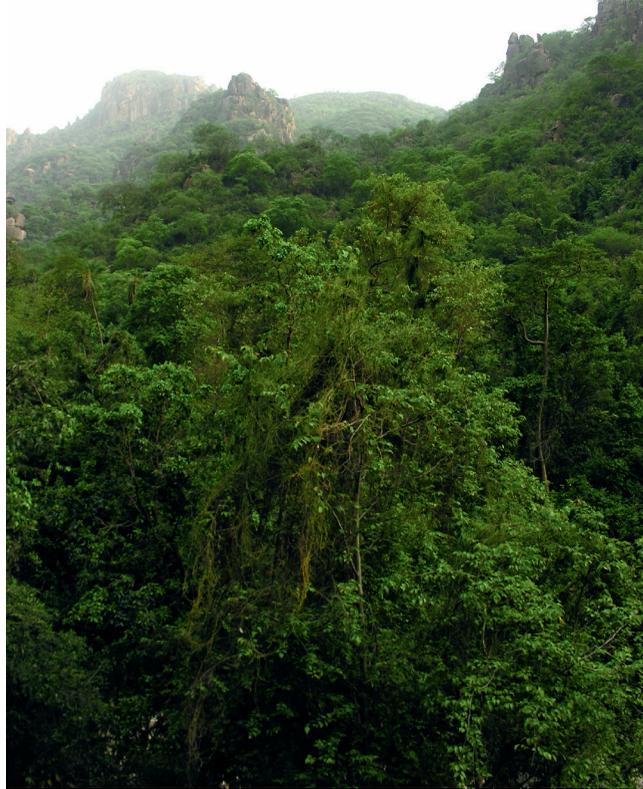


Fig. 4 The dense, closed canopy valley forest in Jabal Bura, Yemen. Photo: Anthony Miller.

which predominantly have a west/southwest aspect and receive locally high levels of orographic rainfall, falling in the spring and late summer. The major recorded sites for valley forest are on Jabal Raymah, Jabal Melhan (Milhan) and Jabal Bura (Yemen), and on Jabal Fayfa and Lejib Gorge (Saudi Arabia) (Hall *et al.*, 2009; Al-Turki, 2004).

Common trees recorded from valley forests in south west Arabia are *Combretum molle* R.Br. ex G.Don, *Terminalia brownii* Fresen., *Mimusops laurifolia*, *Tamarindus indica*, *Trichilia emetic* Vahl and the Arabian endemic *Acacia johnwoodii*. Large riparian tree species such as *Ficus ingens* Miq., *F. vasta*, *F. sycomorus* L. and *Breonadia salicina* (Vahl) Hepper & J.R.I.Wood are frequent along the wadi channels. Common shrubs include *Carissa spinarum* L. (syn. *C. edulis* Vahl), several *Grewia* species including *G. schweinfurthii* Burret, *G. tembensis* Fresen. and *G. villosa*, several species of *Maytenus*, *Ehretia cymosa* Thonn, and *E. obtusifolia* Hochst. ex DC., *Premna resinosa* Schauer and *Teclea nobilis* Delile. Under the dense tree and shrub cover there is an inconspicuous ground flora. Studies in Yemen record approximately 170 species from the valley forest habitat making it one of the richest plant habitats in the region (Hall *et al.*, 2008). The valley forest canopy is composed of taxa with varying distributions, with Arabian

endemics, Sudano-Zambezian, Somalia-Masai, Afromontane, widespread Afrotropical and transitional species present. Floristically the valley forest is considered as a 'relict forest' which has acted as a mesic refuge for elements from different regional centres of endemism (Hall *et al.*, 2008; White, 1983). Although similar forests occur across the Red Sea in Eritrea, there are significant differences in the floristic composition of north east African and Arabian valley forests, which have led to the consideration of the Arabian forests as unique (see Hall *et al.*, 2009).

One of the most interesting features of this vegetation in south west Arabia is the occurrence of 18 species which are largely restricted to the valley forest (see Table 1). In Yemen, Wood (1997) and Hall *et al.* (2008) consider these to be indicators of valley forest. One of the most defining features of many valley forest sites is the presence of the regionally restricted tree species *Mimusops laurifolia*, which is found in both Arabia and north east Africa (Djibouti, Eritrea, Ethiopia, Somalia) and forms part of a small element restricted to the transition zone between Afromontane and Somalia-Masai elements (Friis, 1992). There are approximately 100 individuals of *M.*

Species	Family	Distribution Outside Arabia
<i>Antiaris toxicaria</i> Lesch.	Moraceae	Tropics
<i>Diospyros mespiliformis</i> Hochst. ex A. DC.	Tiliaceae	Tropical and Southern Africa
<i>Triumfetta pentandra</i> A. Rich.	Tiliaceae	Africa and Asian Tropics
<i>Mimusops laurifolia</i> (Forssk.) Friis	Sapotaceae	Horn of Africa
<i>Bauhinia tomentosa</i> L.	Leguminosae	Tropics
<i>Piliostigma thonningii</i> (Schumach.) Milne-Redh.	Leguminosae	Tropical and Southern Africa
<i>Bridelia scleroneura</i> Müll. Arg.	Euphorbiaceae	Somalia-Masai
<i>Meineckia phyllanthoides</i> Baill.	Euphorbiaceae	Somalia-Masai
<i>Croton macrostachyus</i> Hochst. ex Delile	Euphorbiaceae	Tropical and Eastern Africa
<i>Bersama abyssinica</i> Fresen.	Melanthaceae	Tropical and Eastern Africa
<i>Allophylus rubrifolius</i> (Hochst.) Engl.	Sapindaceae	Sudano-Zambezian
<i>Ozoroa insignis</i> (Del.) O. Kuntze	Anacardiaceae	Sudano-Zambezian
<i>Nuxia oppositifolia</i> (Hochst.) Benth.	Buddlejaceae	Sudano-Zambezian
<i>Brucea antidysenterica</i> J.F. Mill.	Simaroubaceae	Somalia-Masai/Afromontane
<i>Gymnema sylvestre</i> (Retz.) R. Br. ex Schult.	Apocynaceae	Africa and Asian Tropics
<i>Stereospermum kunthianum</i> Cham.	Bignoniaceae	Tropical and Eastern Africa
<i>Aneilema woodii</i> R.B. Faden	Commelinaceae	Yemeni Endemic
<i>Endostemon gracilis</i> (Benth.) M. Ashby	Labiatae	Somalia-Masai

Table 1 List of 18 species largely restricted to the valley forest.

*laurifolia* remaining in Arabia and there are only four sites from which 10 or more individuals have been recorded (Jabal Gedu, Wadi Tawila; Jabal Bura, Wadi Rijaf, Wadi Basal; Wadi Jawrah) (Hall *et al.*, 2010). At historically important valley forest localities in Yemen, such as Jabal Melhan and Jabal Raymah, the valley forest is generally heavily degraded (Hall *et al.*, 2009). *Mimusops* is heavily used for building materials and population numbers have declined rapidly over the past decade (Hall *et al.*, 2010). In Saudi Arabia, Al-Turki (2004) notes that the valley forest on Jabal Fayfa is generally heavily degraded and that *Mimusops laurifolia* is threatened locally with extinction. As a result of its fragmented distribution and its declining habitat, *Mimusops laurifolia* has been assessed for the IUCN Red List as regionally Endangered (Hall *et al.*, 2010).

In Arabia, the largest population of *M. laurifolia* is found within the most extensive area of valley forest on Jabal Bura (Yemen) where approximately 40 trees have been recorded. Although there is no regeneration of *Mimusops* in Wadi Jawrah, this site is of great importance for conservation as it represents the second largest stand of this regionally endangered tree species.

#### WADI JAWRAH MIMUSOPS GARDEN – VISION AND GOALS

The new botanic garden in Wadi Jawrah is envisaged as a unique resource for both *ex situ* and *in situ* conservation in the south west Arabian region. Wadi Jawrah will be the first botanic garden in Saudi Arabia that will effectively combine *ex situ* and *in situ* conservation strategies for both rare species and habitats and will be the first site of *in situ* and *ex situ* conservation in the Arabian Important Plant Area programme (Al-Abbasi *et al.*, 2010). The presence of *Mimusops* on the site indicates that the area once held significant cover of valley forest and one of the major aims of this project will be to restore valley forest (including *M. laurifolia*) to the site, within the setting of a botanic garden. However, with the development of a horticultural nursery in the Wadi Jawrah Mimusops Garden, valley forest conservation will also be pursued in an *in situ* setting. A programme is planned to propagate and restore valley forest species, including *Mimusops*, to areas suitable for valley forest, including previously degraded sites in the Jabal Fayfa region. This programme will involve planning for the long-term protection of these sites as part of efforts to strengthen traditional conservation practices centred around *himas* (Llewellyn, 2003, Al-Abbasi *et al.*, 2010).

The primary objectives of the Wadi Jawrah Mimusops Garden are to:

- Conserve the largest population of *Mimusops laurifolia* in Saudi Arabia
- Create an *ex situ* area of valley forest vegetation in Saudi Arabia
- Establish a centre for conservation education and awareness
- Create a centre for botanical research and horticultural expertise in the region
- Construct a nursery for regionally rare valley forest species and a centre for ecological restoration of valley forests

### CHALLENGES

Initial landscaping work has been done to secure the Wadi Jawrah Garden site from flooding and construction has also begun on a number of buildings which are earmarked for both interpretation and horticultural/scientific research. At this early stage in the development of the Garden, there are a number of broad challenges to be tackled:

- Producing a landscape plan– identifying the location of defined habitats within the site and producing a list of plant species to be propagated in specific areas
- Establishing horticultural expertise in plant propagation and establishing a plant nursery both for horticultural use within the Garden and also for restoration ecology of valley forest sites
- Developing collection management protocols for all accessions
- Conducting research on the restoration of valley forest habitats, including establishment requirements and the impacts of climatic change
- Initiating moves to provide education and interpretation materials in the on-site facilities. Although interpretation is often neglected until the final stages of a project, in order to yield good results, it is important that is considered early on
- Developing management strategies and policies. Orientate the garden within the national, regional and international botanic garden network

### RECOMMENDATIONS

With the knowledge of the current moves to establish botanic gardens across the Arabian Peninsula (Al-Farhan *et al.*, 2008) and following a site visit to Wadi Jawrah in February 2009, a number of recommendations can be made on the challenges faced by the Wadi Jawrah Mimusops Garden.

#### *Management Policies*

All botanic gardens, however small and new, need to have a set of guiding objectives, policies and strategies that document and communicate the interests of the garden and provide the context within which they operate. These do not have to be long and complicated, they simply need to be a cascading series of short statements or bullet points for the benefit of staff, funding bodies, partners and the general public explaining what the garden stands for, what it is trying to achieve and how it will operate.

These have already been established and are described above for the Wadi Jawrah Mimusops Garden. However, they need to be formalised into a document which could start with a short description of why the Garden was created followed by a Mission Statement stating the purpose of the Garden. This could be followed by a Values Statement which states the corporate culture of the Garden and its staff. It might

include some bullet points on the desire to combine *in situ* with *ex situ* conservation or about the importance of conserving *Mimusops* in the Garden or about wanting to be a mouthpiece for local conservation or community involvement. This can be followed by a Vision Statement which should connect closely with both the Mission Statement and the Values Statement and can be viewed as a short summary of the Garden's corporate strategy.

Strategic Themes can then be used to make clear a number of objectives that should be delivered by staff and might include tasks such as improving visitor facilities, initiating the *in situ* and *ex situ* conservation measures or improving education programmes.

These strategic statements can also cross reference to Strategic External Influences which might come from local or national government programmes or initiatives. They may also come from international conventions or agendas.

The development of these statements may seem time-consuming and bureaucratic to develop. However, they need only be short paragraphs and they have the benefit of encouraging managers to articulate precisely what they are trying to achieve and why. Such management frameworks need to be in place for the Garden to function effectively.

The establishment of a clear set of principles under which the Garden can operate means that the messages communicated to visitors and staff about the purpose and function of the Garden will flow. The manifestations of these in logos and branding will also be consistent with this message. These are important in communicating the Garden's message and demonstrate the professionalism of the Garden.

Other essential management policies and papers include budgets, a manpower plan, a capital projects plan, health and safety documentation and specific work plans for each department or work area. It should be emphasised again that these documents do not need to be long and complicated; rather, they should be short and concise.

While these management policies are important, no garden exists (or should exist) in isolation, either from other botanic gardens or from other strategic partners. Other gardens offer a wealth of knowledge and 'know how' and are usually more than happy to share techniques and experiences. The *Mimusops* Garden should seek out other botanic gardens on the Arabian Peninsula and seek their advice and help in dealing with local issues. Currently there is no regional network for botanic gardens in Arabia but, with several new ones being created, now is perhaps the time to consider creating a network. Likewise it is important for them to join Botanic Gardens Conservation International (BGCI), the major networking organisation for botanic gardens. By joining meetings and conferences and in receiving BGCI's journals and mailshots, the *Mimusops* Garden will begin to feel part of the wider botanic garden community and will start to appreciate the issues and challenges facing botanic gardens.

Outside of the botanic garden community, it is important for the Garden to develop formal and informal linkages to government departments, agencies and NGOs. Partnership working is often far more effective than working in isolation as it brings extra skills and knowledge to the project or problem in question.

*Landscape design, Horticulture and Restoration*

As with management policies, landscape plans, habitat layouts and horticultural expertise can be generated by building collaborative links with other internationally recognised botanic gardens, such as the Royal Botanic Garden Edinburgh (RBGE) and the Oman Botanic Garden (OBG).

A Landscape Plan first needs to consider the 'macro' elements, such as the external landscape, topography and natural features. It then needs to consider internal issues and ensure that designs are clearly linked into the overall theme of the garden. Decisions should be taken on the types of plants to be displayed (which derive from the Collection Policy, see below), the scale of the landscaping and the areas of the garden that will have formal planting (such as for display and/or education purposes) and those that will be more natural, to represent native habitats such as valley forest.

Once the themes have been selected then the design of individual beds and areas can be considered. The selection of plant species to be planted within the beds or areas should be made by consulting the Collection Policy. A Collection Policy is a document guiding the development of the Living Collection and should include sections on stakeholders and their needs, plant records, labelling and information standards, design and representation policy, collection types and acquisition and transfer. Appendices can then list recommended species for each area or theme. The value of a good collection policy is that it guides the development of the collection over time and ensures that the range of species represented is appropriate to the purpose and functions of the institution.

The type and number of visitors and how they will use the Garden must be considered (for example for education, research and recreation). These in turn will have an impact on circulation patterns, access, path widths and surface materials. Another important consideration for the landscape is the maintenance it will require. In this environment, highly labour intensive formal areas may not be possible or appropriate.

When the landscape is being created, it is vital that the existing tree plantings are protected and the layout of paths and planted beds must take existing trees into account. Measures to limit damage to the existing trees by men and machines must be carried out, for example by protecting trunks with hessian wrapping, and the whole site must be made fully secure.

Horticultural expertise is vital to the success of any garden and without trained horticultural staff it will be impossible to realise the aspirations for the Garden. If possible, trained staff should be employed, but if this is not possible then existing staff should be trained through a combination of staff exchanges with other gardens, on-site training by gardeners from other gardens and through flexible courses such as the RBGE Certificate in Practical Horticulture which has been designed to be taught in a variety of places and situations.

Connected with the issue of developing a landscape plan, it is important here to note that there are a number of tree species on the Wadi Jawrah Mimusops Garden site which are constituents of valley forest, including *Ficus vasta*, *Tamarindus indica*, *Acacia ehrenbergiana* and large populations of the Arabian endemic *A. johnwoodii* (see Fig. 5).



Fig. 5 An individual of the endemic tree species *Acacia johnwoodii* on the site of the new Wadi Jawrah Mimusops Garden. Photo: Matthew Hall.

These should all be conserved *in situ* and should be mapped onto the landscape plans for the site.

Currently, there are no established nurseries for valley forest species in the Arabian Peninsula, and one of the greatest challenges is planning the physical construction of the nursery and the training of horticultural staff. In the Arabian Peninsula, Patzelt *et al.* (2008) describe how these practical problems can be tackled by building relationships between emerging and established botanic gardens.

In terms of nursery design, many lessons can be learnt from the development of the Oman Botanic Garden. In particular, when designing the nursery, a number of factors should be considered including:

- Number of plants to be produced – is the aim of the nursery to produce plants for populating the garden, or will it also produce plants for reserve collections, re-introduction programmes, and for sale?
- Types of plants – speed of growth, how they are propagated and how much care they require in terms of protected environment
- Water supply for irrigation – quantity and quality of water available, this is a fundamental consideration in arid landscapes

- The budget available
- Availability of materials – for the construction of paths, frames, irrigation systems and greenhouses
- The types and sizes of structures to be constructed – For example is a glasshouse needed, or will a shade house be sufficient?
- Availability of nursery materials such as pots, growing media, fertilizers, tools and irrigation equipment

The development of the horticultural and nursery team is vital to the new botanic garden at Wadi Jawrah, both in terms of defining a staffing structure and building capacity within the team. Practical skills can be developed within the garden through courses such as the RBGE Certificate in Practical Horticulture and such training should be backed up with on-site consultancy as required. It is important that staff from Wadi Jawrah are given the opportunity to visit other nurseries and botanical gardens to see first hand how they operate. Although the climate and plants may be quite different in other botanic gardens, first hand experience of the principles of botanic garden organisation and delivery is very useful for horticultural staff. This model of capacity building is one that is being followed by RBGE in the development of the Oman Botanic Garden and it is working extremely well.

A number of specific horticultural and restoration issues can be solved relatively simply. In order to generate data for the propagation and restoration of valley forest species, once a horticultural team has been established, horticultural experiments need to commence to uncover germination requirements and habitat tolerances. This should be conducted as part of a programme that examines the requirements for restoration of valley forest habitats. Following the findings of Broadhurst *et al.* (2008), seed collection for restoring plant habitats should focus on capturing high quality and genetically diverse seed to maximise adaptive potential, rather than simply focusing on collecting 'local' seed. These findings are particularly relevant in this context because many of the species which are characteristic of south west Arabian valley forest are not actually recorded from the degraded valley forest habitats in Saudi Arabia. Collections of these species would need to be made from valley forest localities in neighbouring Yemen.

### *Botanical Research*

In order to support the planting of valley forest species in the Wadi Jawrah Mimusops Garden, and the restoration of valley forest in nearby habitats, a botanical research programme is also required for the valley forest habitats in Saudi Arabia. The starting point of this programme needs to be work on surveying and mapping the remaining areas of valley forest in Saudi Arabia (see Hall *et al.*, 2009). These areas are still not properly surveyed and hence the extent, distribution and composition of valley forest in Saudi Arabia is still not known. This is also the case for valley forests across the Red Sea in Eritrea. In order to ascertain the importance of the south west Arabian valley

forest for global conservation, similar survey work is required in Eritrea to determine the relationship between the south west Arabian and north east African valley forests. For both Africa and Arabia, this surveying research will be greatly aided by the production of photographic identification guides to valley forest species (Hall & Miller, 2009, in press) (Fig. 6). Such work will also feed into training and capacity building aspects of the new botanic garden's research. Building upon this fundamental inventory and distribution mapping, the threat of dramatic climate change in the Arabian Peninsula (Dawson, 2007) also requires research on the response of valley forest habitats to a changing climate.

#### *Interpretation and Education*

Finally, a number of recommendations can be made in order to provide the best possible interpretation for the new Garden. Fundamentally, interpretation professionals need to be involved in the early stages of construction. This is simply to ensure that the new buildings are best suited to their interpretive and educational functions. Additionally, in order to develop stories about the *Mimusops* trees and the valley forest, it may be necessary to conduct basic sociological research in areas of valley forest. Although the social significance of *Mimusops* is relatively well known in North Africa – *Mimusops laurifolia* is regarded as a sacred tree species of the Ancient Egyptians and branches of the tree have been recovered from the tombs of the Pharaohs (Nicholson & Shaw, 2000) – there is relatively little recorded about the cultural significance of *Mimusops* in Arabia. Not only would such social research be the first in the region, it would provide a valuable basis for the development of educational and interpretive literature. This would complement the



Fig. 6 The bright pink flowers of the regional rare valley forest species *Stereospermum kunthianum*. Photo: Anthony Miller.

horticultural research into propagation of valley forest species and the botanical research aimed at producing photographic identification guides to valley forest plants.

#### SPECIES FOR PROPAGATION

Using the checklist of Arabian valley forest habitat (Hall *et al.*, 2008), the following species are suggested for a provisional planting list for this habitat:

##### **Adiantaceae**

*Adiantum capillus-veneris*

##### **Anacardiaceae**

*Ozoroa insignis*

##### **Apocynaceae**

*Gomphocarpus sinaicus*

*Gymnema sylvestre*

##### **Bignoniaceae**

*Stereospermum kunthianum*

##### **Boraginaceae**

*Cordia africana*

*Ehretia cymosa*

*E. obtusifolia*

##### **Buddlejaceae**

*Nuxia congesta*

*N. oppositifolia*

##### **Capparaceae**

*Maerua triphylla*

##### **Celastraceae**

*Maytenus* spp.

##### **Combretaceae**

*Combretum molle*

*Terminalia brownii*

##### **Commelinaceae**

*Commelina* spp.

##### **Cyperaceae**

*Cyperus alternifolius*

##### **Ebenaceae**

*Diospyros mespiliformis*

*Euclea racemosa*

##### **Euphorbiaceae**

*Bridelia scleroneura*

*Croton macrostachyus*

*Meinekia phyllanthoides*

##### **Flacourtiaceae**

*Oncoba spinosa*

##### **Labiatae**

*Endostemon gracilis*

##### **Leguminosae**

*Acacia asak*

*A. johnwoodii*

*A. laeta*

*Bauhinia tomentosa*

*Clitoria ternata*

*Dichrostachys cinerea*

*Piliostigma thonningii*

*Tamarindus indica*

##### **Malvaceae**

*Hibiscus deflersii*

*Triumfetta pentandra*

##### **Meliaceae**

*Trichelia emetica*

**Melanthaceae***Bersama abyssinica***Moraceae***Antiaris toxicaria**Ficus cordata**F. glumosa**F. ingens**F. sur**F. sycomorus**F. vasta***Myricaceae***Myrica salicifolia***Myrsinaceae***Maesa lanceolata***Oleaceae***Jasminum fluminense**J. grandiflorum***Palmae***Phoenix caespitosa***Rhamnaceae***Berchemia discolor**Ziziphus mucronata***Rubiaceae***Breonadia salicina***Rutaceae***Teclea nobilis***Sapindaceae***Allophylus rubrifoliosus***Sapotaceae***Mimusops laurifolia***Simaroubaceae***Brucea antidysenterica***Solanaceae***Solanum schimperianum***Tiliaceae***Grewia erythraea**G. schweinfurthii**G. tembensis**G. trichocarpa**G. villosa***Ulmaceae***Celtis toka***Vitaceae***Rhoicissus revoillii***Selaginellaceae***Selaginella imbricata*

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