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Conservation of the Seychelles sheath-tailed bat *Coleura seychellensis* from 1997-2011 and future prospects

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Abstract: The Critically Endangered Seychelles sheath-tailed bat *Coleura seychellensis* has been the subject of conservation activity on Silhouette Island since 1997, in addition research into its status has been carried out on Mahé island. The species was more abundant in the past and many known roosts have been abandoned. The causes of decline have been speculated to include disturbance and predation but studies of the roosts suggest that habitat change may be the most significant factor. The species occupies small caves in boulder fields in lowland woodland which has been extensively invaded by introduced plants. These plants support reduced numbers of insects, especially Coleoptera. Lepidoptera and Coleoptera dominate the diet with a strong preference for the latter before and during the breeding season. Habitat management on Silhouette has removed alien plants from around the roosts and improved foraging conditions for the bat resulting in an increase in breeding activity. The population at La Passe on Silhouette has increased from 14-25 individuals in the 1990s to 40 in 2009. In 2010 this colony fragmented with 18-20 individuals leaving to start a second colony at Anse Lascars. The forced closure of the conservation project in March 2011 means that all conservation action for the species has ceased. In the absence of Seychelles government commitment to support conservation of this Critically Endangered species its future prospects do not look promising.

Introduction

Of the different vertebrates groups, bats seem to be particularly vulnerable to extinction, poorly studied and rarely managed (Micklburg et al. 2002). In recent times one species is know to have become extinct; the Christmas Island pipistrelle *Pipistrellus murrayi* (Lumsden et al. 2009). One of the most threatened species is the Seychelles sheath-tailed bat *Coleura seychellensis*. This species is categorised as Critically Endangered primarily on the basis of its small population size (Gerlach et al. 2008).

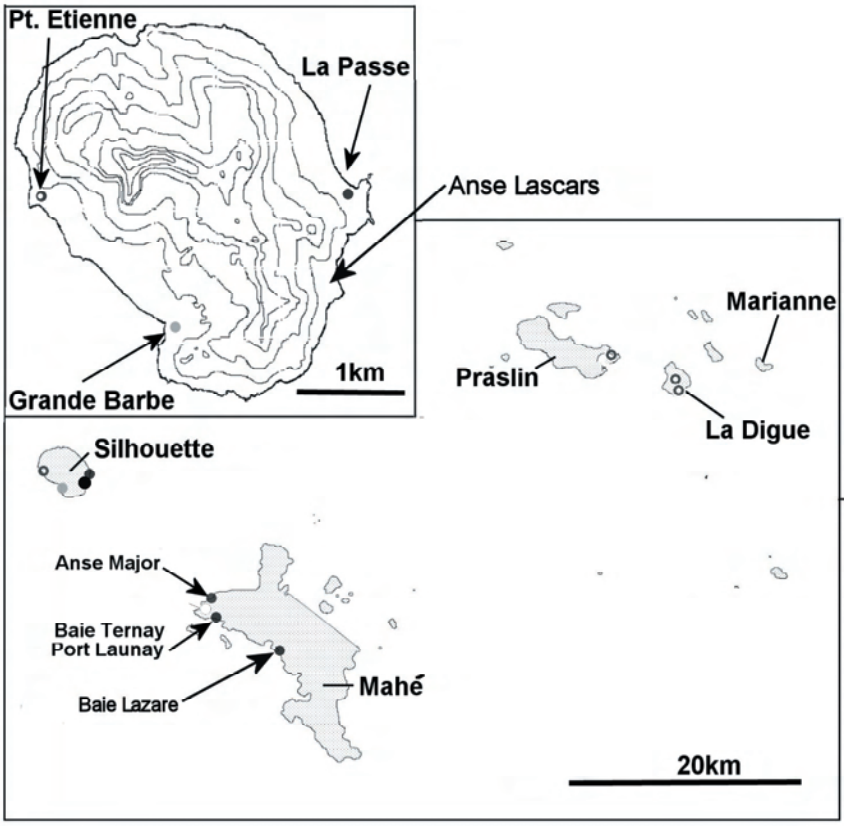
The Seychelles sheath-tailed bat was described in 1868 (Peters 1868) but has only been the subject of significant research in the past 15 years (Burgess & Lee 2004; Gerlach 2004, 2010a, 2010b; Joubert 2004; Rocamora & Joubert 2004; Bambini et al. 2006; Gerlach & Taylor 2006). The 1868 record noted that roost sites were noted to have north-facing entrances screened by palm leaves (Wright 1868). There were no subsequent records until one was shot in 1908 in an attempt to locate parasites (Scott 1914). Research in 1973-1980 located 5 roost sites (2 occupied) with low numbers of roosting bats (1-6 in most roosts) (Nicoll & Suttie 1982). The roost on Silhouette has been monitored by the Nature Protection Trust of Seychelles since 1997 (Gerlach 2004).

The causes of the decline in this species are not known, human disturbance,

predation by barn owls and habitat destruction have been suggested (Nicoll & Suttie 1982; Bambini et al. 2006; Gerlach 2004). The existing Silhouette roost is secure from human disturbance but the invasive Kudzu vine *Pueraria phaseoloides* has threatened to smother the entrance at times (Gerlach & Taylor 2004).

The Seychelles sheath-tailed bat is restricted to the island of Mahé and Silhouette (Fig. 1). On Mahé it is restricted to three roosts containing some 37 bats: Port Launay - Baie Ternay (27 bats), Baie Lazare (8) and Anse Major (1-2 individuals) (Bambini 2008; P. Senior pers. comm.; pers. obs.). On Silhouette three roost sites have been recorded as being active in the past 15 years: Grande Barbe (abandoned in about 2004), La Passe varying from 18-40 individuals and Anse Lascars numbering 18-22. The Silhouette roosts have been the subject of research, monitoring and management by Nature Protection Trust of Seychelles since 1997. The activities undertaken by NPTS for this species are summarised below.

Fig. 1. Granitic islands of Seychelles showing localities mentioned in the text. Occupied roosts are marked with filled circles, historical roosts with open circles. Occasional roosts are marked with shaded circles. Inset – Silhouette Island with 100 m contours shown.



Research

Foraging activity

Research into the Silhouette population has been published in full (Gerlach 2009). This covered the distribution and character of foraging habitat, diet, prey availability, behaviour within the roost, breeding season, reproductive rate and juvenile growth. In terms of conservation management the most important research findings were that foraging ranges changed seasonally in response to prevailing winds and that foraging activity correlated with beetle numbers, which in turn related to management practices (Gerlach 2009). Foraging was only recorded in open areas, in forest clearings or over exposed rocky slopes.

Monitoring

The La Passe roost on Silhouette Island has been monitored since 1997. Installation of roost CCTV in 2006 (Fig. 2) has allowed frequent and accurate counts. Roosts on the west coast have been visited at least once a year since 2005 (Grande Barbe in March/April and December every year and Pointe Etienne in March/April) and searched for signs of recent occupancy - the presence of bats or of recent guano. Guano was categorized as fresh (not completely dry), recent (deposited since the previous visit) or old. No bats have been found in these roosts although occasional small quantities of fresh guano have been located, consequently population estimation is only possible for the La Passe roost. The Anse Lascars roost was formed in 2010 and searches to locate the roost were made in that year. Searches were made in boulder fields and attempts were made to track the movement of bats in the area using automated bat detectors (Anabat II system and SongMeter), these were placed in clearings in woodland or on rocks overlooking the canopy or potential flyways. The bat detectors were set to record between the hours of 18:00 and 06:00. The SongMeter was coupled with an ultrasonic microphone on a 50m extension cable allowing the microphone to be positioned in the canopy.

Fig. 2. CCTV in La Passe roost B

a) positioning of the monitoring camera b) view from the camera

The main roost on Silhouette is the La Passe roost system (Fig. 3-4). Permanent occupation was found in cave B, with daily use of cave A by some bats. Evidence of occasional use (small quantities of fresh guano but no bats) was found at one site at La Passe (roost D) and old guano found in roosts C and E. An abandoned roost was found at Pointe Etienne (Fig. 4), no roosts could be found at Anse Mondon.

Fig. 3. La Passe roost system. A and B are occupied roosts, D used on at least one occasion in the recent past. C and E are abandoned.

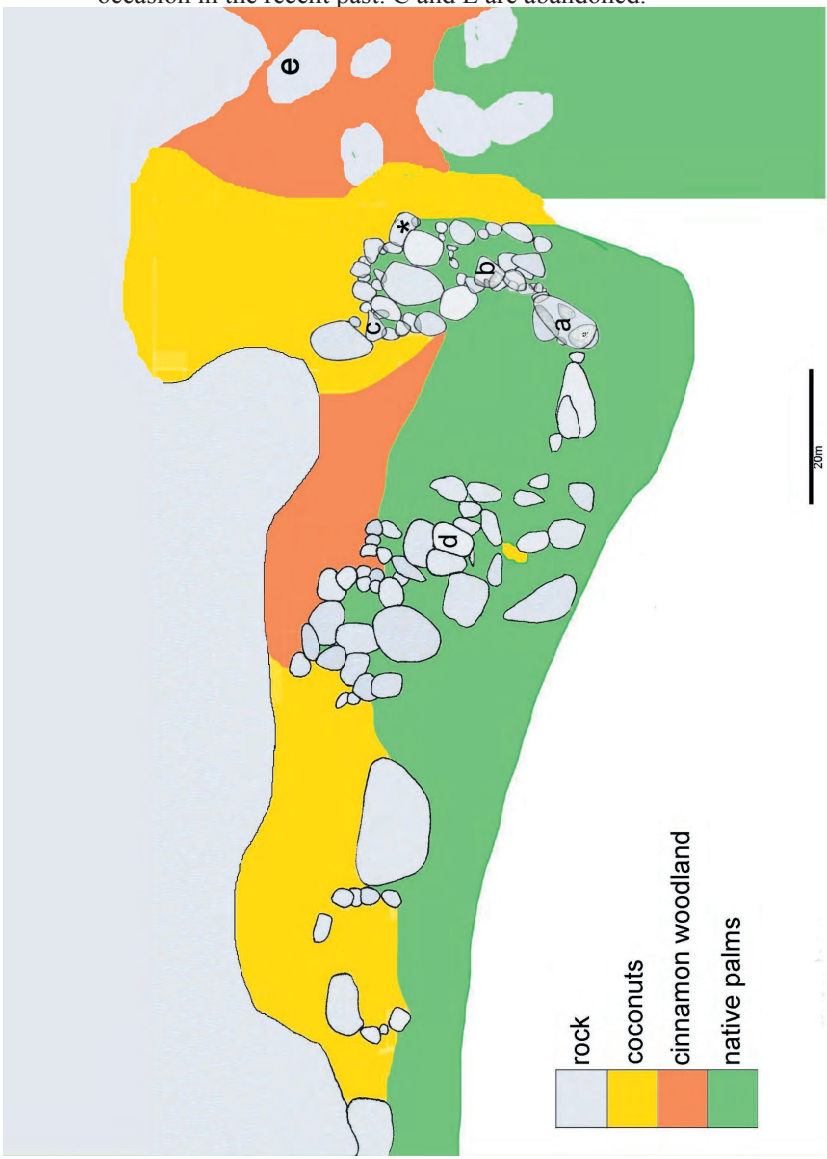
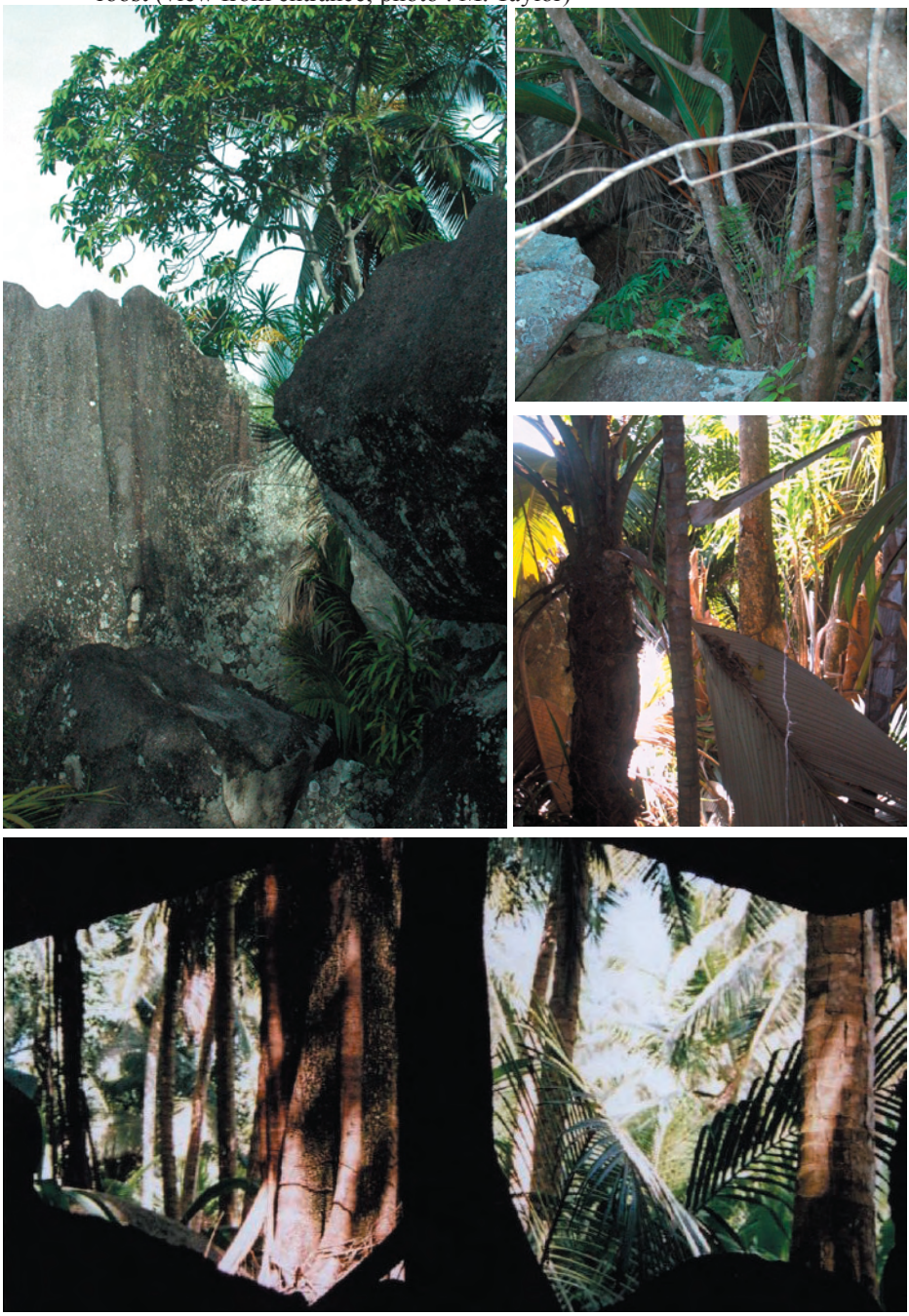


Fig. 4. Views of roosts - clockwise: B, E (entrance), D (view from entrance), Pte Etienne roost (view from entrance; photo : M. Taylor)



Since 2001 the La Passe population has grown significantly (Fig. 5). A maximum of 40 bats was reached in 2009. In March 2010 12 bats left this population and were located at Anse Lascars. A further 6 moved to Anse Lascars in June (Fig. 6). From March 2010 to March 2011 the number of bats at La Passe fluctuated between 18 and 22, suggesting regular movement of some individuals between the La Passe and Anse Lascars roosts.

Fig. 5. Population change in the La Passe roost. Data are grouped into quarters ('Q').

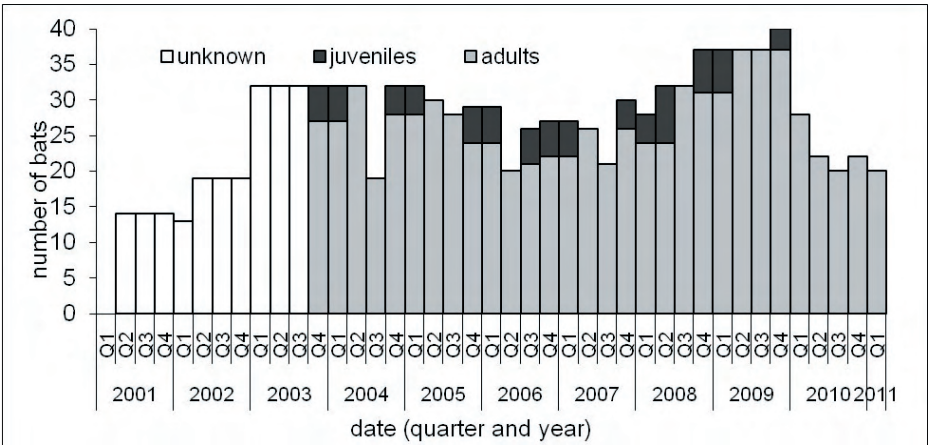


Fig. 6. Bat activity areas on the east coast of Silhouette.
a) Anse Lascars foraging area b) Top – La Passe, bottom – Anse Lascars

At Grande Barbe at least one bat was present between 2006 and 2008 but was not recorded after that date. This probably marks the extinction of that population. From the size of the roost (Fig. 7a) it is probable that a large population used to occur in the area. Habitat degradation (Fig. 7b) is the most likely cause of extinction.

Management

Conservation action covered roost protection and habitat management. Threats to the roost were identified as smoke from fires in the La Passe settlement, rubbish dumping, increases in alien mammal populations, insecticide use and invasive creepers. Direct human disturbance to the roosts is not a significant threat at present (although there are anecdotal reports of deliberate disturbance in the past in some of the abandoned roosts by people knocking bats off the roost ceilings with sticks – Matyot 1995).

Smoke

Until 1998 a copra dryer was in operation 300 m from the roost, during the south-east trade winds season smoke from the dryer was blown directly into the roost throughout the hours of daylight for 5-6 days of the week in the south-east trade winds season. In 1998 an agreement was reached with the island management that no fires would be lit in the vicinity of the roost and since then population increase was recorded in the roost. The creation of a construction workers' camp at the site of the old copra dryer in 2005 (and to the present day) means that a wood cooking fire produces smoke which reaches the roost at times. This was generally at a low level although significant smoke pollution did occur at times. The chemical composition of this smoke is also

Fig. 7. Grande Barbe roost.

7a) roost site 7b) surrounding habitat dominated by coconuts

a cause for concern as the wood being burnt was off-cuts of treated timber from the carpentry workshop.

Rubbish dumping

Rubbish dumping within 250m of the roost started in 2005 when food waste from the hotel labourers' camp was dumped in pits (Fig. 8a). This practice continued until 2007 and resulted in an increase in rats and Indian mynas in the area. Associated with this was a notable increase in cat activity (see below). Since 2007 food waste dumping was replaced by daily dumping of garden waste and household rubbish within the foraging area of the bats (Fig. 8b). Although this practice was reported to the Seychelles Ministry of Environment (NPTS 2007-11) no controls have been put in place.

Alien mammals

As noted above, rat and cat activity increased in the foraging areas used by the bats since 2005. In 2006 the CCTV camera showed high levels of agitation in the roost. No direct cause could be identified but investigation found rat foot-prints in the roost. In October 2006 the roost was completely abandoned but the bats returned in the following month. Rats in the roost may have been a source of direct disturbance or, more significantly, may have attracted cats. From January 2007 three poison bait stations were positioned in the entrance to the roost. These were maintained until March 2008 when it was concluded that the continued high rate of bait consumption could be attributed to snails rather than by rats. No further evidence of rat activity was observed subsequently.

Fig. 8. Rubbish dumping 9a) food waste dumping in 2005, 9b) dumping in 2010 in the National Park

Dog hair was found in roost D in 2006 and a stray dog heard in the vicinity throughout that year. Stray dogs were removed from the island and all domestic dogs neutered in 2007, this appears to have been effective as no stray dogs have been located subsequently. By 2010 no dogs were present on the island.

Predation by barn owls *Tyto alba* has been suggested to be a threat to the sheath-tailed bat (Nicoll & Suttie 1982; Bambini et al 2006). However, this is purely speculative and no data has been presented in support of the suggestion. No evidence of interaction between the two species was found on Silhouette.

Insecticides

Use of DDT for insect control in the mid-20th century may have had some impact but there is no evidence to allow evaluation. In recent years there has been an increase in the application of insecticides applied by fogging around human habitations. On Silhouette this has occurred within 200m of the La Passe roost and insecticide fog was observed drifting up to the roost site in February 2007 (Fig. 9). Such fogging practices have occurred at 3-6 month intervals since early 2006 to provide short-term control of mosquitoes. In March 2007 it was agreed that insecticide use would be restricted to buildings in the main settlement area, at least 300m from the roost and outside foraging areas. Enforcement of this has required continued monitoring as staff changes mean that these regulations are not always adhered to.

Fig. 9. Insecticide fogging

Invasive creepers

In 1997 the La Passe roost was threatened by the proximity of the alien Kudzu vine *Pueraria phaesoloides* which was starting to cover the entrance and change the ecological conditions of the roost. The creepers nearest the roost were cut back in July 2001 and in 2004. The plant seemed to have been eliminated from the area until 2009 when some shoots from underground roots was found and removed. *P. phaseoloides* is restricted to an area of 0.5 hectares on Silhouette (Fig. 10) and was managed by removal of seedling outside of this area. In addition to removal of this plant other invasive creepers (*Passiflora foetida*) were removed from the roost entrance and invasive trees removed selectively. The trees were removed by pruning or by ring-barking so as to cause slow habitat improvement and avoid rapid changes to the microclimate or appearance of the roost areas. Coconut seedlings were removed regularly and coconut leaves obscuring potential flyways removed.

Fig. 10. *Pueraria phaesoloides* invasion

Fig. 11. Habitat management at La Passe

original

2004

2006

Habitat management

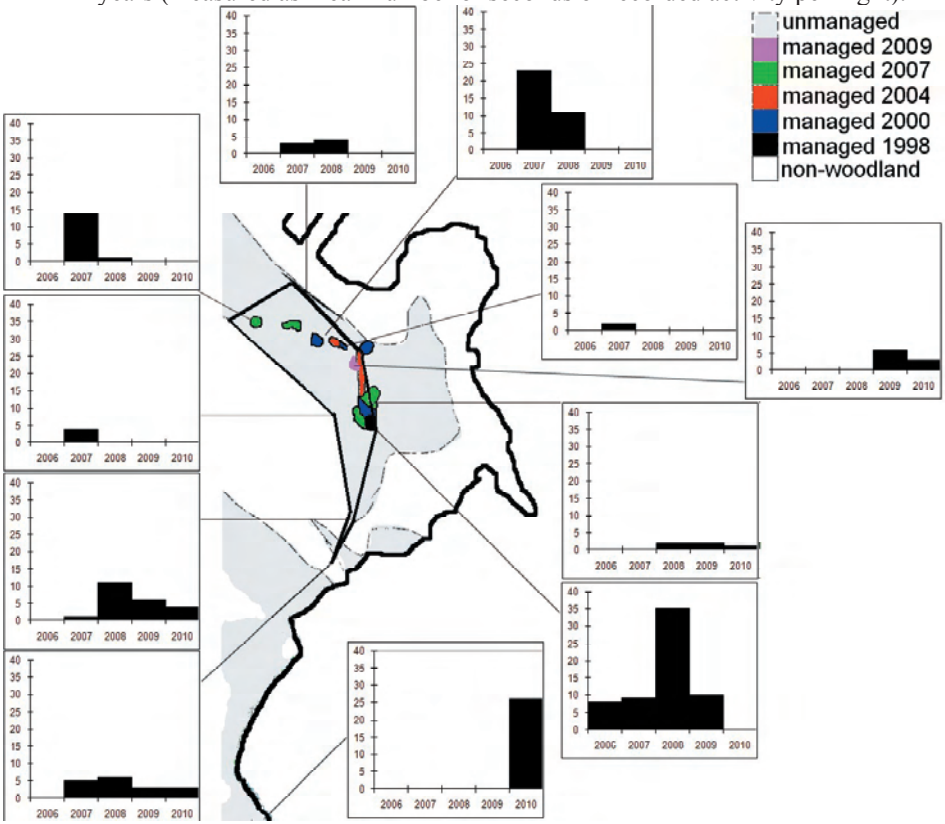
Habitat management was carried out in the foraging areas. Since 1997 *Cinnamomum verum* trees have been selectively removed in these areas to create small clearings. In these clearings existing native plants have been encouraged to grow or have been planted (Fig. 11). This management created a mosaic of un-managed areas, cleared and planted areas of varying ages and closed canopy management areas of varying ages.

Trees planted include fast growing indigenous species (*Ficus reflexa, Morinda citrifolia* and *Ochrosia oppositifolia*), indigenous lowland forest trees (*Carissa spinarum, Heritiera littoralis* and *Intsia bijuga*) and threatened endemics (*Grisollea thomasseti, Mimusops sechellana, Northea hornei, Rothmannia annae* and *Tarrena seychellensis*) and scarce endemics (*Vershaffeltia splendida*). Endemic herbaceous plants have also been established (*Allophyllus seychellensis* and *Gynura seychellensis*). Habitat management was carried out by NPTS (1997-2011) with occasional assistance from volunteers, the Sussex University field course (2000-2010) and Labriz Hotel (2008-2010). This management was highly successful in increasing bat foraging activity in management areas (Fig. 12).

Discussion

At present there is no legal protection of bats in Seychelles. In 2009 it was proposed that most of Silhouette should be declared a National Park. With the support

Fig. 12. Habitat management areas at La Passe showing the woodland areas and the dates of the start of management. Graphs show bat activity levels in different years (measured as mean number of seconds of recorded activity per night).



of international conservation organisations NPTS successfully lobbied the Ministry of Environment to have the proposed area extended to include all areas occupied by the sheath-tailed bat. In 2010 the Silhouette National Park was designated, providing legal protection for all of the Silhouette bat areas.

The research and management carried out by NPTS since 1997 has demonstrated that population recovery can be achieved for the Seychelles sheath-tailed bat. This requires effective protection of roosts and management of roosting and foraging habitat. Most crucially beetle-rich foraging areas need to be restored through the control of invasive plants. This is best achieved by restoring lowland areas to mixed woodland rich in the native plants *Phoenicophorium borsigianum*, *Nephrosperma vanhouetteana*, *Pandanus balfouri, Mimusops sechellarum, Intsia bijuga, Calophyllum inophyllum* and *Premna serratifolia*. Lowland marshes may also be important in some areas although lowland woodland is more significant (Gerlach & Taylor 2006).

Substantial investment in bat research and management by NPTS (Table 1) has enabled the Silhouette population to grow from 18 individuals to 40 and for the species to start to recolonise some of its historical range on the island. The eviction of NPTS from Silhouette in March 2011 puts these achievements at jeopardy. With the cessation of all conservation activity on the island the habitat management has ceased and it is inevitable that invasive plants will start to regain their dominance in the area, reversing the habitat quality improvements. The bats are no longer being monitored and no-one will ensure that pesticides are not used within the foraging areas, or that rats are controlled if populations increase in association with the ongoing rubbish dumping within the National Park.

Conservation prospects on Mahé are similarly poor due to the lack of action by the Ministry of Environment. The 14 years of experience with the Seychelles sheath-tailed bat has shown that reversing the conservation decline of this species is perfectly manageable but cannot be sustained in the absence of a supportive governmental framework. Consequently this species will needlessly remain Critically Endangered with a very real prospect of extinction in the near future.

Table 1. Investment in Seychelles sheath-tailed bat conservation

Item		Expenditure ($)	Source
Research	entomological equipment	1,200	NPTS
	bat detectors	6,954	CI, SAN
	consumables	28	NPTS
	Time	8,736	NPTS
	Transport	4,721	CI
	GIS	9,450	CI
Monitoring	CCTV systems	3,767	CI, private sponsors
	Time	100,020	NPTS
Management	Labour	1,150	CI, NPTS
	Time	76,800	NPTS
TOTAL		212,826	
		NPTS provision $182,124	

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