

Developing horticulture protocols for threatened plants from the UK Overseas Territories

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Abstract

Kew's UK Overseas Territories (UKOTs) Programme has an active training and seed collection programme with local partners in most of the UK's sixteen Overseas Territories. Seeds are being banked at the Millennium Seed Bank for long term storage and conservation of these endemic and threatened species, contributing to Target 8 of the GSPC. The strong capacity building element to this programme contributes to Targets 15 and 16 of the GSPC.

Many of the threatened species being collected have never been in cultivation so as part of documenting how to turn these seeds back into plants, horticulture protocols for each of the threatened species are being developed. Some of the collected seed comes to Kew to undergo germination trials and growing experiments in order to document the most effective way of growing these plants to a stage where they can be re-introduced back in native habitats. The protocol is written up, together with a short quick nursery guide for sharing with local partners. These protocols also contribute to Target 3 of the GSPC.

Introduction

The Royal Botanic Gardens, Kew's UK Overseas Territories Programme, has been developing horticultural protocols for threatened plant species for the past 5 years. This directly contributes to Target 3 of the Global Strategy for Plant Conservation (GSPC, 2002).

The UKOTs comprise 16 former colonies that have elected to retain their direct British links and as such form part of the Nation State of the United Kingdom and they are British citizens. Including many remote oceanic islands, the UKOTs contain unique species and habitats. UKOTs biodiversity is included in the UK's signatory of Environmental Agreements, including the Convention on Biodiversity (CBD) and the GSPC, once these agreements have been ratified locally.

Developing horticulture protocols

Individual Territories are quite different; however the GSPC has provided a really useful framework for conservation action and helping UKOTs to implement the GSPC has become the Programme's overarching goal. (UKOTs, 2010). The Programme's overall approach to developing and implementing conservation projects is very practical. All of the projects involve documenting biodiversity to understand what plants are found there; determining the origin of these plants; calculating their distribution, and assessing the main threats, which enables Targets 1 and 2 of the GSPC to be delivered.

With a comprehensive desk study complete, field based activities begin. This usually includes baseline survey and mapping with our in-country partners which give the opportunity to provide hands on training. The focus is on both habitat and species

level information. This enables a better picture to develop of the vegetation and the individual species. All of the field data are captured using handheld computers that geo-reference these data allowing the mapping of species distributions and the undertaking of modelling work as demonstrated in Figure 1 for *Rondeletia buxifolia* (Clubbe *et al*, 2009; Jones, 2008).

Once the necessary baseline information has been obtained, species of the highest conservation priority are targeted. These may be single island endemic species such as *Rondeletia buxifolia* or restricted range species which occur on only a few islands such as *Charianthus purpureus* both from the Caribbean island of Montserrat. The target species may be threatened with extinction globally or extirpation locally as is the case with the national tree of the Turks and Caicos Islands, *Pinus caribaea* var. *bahamensis*. Some species may be at risk due to exploitation such as the Christmas palm, *Pseudophoenix sargentii*, which has been over collected for landscaping in Florida and the Bahamas archipelago. Finally, species may fall into any of the above categories as well as being of some horticultural merit such as the St. Helena endemic, *Trochetiopsis ebenus*.

In situ conservation is supported by a range of *ex situ* conservation activities and the UKOTs team have embarked on a comprehensive seed collection and conservation programme in the Territories which is a natural extension to the Millennium Seed Bank's successful banking of most of the UK's mainland native flora. The field activities are focused on capacity building and securing high quality collections of seeds with associated herbarium vouchers (Figure 2).

In Territories support is given to key developments in botanical infrastructure. This includes the establishment of native species nurseries. These nurseries are encouraging the use of native species in landscaping as a response to the current usage of non-native and, in some cases, invasive species. For example the Falklands Islands native plant nursery, a joint venture between Falklands Conservation and Stanley Growers, is producing native plants for the local market. There are many horticultural introductions including *Berberis microphylla* that have escaped cultivation, become seriously invasive, and are now causing major problems at both a species and habitat level. These nurseries are also establishing *ex situ* collections to be used for reintroduction and restoration such as the native plant nursery on Ascension Island. The Ascension Nursery is growing endemic species for restoration work following invasive species clearance. Endemic fern species, such as *Pteris adscensionis* and *Marattia purpurascens*, which were once abundant on Green Mountain, are being grown in large numbers for reintroduction.

At Kew there are many different nursery facilities providing the ability to grow plants in a range of different growing conditions (Figure 3). Some, like the UKOTs Nursery are small glass houses that enable close control of conditions specifically for UKOTs collections. Other facilities, like the Tropical Nursery, house many different collections across the 21 climatic zones. The staff who work in these facilities have a vast range of knowledge and experience. These facilities and personnel allow the opportunity to develop back to basics horticultural protocols for a range of species.

UKOTs seed collections banked at Kew's Millennium Seed Bank are used to develop horticultural protocols for threatened species. The protocols focus on producing the best methods for germination of seed and cultivation of the species with low-tech methods.

At Kew, the resulting plants will be used in public display areas, for research, and education. Currently there are over 150 UKOT species being grown in the nurseries

at Kew. Over 70 of these have been a result of seed collections for the MSBP. Many species are currently being grown for full protocols as our contribution to GSPC Target 3. For example: *Acacia anegadensis* (Hamilton *et al* 2007), *Rondeletia buxifolia* (Corcoran *et al* 2009) and *Cordia rupicola* (Wenger *et al* 2010)

The process used in developing the protocols involves a team of horticultural staff in the nurseries at Kew. Firstly the germination trial is carried out, then the cultivation trial and finally the writing up of results after one year. UKOTs Programme and nursery staff meet to discuss the protocol design. This is an opportunity to identify members of staff with specific expertise with the species or a closely related species.

The design includes choosing the growing medium that will be used – normally two different types, one that is close as possible in type to the natural soil, and the other a standard coir/bark compost. Seed treatments are completed where necessary, for example scarification or breaking dormancy and identifying the ideal growing conditions. The temperature, humidity, and light levels are kept as close to the native environment as possible. The number of replicates included is sometimes limited by seed availability. When possible there are four pots of seed used as control and eight pots of replicates used in the trial. Finally, members of staff are identified to take responsibility for recording germination events and undertaking observations throughout the protocol. This could take up to 6 months from the time of sowing, however, will mostly range from 4-12 weeks for germination to stop.

On the day of sowing, the seeds are first divided into replicate groups. Then any treatments required like scarification or chipping are completed. Media are prepared and put into appropriate, labelled containers. The corresponding media type and seed treatment is recorded in the nursery propagation record book. Once seed sowing is completed the pots are placed in two different propagation units. As germination occurs, cocktail sticks are used to mark each emerging seedling. These markers will ensure that germination events are not undercounted, if seedlings die. The event is recorded on a dedicated germination record sheet.

Once the germination trial has been completed, the results are fully recorded. Then before starting the cultivation trial, the seedlings are hardened off for a short period. This hardening off period allows the seedling to become more robust, thus coping better with the transfer to an individual pot. Different media and climate conditions are again used for the replicates.

After potting, the seedlings are returned to the propagation units for a short period before being transferred to their cultivation trial areas. The plants are grown for a full year with observations being undertaken weekly to start with, and then monthly after approximately four weeks, to record overall health and to note any pest and disease or watering issues.

After growing for one year the protocol plants are brought together for a final recording of results. The team of UKOTs Programme Volunteers are usually involved in this process to provide exposure to the volunteers to the wider activities of the UKOTs programme (Figure 4).

Depending on the species, the results recorded differ; however, generally the main interest is in growth rates, any signs of reproduction, and overall health of each plant. These results help to identify the best methods for germination of seed and cultivation of the species using low-tech methods.

Obviously there are different approaches to employ for plants that are destined for field restoration and those for display or retail markets. This is taken into account in the protocol design and the final report.

Two examples of protocols that have been recently completed are *Acacia anegadensis*, a legume tree endemic to the British Virgin Islands (Hamilton *et al*, 2007). This protocol was the pilot and established the overall protocol practices and procedures as well as the cross departmental relationships for the programme. The second was *Rondeletia buxifolia*, a Rubiaceae shrub endemic to the island of Montserrat (Corcoran *et al* 2009). It is threatened by an active volcano, invasive species of plants and animals, and development of local infrastructure.

The results from these protocols are combined with the most up-to-date information about the species taxonomy, distribution, threats in the wild and other conservation concerns. The reports are made available to our in-country collaborators first for comment and use before being made freely available via the Kew website. (www.kew.org)

The Programme has expanded over recent years through the many successful achievements and collaborations. The next year will again see an expansion of activities with many new species being grown at Kew. Several species encountered have required specialist assistance. In these cases, the work is carried out with the staff in Kew's micro-propagation unit. These specialist protocols are undertaken due to the species being difficult to grow, they require special conditions that can only be achieved in the laboratory, or limited propagation material is available (Figure 5).

Currently growing in the micro propagation unit are species from many Territories including several Caribbean orchids, as well as many fern species from Bermuda and Ascension Island including the recently rediscovered *Anogramma ascensionis*. This fern was rediscovered on Ascension Island after not having been seen for more than fifty years (BBC, 2010).

Once the protocol has been completed plants are incorporated into public displays with interpretation that tells visitors about the significance of their conservation. The plants are also used as a teaching tool for students and visitors.

Conclusion

Through collaboration with UKOTs partners, these protocols will hopefully provide the basis for producing plants that will be used for reintroduction of the species in the wild and for the restoration of habitats. The main driver for this work is to prevent any more species extinctions. The last individual of *Nesiota elliptica* (St Helena olive) died in 2003. This resulted in the extinction of this species which now only remains as a sample in the Kew DNA bank. It is vital to ensure that threatened species are secure in well-managed collections, such as *Mellissia begoniifolia* (boxwood) from St. Helena which is now extinct in the wild. Because *Mellissia begoniifolia* is being grown at Kew this has enabled intensive hand pollination to be undertaken which has resulted in 13,000 seeds being collected in 2010, most of which are being sent back to St. Helena for local use (Figure 6).

The GSPC has provided an excellent framework to enable conservation in the UK's precious Overseas Territories and will continue to do so in the post-2010 period.

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Figures

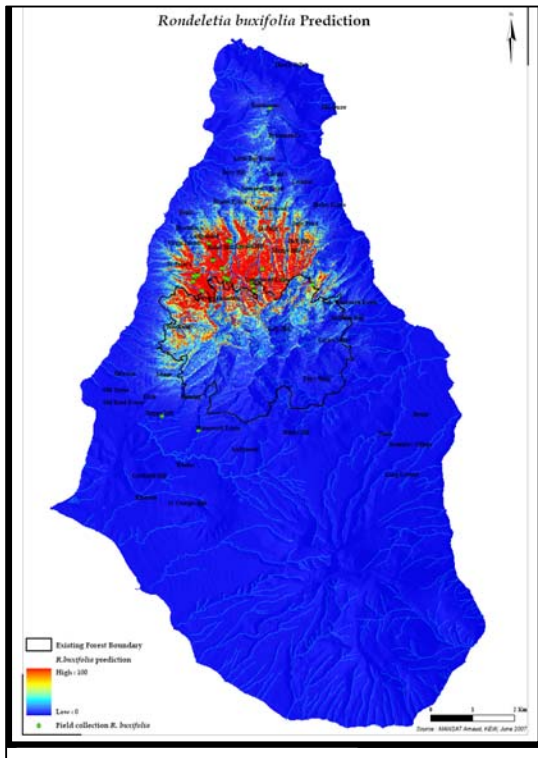


Figure 1: *Rondeletia buxifolia* Prediction Map, Montserrat



Figure 2: Field activities supporting *in-situ* conservation

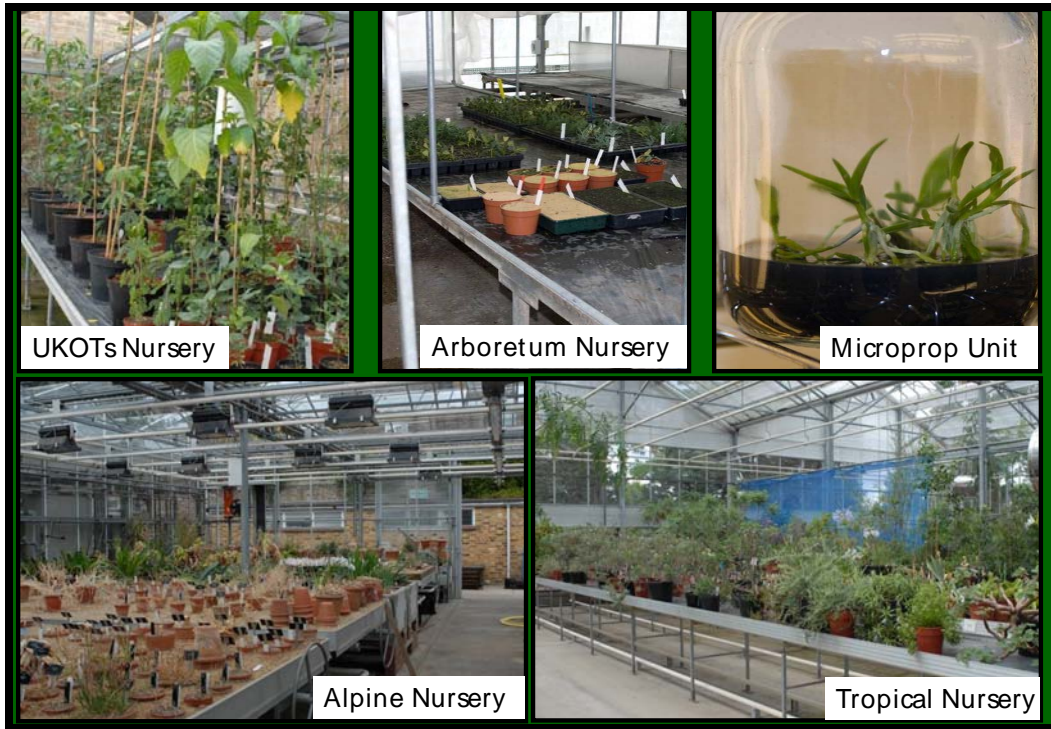


Figure 3: Range of nursery facilities at RBG Kew





Figure 5: Species requiring specialist treatment in the micro-prop unit at RBG Kew



Figure 6: Hand pollination of *Melissia begoniifolia* in the Tropical nursery at RBG Kew.