

Attempts to establish a new population of the threatened plant *Impatiens gordonii* on Silhouette island, Seychelles

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SUMMARY

The endemic plant *Impatiens gordonii* (Balsaminaceae) is one of the most threatened plants in the Seychelles; it is known from a small number of localities on the islands of Mahé and Silhouette. There have been a number of attempts to establish a new population on Silhouette. Between 2001 and 2005, five seedlings and 54 rooting stems were planted at several points in one main field site. Although 11 plantings survived for over three months, all but one died within 2 years. That single plant has now survived for 10 years and has produced two seedlings. Problems with establishment were identified as being vulnerable to desiccation and rot, requiring high light levels but not full exposure to sunlight, and vulnerability to invertebrate herbivory (snails, caterpillars and crickets).

BACKGROUND

The herbaceous plant *Impatiens gordonii* Horne ex Baker (Balsaminaceae) is endemic to the Seychelles. It has long been regarded as one of the most threatened plant species in Seychelles (Procter 1974). This species is related to the African *I. walleriana*, apparently having evolved as a result of dispersal from Africa during the Pleistocene (Janssens *et al.* 2009). It has been recorded from five sites on two islands, Mahé and Silhouette.

The species was first collected in 1874 on both islands but without details of specific localities (Horne 1875a, b). On Mahé it was recorded from Cascade in 1901 and Morne Blanc in 1905 (specimens in the Royal Botanic Gardens, Kew). In 1970 it was found on Morne Seychellois and subsequently Trois Frères (Procter 1974). The Cascade and Morne Blanc populations have not been located since 1970. The Morne Seychellois population (two plants) was relocated in the 1980s (Friedmann 1986), one plant was still present in 1991 (pers. obs.) and 2002 (record cited by Griffiths 2006) but by 2003 it could not be located (Griffiths 2006). The only remaining Mahé

population is at Trois Frères where 20-25 plants are known (Mougal 2005). In 1995 it was rediscovered on Silhouette when some 100-200 plants were found in the Anse Mondon valley (Matyot 1995).

The Silhouette population has been the subject of ecological research, monitoring and *in situ* conservation by Nature Protection Trust of Seychelles from 1997 to 2011. These activities aimed to secure the future of the Silhouette population by improving knowledge of its ecology, determining the threats facing the species, protecting the existing population and establishing additional populations.

ACTION

Study site: The research and conservation actions focussed on the Silhouette island population. Silhouette is the third largest of the Seychelles islands (1,995 ha) and the second highest (740 m); as such it supports a wide diversity of habitats and is one of the richest islands in terms of biodiversity in the archipelago. Several localities on the island are categorised as 'Key Biodiversity Areas',

Table 1. Summary of *Impatiens gordonii* transplanted at Jardin Marron, Silhouette

Date	Number transplanted	Number surviving 1 year	Number surviving 10 years
10 January 2001	1	0	0
31 April 2001	4	1	1
10 April 2003	10	0	0
26 April 2004	4	2	0
24 June 2005	40	0	0

including all localities occupied by *Impatiens gordonii* (Gerlach 2008). *I. gordonii* is present in the Anse Mondon valley, which is a steep-sided valley filled with large granite boulders. There is a thin covering of leaf litter on the boulders; this is the substrate upon which *I. gordonii* occurs. The Anse Mondon valley lacks any path and is very rarely visited. The *I. gordonii* population occurs at 250 m above sea level. Attempts were made to establish a second population at Jardin Marron, a palm forest growing on a small flat area crossed by a small stream, with scattered boulders at 390 m above sea level. This resembles the *I. gordonii* site at Anse Mondon but is accessible from the main settlement of La Passe by a well-established path (Fig. 1).

Establishment of a new population: In order to guard against a catastrophic loss of the Anse Mondon population, attempts were made to establish a new population at Jardin Marron in 2001. This site was selected as it was at a similar altitude, appeared climatically similar and was in a locality accessible by visitors, allowing for an environmental education aspect to the conservation of the species. Seed from 10 seed pods was collected from Anse Mondon plants and germinated by extracting seeds from the pods and mixing them with decomposed leaf litter. This mixture was saturated with water and left at ambient temperature (26-30°C). Resultant seedlings were kept in the germination trays until opportunities for transplanting became available.

Transplanting was attempted at two sites. At La Passe, four plants were planted on 14 January 2001 at 20 m above sea level at the edge of a seasonal stream. At Jardin Marron one plant was planted on 10 January 2001 and four on 31 April 2001 at 390 m at several points within 1-20 m of a permanent stream. Further transplanting at Jardin Marron used wild collected material in 2003, 2004 and 2005 (Table 1) using naturally broken stems from the Anse Mondon population. These had

become detached from living plants, most (but not all) broken stems were producing roots. No plants were deliberately damaged to provide material for transplanting.

Monitoring: The status of all *I. gordonii* plants on Silhouette was monitored every 1-3 years, starting in 2000. Transplanted plants at La Passe were monitored weekly for the first three months, but none survived beyond this time. The plants at Jardin Marron were monitored several times each year (in combination with flowering studies) from 2001. The population at Anse Mondon was visited in 2000, 2001, 2003, 2005, 2007 and 2010. On each visit the health of plants was noted (qualitative observations of vigour), observation made of leaf damage, numbers of caterpillars feeding on leaves, flowering and fruiting. The distribution and abundance of plants were also recorded. Abundance comprised accurate counting of individuals at Jardin Marron and density estimation using 10, 2 x 2m quadrats at Anse Mondon.

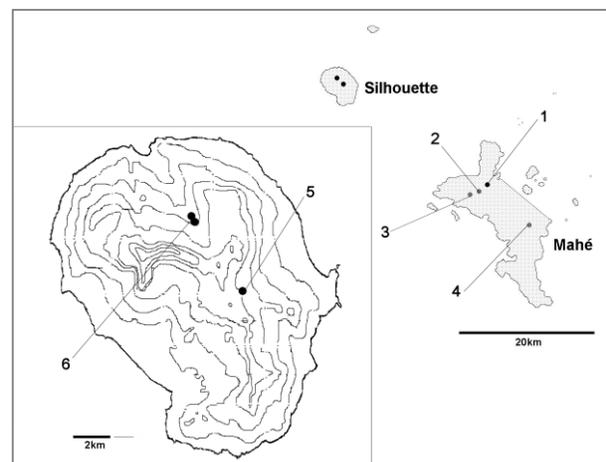


Figure 1. Map of Seychelles showing localities mentioned in the text. Inset shows detail of Silhouette island localities. 1 – Trois Frères, 2 – Morne Seychellois, 3 – Morne Blanc, 4 – Cascade, 5 – Jardin Marron, 6 – Anse Mondon. The only extant populations are at localities 1, 5 and 6.

Flowering times were compared to climatic data from the site (2009-2011). For earlier years proxy data from a sea-level climate monitoring site (La Passe) were used.

CONSEQUENCES

Establishment of a new population: The simple germination system used in 2001 resulted in 15 seeds from the 10 seed pods (individual seeds were not counted) producing seedlings that survived at least 3 months. Seedlings transplanted in wet conditions tolerated transplanting to saturated soil and no immediate mortality was observed. The lowland planting at La Passe was unsuccessful as, although growth was observed initially, within three months all four seedlings had been eaten by snails. It is unlikely that these plants would have survived dry conditions later in the year.

The four seedlings planted in Jardin Marron in 2001 were all flowering and fruiting by July 2001. Three of these plants died in 2002, the remaining plant was still alive in April 2011 (after 10 years). On 18 December 2002 a self-seeded seedling was found 1.5 m away from the largest plant. This survived for two months before disappearing. The 2003 transplantation (10 stems) failed with no plants surviving more than two weeks. Of the four planted in 2004 two survived for more than one year. The 2005 transplantation failed completely. By the end of 2005 the only surviving plant was one of the 2001 seedlings. This plant produced a second seedling in March 2010. This has become established 2 m from the parent plant and has survived for more than a year to date. A final attempt at artificially increasing the number of plants at the site was made in June 2010 when four stems broken off from the main plant were transplanted in June 2010. These were all growing vigorously by December 2010, but had died by March 2011.

Successful transplants were restricted to the lightest areas of the site which were recorded in 2005 as over 1,050 lux, compared to under 920 lux for failed transplants ($t=4.531$, $P_{49}<0.001$). For plants transplanted in 2001, differences in vigour were noted between

plants established in shaded and exposed areas, and in 2005 an increase in invasion by kola nut *Cola nitida* trees was observed. By July 2007 these cast deep shade over the remaining plants; at this time growth was reduced and flowering had ceased. The *C. nitida* trees were felled in March 2008, allowing greater light penetration. Improved *I. gordonii* growth was noticeable by June 2008 and flowering had recommenced within 7 months of the removal of the trees. Subsequently invasion by non-native soapbush *Clidemia hirta* increased in response to higher light levels.

Monitoring: Results of monitoring are shown in Figure 2. In 2003 a complete count of plants at Anse Mondon recorded 108 plants over 2,500m² (Griffiths 2006). A complete count has not been made subsequently but density estimates indicate a decline in recent years; the population appeared to be stable for much of the monitoring period, but a decline in the health and number of the lowest part of the population was noted in 2007. By December 2010 there had been a decline in the area of the population with the loss of the lowest part of the population. This decline was associated with an increase in tree canopy cover (Fig. 3).

A second site was located at Anse Mondon on 27 March 2007. This was approximately 200 m from the main population, in a heavily shaded area (Fig. 1). An estimated 20 plants were present at this site. It was not located in 2010.

Insect damage was noted on several leaves on most visits to the Anse Mondon plants. At least some of these were associated with the presence of caterpillars of the hawkmoth *Hippotion eson*. Particularly heavy damage was noted on several occasions at Jardin Marron when almost all leaves were eaten. At these times no caterpillars could be located and no caterpillar frass was present; it was suspected that crickets (Gryllidae) were responsible for the damage on those occasions. The plants recovered rapidly, with full growth of leaves within a month.

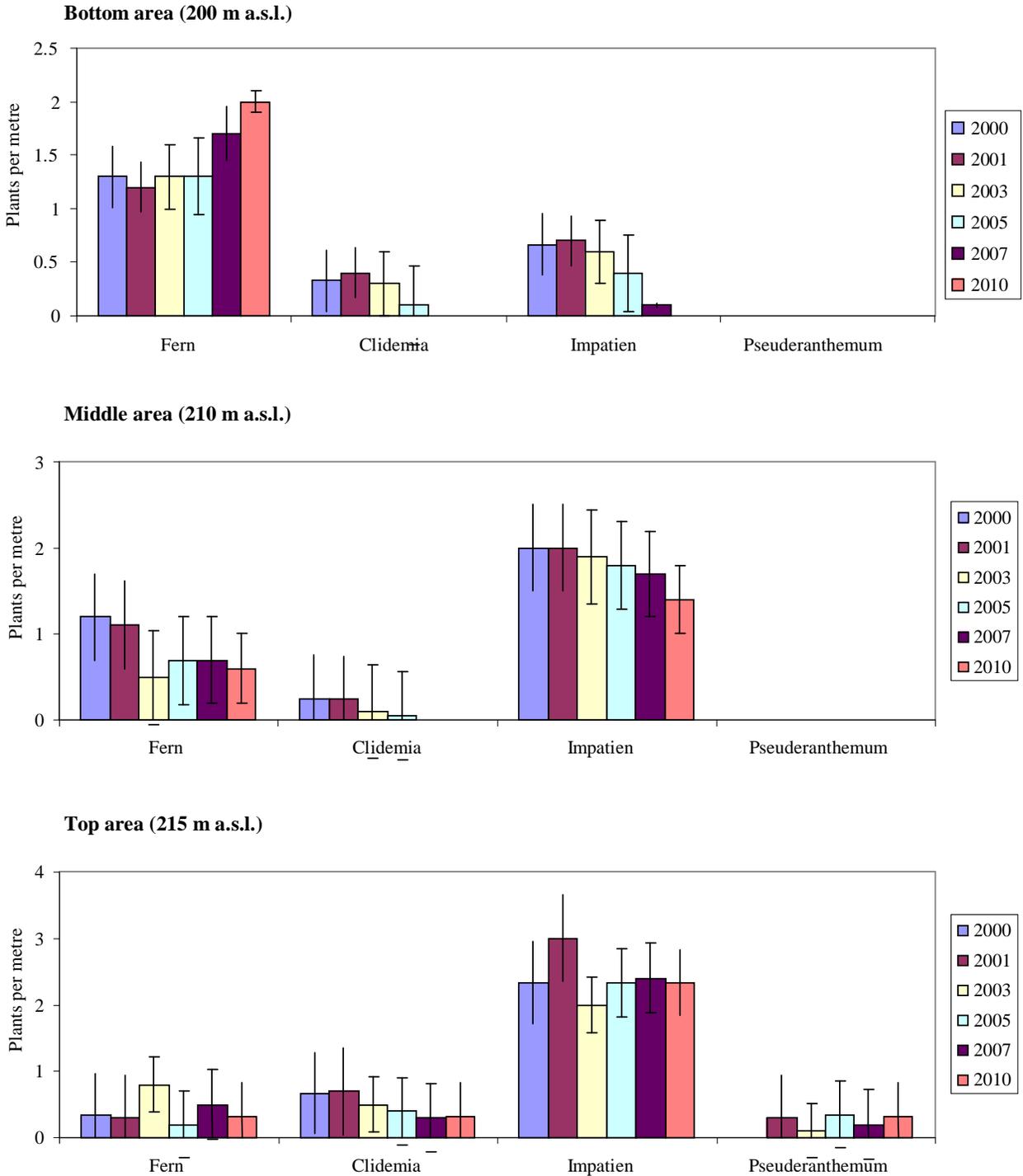


Figure 2. Population monitoring data at Anse Mondon showing densities of *I. gordonii*, the similarly restricted *Pseuderanthemum* aff. *Tunicatum* (an evergreen perennial herb), shade tolerant native ferns and the light demanding invader *Clidemia hirta*.

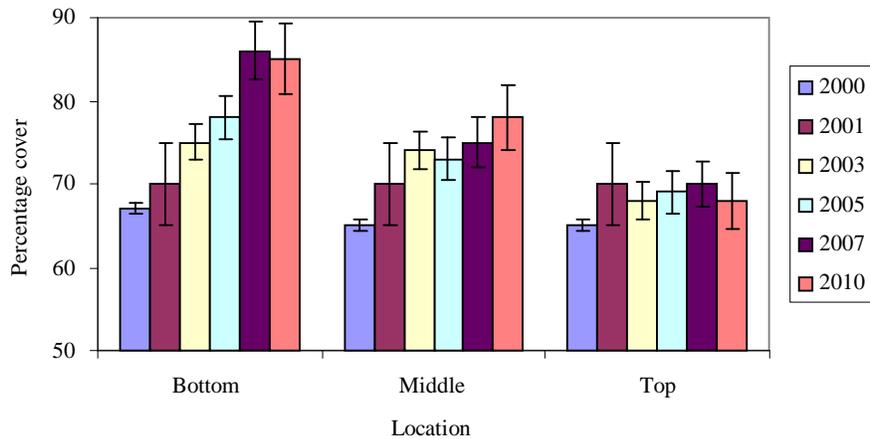


Figure 3. Change in canopy cover at Anse Mondon, 2000-2010.

On 24 March 2009 the complete removal of all leaves on the main Jardin Marron plant was observed (Fig. 4). This was not due to insect damage as the petioles were left (unlike cricket feeding when the petioles were consumed along with the leaf tissue) and the leaf base had been cut across in a perfectly straight line (unlike caterpillar damage where irregular bite marks are obvious). This damage could only have been caused by cutting with scissors. It was presumed that the leaves had been removed for medicinal purposes. This previously unrecorded use of *I. gordonii* was reported to the Ministry of Environment, which had no previous knowledge of such usage (D. Dogley pers. comm.), but no follow-



Figure 4. Complete removal of leaves from the main plant at Jardin Marron on 24 March 2009.

up investigation or action was undertaken. The affected plant regenerated within a month. Complete leaf removal in the same manner was repeated in August 2009 and December 2010.

DISCUSSION

Attempts to increase the number of viable populations of *Impatiens gordonii* on Silhouette has achieved only limited success. Only one planted individual has survived but this has now been present at Jardin Marron for 10 years. Natural reproduction has occurred and at present the population is represented by one planted and one self-seeded plant. Monitoring of this population has suggested that the species is highly vulnerable to changes in moisture and light regimes. The death of most of the transplanted plants was observed to be preceded by either severe wilting or to rotting of the stems, indicating that both desiccation and waterlogging are problematic.

Initially localities for planting were selected that appeared subjectively to be the most suitable. Subsequently planting localities were deliberately varied, covering both sites that appeared suitable and also considered to be of low suitability. This did not improve survival rates. It is probable that attempts to select suitable sites or to maximise the variation in planting site characteristics failed to improve success due to a combination of climatic fluctuations and a failure to consider the light regime adequately. The last attempt at planting coincided with deteriorating light conditions (as the tree canopy developed) and associated deterioration in the health of the surviving plant. Had the light regime been

restored in 2005 rather than in 2008, a better success rate might have been achieved.

Table 2. Investment in conservation of Silhouette *Impatiens gordonii* populations by NPTS.

Item	Expenditure
Surveys	£3,600
Transplanting	£180
Monitoring	£4,000
Climate monitoring	£1,600
Total	£7,780

The small size of two of the populations (Jardin Marron on Silhouette and Trois Frères on Mahé) make them highly vulnerable to damage, either through leaf harvesting or through predation by crickets and the hawkmoth *Hippotion eson*. The latter is a particularly notable threat as the caterpillars rapidly consume all the leaves on a plant. This polyphagous species may be attracted to *I. gordonii* as it is suspected to be the plant's pollinator (A. Griffiths pers. comm.). If the *I. gordonii* population is large and spread over a wide area the impacts of predation are likely to be reduced.

Survival of the species depends on maintenance of the existing populations through habitat management and establishment of new populations. To date investment in *in situ* conservation of *I. gordonii* on Silhouette has been limited (Table 2). If the species is to persist in the wild a considerable increase in investment will be needed to undertake the essential habitat management in addition to restoration of habitat management on Silhouette (Gerlach 2011).

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