Development and implementation of a recovery action plan for the endangered Seychelles Busy Lizzy (*Impatiens gordonii*)

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Introduction

The flora of the granite islands of Seychelles has developed separately from continents since the final split up of Gondwanaland some 65 millions years ago. Unlike most oceanic islands, the native plants of these islands are probably derived from ancestors that were already present on the supercontinent and have gone through natural evolutionary processes, leading to a distinct and remarkable flora (Fleishmann 2003). Despite a long history of isolation, since the settlement of man on its shores some 200 years ago the vegetation has changed dramatically from the coast right up to the summit of Morne Seychellois (910m a.s.l.) (Carlström 1996) and like many small insular islands worldwide, the loss of unique plants is of immense concern to the Seychelles. Although many plants are naturally rare due to their restricted habitat (Carlström 1996), the risk of extinction is certainly higher in places where land is scarce and the habitat is threatened by residential and industrial development, tourism, agriculture and the spread of invasive alien species.

Mountain mist forest above 400-500m, covering an estimated area of 20km² is one of the habitats which has suffered from intensive logging of selected native trees, mainly Kapisen (*Northea hornei*) and Bwa rouz (*Dillenia ferruginea*). These days only a few relict stands of primeval forest are left (Fleishmann 2003), surrounded by large areas of secondary forest predominantly composed of invasive alien plants *Cinnamomum verum, Syzygium jambos* and *Psidium cattleianum*. An endemic plant species which seems to have declined as a result of this great disturbance to its natural habitat is *Impatiens gordonii* Horne ex Baker, the sole representative of the Balsaminaceae family in the Seychelles archipelago (Friedmann 1994).

The Seychelles Busy Lizzy (*Figure 1)*is an attractive perennial herb with large white flowers, 5cm wide, occurring in pairs and displaying an elongated spur, 8cm long (Wise 1998). Normally it is an out crossing plant species, producing fruit in the form of glandular capsule containing some 20 to 50 viable seeds (A Griffiths personal communication) but in the wild, plants very often spread vegetatively in the moist conditions of high altitude forest. Even though flowers have been observed on several occasions; so far we have not recorded any ripe seed capsule (ie. low seed recruitment). An inventory done in 2003 showed that the plant species' distribution had decreased from four previously documented localities to one (Trois Frères) during the past century on the largest island Mahé (J Mougal personal observation). In an analysis of census data collected from 2001 to 2004, the Trois Frères' population revealed a 50% reduction in the population size.

Seychelles Busy Lizzy (Impatiens gordonii)

As a result, in January 2005 the National Botanic Garden and its local partner institution (National Park and Forestry) embarked on a recovery programme to conserve this critically endangered species within its natural habitat *in situ* and in the field genebank at the Biodiversity Centre *ex situ*. Since this was the first comprehensive plant species recovery programmes to be undertaken in the Seychelles (Beaver and Küffer 2005), we had the intricate task of preparing a successful recovery action plan.

Methods and Results

The plan was based on the process for developing a recovery plan (see Bowles and Whelan 1994) and it has been adapted as the project progresses, utilizing the most efficient and most appropriate management responses to ensure the species survival (Maunder and Clubbe 2002). The species recovery programme goal includes the establishment of a reproducing, self-sustaining (viable) *Impatiens gordonii* population in a protected site and our recovery action plan can be summarized in the following stages including the evaluation process.

(see conclusions and recommendations).

Literature Survey and Consultation

We consulted all available published literature, unpublished reports and analyzed previous surveys' data. Though a considerable amount of data was generated from our desk research we still had to fill some key gaps in our knowledge in relation to the plant species' reproductive system, genetics and the best propagation techniques to be used. Therefore, we established contact with a researcher who had been conducting genetic studies and breeding systems research on the species in the UK and a local, experience native plant cultivator who joined the recovery team.

Habitat Assessments and Site Selection

The site selection was base on the IUCN (1998) and HRPRG (1999) Guidelines for Reintroduction. We revisited all historical localities to confirm the species presence or absence and determine the degree of habitat degradation (including invasive plants), accessibility and protection status. This reaffirmed that the species is currently found only at Trois Frères and in a comparative analysis between the three former localities, Cascade Estate had the most degraded habitat and is in an unprotected area and Morne Seychellois had the best habitat quality but is the most difficult to access. As a result, Morne Blanc was selected as the most suitable location for reintroduction.

An in depth habitat assessment was conducted at Trois Frères (part of an on going monitoring programme) and Morne Blanc. In addition to the demographic and reproductive data, we mapped the three patches with GPS at Trois Frères and determined the spatial arrangement and distribution of the individuals. We recorded the threats, of which the primary one was severe leaf herbivory caused by the caterpillar of the Common Striped Hawkmoth (*Hippotion eson*) and compiled a species' list of associated native and alien plants (*see Table 1).* The vegetation description given in the literatures was inadequate for us to select the most suitable location for reintroduction at Morne Blanc. Therefore, we conducted a quantitative vegetation survey using the Trail Transect Method (see Fleishmann 2005) which gave us a good idea of the changes in vegetation along the gradient and after we had compared the set of data with the Trois Frères' plant species list we decided on the best area (recipient site).

Table 1. Native and invasive plant species that are growing in association with Impatiens gordonii at Trois Fréres (600m above sea level). The ground is mostly covered with native ferns and the canopy trees are predominantly invasive species. Species with an asterisk are highly invasive in the Seychelles.

Species	Family	Plant form
Native		
Angiopteris evecta	Marraticeae	Fern
Nephrolepis biserrata	Oleandraceae	Fern
Microsorum scolopendrium	Polypodiaceae	Fern
Asplenium nidus	Aspleniaceae	Epiphyte Fern (usually)
Cyathea sechellarum	Cyatheaceae	Tree Fern
Begonia seychellensis	Begoniaceae	Herb
Pocris insularis	Urticaceae	Herb
Dracaena reflexa var. angustifolia	Liliaceae	Shrub
Pouteria obovata	Sapotaceae	Canopy Tree
Phoenicophorium borsigianum	Palmae	Palm
Invasive		
*Cinnamomum verum**	Lauraceae	Canopy Tree
*Syzygium jambos**	Myrtaceae	Small Tree
*Psidium cattleianum**	Myrtaceae	Small Tree
*Ardisia crenata**	Myrsinaceae	Shrub
Artocarpus heterophyllus	Moraceae	Canopy Tree
*Paraserianthes falcataria**	Mimosaceae	Canopy Tree
Coffea canephora	Rubiaceae	Shrub
Syzygium malaccense	Myrtaceae	Canopy Tree

Development of Propagation Protocol

In May, on a gloomy and damp day we took 40 nodal tip cuttings (13-20 cm long) from 8 individuals of the small Trois Frères' population of 18 plants. We collected plant materials from the 3 patches (2-4 individuals) to capture the maximum genetic diversity (A Griffiths personal communication) but at the same time to ensure that we did not endanger this already fragile population. Each cutting was tagged and given a unique plant ID which included its parent's reference number in the wild. The cuttings were potted in four different propagating media; 50:50 Red soil/Saw dust (A), Humus (decomposed plant materials) (B), Perlite (C) and 50:50 Humus/Perlite (D). The results after six weeks in the propagation house were (A) 50%, (B) 80%, (C) 90% and (D) 80% success. Only plants from propagation media (C) were transplanted into (B) and all the plants grew up to adulthood. One or two cuttings were taken from each plant prior to the reintroduction stage, and further multiplied on three occasions to maintain an adequate nursery stock.

Reintroduction and Long-term Monitoring

Site preparation was restricted to GIS mapping of the area, no vegetation clearance and invasive alien plants were and continue to be uprooted gradually. The reintroduction took place at the beginning of the wet season

(mid October); a first batch of 27 plants was boosted by a second batch of 20 plants (only one month old), and in total 47 plants were planted at the recipient site. We set up a long term monitoring programme with more frequent field visits (3-month intervals). Data on growth, reproduction (floristic and seed production), population dynamics and actual or perceived threats are recorded. Preliminary results are showing a 78% survivorship of the transplants, with surviving individuals continuing to increase in size and some of the younger plants having already flowered. However, herbivores are a short-term threat to the population survival and growth because the caterpillars appear to be more active during the flowering stage (loss of inflorescences). A year later, 80 plants from the nursery stock were planted out in the field genebank at the Biodiversity Centre (Barbarons -30m a.s. l.) as part of the *ex situ* programme but after four months all the plants had died.

Conclusions and Recommendations

The results of our work showed that an integrated conservation approach combining resources of National Park management, on going biological research, and *ex situ* propagation and cultivation techniques is fundamental for successful plant species recovery programme (Wyse Jackson and Sutherland 2000). We have been very successful in propagating and growing large quantities of the Seychelles busy lizzy in the nursery but unsuccessful in our attempt to grow it in the field gene bank at Biodiversity Centre possibly due to unsuitable habitat or unfavorable climatic conditions at lower altitude. In contrast, we have had high percentage of survival rate at the recipient site at Morne Blanc but it brought along new challenges such as the identification of limiting factors that prevent this rare plant species from increasing or maintaining its population size in the wild.

Some of the areas for future works will include:

- Understanding the consequences of damage caused by small invertebrates for individual plants (what impact do they have on the species' reproduction?) and populations of plants (survivorship and regeneration)
- Identification of the pollinator (if the Hawkmoth is really the pollinator, can we control the number of caterpillars on site?) and understanding the pollination biology (is it successful or not?)
- Understanding the consequences of habitat modification (can we partially remove some of the native ferns on site?) caused by human activities or canopy gaps and threats posed by invasive alien plants

In summary, we have achieved an intermediate goal of establishing another wild population which can serve as a field stock or for future field research *in situ* and *ex situ* we have established the protocol for propagation and cultivation of the plant species and ensure continuous supply of plants for the duration of the recovery programme.

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