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Newsletter

Habitat Restoration in Seychelles

Habitat Restoration in Seychelles

Almost all islands around the world are currently faced with the challenge of conserving threatened species in habitats which have been degraded and often invaded by alien species. Restoration of the former qualities of degraded habitats has increasingly been shown to be a feasible way to reverse the situation. On islands, habitat restoration often involves removing alien invasive species with the aim to release native species from competition as far as possible and provide more resilience to coming changes (such as climate change).

In this issue of Kapisen we look at some examples of restoration projects which have been carried out in Seychelles in recent years. Some projects have been more focussed on removal of alien invasive species but most have included rehabilitation of the habitat, including planting of native species and sometimes (re-)introduction of rare birds or other animals. There have been successes and failures and lessons learned. We present examples here in the form of 'case studies' – four short summaries and three longer articles with more details. We have tried to select examples which show successful methods and reveal the importance of regular maintenance and sufficient capacity (both financial and human), but also note the constraints and some of the reasons for failure (or lower success).

North Island has an extensive vegetation rehabilitation programme that started around 2002 and is still going strong (p. 8). Maintenance, monitoring and good management have proved essential for its success, which includes introduction of a rare endemic bird species and giant tortoises. Having the appropriate funding and human capacity matters! Enormous efforts may be required to remove some alien invasive species, as is shown in the eradication of invasive sisal (*Agave sisalana*) from the World Heritage Atoll of Aldabra (p. 13). Persistence over many years, finding an appropriate method, and the need for vigilance (i.e. monitoring) helped. Examples of unsuccessful attempts are mentioned on p. 3 and 13. Voluntary help from local communities is one way of increasing human capacity, and examples of this are given on p. 3, 4 and 11, but it is important to regularly recruit new volunteers and keep motivation high for long-term maintenance to be successful.

Tourism is a very important part of the Seychelles economy, and there are quite a number of small inner islands and outer islands which have high quality tourism establishments and also habitats which have the potential for ecological rehabilitation. Much can be achieved if the hotel has a desire to present more than just a 'green image', as there is a ready source of funds plus human capacity to carry out rehabilitation. Examples are given on p. 7 as well as 8. Other small islands, which are managed as accessible protected areas by government organisations, also have potential (see p. 5).

If a restoration area is well managed over a longer period of time, it can form an excellent site for restoration research, and two examples of ongoing PhD studies are given on p. 16 and 17.

Included in this issue of Kapisen are regular items such as PCA's news and project updates (p. 21-24), news from Seychelles National Herbarium (p. 25), new environmental literature (p. 28), and for light relief a word-puzzle activity (p. 7) and a report on a Seychelles biodiversity world record in an unusual place: on banknotes (p. 19).

Editorial Team: Katy Beaver, Eva Schumacher and Christoph Kueffer

Cover photo: Restored inselberg (glacis) habitat (see p. 21; ca. 10 native plant species are in this PCA photo)

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Restoration in Seychelles

Here we present four short summaries of recent and on-going restoration activities carried out on a number of Seychelles' Inner and Outer islands.

Management of invasive plants in protected areas

Seychelles National Parks Authority (SNPA)

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The control and eradication of invasive alien plant species inside protected areas is within the mandate of the Seychelles National Parks Authority (SNPA), but invasive plants have propagated out of control for many years now, despite many attempts to control them. Various approaches were taken by managers, with differing success (see for instance Kapisen 1, p. 11-13 [2004]; 8, p. 12-14 & 9, p. 8-10 [2008]; 11, p. 15 [2010]; 16, p. 6-7 [2014]). Frequently the methods used and the resources available were inadequate to cover the extensive areas affected and/or to carry out follow-up maintenance for long enough. Complete eradication is no easy task but even controlling them requires regular monitoring and maintenance (see Kapisen 20, p.16-17 for a joint SNPA-PCA collaborative project that shows how important maintenance is).

However, a new attempt was made in 2017, when SNPA started a project funded by the Seychelles Environment Trust Fund (ETF). This campaign to control the spread of invasive alien plants was launched on 5th June 2017 to coincide with World Environment Day and targeted areas in the National Parks and also on state land. The initial project idea was to allocate infested plots to local contractors to clear. But by November 2017, it was decided that the approach would not work as the newly cleared areas had already been overgrown again.

Instead, starting in 2018, a pilot study site was set up at Bel Air, to better manage the removal and control activities in order to produce the intended objective. A private contractor was hired to clear 6070 m^2 of land which was covered with the invasive creepers *Thunbergia spp*. and *Merremia peltata* (for more information on invasive creepers see Kapisen 3, p. 10-13). After the initial clearing, 300 endemic palms were planted by SNPA, ETF, school children and staff from the Ministry of Environment, Energy and Climate Change (MEECC). To better control and eliminate tubers and regrowing stems, controlled application of a chemical (Round–Up) was carried out at the site. The first attempt in April was not successful as the chemical, being a systemic herbicide, did not penetrate stems. In August 2018, 200 palms were planted on a 20m x15m square of the site. A second attempt at chemical control proved successful. Around the same time, SNPA started clearing two new sites at Sans Soucis, amounting to 2850 m^2, using mechanical methods. The maintenance of the pilot site at Bel Air continues, with the control of "Fatak" (Guinea grass, *Megathyrsus maximus*) and replacement of planted seedlings that died. At present SNPA is satisfied with progress on the site and will continue to restore it with endemic plants.

The Bel Air site before intervention (SNPA)

Native tree planting activity at the site (SNPA)

Ecosystem Based Adaptation: getting communities involved in water catchment management

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The Seychelles Ecosystems Based Adaptation (EBA) project is funded by The Adaptation Fund and implemented by UNDP and the Seychelles Government. It has been active for a number of years on various fronts including managing forests and wetlands. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as *"adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities".* A central component of EBA is about helping people to manage their local environment to be more resilient to climate change. So the EBA project in Seychelles now places great emphasis on supporting communities to manage local ecosystems.

The project has a number of different themes: some relate to increasing water storage capacity in catchments using "soft engineering" (based on sustainable ecological principles), and re-profiling coastal wetlands to increase connectivity and flood storage potential. This work sits alongside management of vegetation in five catchments and two coastal areas. The project has also engaged with policy development and, significantly, the establishment of community groups which are actively involved in managing local environments.

The challenges of attempting to rehabilitate vegetation communities are well known, as disturbance leading to elevated light levels generally benefits non-native species, often the more pernicious ones. The approach has been to undertake forest management by thinning non-native understory vegetation and leaving the canopy intact, which creates low light conditions where native species can regenerate but most non-natives do not thrive. Around the re-profiled wetlands, such as those at Anse Royale, there is no protective shading canopy and tree planting has been carried out, along with ongoing vegetation management. The use of tree shelters and weed suppressing geo-textile help but the ongoing cutting of non-native species will be essential until the canopy forms from planted (native) trees.

The pilot work on forest management was undertaken in Baie Lazare, Mahé, and permanent monitoring transects have been established through a collaboration with the University of Seychelles and Swiss Federal Institute of Technology (ETH) in Zurich led by Karl Fleischmann.

The response from local communities has been impressive. Local groups called Watershed Committees are active in Anse Royale, Baie Lazare, Anse Boileau and on Praslin, and are involved in wetland rehabilitation and tree planting. Local groups are now adopting sites and leading the management, with the project supplying planting stock, materials and technical support. To a large extent, sustainable catchment management hinges on local communities valuing wetlands and woodlands, supporting sustainable management and advocating for protection.

The Baie Lazare community group providing after-care for native trees (EBA)

Curieuse Island lowland forest rehabilitation

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Seychelles National Parks Authority (SNPA), financed by the UK government under the Darwin Initiative, has been rehabilitating lowland plateau forest on Curieuse Island.

Two dedicated staff, Anselm Barra and Paul Uzice, spent the last two years growing native lowland tree species from seed in their nursery, clearing invasive vegetation including Albizia (*Falcataria moluccana*), Coco plum (*Chrysobalanus icaco*) and coconut scrub from Baie Laraie, Anse Papay, Grand Anse and Anse Jose on Curieuse. They then planted out around 1500 of the native seedlings and saplings of a wide range of tree species (see list below).

The main challenge for Anselm and Paul was how to prevent the giant tortoises from eating the newly planted out saplings. There are around 120 adult giant tortoises on Curieuse and most of them live in the plateau areas which were being rehabilitated. So tortoise barriers were built with the invasive vegetation that was being removed, to prevent the tortoises reaching the trees.

The second difficulty encountered was visitors to the island leaning over the tortoise-proof barriers, decapitating the native plants and feeding them to the tortoises! This was rather demoralising for Paul and Anselm, as you can imagine! So signboards were made, explaining about the project and asking people (in several languages as tourist visitors are from many different countries) to please not break the plants to feed the tortoises.

This coastal forest rehabilitation was undertaken primarily for the benefit of the Seychelles Paradise flycatcher ('Vev'), an endangered endemic bird which was introduced to Curieuse from the nearby island of La Digue under the same project. However it will also benefit other native biodiversity, as this type of mixed forest is the Seychelles' natural lowland habitat, much of which has been removed in the past because of human land needs. Even the tortoises which wanted to eat the newly planted out trees will benefit once these trees have grown, as they will provide shade and some fallen leaves and fruits as food.

It is hoped that rehabilitation of this lowland forest habitat will continue and be maintained and expanded as it takes well over two years to rehabilitate an ecosystem! Nevertheless this project has made a very good start.

Sapling protection from giant tortoises (R Bristol)

Native tree growth after two years (R Bristol)

Native plants used in this restoration:

Takamaka (*Calophyllum inophyllum*), Bodanmyen (*Terminalia catappa*), Bwadroz (*Thespesia populnea*), Bwa blan (*Hernandia nymphaeifolia*), Porse (*Cordia subcordata*), Bwa kasan bordmer (*Guettarda speciosa*), Bwa torti (*Morinda citrifolia*), Bwa sousouri (*Ochrosia oppositifolia*), Bonnen kare bordmer (*Barringtonia asiatica*), Bwadtab (*Heritiera littoralis*), Var (*Hibiscus tiliaceus*), Bwa kafoul (*Allophyllus pervillei*).

Vegetation management on ICS islands

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Island Conservation Society (ICS) is conducting vegetation management on all the inner and outer islands where it operates in Seychelles.

Outer Islands

Since 2015, the Plant Conservation Action Group of Seychelles (PCA) and Island Conservation Society (ICS) have worked together to produce vegetation management plans for Alphonse (2015), Desroches (2015), and Farquhar (South Island) (2018), under the GoS-UNDP-GEF project titled 'Expansion and Strengthening of the Protected Areas subsystem of the outer islands of Seychelles and its integration into the broader land and seascape'. The plans are being implemented by the Islands Development Company (IDC) with on-site supervision by ICS staff. So far 50% of the vegetation rehabilitation targets set under this project have been met, i.e. 20ha of native forest has been restored. On Desroches, the newly created tortoise sanctuary was designed and built within restored area to accentuate the physical features and beauty of the coralline landscape.

Desroches tortoise sanctuary with nature trail

Removal of tree overgrowth on Aride Island

Aride Island

The GoS-UNDP-GEF project also provided financial support to conduct various training sessions for Aride island personnel on vegetation management techniques to increase the survival of seabirds and Seychelles Magpie-robins, by improving available habitat for these species. Staff were trained on: plant classification, ecology and identification; principles of vegetation rehabilitation; use of the online Seychelles Plant Gallery; plant nursery establishment and plant care; site preparation, planting and maintenance guidelines; and health and safety considerations.

Silhouette Island

Between 1997 and 2010, habitat rehabilitation was undertaken by the Nature Protection Trust of Seychelles (NPTS) across five areas on Silhouette: La Passe, Grand Barbe Rock, Jardin Marron, Gratte Fesse and Mont Plaisir. In these areas, control measures such as cutting, ring barking, herbicides and combined treatments have been trialled on significant invaders like Strawberry guava (*Psidium cattleianum),* Cinnamon *(Cinnamomum verum), Lantana camara* and Rubber tree *(Hevea brasiliensis),* with varying success. From 2016 onwards, ICS identified, mapped and restored 2.55ha

of native vegetation across several key priority and more accessible areas, including the Coco-de-mer forest at Jardin Marron, and two glacis outcrops at Grand Barbe.

The Native Plants Forest Trail on Silhouette was initiated by NPTS in 1997. The trail meanders through a mixed natural ecosystem and botanical garden, where a suite of endemic, native and alien species occur. It is expected to benefit native flora and fauna including land birds, reptiles, invertebrates and the critically endangered Sheath-tailed bat. A key feature of the trail is its close proximity to the La Passe settlement, allowing visitors to experience the true wonder of the island without having to venture too far. ICS has continued the vegetation rehabilitation at this site with financial, technical and logistical support from the Silhouette Foundation, IDC, Seychelles Hilton Resort and Spa, PCA, and the Critical Ecosystem Partnership Fund (CEPF).

The start of the native plants forest trail on Silhouette

All photos ICS

RESTORATION ANAGRAMS

Here is a group of volunteers busy helping with a vegetation restoration project on Praslin.

Below is a list of words which are used when we talk about vegetation restoration. However, the letters of the words are not in the correct order (they are anagrams of restoration words).

Work out what each word is.

The answers are on page 24.

1. AEILN
2. CLNOORT
3. CDEEIMN
4. DEGIINNOSU
5. AAIIMNNT
6. IMNOORT
7. AEINTV
8. DEEGINW
9. ENRRSUY
10. AGILNNPT
11. AILLNOOPRT
12. EEMORV
13. CEEIPSS
14. AABEILNSSTU

Successes and challenges of vegetation rehabilitation on North Island

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The original flora and fauna of North Island is not well known because of a lack of early written and illustrated documents or photographic records. Today's vegetation differs markedly from the original one due to North Island's land use history. Abandoned as a copra plantation in the 1970s, the island is still dominated by coconut palms which cover most of the island including the coastal fringe, inland plateaus, as well as the granite hills. Their ability to outcompete their native counterparts means that coconut dominated areas are difficult to rehabilitate due to their high yield (between 30 and 75 coconuts produced per palm per year) and fast growth rates.

The following definition of rehabilitation was adopted in 2005: *"To re-establish the productivity and some, but not necessarily all, of the plant and animal species thought to be originally present at the site. For ecological or economic reasons, the new habitat might also include species not originally present at the site. The protective function and many of the ecological services of the original habitat may be re-established"* (cited from Beaver et al. 2013).

North Island's Noah's Ark program has been running for 21 years and during that time, vegetation rehabilitation has been one of the main facets of the program, and also the most challenging. The island aims to rehabilitate the forests to a state reminiscent of that prior to the impacts of man. This allows for the introduction of endangered endemic bird species to the island. The Seychelles White-eye, once one of the most endangered birds in the Seychelles, was successfully reintroduced to North Island in 2007. The birds have established well and the population has increased 6-fold since their introduction. Their establishment and subsequent increase in population size is due to the extensive habitat restoration that was carried out across the island. Thousands of tree species known to be important for the White-eye were planted across the island, creating suitable habitat for this small passerine bird.

The vast majority of rehabilitation work on North Island in the last 5 years has focused on the low-lying areas of the island, namely the coastal fringes and inland plateaus, both on the western and eastern parts of the island, as well as the road which connects the east and west of the island. These rehabilitation zones received extensive work in the early stages of the Noah's Ark program and rehabilitation in some of these areas is nearing completion. The success of the early rehabilitation work can be seen in the comparison photographs below (Figures 1 and 2). Figure 1A shows a section of West Beach in 2005 after stands of invasive *Lantana camara* (Vyey fiy) and juvenile coconuts had been removed. All tall trees are introduced coconut palms. The coastal fringe is now (2019, Figure 1B) dominated by *Scaevola* (Vouloutye) and juvenile native tree species such as *Thespesia populnea* (Bwadroz) and *Barringtonia asiatica* (Bonnen kare), planted in 2005-2007 and now providing the canopy under which further native species are being planted.

Figure 1. West Beach junction (A) 2005, and (B) 2019 (see above for details) (North Island).

Figure 2. Road to Honeymoon Beach (A) 2008, dominated by invasive *Lantana camara* (Vyey fiy), and (B) 2019, *Lantana* removed, native *Thespesia populnea* (Bwadroz) growing (North Island).

While the benefits of vegetation rehabilitation on ecosystems are well understood, there are several challenges faced when undertaking rehabilitation on any scale. To date, 58ha of the 201ha island have received some degree of vegetation rehabilitation work (Figure 3). Some areas are considered to be completely rehabilitated (i.e. self-sustaining and not requiring further intervention) while the others require ongoing maintenance to remove coconut saplings and other invasive plant species still present in the forests. Regular maintenance within previously rehabilitated areas is the single most important factor constraining the capacity to expand rehabilitation work to further areas on North Island. The labor-intensive nature of vegetation rehabilitation work means that there is always more work to be done than people available to do so. North Island currently employs a team of 3 staff members to carry out the rehabilitation work. Government permits have been obtained to remove coconuts from specific areas on the island. The removal of the adult coconuts drastically reduces the need for follow up maintenance work as the source of coconut saplings can be removed.

While coconuts are the most obvious species being removed from the forest, they are by no means the

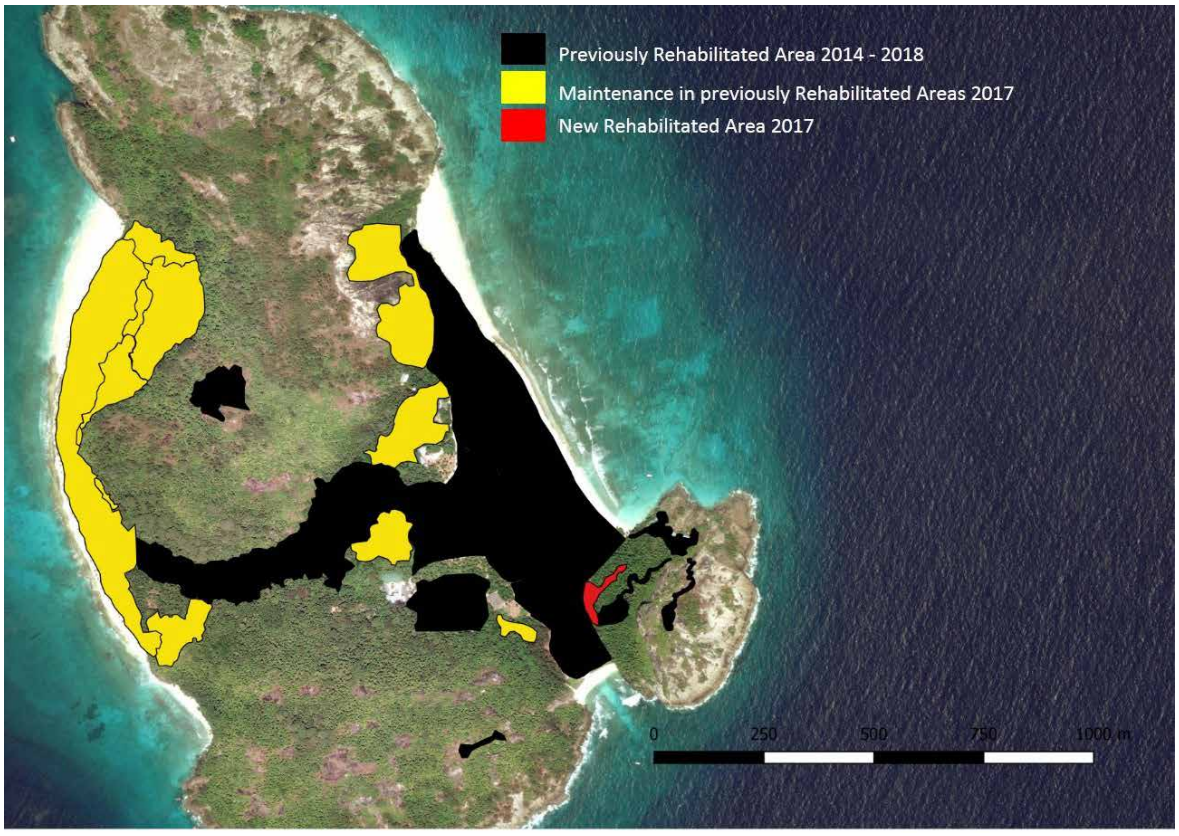

Figure 3. North Island's rehabilitated areas 2014-2018.

only species requiring attention. Vast areas of the granite hills are covered in *Lantana camara* (Vyey fiy) together with stands of *Clidemia hirta* (Fo watouk) and *Chrysobalanus icaco (*Prindefrans or Cocoplum*)*. Other invasive species still present in large numbers on the island include *Casuarina equisetifolia* (Sed), *Alstonia macrophylla* (Bwa zonn)*, Falcataria moluccana* (Albizya) and *Adenanthera pavonina* (Agati) to name a few. Each of these species tend to form homogeneous stands, outcompeting any remaining native flora.

Vegetation rehabilitation requires a steady supply of indigenous and endemic saplings to be planted in the rehabilitation zones. The North Island tree nursery maintains a stock of approximately 8000 to 10000 saplings belonging to 42 different species. These trees are planted in the various zones based on the island's Vegetation Management Plan which outlines the priority areas as well as the species to be planted within each area. The island's Eco-tourist volunteers assist the rehabilitation team with propagating seedlings and saplings in the tree nursery under the guidance of our Tree Nursery Groundsman, as well as planting out saplings in the forest.

North Island hopes that the continued rehabilitation of its forests will one day provide a safe haven for indigenous and endemic flora and fauna of the Seychelles. Vegetation rehabilitation forms the cornerstone of the Noah's Ark Project and will likely continue for many years, if not decades, into the future.

References

Beaver, K, L Vanherck & G Wepener (2013) North Island Vegetation Management Plan 2013-2017, North Island & Plant Conservation Action group (PCA), unpublished document 43pp (2013).

PCA's role in vegetation rehabilitation on North Island (2005-2013)

PCA became actively involved in the North Island vegetation rehabilitation programme in 2005 through the Island Conservation Society-led FFEM Rehabilitation of Island Ecosystems 5-year project (Kapisen 6, p. 16-17), which ensured among other outcomes that rats were eliminated from the island and biosecurity protocols were in place. In the early years of rehabilitation, students from ETH Zurich set up monitoring protocols, and regular maintenance was initiated right from the start (Kapisen 9, p. 4-7). Collaboration with the North Island Environment and Landscape team resulted in a first Vegetation Management Plan 2007-2011 and a follow-up plan 2013-2017 (Kapisen 15, p. 18). A long-term holistic ecosystem approach was taken and a list of suitable native plants was drawn up for the various island habitats, taking into consideration e.g. the proposed fauna introductions (Aldabra Giant Tortoises and Seychelles White-eyes), monitoring, maintenance, pest and disease control, staff limitations, education and awareness, and the fact that the island is an eco-tourism establishment. An adaptive management system was also adopted, based on yearly reviews of progress and setbacks. Although our partnership with North Island ended in 2013, the processes put in place are still the basis of the rehabilitation work on the island today.

Taken from an email in praise of Kapisen newsletter and the work that PCA does:

«It's a great pleasure to read about plants of the Seychelles. I will let others know of such noble work that PCA are doing in the preservation of our environment, and education about Seychelles' wonderful biodiversity.»

Andre (a local reader)

Rehabilitation of Praslin Island's degraded lands with community engagement

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The Terrestrial Restoration Action Society of Seychelles (TRASS) is a non-governmental organisation committed to the rehabilitation of degraded terrestrial sites of Seychelles islands. TRASS mobilises actions for rehabilitation, enhancement, maintenance and safeguarding of such areas, especially those affected by forest fires. In 2009, TRASS established a long-term rehabilitation programme to meet its objectives. Most of the work is undertaken on Praslin Island which has suffered numerous forest fires and where 40% of the island is degraded and in need of rehabilitation (Senterre, 2009).

Pointe Chevalier, which belongs to a private landowner, and Newcome owned by the State, were the first sites chosen to test some rehabilitation factors to inform the long-term rehabilitation programme. This trial was initiated as part of a GEF funded project on Sustainable Land Management. Pointe Chevalier is a degraded hill above Anse Lazio, whilst Newcome is a shrubland that had previously been replanted by the Forestry Department but where invasive alien species like *Chrysobalanus icaco* (Cocoplum) and the native *Dicranopteris linearis* (Bracken fern) had overgrown the understory. Rehabilitation trials started in 2010 and aimed at establishing appropriate planting techniques and identifying species suitable for replanting on degraded sites. Planting plots on the bare degraded land at Pointe Chevalier were compared to plantings in strips opened up within the shrubland at Newcome. The sites were monitored during the project (2010-2014) and again in 2017 as part of the long-term monitoring programme. Results from this trial indicated that *Planchonella obovata* (Bwa mon per) appears to be the most successful species on both bare soils and pioneer shrublands. The other native species that are showing good results include *Dodonaea viscosa* (Bwadrenet), *Ludia mauritiana* (Prinn maron), *Intsia bijuga* (Bwa gayak) and *Mimusops sechellarum* (Bwadnat).

Regarding planting treatments, addition of charcoal and humus ('limis') more than doubled the growth rate compared with plantings done on bare soil. Plots which were subjected to identical treatments indicated that plantings on bare soils developed slower than plantings done on pioneer shrublands in the short term only, while in the medium term, the opposite was observed. This is because open strips in shrubland become re-encroached with Cocoplum which competes with the planted seedlings and hence slows their growth. The results suggest that strips need to be >1 m wide (ideally ca. 1.5-2 m) and need to be maintained every 2 to 5 years.

One of the experimental plots

The rehabilitation work done by TRASS during this long-term programme resulted in the development of key knowledge and skills for future planning and rehabilitation work on highly degraded lands. Indeed, the knowledge has been used in wide-scale replanting activities in other areas on Praslin, notably Pointe Chevalier, Fond d'Albaretz, La Hauteur and Fond B'Offay within the National Park. To date, TRASS has undertaken rehabilitation activities on more than 30 ha of land. This represents the largest rehabilitation work on degraded lands and shrublands done in Seychelles by TRASS over the last decade.

Such large-scale rehabilitation would not have been possible without the active engagement of volunteers from different communities on Praslin, Mahé, La Digue, Curieuse and Fregate islands. Rehabilitation activities such as plant propagation, transportation of plants by foot (a walk of more than 30 minutes uphill) and plantings can be very costly (rehabilitation of degraded lands costs on average SCR 500,000/ha). So TRASS makes great efforts to engage members of the communities in its long-term rehabilitation programme, not only to reduce the cost of operation but most importantly to sensitise the people and build a sense of ownership in the greening of Praslin

Replanting of degraded bare land by volunteers

Community members monitoring plant growth

Island. As a result, within ten years the NGO has developed a large volunteer support base: 10-30 volunteers participate in 2-4 activities each month on a yearly basis. They come from different islands and institutions including tourism, educational, governmental and non-governmental organisations as well as the private sector.

Apart from rehabilitation of degraded hills, TRASS has been involved in the rehabilitation of wetlands, including mangroves on Praslin and Curieuse. Thirty thousand seedlings of mangroves and other non-mangrove coastal plants have been produced and replanted on 16 ha (12 ha on 6 sites on Praslin and 4 ha at Baie Laraie on Curieuse) to enhance the biodiversity and the resilience of these ecosystems to the impacts of climate change.

Compilation of all TRASS rehabilitation actions done so far and monitoring of all pre-existing trials has revealed that medium-term monitoring is required to start detecting differences in relative success between species or planting treatments. This stresses the need for long-term monitoring and data analysis to derive valuable lessons and provide feedback on the success of ecosystem rehabilitation.

References

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A photographic example of the restoration challenge

Imagine you are faced with a thicket of invasive alien shrubs life you see in the photo on the left. Care and knowledge of the plants is needed, as well as hard physical work, to ensure that you remove the aliens but retain the precious native plants, as well as adding more native seedlings to fill gaps. But the results can be amazing, as you can see in the photo on the right.

Photos from the same glacis site on Mahé before (left) and after restoration (right) (PCA).

Sisal on Aldabra: Success after 40 years of eradication attempts

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The Seychelles Islands Foundation (SIF) announced the successful eradication of the invasive plant sisal *Agave sisalana* from Aldabra Atoll in January 2019, after more than 40 years of control efforts.

Sisal is a large agave plant (Asparagaceae, Monocots) native to Mexico but has been introduced and cultivated widely across the hot dry tropics for its fibrous leaves, which are used in sisal 'hemp' production, for rope and twine. Sisal is now considered an invasive species in the Seychelles and across most of the Western Indian Ocean region (some is still grown commercially in Madagascar), where it grows quickly and produces mono-dominant, impenetrable stands which clearly decrease biodiversity and outcompete native plants. It is not a well-loved plant on the islands on which it occurs: not only is it painfully spiky, with pointed, serrated and very sharp leaves, but it also produces toxic sap which can cause burning and extreme irritation to human skin. One can only imagine that it must be a sought after plant by herbivores in its native range to produce such an effective arsenal of defence mechanisms! One reason for sisal's invasiveness is that it can reproduce easily, both sexually or asexually. Sexual reproduction happens via small plantlets or 'bulbils' which are borne in their hundreds atop towering flowering stems which eventually topple to the ground, spreading the mini-sisal plants. Asexual reproduction is by means of roots or 'stolons', which can penetrate deep into soil and rock crevices and make the plant exceptionally difficult to remove.

History of sisal control on Aldabra

Sisal was probably introduced to Aldabra in the 1920s for cultivation of its tough fibres but it was first documented on the island of Picard on Aldabra in 1956 (Beamish, 1970). It was noted by the Royal Society of London in the early 1970s to be an important cultivated species on the atoll and was already present at four sites by then. These four sites were: (1) at and around the Old Settlement and Back Path on the island of Picard (900 m^2); (2) on west Polymnie (<10 m^2); (3) at Anse Badamier on Malabar (ca. 30 m^2); and (4) by far the largest patch (ca. 1500 m^2) in the north of Ile Michel, in the eastern part of Aldabra's huge lagoon (Fig. 1). The total area covered by sisal was just under 0.25 ha.

Since then, there have been numerous attempts to remove sisal from all four sites, starting with Royal Society efforts in 1976 and 1977, when most sisal was cleared from the Picard, Polymnie and Ile Michel sites. This was done manually and must have been arduous and painful work. It was also unfortunately not successful, with sisal returning to all three areas, due to the roots not being entirely removed from the hard porous limestone of the atoll, which allowed them to root deeply in crevices. In 1986, efforts to clear sisal from Malabar, the smallest patch, were initiated, also manually, but it was again not possible to remove all plant material. In 2005, the sisal patch

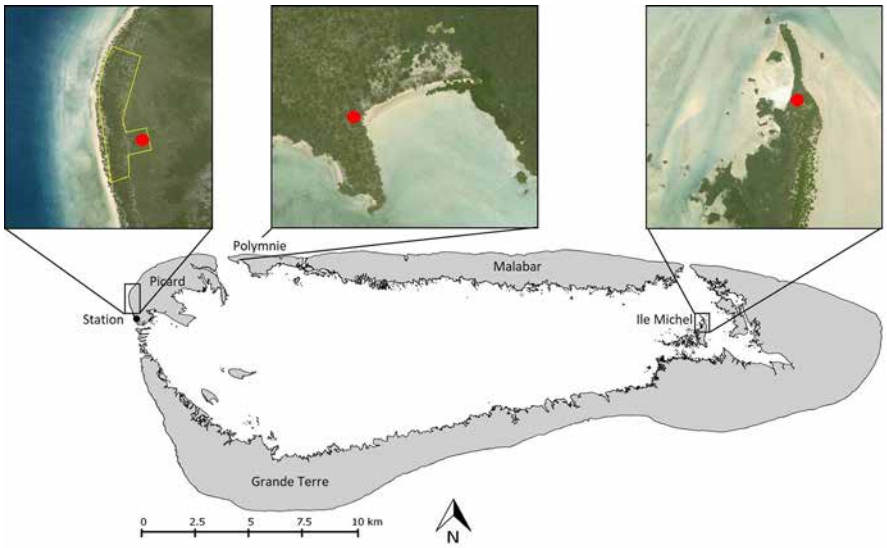

Figure 1. Aldabra Atoll, with main islands and four sisal patches shown in red at (from left to right) on Picard, Polymnie, Anse Badamier on Malabar island, and Ile Michel.

on Malabar was tackled again manually, and this time was successfully cleared, leaving only three patches remaining on Aldabra. Similar efforts at the same time were once again unsuccessful on Picard, Polymnie and Ile Michel where the plant was heavily controlled but continued to reappear. The Picard sisal patch was thought to have been successfully controlled in 2005 but was re-discovered in 2010, when it was cleared manually again. In 2013, during surveys for sisal to assess the scope of the invasion, an entirely new patch of sisal was discovered further inland on Picard, about 70m away from the original patch nearer the Old Settlement.

A new approach: herbicide trials

It became clear that a new approach would be needed. The manual method had been tried repeatedly and was time-consuming, labour-intensive, difficult and risky work for staff involved, plus it was not proving to be a successful method, especially for large patches of sisal, due to the deep roots. Herbicide, which was initially not considered due to Aldabra's highly protected and sensitive environment and the high priority of avoiding non-target impacts, was eventually considered a potentially more effective measure, likely to reach and kill the roots of the plants and prevent re-growth. Furthermore, herbicide application could be done locally (on individual plants), which was expected to limit exposure to herbicide of the surrounding plant community. The selected herbicide (Tordon 101 based on Picloram) also has a rapid breakdown time in sunlight, minimizing its long-term effects on the environment.

SIF was reluctant to rush straight into herbicide use on Aldabra so in 2013, under project funding from the European Union, a trial was run on Aldabra comparing several different methods and concentrations of herbicide. Plants were divided into different size classes to ensure even distribution of sizes across treatments. Selected sisal plants were allocated to one of eight experimental groups under four methods: (1) whole plant sprayed with a 0.5%, 1% or 2% herbicide concentration; (2) plant had central growing stem cut and immediately treated with 5%, 20% or 50% herbicide concentration applied directly to the cut stem; (3) plant had stem cut (i.e. growth tip removed) but no herbicide treatment; and (4) no treatment (control group). The plant health was then checked monthly for 6 months and the surrounding area was checked for any effects of herbicide.

The results showed that neither plants which had had their growth-tip removed, nor those in the control group, suffered any mortality, as expected. Furthermore, spraying whole sisal plants (without cutting the growth stem), even at relatively high concentrations, had very little effect. Even applying herbicide neat to the cut, while effective on smaller plants, was only effective for large plants at the highest concentration (van Dinther et al. 2015). Importantly, no target effects on the surrounding vegetation were recorded, giving us confidence that localized herbicide treatment of sisal would not negatively impact on Aldabra's fauna and flora. Based on the results of the herbicide trial we decided to make two changes to the final method, first to make a larger (more diagonal) cut to the growth stem to create a larger contact area for the herbicide, and second, to reduce the final herbicide concentration to 30% (down from 50% used as the highest concentration in the trials) to minimize the herbicide use as much as possible.

Eradication methods based on trial results

The eradication proceeded in 2014, under the same EU-funded project, with all individual plants treated using the method above, and multiple treatments

Figure 2. Sisal plants on Picard, Aldabra, before (above, June 2014) and after (below, September 2014) the eradication (© SIF).

being required for all three sites to achieve the goal of complete eradication. The Picard patch was treated in June and September 2014 (Fig. 2), Polymnie in February and July 2014 and the large Ile Michel patch in March, July and October 2014 (Fig. 3). Great care was taken to ensure that the application methods trialled were individual plant-specific, there was no spraying of any plants other than sisal and care was taken to prevent herbicide from coming into contact with other plant species or the soil.

Post-eradication monitoring is essential

Following any eradication, a period of monitoring is required. For sisal we were particularly interested in monitoring any re-growth in the wet season, when it was anticipated that any remaining material might re-sprout but we monitored all patches every 3 months, for at least 2 years after the eradication. While there was no re-growth in the Picard or Polymnie patches, we did record re-growth at Ile Michel during the three wet seasons after the eradication. In January 2015, 206 new plants were discovered on Ile Michel. Despite immediate treatment, more new growth was seen in November 2015, then 44 new shoots in January and February 2016. Monitoring over the 2016 dry season showed no new growth but a final group of four new plants was found in December 2016, which were treated in January 2017. Monitoring continued, to ensure that Ile Michel was free of new sisal growth for two years before it could be considered in the clear. When the final monitoring trip by the Aldabra team found no re-growth of sisal on Ile Michel in December 2018, more than 4 years after the intensive control efforts, SIF was confident that the species had been completely cleared from Aldabra.

So far, the areas cleared of sisal on Aldabra have remained oddly unchanged (see post-eradication photos in Figs 2 and 3), although the existing native plants in the area appear to be healthy. Whether the lack of recruitment and succession is due to a change in the soil ecology cause by sisal, the plants fibrous leaves taking a long time to break down and preventing re-growth of native species, or perhaps another factor, we are not yet sure but SIF will continue to monitor these areas with interest and it seems likely that they will regenerate before long.

With the Ile Michel patch finally removed, SIF was delighted to announce in January that sisal had been successfully eradicated from Aldabra, a significant step in protecting its biodiversity and restoring its terrestrial ecosystem. This eradication marks the fourth successful eradication of an invasive species from Aldabra in recent years but probably not the last.

Figure 3. Ile Michel sisal patch on Aldabra before (above, March 2014) and after (below, October 2014) the eradication (© SIF).

Acknowledgements

We thank the European Union for funding this research and eradication (under project DCI-ENV/2010/220-252: "*Mainstreaming the management of invasive species as fundamental to preserving the ecological integrity and enhancing the resilience of Seychelles' World Heritage Sites*"). A huge thanks to Aldabra staff, particularly Ronny Gabriel, Marvin Roseline, Catherina Onezia, Sheril de Commarmond, Samual Basset, Rowana Walton, Janske van de Crommenacker and Heather Richards for their logistical help and support, and to Frauke Fleischer-Dogley, Wilna Accouche and all SIF Head Office staff for their support.

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Restored areas create research opportunities

When vegetation is restored or rehabilitated to something like its original state – for instance free of alien plant species (or at least these are kept under control) – the restoration site can be very valuable for carrying out research that enables us to better understand the functioning of the plant and animal communities that live there. How do native species react to being freed from the competition from alien species? Do native plants produce more flowers or fruits, or native animals lay more eggs? Does restoration thereby help populations of native species recover? Do animals which are rare return or spread into restored areas because these are now conducive places to live?

Often it is necessary to compare a restored area with an unrestored area (and there are still plenty of those available!) in order to understand how the native species are affected by the presence of alien species. Exactly what was preventing or reducing the viability of the native species living among aliens, and how did these factors work?

Some of the restoration projects which are described in this and earlier issues of Kapisen are being used for research of this kind, attracting both local and overseas researchers (see e.g. Kapisen **8**, p. 12-14; **9**, p. 8-10; **16**, p. 6-7; **20**, p. 16-17). Recently, Seychelles has been host to 2 PhD students and several BSc and MSc students who have been studying the effects of restoration on native communities. Here we present preliminary results from the two PhD studies.

The response of seed dispersers to restoration of inselberg (glacis) vegetation

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In Seychelles, as in all other tropical regions, the majority of the woody plant species produce fleshy fruits, which require frugivores (fruit-eating animals) for dispersal. However, on many of the world's islands, dispersal processes have been substantially disrupted because of the presence of invasive alien species. These invasive species can alter the mutualistic (mutually beneficial) interactions between native plants and their seed dispersers, meaning that regeneration of the natural vegetation is affected and may be less successful.

The main aim of my PhD study is to determine whether plant-seed disperser interactions can be restored by habitat restoration. For that, we used a restoration community experiment established in 2010 to 2011 on eight inselberg (glacis) communities in Mahé, consisting of four restored and four unrestored sites. At restored sites alien plants were removed and native seedlings were planted by a team of 7-10 invasive species specialists from Seychelles National Parks Authority (SNPA), while the other four inselbergs remained unaltered and contain both native and alien plant species. In August 2018, a team of 2-3 research assistants (Eleanor Huckle, Sara Mendes and Yanick Dufrene) and myself started collecting data on plant-seed disperser interactions over a ten-month period across all eight inselberg sites. Four different methodologies were combined: direct observations of feeding bird and reptile frugivores using binoculars, camera traps, analysis of faeces, plus analysis of bird faeces collected with faecal traps (stick perches placed in open areas – see photo). Also at each site, fruit crop and bird and reptile abundance were recorded monthly. Faeces were collected from birds caught with mist-nets and from reptiles using baited traps. Later the faeces were inspected for seeds in order to identify the plant species – by comparing them to a seed reference collection. The disperser species of those faecal samples collected with perches/faecal traps will be identified through a method called DNA barcoding.

The team conducted a total of 960 hours of mist-netting and 800 hours of reptile trapping, analysed more than 1200 faeces, and recorded around 1000 individual visits of dispersers on fruits! We found that the Seychelles bulbul (Merl, *Hypsipetes crassirostris)* is by far the main disperser in both restored and unrestored sites, followed by the Seychelles skink (Lezar mangouya, *Trachylepis seychellensis)* and the Seychelles blue pigeon (Pizon olande, *Alectroenas pulcherrimus).* The Seychelles bulbul disperses seeds from 17 native plant species, for example Bwa rouz *(Dillenia ferruginea)* and Bwa kalou *(Memecylon eleagni)*, including some rare and endangered species such as Bwa dou *(Craterispermum microdon).* The Seychelles skink

A trap for collecting faeces from perching birds (A Costa).

The research team (Alba is 2nd from left) (S Mendes).

feeds mainly on plant species that produce small fruits close to the ground, such as Vakwa montanny *(Pandanus multispicatus)* and Bwa dir rouz *(Pyrostria bibracteata).* Those plant species with larger fruits such as Latannyen milpat *(Nephrosperma vanhoutteanum)* and Lafous gran fey *(Ficus lutea)* are dispersed mainly by the Seychelles blue pigeon. However, we found that the Indian mynah *(*Marten, *Acridotheres tristis)* and Turtle dove *(*Tourtrel de zil, *Streptopelia picturata),* both alien birds, barely contribute to the seed dispersal on inselberg plant communities.

At a plant/animal community level, our preliminary results (obtained by using network analysis) suggest that despite the small size of the community and the fact that the main plant and animal species involved are the same, there are differences in network structure when alien plants are removed. Restored networks are more attractive to frugivores, with a higher number of visits and interactions by more generalised frugivores.

Overall, it appears that the removal of invasive alien plant species from Seychelles inselbergs not only restores pollination interactions, as shown by Kaiser-Bunbury et al. 2017 (Kapisen 20, p. 16-17), but may also positively affect seed dispersal interactions. Results from DNA barcoding and more in-depth analysis will shed light on these interactions and also the broader implications of vegetation restoration on ecosystem functioning.

Acknowledgements

We thank the Seychelles National Parks Authority for permission to conduct the work and for assistance, and the German Research Foundation (DFG) for funding. We also thank Eleanor Huckle, Emma Pool, Ronny Gabriel, Sara Mendes and Yanick Dufrene for their help in the field.

Reference

Kaiser-Bunbury, C.N., Mougal, J., Whittington, A.E., Valentin, T., Gabriel, R., Olesen, J.M. and Blüthgen, N., 2017. Ecosystem restoration strengthens pollination network resilience and function. *Nature*, 542(7640), p.223.

Effect of Honeybees on plant-pollinator communities and plant reproduction

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Many studies have dealt with the effects of honeybees on native plant communities and reproduction, but the results found are often contradictory. Nevertheless, there is enough evidence to say: honeybees can affect plant-pollinator communities.

Honeybees, by nature, are very competitive pollinators, consuming huge amounts of plant resources to sustain their colonies. Honeybees are very effective at collecting pollen and nectar from flowers, leaving less for other pollinators, some of which are native. On the other hand, honeybees are known to be generalists, visiting a wide array of plant species, sometimes increasing the reproductive output of plants and enhancing community connectivity.

In Seychelles, we are studying the effects of honeybees on plant-pollinator communities in the mountaintops on Mahé. For that, we compare four sites where honeybees are more abundant with

Native sweat bee (*Lasioglossum mahense*, left) and alien honeybee (*Apis mellifera*, middle), visiting the endemic palm *Nephrosperma vanhoutteanum* (with fruits, right)

Photo credits: C Kaiser-Bunbury for *Lasioglossum*, JM Olesen for *Apis,* C Morel for *Nephrosperma.*

four sites where they are less abundant. This is particularly important for several reasons. Apiculture is a very common human activity - using honeybees to produce honey and to pollinate cultivated and wild plants can have a huge impact on the economy, culture and human diet, for example, as well as on conservation. But, despite its importance, a disproportionate use of apiculture can also negatively impact both plant and pollinator communities.

Islands such as Seychelles are the closest example we have to a laboratory within the natural environment, so island studies are often used as a basis for understanding more complex communities elsewhere. From a conservation perspective, Seychelles' mountaintops harbour many unique and endangered plant species, and our research aims to identify and mitigate the threats to these plant communities.

To assess the competition effects of honeybees in the community, we observed the visitation frequencies and foraging behaviour of pollinators to plants in our study sites. This was done in a standardized way, taking into account the resource amount removed to assess the importance of the interactions. To know the effect of honeybees on plant reproduction, we compared the fruit set (number of flowers that turned into fruits) of the most abundant native plant species.

We have collected data for one of two consecutive seasons so far, and preliminary results are starting to show. We have detected signs that abundant honeybees affect the plant-pollinator community, specifically we have found that honeybees create more generalised pollinator communities and reduce the abundance and richness of other pollinators.

In one way this is positive, since more generalized communities are more cohesive and there is a higher chance of different species helping to pollinate the same plant species. However, in another way it is negative since some plants depend on specialised pollinator species, so fewer visits from specialised pollinators can reduce pollination, and pollinator diversity. If unique pollinators disappear, then the overall performance of the pollinator community might decline.

But, surprisingly, the negative effects of honeybees on communities seem to fade at sites where alien plant species have been removed. It appears that at sites where only native plant species are present, honeybees have little effect on the plant-pollinator community and fruit set. At sites with only native plant species, honeybees did not alter fruit set, but at sites with alien plant species and honeybees present, fruit set of native plants is lower than in the absence of honey bees. The results are intriguing and raise questions about the mechanism that generates these patterns. Currently, we cannot say whether the observed patterns are due to behavioural changes in the native pollinator community (i.e. an indirect effect between honey bees and other pollinators that result in reduced pollination) or a direct result of the foraging behaviour of honey bees, but we hope that the data from the upcoming second season will shed light onto the mechanism that drives these patterns.

An unknown Seychelles' world record

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During my work in Tanzania, Seychelles, India and Malaysia I noticed that besides key historical figures and cultural achievements, banknotes often show native animal and plant species. This triggered my naturalist's interest in understanding what kind of species are used and asking why they are chosen. Issuing a currency is an important act for establishing a state's power. Therefore, the design of money commonly uses strong symbols to underline the nation's sovereignty. Most research into the design of banknotes has been investigated in a geopolitical sense, focussing on which images are used in building national identities. In such studies any images of plants, animals or landscapes that are mentioned are summarized under the category "natural". The only scientific analyses of biodiversity on banknotes investigate the pathogens which are found on their surface and their role as disease vectors! However, when looking at the design of all banknotes in the world it becomes obvious that besides important personalities and cultural achievements, native species are an ideal symbol of national uniqueness which can convey a sense of national identity to both citizens and visitors.

In order to understanding the importance of native species on banknotes, I supervised together with Professor René van der Wal from the University of Aberdeen two BSc honours projects (of John Chrystal and Kayleigh Simmons) who compiled a database of all species depicted on the banknotes used worldwide. Of the 157 currencies which were used in 2017, more than half show at least one species on one banknote. In total there were 1264 organisms depicted on 396 of the 1014 investigated banknotes. After excluding multiple appearances of species, we found 419 different species on the banknotes of the world, of which we could identify 377 down to species level. The vascular plants achieved the highest diversity on banknotes (126 species), followed by birds (112 species), mammals (89 species), fish (28 species), reptiles (16 species), insects (15 species) and gastropods (12 species). Occasionally also amphibians, echinoderms, bivalves and crustaceans appear, and in only one case a sponge is depicted (the orange elephant ear sponge on the one dollar note of Cayman Islands).

Commonly national banks choose emblematic, unique, rare, culturally significant or economically important species to represent their country. Although being rare does not necessarily result in being endangered, 24% of the depicted species are considered endangered according to the IUCN Red List (while 40% of the depicted species are not assessed). In this compilation it became obvious that almost all island states use endemic species on their banknotes as they are ideal symbols of territorial uniqueness.

With the issue of the new banknote series at the end of 2016, the Central Bank of Seychelles mastered this idea to perfection. Under the theme "Seychelles' Unique Biodiversity - the Backbone of our Economy", all banknotes prominently feature a variety of endemic species. While implementing its biodiversity theme,

Three of Seychelles' bank notes (Z Chong-Seng)

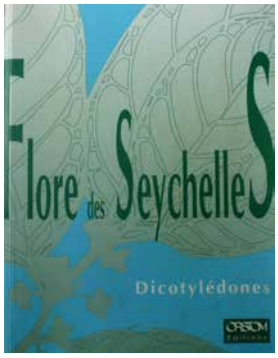
the Central Bank of Seychelles issued not only the banknote with the highest number of species in the world (the 50 Rupee note with 14 species), it also issued the banknotes with the second most species (the 25 and 100 Rupee notes, each with 12 species) and the third most species (500 Rupee note with 11 species). These numbers include the four species (Coco-de-Mer, Aldabra Giant Tortoise, White-Tailed Tropic Bird and Sailfish) on the Seychelles coat of arms and the turtle logo of the Central Bank, which are found on all four banknotes. The fourth rank of 8 species goes to the Solomon Islands for their 100 Dollar note. Although banknotes are themselves pure monetary value, the species they depict remind us of a much greater value – the emotional value of biodiversity.

List of species depicted on the 2016 series of Seychelles banknotes (excluding the 5 species found on all four banknotes):

Species no.	**25 Rupees**	**50 Rupees**	**100 Rupees**	**500 Rupees**
6	Orkid zepile *Malaxis seychellarum*	Lantannyen lat *Verschaffeltia splendida*	Bwa zoliker *Pittosporum senacia*	Horne‘s pandanus *Martellidendron hornei*
7	Kapisen *Northia seychellana*	Lantannyen fey *Phoenicophorium borsigianum*	Mangliye granbwa *Glionnetia sericea*	Bilenbi marron *Colea seychellarum*
8	Moss	Bwadou *Craterispermum microdon*	Seychelles black paradise flycatcher *Terpsiphone corvina*	Seychelles kestrel *Falco araeus*
9	Seychelles magpie-robin *Copsychus sechellarum*	Seychelles black parrot *Coracopsis barklyi*	Coopers black caecilian *Praslinia cooperi*	Seychelles vinegar fly *Drosophila sechellia*
10	Seychelles house snake *Lamprophis geometricus*	Seychelles giant millipede *Sechelleptus seychellarum*	Giant bronze gecko *Aliuronyx trachygaster*	Seychelles scops owl *Otus insularis*
11	Seychelles killifish *Pachypanchax playfairii*	Seychelles island treefrog *Tachycnemis seychellensis*	Seychelles sunbird *Cinnyris dussumieri*	Seychelles tiger chameleon *Archaius tigris*
12	Seychelles blue pigeon *Alectroenas pulcherrimus*	Seychelles giant day gecko *Phelsuma sundbergi sundbergi*	Aldabra banded snail *Rhachistia aldabrae*	
13		Seychelles white-eye *Zosterops modestus*		
14		Mushroom		

PCA News

Important Seychelles Botany book available online



It has been brought to our attention that the important flora of the dicotyledons of Seychelles by French botanist Francis Friedmann published in 1994 is now ***free*** as a PDF eBook online:

https://www.editions.ird.fr/produit/229/9782709919968/Flore%20des%20Seychelles

"Flore des Seychelles – Dicotylédones" (it is in French) is still the best scientific guide we have, with line drawings of all the native dicotyledon species, although the taxonomy is becoming somewhat outdated. It is well worth downloading as a reference.

Update on the "CEPF Project"

PCA has an ongoing 2-year project funded through the CEPF (Critical Ecosystem Partnership Fund) relating to biodiversity data management, such that local biodiversity data can be collected and shared online by various national partners with the aim of improving the management of Key Biodiversity Areas (KBAs) (Kapisen 21, p. 3-4). One of the outcomes of this project has been the setting up of an iNaturalist project (called the "Seychelles Bio Gallery"), also reported in the same Kapisen article, which is now receiving contributions from a small number of people. In order to widen the network of contributors, the use of iNaturalist formed part of the recent training by PCA and the Herbarium (see p. 25). The development of the database has taken longer than expected, mainly due to technical issues. To mitigate the delay an Android phone-based field data collection tool has been developed for professional KBA inventories, including ecosystem components. Training on the use of this new tool is coming soon.

Maintenance at the Tea Tavern glacis restoration site

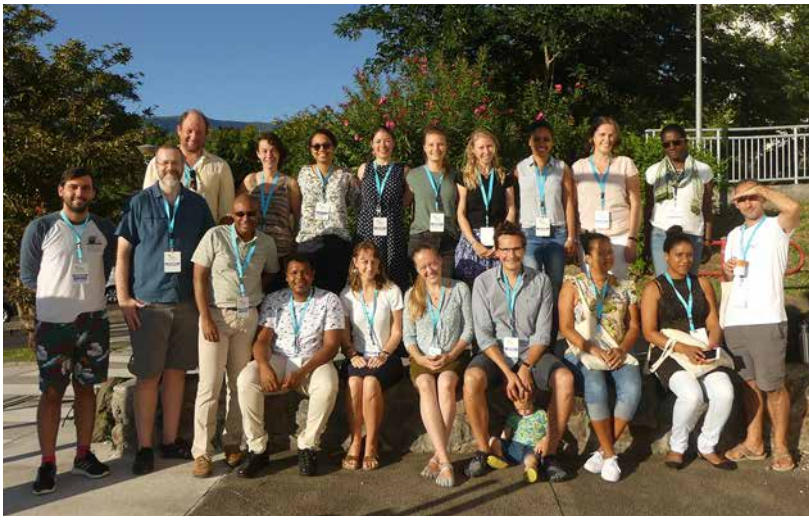
Maintenance at the Tea Tavern glacis vegetation restoration site near Morne Blanc (Kapisen 21, p. 16) has been ongoing during 2019, but it is proving challenging as we now rely entirely on voluntary activities by PCA members and a small group of Port Glaud residents. Invasive Cocoplum (Prindefrans, *Chrysobalanus icaco*) seems to be re-growing faster than we can control it in the parts of the site which are more difficult to access; likewise Lemongrass (Sitronnel). While some of these plants are providing shade and protection from soil erosion, much is overgrowing young native plants which are struggling to establish. We have been cutting off all flowering heads of lemongrass to prevent seed formation and spread, and also of Cocoplum when we see branches which have started to produce flowers and fruits. But this has to be done along with weeding of new alien seedlings, so we may have to rethink our maintenance strategy. We do not think the answer is to bring in a lot of volunteers at one time, as it is too easy to cut valuable native plants without due care, and to trample tiny native seedlings; and weeding requires familiarisation with alien and native seedlings which are not always easy to distinguish! However, the good news is that the restoration site is getting many visitors and it is still a wonderful site for them to see restored native vegetation and also for research work (see p. 16).

Community volunteers at work (both photos: PCA

A section where Lemongrass is growing too much!

Third International Island Biology Conference in La Réunion

To have an international conference in the Western Indian Ocean region (https://ib2019.sciencesconf.org) was a wonderful chance for island biologists in our area and from East and South Africa, as well as the rest of the world. La Réunion hosted the conference from 8th to 14th July and welcomed quite a large contingent of Seychelles biologists from various local organisations and international researchers working in Seychelles, many of whom presented the results of their project work and research. Several PCA members were there, either as members of PCA or of other organisations – Bruno Senterre, James Mougal, Alba Costa, Arturo Lonighi, Lorraine Cook, and Christopher Kaiser-Bunbury, who is now one of our overseas members but is still very much linked with our glacis restoration sites.



Most of the Seychelles contingent at the conference (photographer unknown).

PCA's Facebook page

The Plant Conservation Action group (PCA) depends on volunteer assistance to carry out its conservation and awareness-raising work (see p. 27). One of the group's objectives has been to develop a Facebook page in order to establish a social media presence and to reach out to people who share our love for nature, and hopefully prompt more engagement with our planned activities.

Mariette Dine took on this task by acting as the main administrator of the page, and Andre Dufrene became the main photographer for field-related content. The group agreed to run posts of PCA activities as a practical exercise recommended during previous CEPS*-facilitated training on marketing and communication for NGOs. As a test run, posts were created over a period of 12 weeks, from 18 February to 11 June, during which time a total of 24 posts were placed on the page. Analysis of the test-run was then carried out, as seen in Figures 1 and 2.

Figure 1. Audience insight on engagement: gender, age group, location, numbers and timing.

* CEPS: Citizens Engagement Platform for Seychelles

Over the 12 weeks, PCA Facebook page had about 185 likes, with most individuals coming from the Beau Vallon district. The data also showed that about 51% of the page likes are from female and 49% from males, and the most common age group is 25-34 years. The most recorded time for engagement with the page fans was between 7am and 9am, mostly on Tuesdays, Thursdays and Fridays, as cited in Figure 1.

The posts included organized weeding activities and small games that the public could engage with. The audience was also encouraged to contribute field observations to the biodiversity online project that PCA set up through iNaturalist, which can be downloaded and install on any android or smart phone (see Kapisen 21, p. 3-4).

Individuals can follow PCA's activities via this link https://www.facebook.com/pcagroup2018/. The following are a few examples of PCA community engagement on social media. Videos proved to be the most engaging of posts.

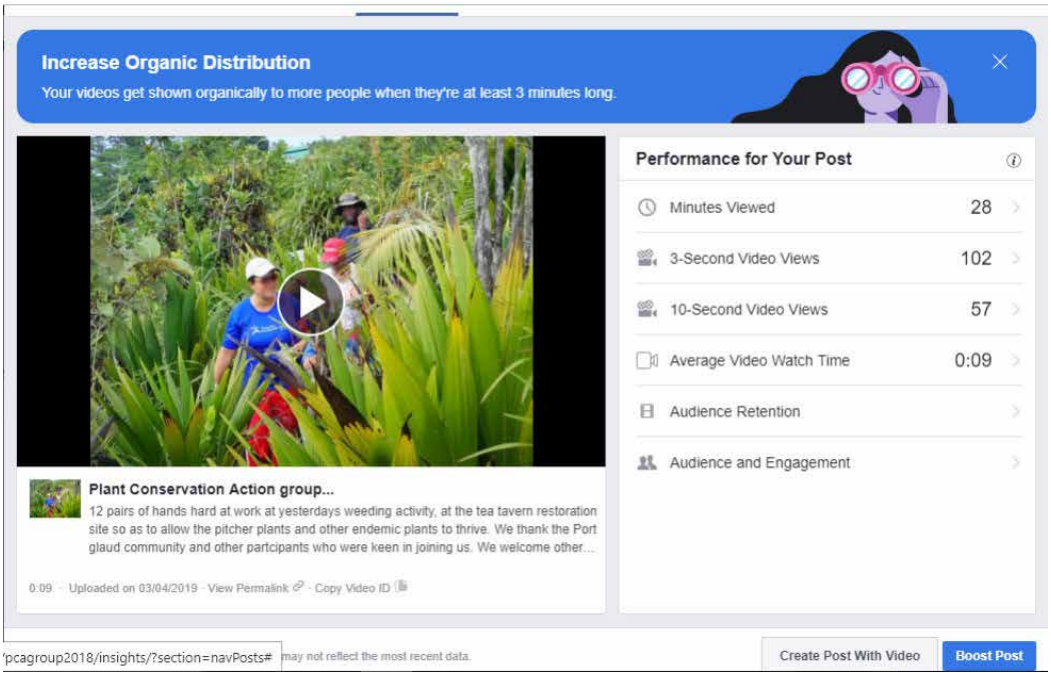


Figure 2. According to Facebook-post analysis, videos are much more effective than picture posts and helped to increase community participation.

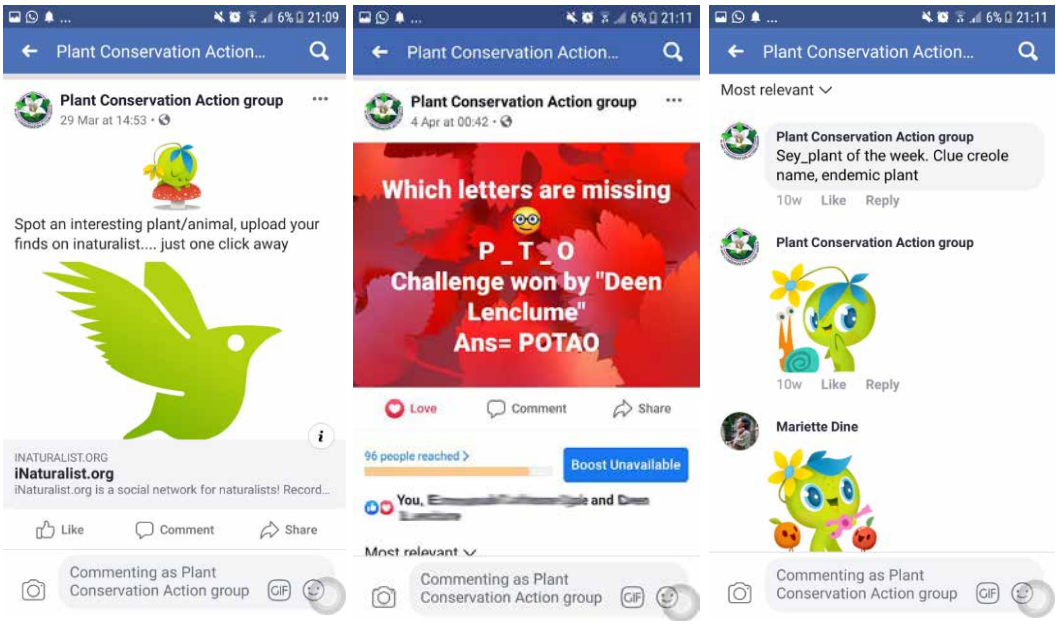


Figure 3. A mixture of games and promotion of iNaturalist and PCA website for more information

Marine plant studies aboard the Seychelles Nekton Deep Ocean Expedition

Jeanne A. Mortimer, who is well known in Seychelles as a turtle expert, and is also a PCA member, was lucky enough to receive a “Deep Blue Grant” – a collaboration between the Seychelles Conservation and Climate Adaptation Trust (SeyCCAT) and Nekton – that enabled her to participate in an amazing expedition. Jeanne describes her experience in her own words:

Between 1 March and 18 April 2019, the “Seychelles Nekton Deep Ocean Expedition” spent seven weeks exploring both deep and shallow marine ecosystems in the Outer Islands of Seychelles. Manned deep-sea submersibles conducted surveys at depths ranging from 30 to 250m, alongside Remotely Operated Vehicles (ROVs) capable of reaching 450m depth. The expedition used neuston nets to sample the ocean surface, and snorkel and SCUBA gear to study the benthos at depths shallower than 30m.

I joined the expedition for two weeks on the Amirantes Islands leg of the expedition. My focus of research was marine plants – especially seagrass ecosystems and associated marine algae (which, by the way, are both very important to sea turtles). Specimens collected and preserved during the expedition are now being identified taxonomically and will be donated to the Seychelles National Herbarium.

The Nekton Expedition helped to demonstrate the connectivity between seagrass meadows and a wide range of other Seychelles coastal and marine ecosystems. Beach vegetation is fertilized when dead seagrass leaves wash ashore. Coral reefs benefit when living seagrasses absorb CO_2, thereby reducing the acidity of the water column, and when seagrass leaves bind sediments and inhibit siltation. Seagrass leaves floating at the surface (neuston layer) provide habitat for small marine organisms. The Nekton Expedition discovered that dead seagrass leaves are continuously raining down onto the otherwise relatively nutrient-poor benthic ecosystems of our deep seas. In this way seagrasses not only provide nutrients to deep-sea habitats; they also serve as blue carbon sinks that counteract climate change by shunting carbon away from the atmosphere and into the deepest reaches of the ocean.

Jeanne examining a sample of seagrass leaves captured in the neuston net (Photo: A de Comarmond)

As a member of the expedition I was able to go down in the submersible—a unique and amazing experience! The expedition enabled me to interact with a range of people from many walks of life, including other scientists from Seychelles and abroad, submersible and ROV pilots and engineers, members of the international media, the crew of our ship, and even the President of Seychelles. We also enjoyed perfect weather the entire two weeks I was on board.

Answers to the activity game on page 7:

1. ALIEN
2. CONTROL
3. ENDEMIC
4. INDIGENOUS
5. MAINTAIN
6. MONITOR
7. NATIVE
8. WEEDING
9. NURSERY
10. PLANTING
11. POLLINATOR
12. REMOVE
13. SPECIES
14. SUSTAINABLE

Seychelles Herbarium News

Tarah Padayachy and Charles Morel, Herbarium staff, tarah_p@hotmail.com

The Herbarium team and PCA recently held a series of training sessions for anyone interested in learning how to identify native and non-native plants. It was a nice surprise to receive applications from a diverse group of people - from members of various governmental agencies and environmental NGOs to environmental consultants and interested enthusiasts such as tour guides. The training covered methods for identifying plants found in different habitats, through hands-on instruction and field observations, the use of local books, field guides and websites (e.g. Seychelles Plant Gallery). It also included tips for taking useful photos, and learning how to use and contribute information through the local iNaturalist project (Seychelles Bio Gallery: https://www.inaturalist.org). Participants learnt common terminology for describing leaves and flowers and gained an introduction to the major invasive species, common native plants, and largest plant families in our area. This initiative was funded by our current CEPF-PCA project (see p. 21).

Participants indoors working in pairs to identify some of the plants shown in the next photo…

Plants to try to identify!

Participants getting their first field instructions.

Participants making observations on *Medusagyne.*

Taking photographs of useful plant characters.

Group photo, after specimen collecting at Mt Sebert.

Practice with fern photos for iNaturalist.

Marsha giving tips on diffusing harsh light using especially when taking photos in the midday sun.

Marsha Dine gives tips on how to play with the lighting, using simple non expensive material.

All photos: Seychelles National Herbarium

Plant Conservation Action group – who we are and what we do

When we started: November 2002

Who we are: We are a voluntary membership organisation (NGO), with an executive committee elected every two years. We have meetings every two months and regular field trips.

Our mission: PCA mobilises action for the scientific research and conservation of plant species, and promotes community awareness of the fundamental importance of plants in Seychelles.

What we do:

- Plant species identifications
- Advice on vegetation rehabilitation
- Vegetation surveys and management plans
- Collaborative research and monitoring
- Hands-on training in practical plant conservation
- Promote awareness about plants and conservation
- Field trips for members and plant enthusiasts
- Advocate for plant conservation

Our current projects: "Key Biodiversity Area database management"; "Restoring endangered 'glacis' vegetation"

Website: www.pcaseychelles.org **See also:** www.seychellesplantgallery.com

Facebook: https://www.facebook.com/pcagroup2018

Contacts: pca.seychelles@gmail.com; Telephone +248 4241104 or +248 2637533

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