

Attempting to balance development and conservation on Silhouette island, Seychelles

Justin Gerlach
Nature Protection Trust of Seychelles
PO Box 207, Victoria, Mahé,
SEYCHELLES
jstgerlach@aol.com

Abstract: The island of Silhouette in the Seychelles group has been identified as one of the richest biodiversity hotspots in the Western Indian Ocean and a top priority for conservation in Seychelles. Since 1997 Nature Protection Trust of Seychelles worked to preserve the environment of the island and to restore it to a naturally functioning ecosystem. The Silhouette Conservation Project achieved its major success in 2010 when most of Silhouette was designated as the Silhouette National Park. However, NPTS was evicted from the island by the Islands Development Company in 2011. This means that all conservation action and oversight has been removed from the island and the achievements of the past 14 years are now at risk.

Introduction

Silhouette Island is the third largest of the granitic Seychelles islands. It has a land area of 1,995 hectares and a maximum altitude of 750m, making it one of the most important biodiversity hotspots in the Indian Ocean. Silhouette, due to its steep mountainous nature is the island least suitable for development and has therefore retained much of its natural flora and fauna. The island has important populations of rare animals, especially the Seychelles sheath-tailed bat (*Coleura seychellensis*), endemic amphibians and many endemic invertebrates. The flora includes several species that are now rare on other islands in Seychelles and a number of species confined to Silhouette only. The steep slopes of the island and rocky terrain that have so far prevented development of the island have served to protect its mountain forests. The low altitude forests were extensively cleared in the 1930s but those above 400m are almost untouched, consequently Silhouette has the best remaining areas of high altitude mountain forest in Seychelles.

From 1997 until 2011 the Nature Protection Trust of Seychelles was the conservation management agency for Silhouette. The history of development and the Silhouette Conservation Project are summarised here.

Biodiversity of Silhouette island

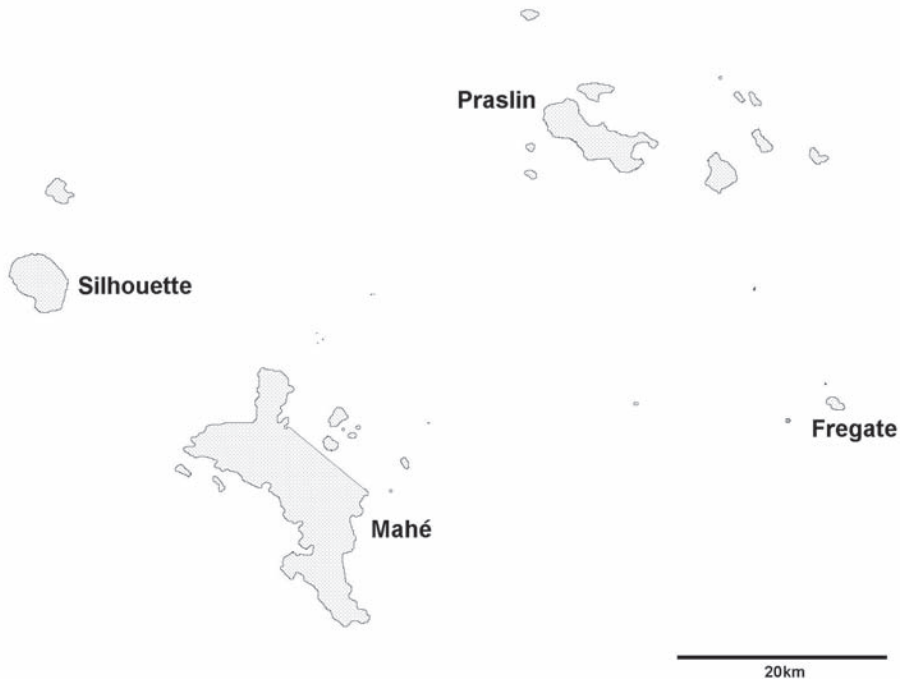
2,083 non-marine species have been recorded on Silhouette island (of which 265 species are in groups still under revision). There has been no comprehensive inventory of marine species; 307 fish species have been recorded and 372 molluscs (Appendix I).

The avifauna of Silhouette is relatively low in species diversity and does not support any of the highly threatened species of the islands. The extinct Seychelles green parakeet *Psittacula wardii* formerly occurred on Silhouette and the island supported this

species until its extinction in the late 1880s, a species of white-eye *Zosterops* sp. was also present (H. Dauban pers. comm.). The most significant bird species on the island is the Seychelles kestrel *Falco araea*; with a population of approximately 40 pairs (Gerlach 2002b), this is the second largest population of the species. The white-tailed tropic bird *Phaeton lepturus* population appears to be the largest found on any of the larger islands of the group but has not been accurately quantified (estimated at 5,780 birds present in August 1989 – NPTS unpublished). Other sea-birds are uncommon, fairy terns *Gygis alba* attempted to breed in 2010 but failed due to storm conditions. A roost of several hundred lesser noddies *Anous tenuirostris* was present at Pointe Ramasse Tout in 1998 but was not recorded subsequently. A small colony of wedge-tailed shearwater *Puffinus pacificus* is present in the same area.

Few visits to Silhouette island were made by naturalists before the late 19th century (the only recorded exceptions being Newton and Nevill in 1867). Significant research into the biodiversity of the island started in 1892 (Alluaud), 1894 (Brauer), 1905 and 1908 (Percy Sladen Memorial Expeditions), Legrand (1956), Jeffrey (1968), Musée Royale de l’Afrique Centrale (1972) and the Soviet Zoological Expedition (1984). Applied entomological studies by Brown and Vesey Fitzgerald in the 1950s

Fig. 1. Location of Silhouette island



and 1960s added several species to our knowledge of the island. There was a major increase in research on the island from 1986 with the botanical research of F. Friedmann and the Oxford University Expedition of 1990, followed by various individual researchers. Many of these were encouraged by the NPTS Silhouette Conservation Project and the Indian Ocean Biodiversity Assessment (Gerlach 2005). The pattern of increased documentation of species is shown in Fig. 3.

Human history

Silhouette was first visited by humans on 28th January 1771 and the earliest date of settlement is not recorded but is thought to be in the early 19th century. In addition to land owning settlers a number of slaves escaped from Mahé and managed to hide in the forests of Silhouette. The impacts of these earliest occupants are completely unknown. By around 1840 settlements and plantations had been established in the lowland plateau areas (La Passe, Anse Lascars, Grande Barbe and Anse Mondon). Shortly afterwards all property on the island was purchased by the Dauban family who became the first owners of the whole island. They expanded the plantations and established much of the infrastructure of the island.

The timing of agricultural developments on the island have not been recorded although it is known that rubber plantations were being actively planted in 1908 (H. Scott, unpublished journal) and coconuts were widely planted, and a small plantation had been established at high altitude (Mare aux Cochons - 500m) by this time (Scott 1910). Subsequently small plantations of coffee *Coffea* sp. and the timber tree *Tabebuia pallida*

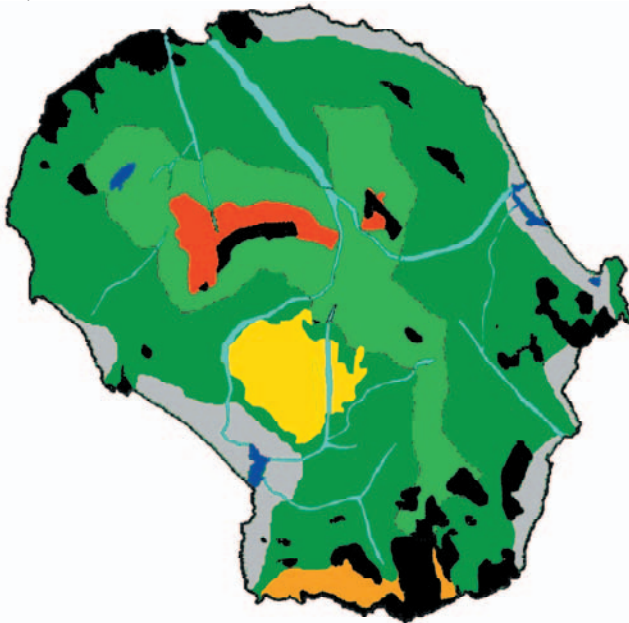
Table 1. Areas of habitats on Silhouette

| Habitat | | Area (hectares) |
|------------------------------|--|--------------------|
| Marsh | Open marsh | 4.6 |
| | Mangroves | 7.5 |
| | Coffee plantation | 8.4 |
| Abandoned coconut plantation | Suburb | 17.6 |
| | Dry coastal forest | 5.7 |
| Primary coastal forest | <i>Casuarina equisetifolia</i> habitat | 1.5 |
| | Mixed coastal forest | 82.2 |
| | <i>Hevea brasiliensis</i> plantation | 7.4 |
| Rock | | 112.0 |
| | littoral | 4.0 |
| Riverine forest | | 20.0 |
| | <i>Pisonia sechellarum</i> forest | 0.5 |
| Submontane rain forest | Mid-altitude forest | 351.4 |
| | Palm rich forest | 1077.5 |
| | <i>Clidemia hirta</i> scrub | 2.3 |
| | <i>Cyathea sechellarum</i> scrub | 0.7 |
| Old fire zones | <i>Dicranopteris linearis</i> scrub | 70.3 |
| Lower montane rain forest | Mist forest | 215.3 |

were established.

In 1969 the last individual owner of the island (Henri Dauban) was forced to sell the island due to financial difficulties. From 1969 to 1981 the island continued to be managed as a productive plantation island. From the late 19th century to 1986 the island was a major producer of copra, with small scale production of spices. By the 1980s changes in agricultural economics meant that copra production did not produce a significant return on investment. In 1971 the island was sold to a French consortium who started tourism on the island. A 12-room hotel, the Silhouette Island Lodge, was constructed at La Passe, but the majority of the population continued to be employed in agriculture and fishing. In 1983 the island was seized by the Seychelles government and taken into state ownership under the management of the Islands Development Company (a government parastatal company). Under the Chairmanship of G. Savy IDC started a series of experimental development projects. These included attempts to expand agriculture, especially through industrial chicken farming (Fig. 4). The chicken farm imposed a major strain on systems at La Passe, particularly through heavy water consumption. The water supply for La Passe was all extracted from the Grande Rivière which normally carries 2,721.6m³ per day in the dry season. In June-August 1993 all water was being extracted and none was reaching the coastal marsh. In addition to water

Fig. 2. Habitats of Silhouette island, modified from Gerlach *et al.* 1997 and Senterre *et al.* 2009. black – rock; grey – abandoned coconut plantations; dark blue – marshes; light blue – riverine forest; dark green – lowland rain forest; orange – primary coastal forest; yellow – old fire zones, light green – submontane rain forest; red – lower montane rain forest



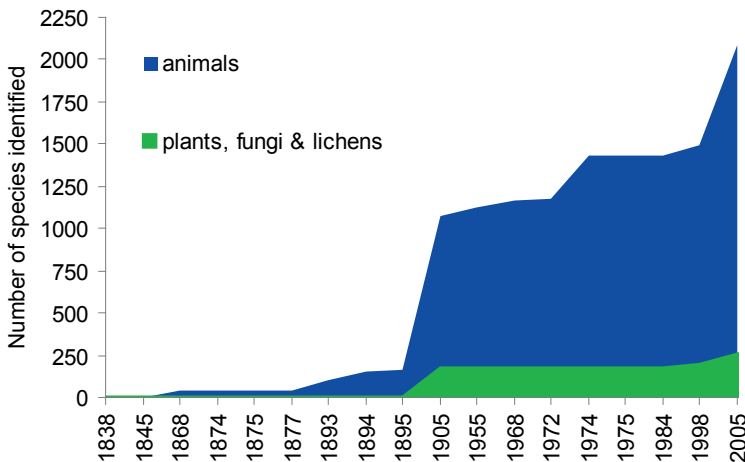
extraction the chicken farm was a source of pollution with carcasses and guano being buried on the plateau. Chicken food was imported from Mahé and unloaded by hand, this resulted in the spillage of approximately 30 kg of chicken feed onto the reef flat every month. The impacts of this influx of nutrients was not investigated. The chicken farm did have a substantial impact on the hotel which was adjacent to the farm, with frequent complaints from guests regarding the smell, flies and the occasional finding on the beach of debris from the slaughter of the chickens. In 1995 the chicken farm was closed.

In 2005 the only economic activity on the island was related to tourism (copra production ceased in 2000 and cinnamon bark harvesting in 2003). In 2005 the Silhouette Island Lodge was closed and replaced with the 110 room Labriz Resort. These changes are summarised in Table 2.

Silhouette Conservation Project

In 1995 the IDC invited Nature Protection Trust of Seychelles to take over the management of the non-settlement areas for conservation purposes. Formal agreement to undertake conservation on the island was given by the Ministry of Environment and IDC. Advice and help to draw up a contract was given by Fauna and Flora International but unfortunately IDC never signed it. NPTS started the Silhouette Conservation Project in 1997 when a building became available on Silhouette enabling NPTS projects to be based there. Subsequently (in October 1999) NPTS converted a ruined building into the NPTS Information Centre with funding from the Prince Bernhard of the Netherlands Nature Trust Fund (Fig. 5). This building was used to provide information to visitors to the island, a shop to raise funds for NPTS work on the island as well as climate controlled facilities for storage of scientific collections and laboratory facilities for the project and for visiting scientists.

Fig. 3. Numbers of species recorded on Silhouette since the early 1800s.



The Silhouette Conservation Project aimed to conserve all native plants and animals, including the wide diversity of insects, reptiles and amphibians. Key target species were those categorised as Critically Endangered or are currently extinct in the wild. These included the Seychelles sheath-tailed bat which numbered only 18 individuals at the time. NPTS also aimed to reintroduce the Critically Endangered Seychelles terrapins *Pelusios subniger parietalis* and *P. castanoides intergularis* and giant tortoises *Dipsochelys hololissa* and *D. arnoldi* to the island.

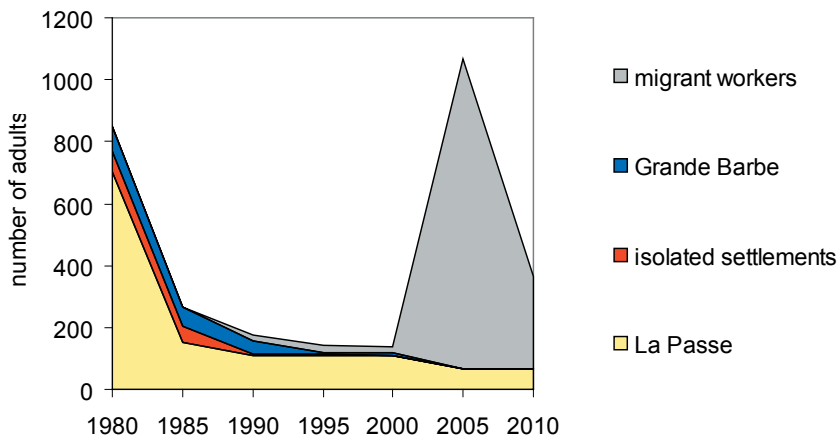
The aims of the Silhouette Conservation Project were summarised in the Silhouette Management Plan (NPTS Scientific Committee 1996) as follows:

1. To protect the existing natural and semi-natural habitats on, and around the island from un-natural change.
2. To preserve the existing indigenous and endemic species and ecosystems.
3. To restore the island to as close to its natural state as is practical (including the management of habitats, reintroductions and removal of introduced taxa).

Table 2. Economic activity on Silhouette island

| | Major activity | Economic value |
|-----------|---------------------------------------|------------------------------|
| 1900-1979 | Plantations: copra, minor other crops | Highly productive |
| 1979-86 | Plantations: copra, cinnamon bark | Productive but reduced value |
| 1986-89 | Plantations: copra, cinnamon bark | Productive but low value |
| | Tourism | Small scale |
| 1989-1995 | Plantations: copra, cinnamon bark | Reduced scale |
| | Tourism | Small scale |
| | Chicken production | Loss making |
| 1995-2005 | Tourism | Small scale |
| | Fish farming | planned but not implemented |
| | Palm leaf harvesting | Small scale |
| 2005- | Tourism | Large scale |
| | Plantations: coconut harvesting | small scale in 2011 |

Fig. 4. Human population (adults)



In order to achieve this NPTS intended to undertake biodiversity and ecological research and specific management actions. These actions were specified as:

1. Reduction of coastal erosion at La Passe through beach crest planting at La Passe
2. Improvement of water resources through tree planting in the open areas above La Passe and restoration of Mare aux Cochons and Grande Barbe
3. Elimination of small populations of invasive plants before establishment/spread (*Opuntia vulgaris*, *Chrysobalanus icaco*, *Leucaena leucocephala*, *Syzygium jambos*, *Ananas comosus*, *Agave saislana*)
4. Control of established invasive plants through habitat restoration (*Psidium cattleianum*, *Cinnamomum verum*, *Lantana camara*, *Hevea brasiliensis*)
5. Eradication of introduced mammals
6. Plant population management through reintroductions and establishment of new populations of rarities
7. Reintroduction of animal species (terrapins, tortoises, birds)

This Silhouette Management Plan was circulated to IDC and to the Ministry of Environment, both of whom agreed to the proposed Silhouette Conservation Project (T. Jones *in litt.* 14.ii.1996).

Biodiversity and ecological research

NPTS has undertaken intensive research on biodiversity and the ecology of the island since 1992, building on the studies initiated by the Oxford University Silhouette Expedition in 1990 (OUSE 1990). These studies have covered the ecology of plants, snails, insects and bats, population changes in plants, invertebrates, reptiles and bats (Cariou et al. 2008; Gerlach 1992, 1993, 1994a-b, 1995a-b, 1996, 1998, 1999a-c, 2000, 2001a-b, 2002a-c, 2003, 2004, 2007, 2008a-e; 2009a-d, 2010, 2011; Gerlach & Bruggen 1998, 1999; Gerlach & Gerlach 1997; Gerlach & Gerlach 2008; Gerlach & Taylor 2006; Gerlach & Willi 2002 ; Gerlach et al. 1997; Gerlach et al. 2005; Legrand et

Fig. 5. Information centre building.

a) 1997 prior to renovation



b) 2000 following renovation



al. 2009; Meijden et al. 2007; Senterre et al. 2009; Suvi et al. 2010), and diversity of all taxonomic groups. The Silhouette Conservation Project has recorded 517 non-marine species previously unknown from Silhouette, increased the species list of the island by 35%, to a total of 2,004. Marine records have been made for molluscs and the recorded fish list increased by 257 species, from 50 to 307 species.

Conservation management

1. Reduction of coastal erosion

Coastal erosion is a long-term, possibly natural, issue. *Calophyllum inophyllum* trees were planted at Grande Barbe in the mid 20th century to reduce coastal erosion (H. Dauban pers. comm.). It has not been noted as an issue at Grande Barbe in recent years but has been significant at La Passe. In 1993 erosion was particularly rapid at La Passe (0.08m per month) where it was associated with damage to the beach crest. This was due to several factors: trampling and grazing by cattle, removal of beach crest vegetation and sweeping of strand debris from in front of the Silhouette Island Lodge. This resulted in complete loss of the *Scavola sericea*/*Ipomoea pes-caprae* beach crest habitat. The management of LaBriz Resort were persuaded to restore the beach crest vegetation and replanting of *S. sericea* and *I. pes-caprae* resulted in a stabilisation of the beach crest at La Passe, with only seasonal loss being balanced by seasonal gain. In 2011 new management by Hilton Hotels started reducing beach crest vegetation, which makes coastal erosion a threat in the future.

In other coastal areas erosion is apparently seasonal, there is observational evidence that this is increasing in severity but this has not been quantified.

2. Improvement of water resources

Water availability was identified as an issue at La Passe (Gerlach & Canning 1993; Gerlach 1994c) and an opportunity for conservation at Mare aux Cochons. At La Passe the industrial chicken farm was found to be the primary cause of excessive water extraction from the only permanent river on the east side of the island. NPTS undertook a survey of the Mare aux Cochons marsh system in 1997, proposing the restoration of this site (Gerlach 1997). Attempts to introduce agriculture in the past proved unsuccessful due to the difficult access to the marsh. Historical records show that some 95 insects which are now considered Critically Endangered were recorded from Mare aux Cochons, indicating the presence of important communities of plants and animals. The importance of this high-altitude marsh to the biodiversity of Silhouette and Seychelles, makes restoration of the site a high priority. The marsh was partially drained and much of the native vegetation was removed and replaced by alien plants. NPTS proposed the restoration of this site through the reversal of historical drainage and subsequent habitat management. It was proposed that this could be combined with tourism through the creation of a 3-day hiking trail. This was discussed with the Silhouette Island Lodge and subsequently with North Island but plans did not progress further due to changes in tourism infrastructure and management on Silhouette.

Freshwater systems may be threatened by water extraction locally, changes in rainfall associated with climate change and exploitation of some species. The only

freshwater species that is likely to be threatened by human consumption is the freshwater crayfish *Macrobranchium lar*. This is trapped at La Passe in small number, but remains common in freshwater pools at La Passe and Anse Mondon.

3. Elimination of small populations of invasive plants

In 1996 *Opuntia vulgaris*, *Chrysobalanus icaco*, *Leucaena leucocephala*, *Syzygium jambos*, *Ananas comosus* and *Agave saislana* were plant species that were considered localised and that could be eliminated. Subsequent surveys identified all as being more widespread than initially believed with the exception of *O. vulgaris*. This was known from two sites: La Passe and Anse Lascars. It was eliminated from Anse Lascars in 1998 but two small plants are still present at La Passe.

Additional invasive plants representing localised or potential threats were identified: *Alstonia macrophylla*, *Philodendron* sp., *Poueraria phaesaloides* and *Syngonium podophyllum*. Attempts were made to eradicate *A. macrophylla* from the island from 2006 when one mature tree was felled at La Passe. From that date to 2011 95 seedlings were removed. A further tree was killed by ring-barking in 2009, leaving one surviving tree at La Passe. A sapling was felled at Baie Cipailles in 2000 approximately 30 seedlings removed from above Grande Barbe. In 2010 12 trees were found at Anse Lascars and a substantial number of trees observed on Mont Cocos Marrons and it was determined that complete eradication was not possible. In addition to these areas single trees are known from Mt. Pot a Eau, Mont Laurent and Jardin Marron. *Philodendron* sp. was noted to be localised and stable around La Passe and lower priority than the other species. *Poueraria phaesaloides* was also localised but was the subject of control due to its proximity to ecologically sensitive areas (see Fig. 6). *S. podophyllum* was

Fig. 6 *Poueraria phaesaloides* invasion



restricted to five patches within La Passe. One of these (a single plant) was eliminated, as the remaining patches were more established and were within gardens their presence was highlighted in reports to IDC and MENR from 2007 and in discussions with hotel management. Unfortunately there was no response to recommendations for eradication in the IDC village and although hotel management directed the gardeners to remove the plants on hotel property this was not sustained and the risk from this species remains.

Fig. 7. Habitat restoration: La Passe
1998 before restoration



2004



2008



Fig. 8. Habitat restoration: Jardin Marron
2000 before restoration



2004



2009



4. Control of established invasive plants

Habitat change as a result of invasion by alien plants is well established as a major threat to biodiversity in Seychelles (Baider et al. 2010) at least 123 introduced plants are known from Silhouette and 12 are considered invasive plant species. A full analysis of the impacts of invasive plants on Silhouette is in preparation.

Significant invaders identified in 1996 were *Psidium cattleianum*, *Cinnamomum verum*, *Lantana camara* and *Hevea brasiliensis*. Further research identified *L. camara* as a scarce but widespread species posing little significant threat and supporting populations of endemic animals, consequently this was not considered further for control. Additional problem invaders were identified as *Clidemia hirta*, *Coffea canephora*, *Cola nitida*, *Tabebuia pallida* and *Paraserianthes falcata*. *Sandoricum koetjape* is also present but currently very localised. Habitat restoration was undertaken in 5 areas: La Passe (1998-2011), Grande Barbe rock (2004-2008), Jardin Marron (1999-2010), Gratte Fesse (2010) and Mon Plaisir (2010).

In these areas experimental techniques were tried for the control of the main invasive species: cutting, ring-barking, poisoning with Glyphosate herbicide and combined treatments (Table 3), *Coffea canephora* was not included in experiments as it was not present in any of the management areas.

Fig. 9. Habitat restoration: Grande Barbe rock.

a) 2004 before restoration

b) 2006



Fig. 10. Habitat restoration areas started in 2010. a) Gratte Fesse, b) Mon Plaisir



5. Eradication of introduced mammals

Eradication of introduced mammals was considered in the management plan. For rodents, black rat *Rattus rattus* and house mouse *Mus musculus* populations cannot practically be eradicated due to the size and complexity of the island and the impacts poisoning would have on non-target taxa. Rats are not a significant problem on the island except in settlement areas. Periodic population increases in the settlement occurred in the 1990s and these increased in frequency from 2005 due to food dumping during hotel construction and the Indian labourers' practice of feeding rats in their construction camp. Domestic and feral cats *Felis catus* are present in low numbers. These seem to subsist mainly on rats and insects. Poisoning of feral cats and dogs was carried out in 2006 at a food waste dump (see section on hotel development below for details of this dump site). Dogs *Canis familiaris* were present as domestic animals (approximately 20 in 1996). All were sterilised in 2008 and by the end of 2010 no dogs were present.

Although not included in the management plan as a point needing action introduced land-birds were monitored by NPTS. Feral pigeons *Columba livia* were very common at La Passe and Grande Barbe in 1997. NPTS encouraged local consumption of this species and it was eliminated by 2000. Barn owls *Tyto alba* were only recorded on three occasions from 1997; one individual was observed at La Passe in August 2002 and possibly this individual was found dead in September 2002. A second dead owl was found in 2005. Both dead birds were emaciated and had empty crops, it is not known if starvation was the cause of death or incidental to other health problems. Indian mynahs *Acridotheres tristis* are common in lowland areas, particularly around settlements. They were reported to have declined between 1979 and 1996 (Cresswell *et al.* 1997) but at La Passe the population increased substantially with rubbish dumping from 2005. Barred ground dove *Geopelia striata* populations were restricted to open lowland areas and remained stable throughout. Indian house crows *Corvus splendens* were recorded on the island in 1978/9 (Greig-Smith 1986) and in 2005. Since 1995 a single ring-necked

Table 3. Effects of control treatments on different plant species

| Species | Cutting | Ring-barking | Poisoning |
|-----------------------|---|---|--|
| <i>Psidium</i> | ineffective | ineffective | not tried |
| <i>Cinnamomum</i> | suckers need frequent removal unless poisoned | effective, suckers need removal, suckering reduced by poisoning | ineffective in isolation, effective post-cutting or ring-barking |
| <i>Hevea</i> | effective | not tried | not tried |
| <i>Paraserianthes</i> | effective, causes damage to surroundings | effective | not tried |
| <i>Cola</i> | effective | not tried | not tried |
| <i>Tabebuia</i> | hard wood, suckers need removal | difficult but effective | ineffective in isolation, effective post-cutting |
| <i>Clidemia</i> | Uprooting effective | - | not tried |

parakeet (*P. krameri*) has been present; the precise origin of this bird is not known.

6. Plant population management

NPTS aimed to improve the status of threatened plants through reintroductions and establishment of new populations of rarities. In addition one species (*Lodoicea maldivica*) needed management of an existing population.

The coco-de-mer on Silhouette were all planted in the 1940s (being naturally restricted to the islands of Praslin and Curieuse). One female tree is present at La Passe and a breeding population at Jardin Marron. These have been maintained as a self-sustaining population. In 1997 21 trees were present. Two of these were lost due to damage caused by falling *Paraseriantehs falcataria* trees. Fruit fallen on the path were stolen so any located were hidden and allowed to germinate naturally, of 10 seeds so treated only one has germinated, and that after two years of being hidden (Fig. 11). However, from 2005 systematic harvesting (through cutting of immature fruit) was detected, with removal of 10 fruit in 2005 and repeated removals subsequently. The island manager attributed this to the immigrant Indian labourers employed by IDC, but no action was taken. This means that no populations of this species are reproducing naturally, all being either managed or poached.

Critically low populations have been identified for several plants, several of which were planted in experimental reintroductions (Fig. 12):

Trilepisium gynandrum (Moraceae) – Fewer than 10 adult trees are known, these are scattered except for one site at Gratte Fesse.

Vateriopsis seychellarum (Dipterocarpaceae) - The critically endangered endemic ‘bois de fer’ is now restricted to Mahé although it was present on Silhouette in the 1800s (when it was used in the construction of the Gran Kaz at La Passe).

Fig. 11. *Lodoicea maldivica* seedling



Rapanea seychellarum (Myrsinaceae) – approximately 10 individuals on Silhouette.

Impatiens gordonii (Balsaminaceae) – known from two populations on Silhouette. This species is declining on Silhouette and in need of conservation action (Gerlach submitted).

Amaracarpus pubescens sechellarum (Rubiaceae) – known from 9 individuals

Rothmannia annae (Rubiaceae) – reintroduced by NPTS in 1998, currently represented by one tree and 5 saplings.

Fig. 12 Planted seedlings of threatened plants.

a) *Grisollea thomasseti*



b) *Vateriopsis seychellarum*



c) *Impatiens gordonii*



d) *Mimusops sechellana*

e) *Rothmannia annae*



Drypetes riseleyi (Euphorbiaceae) – restricted to isolated areas.

Pisonia grandis (Nyctyginaceae) – naturally recolonised in 2005, now known from 6 immature trees.

7. Reintroduction of animal species

NPTS intended to reintroduce terrapins, tortoises and some bird species to Silhouette. These were implemented in part for terrapins and tortoises (Fig. 13) but not birds. The Seychelles black mud turtle *Pelusios subniger parietalis* was reintroduced to Grande Barbe in 2005-2010 and a relict population of yellow-bellied mud turtle *P. castanoides intergularis* at La Passe was augmented in 2010. Five adult Arnold's giant tortoise *Dipsochelys arnoldi* (currently listed by the Tortoise and Freshwater Turtle Specialist Group as *Aldabrachelys gigantea arnoldi* or *Dipsochelys dussumieri arnoldi*) were reintroduced to Grande Barbe in 2006. Despite IDC and the Ministry of Environment having agreed to the reintroduction of tortoises as part of the Silhouette Conservation Project in 1996 both organisations refused to allow NPTS to complete this activity in 2010, denying permission to release tortoises in any part of the island. This means that restoration of the island is being prevented by the unwarranted exclusion of a key component of the natural ecosystem. The terrapin and tortoise releases are discussed in further detail in Gerlach (2011b).

Fig. 13. Reintroduced animals.

Pelusios subniger



Pelusios castanoides



Dipsochelys arnoldi



8. Additional conservation actions

In addition to the planned actions NPTS carried out management of populations of Seychelles sheath-tailed bat *Coleura seychellensis* and sea turtles. The Seychelles sheath-tailed bat (*Coleura seychellensis silhouettae*) is a Critically Endangered species known from Mahé and Silhouette. Approximately 40 individuals are known in three roosts on Mahé. The Silhouette roost has been the focus of intensive management and research by NPTS and this has resulted in population growth from a low of 18 individuals to 40 in 2010 (Gerlach 2011a).

Nesting by marine turtles (the hawksbill *Eretmochelys imbricata* and green turtle *Chelonia mydas*) was monitored from 1997. Prior to this date the only data on Silhouette turtles was an estimate that only 25 females used Silhouette for nesting beaches each year between 1980-83 (Mortimer 1984). The Silhouette Conservation Project aimed to 'improve the protection of turtles around Silhouette' which was achieved by providing a monitoring presence that discouraged poaching (old remains of poached animals were found in 1997 and a single poaching events recorded in 1999, with dead turtles washing ashore from off-shore poaching in 2002 and 2003). The most significant impact detected was caused by hotel construction, with imported labourers consuming eggs in 2005, and hatchling disorientation caused by hotel lighting. Attempts to resolve the latter problem by changing lighting in 2007 was not effective and was resolved with the novel solution of creating a 'light-box' which could be placed over a nest prior to hatching, thus eliminating the un-natural illumination (Gerlach 2010). Use of the light-box had a substantial effect on hatchling disorientation in 2008-9, but was discontinued by new hotel management when Hilton Hotels took over management of the resort. A review of turtle nesting from 1997 to 2011 is in preparation.

The spread of new invasive species was monitored throughout the project, particular attention was paid to fungal diseases of *Calophyllum inophyllum* and *Pterocarpus indicus*, and to the whiteflies *Aleurodiscus dispersus* and *Aleurotrachelus atratus*.

Verticillium wilt disease of *Calophyllum inophyllum* trees was noted on Silhouette after 1996 and was extensive by 1999 (Fig. 14). Visits from the Division of Forestry occurred on several occasions from 1999 and some fungicidal treatment of trees was attempted. However, this was on a small scale and the majority of infected trees were not treated. Fusarium wilt was recorded in *Pterocarpus indicus* in 2005. All trees (one at La Passe and a group of trees at Glacis Noel) appeared infected in 2005-6. The Glacis Noel trees subsequently recovered but the La Passe tree died.

Spiral whitefly *Aleurodiscus dispersus* was first recorded on Silhouette in 2005 and the coconut whitefly *Aleurotrachelus atratus* in 2007. The spread of these was monitored annually (Fig. 15). No management of these whiteflies was carried out. Increases in natural predators (principally Neuroptera) were observed and by 2010 declines in the severity of infestations was recorded. These outbreaks continue to be problematic on agricultural plants but are no longer significant threats to native species.

Fig. 14. Verticillium wilt of takamaka. a) dead tree at La Passe; b) distribution in 1998-2003; green – low infection (10% of trees), blue – moderate infection >50% of trees, orange – high infection >60%, red – very high >90%

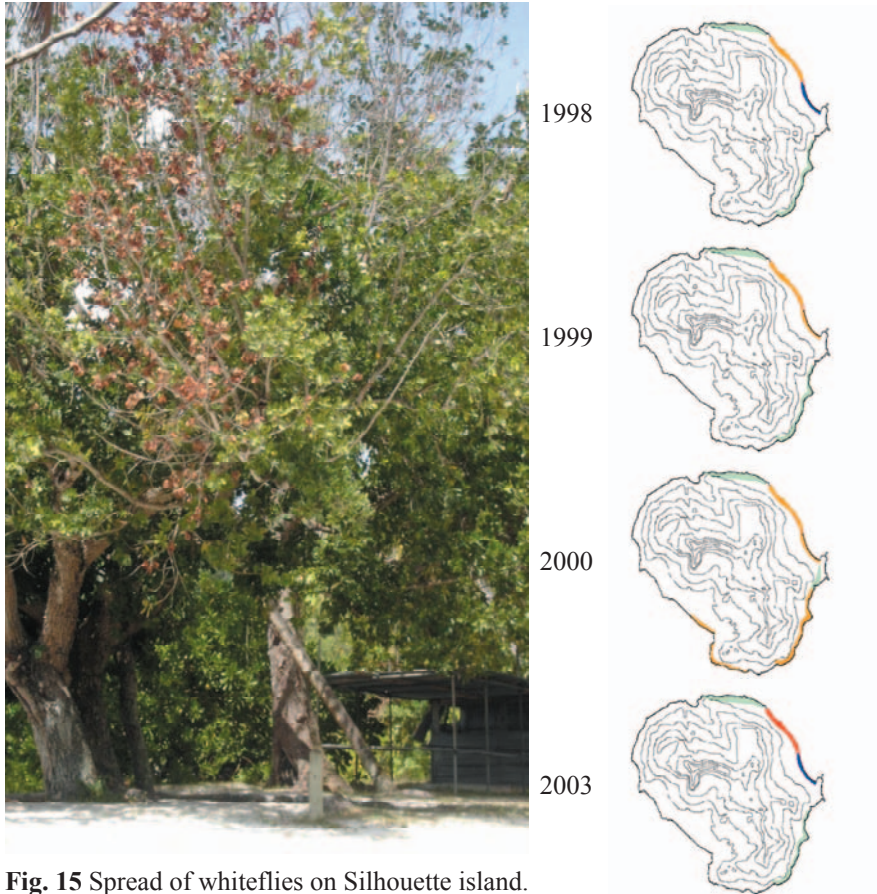


Fig. 15 Spread of whiteflies on Silhouette island.

