Kapisen

Plant Conservation Action group Newsletter

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Botany Indoors and Outdoors

Forest within a forest

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Charles Morel checking the tiny epiphyte plants on a tree trunk. A hand lens is essential for the detailed work (K Beaver).

As part of my duties in the Natural History Museum I was given the responsibility of managing the National Herbarium. The Herbarium at the time was in no way complete (it is still not) and I had to be involved in collecting, preserving and identifying species which were not present in the collection.

So I have been making frequent trips to different islands of Seychelles and I have come to develop a passion for plants. Lately I have been giving guided tours to nature lovers. Standing in the middle of one of our forests, I can now easily point out all the different species around.

But then came Katy Beaver with her project on epiphytes (see Kapisen 1, p.6).
As we know, our Sandragons (*Pterocarpus indicus*) are dying as a result of attack by a virus and/or tiny moths. The study was to be carried out on Sandragon trees high up on Morne Blanc.

The Sandragon trees in question were covered with epiphytes, and our study was to study the effect the dying Sandragons would have on them (assuming that the trees die – as have so many others).

I never gave a thought to epiphytes during my previous walks in the forest. To me they were all mosses and ferns and that's it.

The project takes off. I look through a small hand lens and Wow! I am looking at a forest in miniature, and you know what? There are species that look so much alike that at first glance you'd think they were the same, but looking closer, or using a microscope, you come to realise that they are different.

Now that I am involved in the project, it has provided a new area of interest for me and it makes me realise how much we have in the Seychelles environment that we still don't know about.

My point is, there exists within our forest, other 'forests' which I took for granted. My new-found 'forests' are made up of mosses, lichens, liverworts and they are home to several species of tiny animals. What a discovery!

Join PCA!

Any person interested in plant conservation in the Seychelles, either from the Seychelles or somewhere else in the world, is invited to join the Plant Conservation Action group (PCA). As a member you support plant conservation in the Seychelles, get Kapisen - the PCA newsletter - twice a year sent to you by e-Mail, and get regular invitations to events and field excursions.
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Content

Welcome to the first Kapisen of 2005!

This issue of Kapisen brings together local and international botanical research in the Seychelles. Such collaboration is one of the keys to bringing about real progress in botanical research and conservation. James Mougal from Botanical Gardens worked together with Eden Project in the UK on rare endemic plants (p.4); while Terence Valentin from the National Parks Unit was working with the Geobotanical Institute of ETH Zurich on invasive creepers (p.10). Maria Burger and Nathalie Stampfli, two Swiss students, report on another collaboration with the Geobotanical Institute. They have assisted in applying the IUCN red data list guidelines to the rare plants of the Seychelles (p.14). Charles Morel from Seychelles Natural History Museum tells of his work on epiphytes (p. 2), which by contrast is a purely local initiative. The international interest in the Seychelles flora is exemplified by Josef Bogner and Susanne Renner in their article on the endemic herb *Protarum sechellarum* (Larourout dilenn maron) (p. 7).

This Kapisen also brings to light another important link that should be built for plant conservation – the link between botany in the field and botany in botanical gardens, herbariums and laboratories. It is taxonomic research in the laboratory that has revealed how unique Protarum is. This should now be taken up by conservationists working in the field so as to ensure protection of this amazing forest herb. Similarly, botanical gardens in Europe have been able to assist in the taxonomical identification of problematic invasive creepers, which will be important for good management of these weeds. Charles Morel's interest in field work arose from his responsibilities for the dried plant specimens in the Seychelles Herbarium. James Mougal explains why Seychelles Botanical Gardens should move on from the successes they have had with reproducing rare endemic plants in the nursery (ex situ conservation), out into the forest, with the ultimate aim of preserving all endemic plants in their natural habitats.

The leaves of the critically endangered mountain forest species *Psathura sechellarum* (C Kueffer).

The story of the Araceae family is particularly interesting. Prof. Renner has recently shown that Seychelles' *Protarum sechellarum* (Larourout dilenn maron) is probably an ancient surviving lineage. Surprisingly, another old remnant of the Araceae is also well known in Seychelles. It is the Water lettuce (*Pistia stratiotes*), an invasive species in freshwater marshes. Some 70 million years ago these two species may have grown near to each other but after Seychelles separated from the Indian sub-continent during the gradual break up of Gondwana, the only place Protarum survived was Seychelles, while Water lettuce spread widely over other continents. Did they ever grow together in Seychelles? We may never know. But sometime in the late 20th century Water lettuce was brought to Seychelles as an aquarium plant and quickly invaded wetlands. Araceae species also appear in the article on invasive creepers in this Kapisen – the Philodendrons, Epipremnums and Arrowhead vine (*Syngonium podophyllum*) all belong to this family, as does *Caladium bicolor*, a garden and pot plant with pretty variegated leaves that has escaped into the forest.

Why Water lettuce became a globetrotter while Protarum turned into an isolated island plant is an unanswered question. But it is one of the many stories that lay hidden within the plants that grow in Seychelles. Revealing such stories is one of the rewards of research and makes field conservation work more worthwhile.

Eva Schumacher, Katy Beaver & Christoph Kueffer
Editors

The electronic pdf version of Kapisen can be ordered from boga@seychelles.net or downloaded from www.geobot.umnw.ethz.ch/staff/kueffer

Going one step further in saving the rare plants of Seychelles

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From the nursery to the field

The success story of the Barbarons Biodiversity Centre (see Kapisen 1(2), p. 13) in partnership with Eden Project (UK) is remarkable. Many of the Seychelles endemic plants are now growing successfully in the nurseries of both places. A triumph has been that of the critically endangered *Impatiens gordonii* (Belzamin sovaz) (see Kapisen 1(2): p. 6-7). More than 100 plants have been multiplied at the Biodiversity Centre from cuttings collected from the two remaining populations (Anse Moudon, Silhouette / Trois Fréres, Mahé).

The next step after ex situ reproduction of rare plants is the reintroduction or reinforcement of these plants in their natural habitat, in line with the goal addressed in the Seychelles National Strategy for Plant Conservation to "ensure viable representation of 95% of threatened flowering plant taxa within protected areas" (Target 4b).

I discuss in this article two on-going field monitoring projects of the Botanic Gardens Section (MENR). The monitoring of the remaining populations in the field is the basis of a successful reintroduction. Then, I present a recently funded project for the reintroduction of Belzamin sovaz and two more rare endemic plants.

Field monitoring of Belzamin sovaz

The question that keeps popping up is whether Belzamin sovaz will survive the transplantation back to places where it is still under threat or has completely disappeared. During field searches carried out in 2001 together with Alistair Griffiths, out of five populations known from the literature only two were found. The only population on Mahé was at Trois Fréres, approx. 600 m above sea level (Fig. 1). It consisted of two groups – 14 plants in total. The first group of 12 plants was heavily attacked by caterpillars of the possibly native Common Striped Hawkmoth (*Hippotion eson*) (Fig. 2). Four individual plants were small and probably young seedlings (20-25 cm in height). Four of the larger individuals (40-100 cm in height) were flowering. The second group consisted of two individuals (80 and 108 cm) with the larger one bearing flowers and fruits.

We re-surveyed the population at Trois Fréres in March 2004. Three groups of plants were located – approximately 20-22 plants in total. The largest group of c. 10-12 plants, with an average height of 90 cm, was not recorded in 2001 (covered area: 1.9 m by 1.6 m). The smaller of the previously located groups increased from two to three individuals. The larger group decreased its size from 12 to 7. However, because among the located plants there were 2 new

Fig. 1 James Mougal with one plant of the only Belzamin sovaz population on Mahé (W Mangroo).

Fig. 2:The caterpillar of the Common Striped Hawkmoth (J Mougal).

seedlings, at least 7 plants must have died. Out of the relocated plants that were still labeled with a metal tag only one increased its height considerably (from 23 to 84 cm). In all groups, herbivory damage was found on a few plants. Some plants were growing in between a recently fallen Jambrosa tree (*Syzygium jambos*) and the whole population was surrounded by the invasive Christmas tree (*Ardisia crenata*).

From our survey we can conclude that adult mortality in the field seems to be high, and that reproduction, probably vegetatively, is happening. Flowering and fruiting occurs but not much is known about pollination. The long spur of the flower suggests that long-tongued insects such as hawkmoths are possible pollinators. The plants seem to suffer from attacks by generalist herbivores (Common Striped Hawkmoth, Pachnodus snails, slugs). The populations are surrounded by invasive shrubs (especially the Christmas tree *Ardisia crenata*) and invasive trees (e.g. *Syzygium jambos, Paraserianthes falcataria*). All known Belzamin sovaz plants were found within 15 meters, and each of the three groups covers no more than a few square meters. So, a single large falling tree may destroy a major part of the remaining population.

It is highly questionable whether this population of Belzamin sovaz in a disturbed secondary forest, almost completely dominated by invasive species, will survive in the long term, even after reinforcement. Also, the accessibility of the population is difficult and therefore management costs are high.

At the moment there are only three known individuals of the Trois Fréres population in ex situ collections in Seychelles. The first priority is to reproduce more individuals from the remaining plants of the Trois Fréres population in nurseries. Secondly, a search should be initiated in private gardens in the Seychelles, for Belzamin sovaz plants known to derive from the Trois Fréres or one of the extinct Mahé populations. No plants from the Silhouette population should be reintroduced to Mahé as long as the population genetics of Belzamin sovaz is not better known.

Morne Blanc has been suggested as an alternative re-introduction site on Mahé. From historical records it is known that Belzamin sovaz has grown there in the past. The site is easily accessible, and the vegetation is still relatively undisturbed. After the re-introduction, the first priority should then be the monitoring of herbivore attack, and the identification of pollinators.

Field monitoring of Kapisen *(Northea hornei)*

Other on-going fieldwork that has been taking place over the past 7 years is regular monitoring of the natural regeneration of Kapisen (*Northea hornei*) in the Mare aux Cochons valley (430 m altitude, Morne Seychellois National Park). The monitoring programme came about when we noticed a high abundance of Kapisen seedlings and saplings beneath a mother tree (256 individuals per 95 m^2; max. density in one cluster: 85 ind. / 20 m^2 !) during a reconnaissance of the area. It was an unusual sighting since most of the time we observed around 15 to 40 seedlings or saplings beneath an adult tree (Fig. 4).

The monitoring started in July 1997. All saplings (>50cm,<2m) and seedlings (<50cm) were counted and mapped, and 14 saplings and 6 seedlings were tagged and measured. From July 1997 to July 2004 the population size has dropped by almost one third to 167 individuals. 42 dead individuals could actually be re-located. Out of the 6 tagged seedlings 4 died; out of the 14 saplings none died naturally (but one was cut accidentally).

Fig. 3 Rapanea seedling in the Congo Rouge mountain forest (C Kueffer).

In 1997, the smallest tagged seedling had a height of 24cm, the largest sapling had a height of 144.4cm. The seedlings and saplings increased their height in 7 years to 115%-195% of their initial height. The relative growth rate was not correlated with the initial height. However, the second highest saplings had by far the highest growth rate and doubled its size in 7 years from 1.3m to 2.6m in 2004. Assuming that the fastest growing sapling will survive in the end, and that it will sustain the growth rate of doubling its size once every 7 year, we can estimate that it will take 35 years from a freshly germinated seedling of say 30 cm to an adult tree of 10 meters.

Kapisen is the main native canopy tree of mid- to high-altitude forests in the Seychelles (see Kapisen 1(1), p.2). It is therefore crucial to assure its regeneration in the wild. Kapisen seeds are large and apparently not well dispersed. Seedlings and saplings are often found in clusters under a mother tree even though it has been reported that fruit-bats are dispersing the seeds. Amongst a cluster of seedlings and saplings it is likely that only one will survive and replace the mother tree. According to our data, mostly seedlings are dying, maybe because of the competition from larger Kapisen saplings. However, we also observed that Kapisen juveniles growing far from other juveniles have a high mortality rate. The leaves suddenly dry out (Fig. 4). It may be that a pathogen is involved. While seedlings and old adult trees are relatively abundant, almost no intermediate age classes can be found in the field.

In the nursery, the germination rate of Kapisen seeds is almost 90% (D. Doudee, pers. comm.). In the field, however, it has to be assumed that it is lower, because dead seeds attacked probably by rats or tenrecs are frequently found. So far, the survival rate of seedlings germinated and grown in the nursery before transplantation to the field has been low. For instance, 20 saplings have been planted out at Mission Lodge, but only 6 survived after one month.

The best for enhancing the regeneration of Kapisen in the wild would probably be to move freshly fallen seeds directly in the field away from other Kapisen saplings and the mother tree to unoccupied places. To improve seed survival these seeds may be protected with mesh from seed predation by rats.

A new project for the reintroduction of endangered endemic plants

The Botanic Gardens Section has recently received a grant from the African Small Grant Programme under the “Investing in Nature” initiative undertaken by Botanical Gardens Conservation International (BGCI), with the support of HSBC plc. The project is to implement a first reintroduction for Belzamin sovaz (*Impatiens gordonii*) on Mahé, and to monitor this in the field. Also, two other endangered plant species will be propagated in the Biodiversity Centre. For this we have chosen two mountain forest species: the critically endangered *Psathura sechellarum* (see p. 3) of the Rubiaceae and the endangered *Rapanea seychellarum* (Bwa klate) of the Myrsiniaceae familiy (Fig. 3).

Fig. 4 Dense regeneration of Kapisen saplings in the Mare aux Cochons mid-altitude forest (left). Two dead Kapisen saplings (right) (J Mougal).

Protarum sechellarum, the only endemic Araceae of the Seychelles

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Summary

Protarum sechellarum (Larourout dilenn maron) belongs to the same family as the edible Cocoyam (Larouy or Taro) and the invasive duckweeds and Water Lettuce that threaten to smother waterways and marshes. However, Larourout dilenn maron grows in forests and is endemic to Seychelles. Protarum has flowers that are rather primitive in form, and it seems that this species is another 'relict', surviving from the time when the Seychelles split away from the Indian sub-continent. Protarum has an underground tuber (Fig. 1) and a single leaf divided into around 7 to 11 leaflets (Fig. 2). The flowering part is not often seen as it is not brightly coloured. It consists of a leafy cover (spathe), inside which is a finger-like flower stalk (spadix) (Fig. 3) that has male flowers on the middle part and female flowers at the base (Fig. 4). The obovoid fruits also form at the base, turning orange when ripe.

The family of the Araceae

The Seychelles have only one endemic Araceae, *Protarum sechellarum* Engl. (Larourout dilenn maron). Araceae are a family of herbaceous monocots with 108 genera and about 3750 species. Morphological and molecular data indicate that duckweeds (Lemnaceae) are nested within Araceae and hence should be included in that family. Duckweeds and Water Lettuce (*Pistia stratiotes* L.) are the only free-floating aquatic Araceae, and both exist on the Seychelles as invasive plants. The majority of Araceae, however, occur in the New World tropics, and life forms range from submerged or free-floating aquatics to terrestrial, epiphytic, or hemiepiphytic herbs or climbers. The easiest way to recognize an Araceae is the distinctive inflorescence, a spadix with bisexual or unisexual flowers, subtended by a solitary bract called spathe. On the Seychelles, the family is also represented by a few introduced horticultural or edible species, for example, *Colocasia esculenta* (L.) Schott.

The late discovery of *Protarum sechellarum* was described in 1901 by the German botanist Adolf Engler. The material that Engler worked on had been collected by A. F. W. Schimper in March 1899 during the Valdivia Deep Sea Expedition. During a four-day stay on the main island of Mahé, Schimper had a chance to visit the forests on Mt. Harrison. Since then, Protarum has also been discovered at other localities on Mahé, such a Morne Blanc, Copolia, Cascade Estate, Congo Rouge, and Casse Dent, as well as from localities on the islands of Silhouette and Praslin. On Praslin, it occurs together with *Lodoicea maldivica* (Gmelin) Pers. in the Vallée de Mai. Illustrations of *Protarum sechellarum* have appeared in Hooker's Icones Plantarum (1902, pl. 2750) and in Rosemary Wise's (1998) book with paintings of endemic plants of the Seychelles, „A Fragile Eden."

Fig. 1 Tuber and old inflorescence of *Protarum sechellarum* (J Bogner).

Description of Protarum

Protarum sechellarum is a seasonally dormant herb with a subglobose tuber that can reach 12 cm in length and 8 cm in diameter (Fig. 1). The plant typically has a single leaf, the dissected blade of which can reach c. 80 cm in diameter and can have (5-)7-11 leaflets, each about 25-40 cm long and 8-10 cm wide (Fig. 2). The inflorescence is solitary and can appear before the leaf or simultaneous with it (Fig. 3). The spathe of the inflorescence is 13-18 cm long and the spadix, which bears the flowers, 8-12 cm. The flowers are unisexual, with the female ones borne basally on the spadix, the male ones more distally. The flower-bearing zones are separated by a sterile section with fused and much-reduced stamens (called synandrodes; Fig. 4), and the spadix then ends in a terminal appendix up to

4.5 cm long. The gynoecium (pistil) of each female flower is surrounded by four to six staminodes (Fig. 4), while the male flowers have three to six stamens that are fused to form a synandrium. When the fruits are mature, the inflorescence curves, such that the bright orange berries are exposed.

Protarum sechellarum grows on the forest floor in humus-rich soil (Fig. 2) or among leaf litter in rock crevices, often on large granitic rocks. It prefers shady habitats, but has also been found in exposed, sunlit places. Flowering has been observed in October, March, and April, fruiting in October.

The ancient age of Protarum

Protarum has only one species, *P. sechellarum*, and it was long unclear to which other Araceae the genus might be most closely related. As already noted by Engler, the staminodes surrounding each female flower are unusual among advanced Araceae. They are interpreted as a relict from an ancestral stage because more basal Araceae have bisexual flowers. In a way then, Protarum maintains morphological features that have since been lost in most higher Araceae. The great age of Protarum, a lineage that may be as old as the Seychelles, is also apparent from an analysis of chloroplast gene sequences, which are highly divergent in their sequence motifs (Renner and Zhang 2004). A Bayesian molecular clock approach resulted in an age estimate for the divergence between Protarum and its closest relatives of 76 million years (with 95% credibility intervals between 64.6 and 83.5 million years). Although there are no fossils of Protarum, its ‚old-fashioned' flowers and genetic uniqueness fit with its paleoendemic status as the only Araceae persisting since the separation of the Seychelles from Madagascar and India.

Fig. 3 New leaf growing at the same time as the inflorescence, which has a leafy covering (spathe), inside which is the finger-like flower stalk (spadix) (K Beaver).

Fig. 2 Protarum growing naturally on the forest floor (E Schumacher).

The fossil record of Araceae documents the Cretaceous age of the family, with the northern Eurasian and North American Golden Clubs (the Orontium group) occurring already in the Campanian (83-73 my), the Monstera group in the Maastrichtian (72-65 my) of India, and Lemna-like fossils in the Maastrichtian of North America. Very recently, pollen close to the Spathiphyllum group was described from the early Cretaceous (Barremian to Aptian, 120-110 my) of Portugal (*Mayoa portugallica* see Friis et al. 2004). Araceae with unisexual flowers, such as Protarum, are only known from the Eocene (c. 50 my) onwards, but judging from the molecular clock estimates for the divergence of Protarum and Pistia (above) are expected to be ten to twenty million years older.

Conservation of Protarum

The first to bring Protarum sechellarum into cultivation was C. Jeffrey at the Royal Botanic Gardens Kew in 1962. Other wild-collected plants were brought into cultivation in the Botanical Gardens of Munich by J. Bogner in 1968, the Botanical Garden of Nancy (France) by F. Friedman in 1982, and a private garden in the Netherlands by A. Hay in 1992. Unfortunately, none of these plants survives today. In 2001, A. Griffiths brought a new plant to the Eden Project (UK), and the species is also in cultivation at the Biodiversity Centre in Barbarons (Mahé) (J. Mougal, pers. comm.). According to Carlström (1996) it is near threatened.

Fig. 4 Inflorescence spathe cut open to show the female flowers (below) and the synandrodes of the sterile zone. The white particles are pollen masses. Note how each gynoecium is surrounded by four to six small staminodes (J Bogner).

Fig. 5 The leaf of a variety of Protarum with a reddish colour (E Schumacher).

Fig. 6 Protarum (E Schumacher).

Literature:

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Invasion of creepers on the island of Mahé, Seychelles

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Introduction

Global aspects

Creeper invasions are a serious threat to natural and managed ecosystems worldwide (Hobbs and Humphries, 1995). For example, exotic vines impact small reserves in Singapore and completely cover fragmented forest remnants in tropical Australia (Fine, 2002). In Papua New Guinea, *Piper aduncum* invaded the rain forest successfully (Leps et al., 2002). In the Pacific, the creepers *Merremia peltata*, *Mikania micrantha* and different Passiflora species are among the dominant invasive species in most island groups (Meyer, 2000). *Thunbergia grandiflora* is invasive in Australia and Singapore and naturalized in many other tropical countries (Meyer and Lavergne, 2004). In the Comoros archipelago, invasive creepers like *Merremia peltata* are one of the major threats to biodiversity (Vos, 2003). The most problematic invasive creepers in the Mascarenes are *Hiptage benghalensis* and *Rubus alceifolius* (Kueffer et al., 2004).

Invasion of *Meremia peltata* (E Schumacher).

Local aspects

Similarly, an explosive growth of invasive alien creepers has been observed in the last twenty years in the Seychelles. Some alien creepers like *Merremia peltata* have been present for a long time period without posing problems (Frank Payet, pers. comm.). Only recently, some species have become a big problem for the native flora and for agriculture. Many of these species like *Thunbergia g.*, Monstera spp., Epipremnum spp. and Ipomoea spp., are introduced garden ornamentals that escaped.

The full account of factors causing this recent explosive spread is still unclear. Similar to the spread of many other invasive weeds, creeper species could have a long lag phase following introduction before they spread explosively (compare Hobbs and Humphries, 1995). Furthermore, the multiplication of forest gaps due to houses, electric lines and roads, decline of management efforts in agriculture, climate change and increased level of atmospheric CO2 are presently discussed as possible reasons for the recent explosion of invasive creepers. Whatever reason may be responsible for the spread of these creepers, the negative impact on the vegetation and the landscape in the Seychelles is dramatic.

Aims of study

The study was conducted from October to November 2003. The focus of the survey was mostly on the characteristics, early detection and appropriate control measures of invading creeper species (Katulic 2004). The work comprises a view on the taxonomy, the conception of an identification guide of the most abundant creepers, the quantification of their propagule pressure and the design of a standardized intervention protocol for early detection. The most frequent creeper species can be seen in an internet-based photo herbarium.

Invasive and non-invasive creeper species were surveyed on Mahé along the three passes over Sans Souci, La Misère and Les Cannelles, along the roadside at Fairview-Salazie and in six high rated biodiversity sites, namely Copolia, Mission Lodge, Mare aux Cochons, Casse Dent, Montagne Palmiste and La Résèrve.

The Pearson correlation test was used to test the correlation between species abundance and the density of habitations along the road transects. Hereby the number of invasive creepers within a subtransect was compared with the number of habitations along the same subtransect. Habitations were not counted if more than 300 m away from the transect line.

Results

Creeper abundance along roadsides

33 alien and 5 native creeper species were collected and identified. Among the alien species 24 were rated as invasive. Their taxonomy and status can be seen in Tab. 1. In this study the most abundant alien creepers were *Merremia peltata, Philodendron sp.*, *Philodendron lacerum, Epipremnum pinnatum "Aureum", Syngonium podophyllum, Passiflora suberosa*, and *Ipomoea cairica*.
Invasive alien creeper species not yet abundant but showing the potential for invasions are *Passiflora edulis, P. foetida, Ipomoea obscura, I. mauritiana, I. batatas, Porana paniculata, Thunbergia grandiflora* and *Antigonon leptopus*. Alien creepers not yet abundant but very problematic in other countries of the Indian or Pacific Ocean are *Antigonon leptopus, Hiptage benghalensis, Passiflora foetida*, and *Quisqualis indica*.

The results of the Pearson correlation test reveals that the abundance of creepers correlates positively with the number of habitations ($p = 0.03$, significant).

Epipremnum pinnatum (S Katulic).

[1] http://www.geobot.ethz.ch/publications/books/bull/2003 on this web page select „App. 2003-8 (K. Fleischmann & S. Katulic) (Link)".

Ipomea cairica (S Katulic).

Creeper abundance in important biodiversity sites

On Mahé creepers have started to invade important biodiversity sites. The relative abundance (as the percentage of all creepers found in an area investigated) of the alien creepers was as follows:
Copolia: *Merremia p.* 34%, *Syngonium p.* 13%, *Passiflora s.* 13%, *Vanilla p.* 12%, *Thunbergia g.* 4%, *Ipomoea c.* 3%, natives (*Vanilla ph.* & *Nepenthes*) 21%.
Mission Lodge: *Thunbergia g.* 40%, *Ipomoea o.* 20%, *Philodendron sp.* 20%, *Epipremnum a.* 20%.
Casse Dent: *Vanilla p.* 45%, *Passiflora s.* 14%, *Philodendron sp.* 3%, natives (*Vanilla ph.*) 38%.
Mare aux Cochons: *Merremia p.* 29%, *Vanilla p.* 19%, *Syngonium p.* 10%, *Passiflora f.* 6 %, *Passiflora e.* 5%, *Ipomoea m.* 5%, *Ipomoea o.* 4%, other alien creepers 11%, natives (*Vanilla ph.*) 11%.
Montagne Palmiste: *Vanilla p.* 32%, *Merremia p.* 30%, *Passiflora s.* 19%, *Syngonium p.* 6%, *Porana p.* 4%, other alien creepers 5%, natives (*Vanilla ph.*) 4%.
La Résèrve: *Vanilla p.* 57%, *Ipomoea b.* 14%, *Merremia p.* 14%, natives (*Vanilla ph.*) 15%.
Congo Rouge: *Merremia p.* has been reported from this area as well (J. Mougal, A. Roucou & C. Kueffer, pers. comm.).

Discussion

This study shows that a high diversity of alien creepers has naturalized along roadsides on Mahé. The correlation between the number of habitations and the abundance of creepers indicates that gardens are a major starting point for creeper invasions. The high diversity and abundance of creepers along roads is especially problematic because many of these invasive creepers show already a tendency to invade biodiversity sites, e.g. *Merremia p., Syngonium p.,* Passiflora spp., Ipomea spp., *Thunbergia g.*.

Table 1. Alphabetic list of the 38 creeper species identified during this study, their common names and their status: endemic, native, alien, invasive.

Scientific name	Family	Synonyms	Status
MONOCOTYLEDONS			
Dioscorea bulbifera	Dioscoreaceae	morts aux rats, potato yam	invasive
Epipremnum pinnatum ‚Aureum'	Araceae	many variations; *Rhaphidophora aurea*, *Scindapsus aureus*	invasive
Philodendron cf. hederaceum	Araceae	Philodendron	invasive
Philodendron lacerum	Araceae	Philodendron	invasive
Philodendron sp.	Araceae	Philodendron	invasive
Syngonium podophyllum	Araceae	many variations; Arrowhead vine	invasive
Vanilla phalaenopsis	Orchidaceae	Lavannir maron	endemic
Vanilla planifolia	Orchidaceae	*Vanilla fragrans, V. mexicana, V. aromatica*; Vanilla	alien
DICOTYLEDONS			
Abrus precatorius	Papilionaceae (Fabaceae)	*Abrus abrus, Glycine abrus*; Lalyann reglis	invasive
Allamanda cathartica	Apocynaceae	Alamanda, Golden trumpet	invasive
Antigonon leptopus	Polygonaceae	Antigone, Lalyann koray	invasive
Centella asiatica	Umbelliferae	Bevilaqua, Vilaqua	alien
Cissus rotundifolia	Vitaceae	Arabian wax cissus	invasive
Clerodendrum thomsonae	Verbenaceae	Bleeding heart vine, Coeur de jesus	alien
Clerodendrum x speciosum	Verbenaceae	Hybrid of *C. splendens* and *C. thomsonae*	alien
Episcia cupreata	Gesneriaceae	Flame violet, Carpet plant	alien
Ficus pumila	Moraceae	Creeping fig	alien
Hiptage benghalensis	Malpighiaceae	*Banisteria benghalensis, Hiptage madablota*	invasive
Ipomoea batatas	Convolvulaceae	Sweet potato vine, Yam	alien
Ipomoea cairica	Convolvulaceae	*Ipomoea palmata*, Railway creeper	invasive
Ipomoea mauritiana	Convolvulaceae	*Ipomoea digitata*	invasive
Ipomoea obscura	Convolvulaceae	Liane marron, Titoupi	invasive
Ipomoea pes-caprae	Convolvulaceae	Beach morning glory	native
Macfadyena unguis-cati	Bignoniaceae	*Bignonia tweedieana, B. unguis-cati, Doxantha unguis-cati* , Cat's claw	invasive
Merremia dissecta	Convolvulaceae	*Ipomoea sinuata*	invasive
Merremia peltata	Convolvulaceae	Liane d'argent, Liane tortue	invasive
Nepenthes pervillei	Nepenthaceae	Lalyann potao,Pitcher plant	endemic
Oxalis corniculata	Oxalidaceae		alien
Passiflora edulis	Passifloraceae	Passion fruit	invasive
Passiflora foetida	Passifloraceae	Poc-Poc, Wild passion fruit	invasive
Passiflora suberosa	Passifloraceae	Devil's pumpkin, Lepeka	invasive
Piper nigrum	Piperaceae	Poivre, Black pepper	alien
Porana paniculata	Convolvulaceae	Liane de mai, Snow vine	invasive
Quisqualis indica	Combretaceae	Rangoon creeper	invasive
Sarcostemma viminale	Asclepiadaceae	Lalyann san fey	native
Thunbergia alata	Acanthaceae	Black eyed susan	invasive
Thunbergia grandiflora	Acanthaceae	Thunbergia	invasive
Vigna marina	Papilionaceae	Pois marron, Shore bean	native

Recommendations

- Border control: Among the alien creepers the percentage of ornamentals is especially high. Introduction of new alien species should be controlled at customs. This is especially the case for alien creepers that have already proved very invasive in other countries, e.g. *Rubus alceifolius, Mikania micrantha* or *Lonicera japonica.*
- Early detection: Early detection of alien invasive creepers is important because their eradication is often very difficult in a later stage of spread. Prevention is cheaper than repair. The wider public and especially people who encounter creepers in their work, e.g. roadside maintenance, should be involved and made aware.
- Control: A future strategy should include collaboration with landowners. Some decades back, landowners tended their gardens by removing invading plants from them. Weeding and management of agricultural areas and private gardens should be encouraged. The ministries and other agencies responsible for land management should act as good examples and invest in public awareness building. Control efforts should be built on existing experiences. For instance, Forestry Section personnel gained experience in removing creepers. Control of *Thunbergia g.* proved to be far more difficult than of *Merremia p.*, because of the tuber-like roots of *Thunbergia g.* (Acanthaceae family).
- Habitat management: Hobbs and Humphries (1995) found that a focus on the invaded ecosystem and its management, rather than on the invader, is likely to be more effective. It is recommended that the frequency of open canopies is reduced. Most creepers need relatively high levels of light to establish themselves. It is therefore important to encourage public cooperation by making it clear that gap restoration efforts, notably by planting native palms, leads to closed forest canopies which are probably the most effective means against the spread and establishment of creeper species.

Passiflora suberosa (S Katulic).

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Red Data List Project – Phase Two

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We are two environmental science students at ETH Zurich. Between December 2004 and February 2005 we carried out a practical course requirement working with PCA on the Seychelles' flowering plants red data list project. We have continued a project that started in 2004 with two other Swiss students (see Kapisen 1(1), p. 8). Our research was co-supervised by Karl Fleischmann (Geobotanical Institute, ETH Zurich) and a local working group consisting of five PCA members (James Mougal, Frauke Dogley, Didier Dogley, Eva Schumacher, Christoph Küffer).
The red data list project is coordinated by James Mougal. It takes up several targets of the Seychelles' National Strategy for Plant Conservation, namely to establish a database on the conservation status of flowering plants (target 1a), to develop a quantitative assessment of flowering plants (target 2a), and to publish a red data list of flowering plants (target 2b).

The objectives of our work attachment were

- to design an assessment method of the conservation status of Seychelles' native plants. This method needed to be compatible with the IUCN red listing guidelines and adapted to the specific situation of the Seychelles (small oceanic island, high endemism, difficult topography, low capacity for field monitoring).
- to create a database that allows the storage of data necessary for the IUCN assessment plus additional information relevant to in situ (in the field) conservation of rare plants in Seychelles, including photographs and GIS maps.
- to communicate the gained knowledge (through literature review, testing of field sampling methods, development of assessment method and database) by organising an expert workshop in Seychelles.

[1] 2001 IUCN Red List Categories and Criteria (Version 3.1), Guidelines for Using the IUCN Red List Categories and Criteria (March 2004), Guidelines for Application of IUCN Red List Criteria at Regional Levels (Version 3.0)

IUCN red data listing criteria
To determine the conservation status of a species, five criteria have to be checked: A. Population Reduction, B. Geographic Range, C. Small Population Size and Decline, D. Very Small or Restricted Population, and E. Quantitative Analysis. These criteria relate mainly to three aspects of a rare plant species: The total number of mature individuals left, the spatial distribution of the remaining individuals or populations, and changes over time. A species is considered threatened if there are only few individuals left, if those are concentrated in only a few areas, and if a population decline can be observed. Criterion E allows a more scientific assessment of the viability of the remaining populations of a species based on specific information about the biology of the species. For each of the five criteria, thresholds are given which determine the IUCN status of the species (least concern, near threatened, vulnerable, endangered, or critically endangered). Thereby the global risk of extinction of a species is assessed. However, we realized that these global IUCN criteria would classify most Seychelles' species into a high threat category because of the naturally small population of Seychelles' endemic plants. E-mail correspondence with IUCN representatives and plant conservationists from other oceanic islands revealed that nevertheless a Global Assessment has to be done so that Seychelles' species can be included in the global IUCN Red List. Complementing this, a prioritisation method for the conservation of rare plants tailored to the specific context of the Seychelles is required.

Fig. 1 The flower of the common endemic *Timonius sechellensis* (E Schumacher).

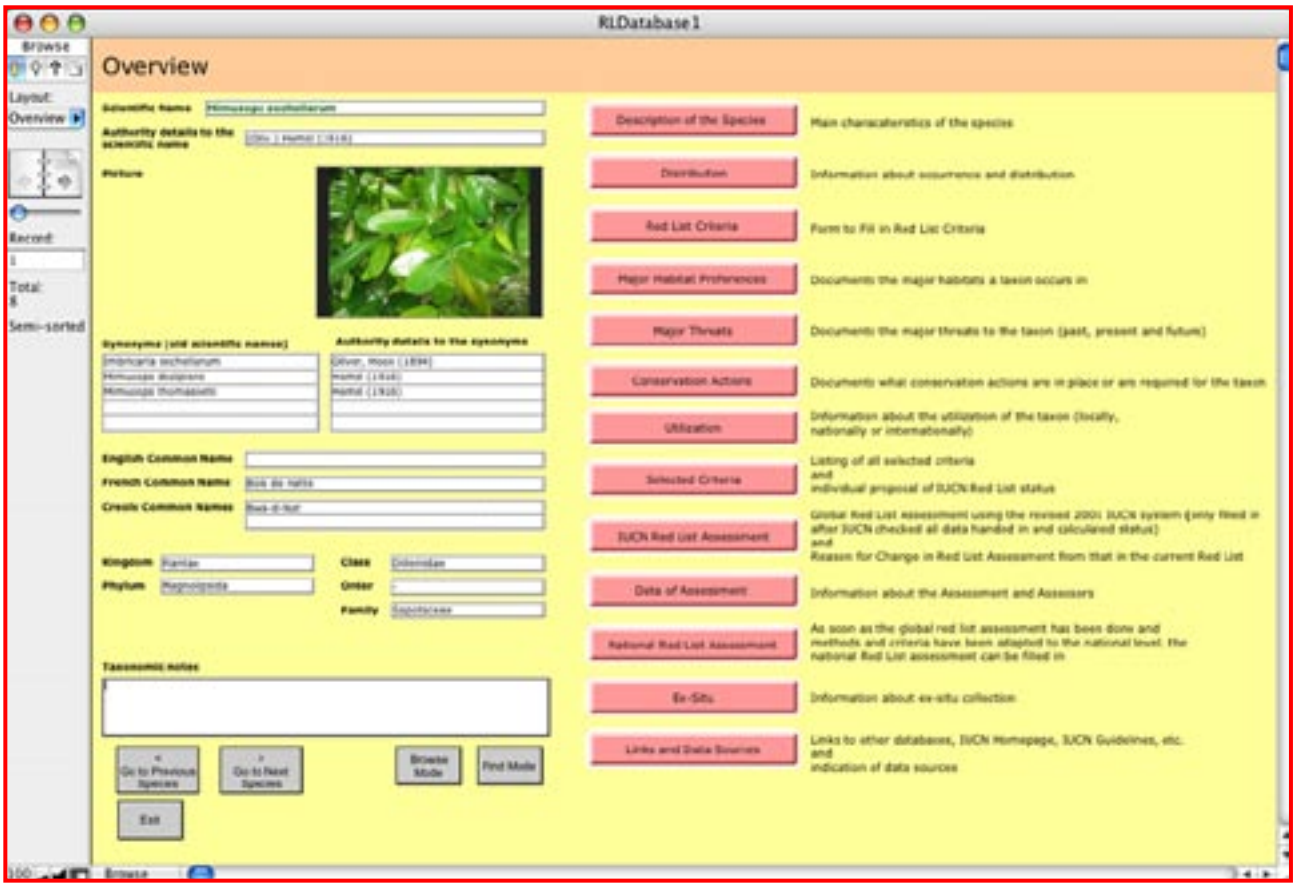

Fig. 2 The 'overview' table of the database. This table gives some general taxonomic information of a species and shows a photograph. Each of the red buttons on the right side leads to a specific data table, e.g. on the distribution or the utilization of the species (M Burger and N Stampfli)

Methodology to survey threatened plant species in Seychelles

To determine the IUCN Red List Status of a species, specific data is needed. The question was how to obtain such data and more particularly which field methods to use for very rare plant species.

For commoner species (Fig. 1) fast sampling methods such as trail transects that have been widely applied in Seychelles are suitable. For many areas on Mahé and Praslin such data exists (see e.g. Kapisen 1(1), p. 8). These datasets need to be standardized, compiled and completed.

For very rare species, sampling data is of limited use because it will never be possible to completely sample the natural areas of the Seychelles. For these species we therefore propose to locate individuals known from the literature or expert knowledge with GPS (Fig. 3). Based on knowledge about the biology or the known locations of a species, further individuals can be sought. A problem is that a dense canopy cover and/or cloudy weather can make GPS reception impossible. In such cases the position of the plant has to be estimated with the help of a compass and a measuring tape relative to the nearest known GPS position.

Database

A database was designed in FileMakerPro (Version 7) (Fig. 2). This database allows the storage and organization of information and data about the taxonomy, description, biology, distribution of and threats to Seychelles' plants, including photographs and GIS maps. The database calculates a preliminary assessment of the conservation status of each species according to the IUCN guidelines. For a final assessment the necessary data can easily be transferred to the entry form of the database hosted by IUCN. Besides managing the data necessary for the IUCN assessment, the database can be used by managers and scientists who want to retrieve specific information about a species. Some of the information may be made accessible to a wider public for awareness building. More sensitive information, such as GPS positions of rare species, will be protected by password.

Expert Workshop

On February 2nd 2004, a workshop was organised by us (Maria, Nathalie and James) to present the status of our work (Fig. 4). The workshop saw the participation of PCA members and various stakeholders

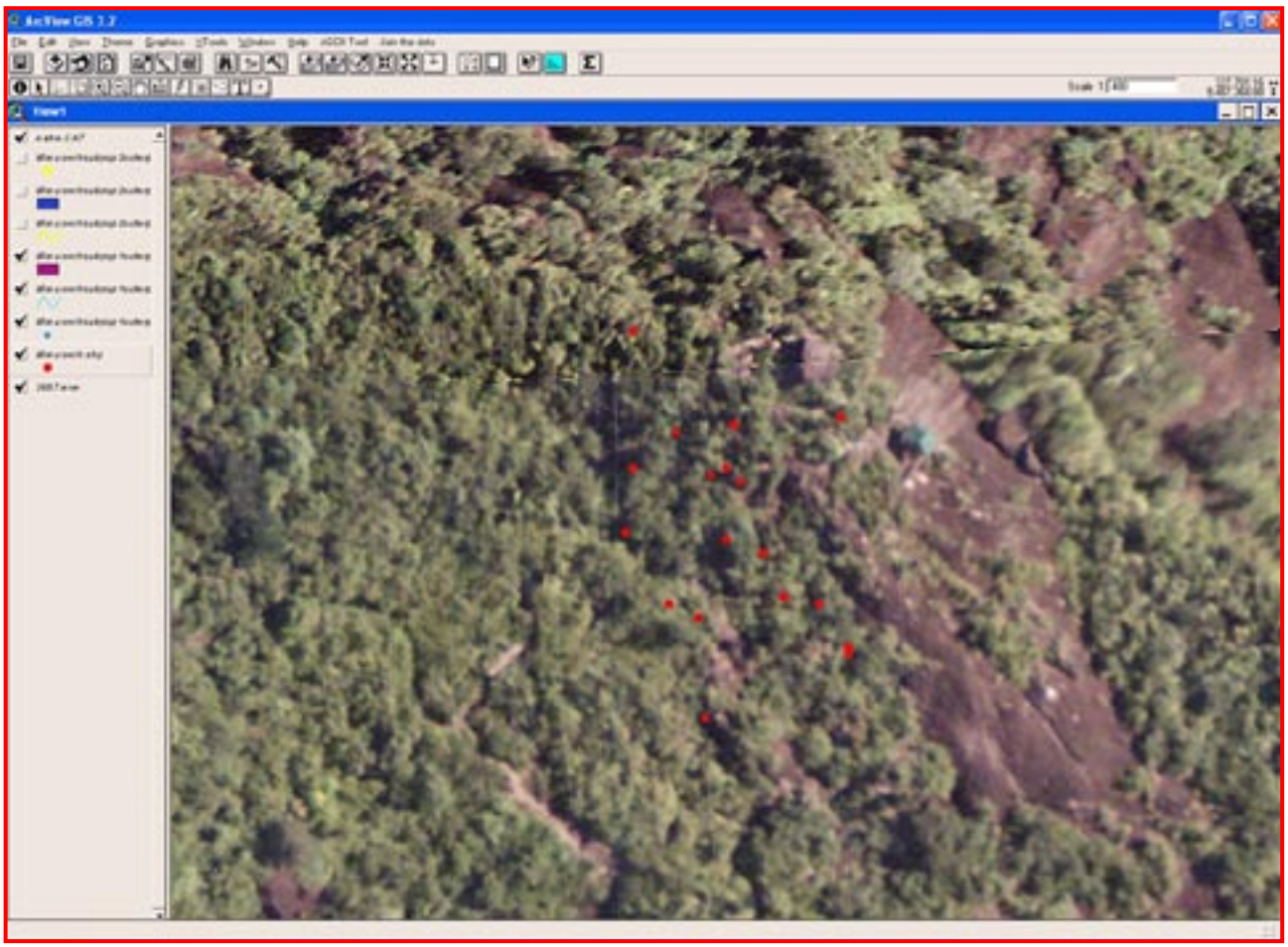

Fig. 3 On the aerial photograph the positions of all *Mimusops sechellarum* (Bwa-d-nat) individuals recorded in the field in one particular area are indicated in pink color. The position of each individual has been located in the field with GPS. This data on the spatial distribution of the located plants can be further analysed with GIS (M Burger and N Stampfli).

from the government (Forestry & National Parks and Botanical Gardens Sections), NGOs (Island Conservation Society, Nature Protection Trust of Seychelles), and a parastatal (Marine Park Authority).
It was an interactive session in which the participants were familiarized with the database, the IUCN assessment method, and the use of GIS and GPS. The workshop was facilitated with the aid of computer visualizations and with the case example of one rare species – *Mimusops sechellarum* (Bwa-d-Nat). The debate was about three main issues: applying the IUCN criteria on a national level (its pros and cons), using GPS and GIS (availability, time and human constraints) and access rights to the database.

We hope that this article gives an insight into our work over the past few months in Seychelles. We would like to take thank PCA for their support and for giving us the opportunity to work on this project. We look forward to the publication of the Red List of Seychelles' flowering plant species.

Fig. 4 Some participants at the expert workshop held in Victoria on the February 2nd 2004 (M Burger).

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