

Figure 1. Marianne: physical, with locations of vegetation plots.

MARIANNE

BY

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GEOLOGY, TOPOGRAPHY AND CLIMATE

Marianne has an area of 94.7 ha, and is the twelfth largest of the granitic Seychelles Islands. At its highest point (Estel Hill, grid ref. CL8034 2068) it reaches 130 m above sea level. A second lower peak (about 85 m) occurs to the South (grid ref. CL8023 1977). Most of the island is gently sloping land below 50 m (see Table 1).

The island is made up of porphyritic granite, which differs slightly from that of the other islands in the Praslin-La Digue group. Traversing the island in a northwesterly direction is a dyke of closely jointed metadolerite rock. On the northern slopes of the island, brown earthy rocks occur, the result of guano deposition on granite soils (Baker, 1963). On the western side of the island is a small “plateau” with a fringing reef. The plateau is made up of recent calcareous sediments and marsh deposits. The island’s gentle slopes have allowed the accumulation of red earth soils throughout, excluding only some areas of coastal glacia, where little or no soil occurs. The plateau has soils of the Shioya series (DOS, 1966).

Fresh water on the island is limited, especially during the dry season. At the site of the main former settlement (La Cour), there are two shallow wells. Much of the plateau area supports marsh vegetation (mainly sedges and *Ludwigia*), but in October 1999 there was no standing water. In March, after heavy rain, most of the plateau area was under fresh water to a depth of several centimetres. The marsh must occasionally be inundated; Shah and Parr (1998) reported the presence of mullet *Mugil cephalus*. On coastal glacia in the South of the island near Pointe Grande Glacia (grid ref. CL8035 1925), standing pools of fresh water were present in October.

Marianne is the most remote of the La Digue group of islands. The nearest island is Félicité, 3.8km away. The nearest large inhabited island is La Digue, 7.2km from Marianne.

The Seychelles islands experience a seasonal humid tropical climate (Walsh, 1984). While no weather data exist for Marianne, it could be predicted that the climate of the island follows a similar pattern to that of Félicité, with lower total rainfall than coastal sites on the larger islands.

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Table 1. Area of Marianne by altitude (calculated from maps published by Directorate of Overseas Survey (UK)/Seychelles Government).

Altitude range (m. asl.)	Approx. area (ha)	Percentage total area
100 - 150	3	3.2
50 - 100	24	25.5
10 - 50	49	52.1
0 - 10	18	19.1

HISTORY

The Marion Dufresne expedition of 1768 (prior to settlement of the Seychelles) made only a short note on Marianne Island, recording that only a little woodland was present (Lionnet, 1984). They also recorded the presence of giant tortoises (Bour, 1984).

In the earliest days of the colony, the lack of fresh water (perhaps combined with difficult access) probably restricted development on the island, although it passed into private hands in the early nineteenth century. By the 1830s, maize was being produced on Marianne Island in quantity (McAteer, 2000), but natural habitats remained; in 1866, the visiting naturalist Edward Newton recorded that the north side of Marianne appeared 'tolerably wooded, but...not with any very large trees' (Newton, 1867), although it seems that during his short stay he remained on the western side of the island around the settlement at La Cour. At the time of his visit, the human population of Marianne was one family of five people. During a short stay on the island he recorded seven endemic species of birds, two of which (Seychelles fody *Foudia sechellarum* and the chestnut-flanked white-eye *Zosterops mayottensis semiflava*) were new to science. He noted that the island had no cats or rats, while the nearby Félicité Island, although well-wooded (it was government-owned and supplied timber for other Seychelles islands at the time of his visit) had few birds and had populations of introduced predators. Noting that the owner of Marianne (M. Choppy) intended to start a coconut plantation on the island, he suggested that this act could be as destructive to the native avifauna (which was obviously outstanding for the period) as the introduction of predators.

Native vegetation and endemic species prevailed on Marianne for longer than on neighbouring islands. In 1890, most of the endemic birds recorded by Newton were still present (Ridgway, 1895). However, in the early twentieth century plantations replaced native forest; in the 1920s, extensive stands of the Seychelles endemic tree bwa-d-nat *Mimusops sechellarum* were cleared for firewood (Procter, 1974). By 1940, the human population of the island was 60 (Bradley, 1940). Marianne's extensive plantations supplied copra, fruit and other crops such as sweet potatoes until 1983, when coconut palms on the island were hit by disease (thought to be caused by a combination of insect pests, drought and high winds). A five-month quarantine was imposed on the island, banning the removal of agricultural produce. At the time, Marianne was said to be one of the major copra-producing plantations in Seychelles, and the quarantine caused a significant reduction in Seychelles' copra exports for the year (Seychelles Nation, 7/10/83).

Marianne Island is still privately owned, but its plantations have fallen into disuse. At the time of the survey visit, the island was uninhabited although a caretaker occasionally stayed overnight and had planted crops (including pumpkins, cassava and aubergine) on part of the plateau. The island was occasionally visited by day-trippers from La Digue and local fishermen.

FLORA AND VEGETATION

Flora

A total of 152 plant species were recorded on Marianne, including six ferns and 146 angiosperms. Of the angiosperms, 81 (53.3%) species are regarded as introduced in Seychelles (Friedmann, 1994) and 48 (32.9%) native. Of the native species, eight were endemic to the Seychelles (5.5% of the angiosperm flora). At least seven species of introduced plant (4.6% of the total flora) recorded on Marianne were restricted to cultivated areas of the plateau, where they had been planted in 1999. They were observed nowhere else on the island and would probably become extinct were cultivation to cease.

The proportion of the angiosperm flora made up of Seychelles endemics was lower than the average for the Seychelles as a whole (of the total Seychelles flora, around 54% are introduced and 9% endemic: Procter, 1984). The low proportion of endemics reflects the island's relatively small size and also the destruction of the natural vegetation of the island in the twentieth century. The surviving endemic species were restricted to the rockiest parts of the island when the plantation was functioning, although some have begun to spread out from these refugia. Both *Gastonia sechellarum* and *Tarenna sechellensis* were found as young plants amongst *Canthium* scrub in the former plantation. *Mimusops sechellarum*, which was among the dominant trees of the original native forest (Procter, 1974) was uncommon but several extremely large trees (two of which each reached around 20 m) were observed in predominantly native vegetation in the north of the island. Regeneration of this species appeared poor, perhaps as a result of seed predation by rats (Carlström, 1996a). No endemic palms were found.

Of the introduced plants established on Marianne, 15 are invasive weedy species. Compared to other granitic islands, Marianne had relatively few woody weed species. The cocoplum *Chrysobalanus icaco* was notably absent and cinnamon *Cinnamomum verum*, although present was very rare. Only a handful of mature cinnamon trees were observed, with some regeneration. This was an extremely unusual situation; on other islands, cinnamon appears extremely invasive and has come to dominate large areas. Previous work on the flora of Marianne has been limited. Robertson (1989) includes some records from the island, but lists no species not recorded in the current survey.

Vegetation

The extents of major vegetation types on Marianne are shown in Table 2 and Figure 2. The vegetation has undergone great change since the plantation was abandoned and much of the island is characterised by tall, dense scrub regenerating beneath coconut or fruit trees. Areas on the east coast of the island still have the appearance of a managed

coconut plantation, with scrub invasion restricted by exposure to salt spray. Throughout the former plantation many of the old coconut palms are dead, probably through a combination of exposure, drought and insect attack. At higher altitudes, almost all old palms are dead. Near the summit of Estel Hill and to the north, there is an area of native woodland with very few palms or introduced plants.

Table 2. Extent of major vegetation types, Marianne Island.

	Vegetation type	Approx. area (ha)
Hill (>10 m asl)	Woodland (predominantly native)	7
	Woodland (mixed)	7
	Coconut plantation	1
	Coconut with regeneration	22
	Scrub (native)	7
	Scrub (mixed)	29
	Grassland/garden	2
	Bare rock	< 1
Plateau (<10 m asl)	Woodland (predominantly native)	< 1
	Woodland (exotic)	3
	Coconut plantation	4
	Coconut with regeneration	1
	Scrub (native)	< 1
	Scrub (mixed)	< 1
	Beach crest vegetation	3
	Freshwater marsh	< 1
	Grassland/garden	< 1
	Bare rock	< 1

Ten plots were established in native woodland, with a combined area of 1,000 m² (approximately 1.4% of the total area of this vegetation type), and 20 in the former plantation covering 2000 m² or 0.3% of the total area of the habitat. A summary of results is shown in Table 3.

Native woodland plots had a relatively mature aspect with a high density of trees and sparse shrub and herb layers. The tree layer was dominated by two native species, takamaka *Calophyllum inophyllum* (36 trees, 35% of total trees) and *Canthium bibracteatum* (26 trees, 25.2% of total trees). Only one (possibly) non-native tree species was present in the tree layer, *Morinda citrifolia* (seven trees, 6.8% of total trees). Only one mature *Cocos* was found although many fallen stems indicated that they were formerly abundant here.

The most widespread species of the shrub layer were *Canthium bibracteatum* (in all 10 plots), coconut *Cocos nucifera* (in nine of 10 plots), *Dracaena reflexa* and *Premna serratifolia* (each in eight of 10 plots). Of these, *Cocos* was the most dominant species; in plots where it occurred, it formed on average 19.6% cover in the shrub layer. *Canthium* had an average of 4.9% cover. In the shrub layer, only one individual plant (of 335) was introduced (*Citrus* sp.); all others were native or possibly native (five individuals were *Morinda citrifolia*).

The 20 plots surveyed in the former plantations had a relatively sparse tree layer and dense shrub and herb layers. Compared to the native forest, the tree layer had a more

varied composition with 23.8–34.3% of all trees introduced, and 9.1% *Cocos*. Most of the larger trees were introduced plantation species; of trees with DBH 10 cm or over, only

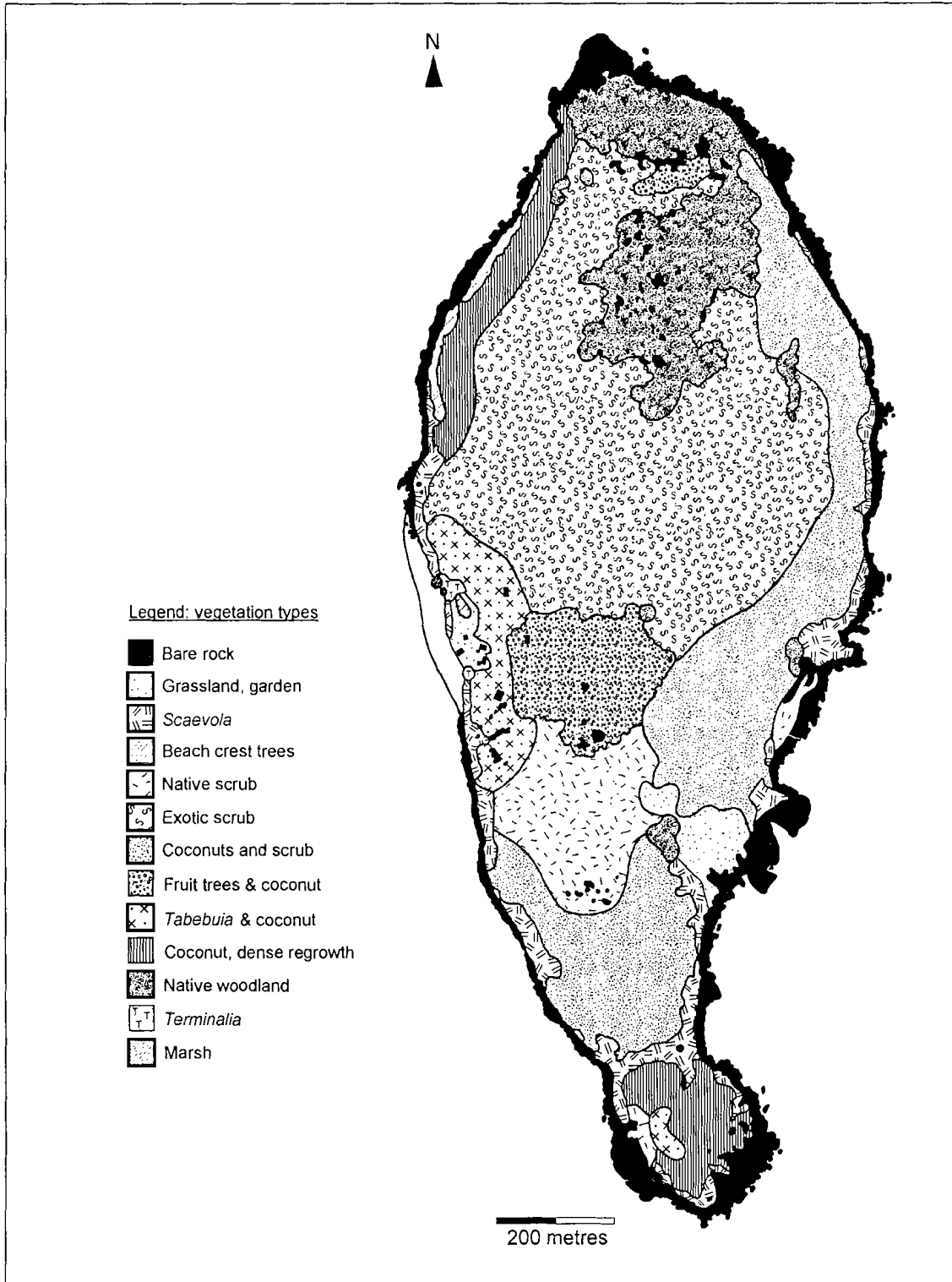


Figure 2. Marianne: vegetation.

19% were native broad-leafed species. However, the most abundant species in the tree layer were *Canthium bibracteatum* (52 individuals, 36.4%) and *Premna serratifolia* (21 individuals, 14.7%), both small native trees. This indicates a rapid growth of native early-successional species following the abandonment of the plantation.

In the shrub layer, only 94 individuals (6.9%) belonged to introduced species. However, the most widespread species in the shrub layer was *Cocos nucifera* (found in all 20 plots) with mean coverage of 45%. *Canthium bibracteatum* was present in 18 of 20 plots and *Morinda citrifolia* in 12.

Table 3. Vegetation plot summary.

Habitat	Plots	Mean altitude (m asl)	Mean trees ha ⁻¹	Mean shrub layer cover (%)	Mean herb layer cover (%)	Open leaf litter cover (%)	Bare rock (%)	Dead wood (pieces per plot)
Native woodland	10	110	1030	36.2	34.4	37.8	27.8	3.0
Former plantation	20	40	477	67.6	57.3	24.3	18.4	3.6

The dense herb and shrub layers of the former plantation sites show that this environment is dynamic. The end point of such a process is difficult to predict; although the tree layer is now dominated by native broad-leaf species, these are small trees adapted to early succession conditions. The strong germination and growth of *Cocos* will probably cause some areas to become dense single-species stands shading out other species.

INVERTEBRATES

Pitfall Trapping

The pitfall trap assemblages were generally small compared to those of other granitic islands (Table 4). In native woodland, assemblages were considerably smaller than in the mixed former plantation areas, perhaps because the native woodland was at high altitudes, more exposed and drier than the plantation sites. The richness of plantation sites (which have a greater proportion of introduced plant species) suggests that ground invertebrate density is not dependent upon native or endemic vegetation.

The composition of assemblages also differed between the native and mixed woodland, although both were dominated by ants (Hymenoptera: Formicidae). In native woodland, the most abundant invertebrate in both seasons was the native ant *Odontomachus troglodytes*, which formed 29.7% of all individuals in the south east and 58.8% of all individuals in the north west monsoon. In mixed former plantation, the dominant species was the introduced crazy ant *Anoplolepis gracilipes* (which formed 48.1% and 66.0% of all individuals). This ant was the most abundant species overall in pitfall collections from Marianne (51.4% of individuals were *A. gracilipes*) but it was rare in native woodland. *Anoplolepis gracilipes*, introduced to the Seychelles in the early 1960s, is a domestic and agricultural pest with effects on natural ecosystems that are

difficult to gauge (Haines *et al.*, 1994). Densities of the ant can become extremely high and, because the ants encourage soft bugs on foliage and stems, they can cause tree dieback and death, altering the composition of woodland (Hill, in prep.).

Pitfall assemblages contained representatives of 15 taxonomic groups other than ants. The most abundant groups were Dermaptera (earwigs), Collembola (springtails) and Blattodea (cockroaches) (Fig. 3). Several endemic species were collected in pitfall trap assemblages. Perhaps the most notable was the pill millipede *Cyliosomella furciparum*, believed extinct on Marianne (Gerlach, 1997). Three individuals were collected, two in native woodland (at 120 m and 100 m asl) and one at a slightly lower altitude (87 m asl) in mixed woodland adjacent to native woodland.

Table 4. Pitfall assemblages from Marianne: only invertebrates >2 mm body length included (numbers in parentheses: excluding ants).

	Habitat	Mean no. individuals per 5 traps	
		SE season	NW season
Marianne	Native woodland	21.6 (9.0)	20.6 (3.4)
	Former plantation	49.6 (12.7)	67.9 (12.1)
All granitic islands		61.8 (9.4)	61.1 (16.0)

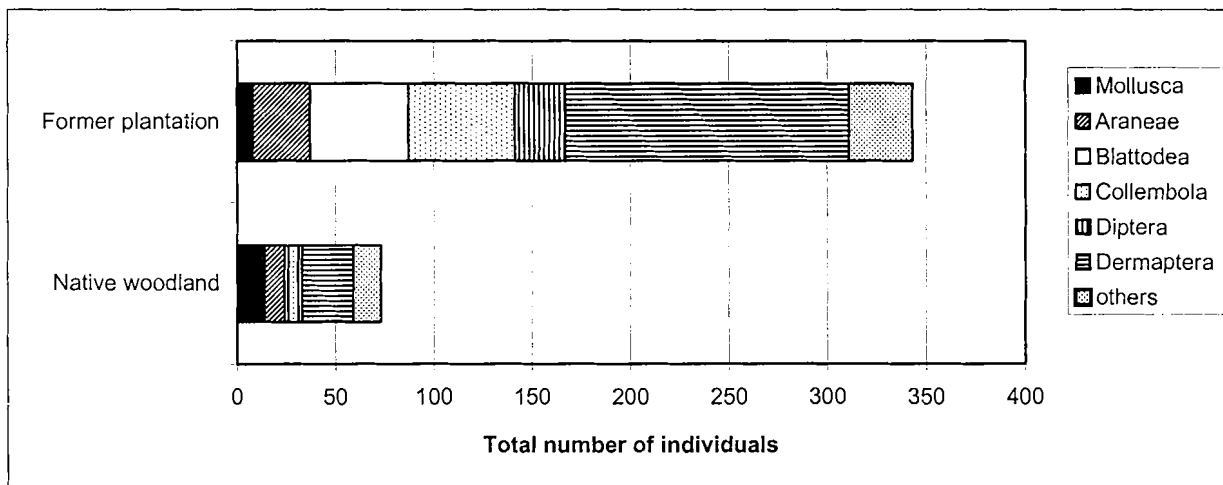


Figure 3. Total pitfall assemblages from Marianne, excluding ants.

Leaf-insect Counts

Leaf-insect counts were carried out for 16 tree and shrub species, seven of these in both seasons. Results are shown in Table 5. Extremely high counts occur for *Morinda citrifolia* (status uncertain; possibly introduced) and Chinese guava *Psidium cattleianum* (introduced) in October, due to high numbers of soft bugs. In general, the highest leaf counts were for native species and a few fruit tree species (e.g. *Citrus*, *Psidium*) which are favoured by ants culturing soft bugs (mealy bugs and scale insects).

Table 5. Density of invertebrates on foliage, Marianne.
 n = no. of leaves counted; NI = number of individual invertebrates.

Species	SE season (October)			NW season (March)		
	n	Mean NI leaf ⁻¹	mean NI m ⁻²	n	mean NI leaf ⁻¹	mean NI m ⁻²
Introduced species						
<i>Annona muricata</i>	50	0.020	4.51	0		
<i>Citrus</i> sp.	150	0.140	42.47	100	0.170	72.57
<i>Mangifera indica</i>	150	0.053	8.46	50	0.060	9.56
<i>Psidium cattleianum</i>	50	1.280	495.16	0		
<i>Tabebuia pallida</i>	0			100	0.210	45.89
Native species						
<i>Calophyllum inophyllum</i>	350	0.183	20.05	550	0.140	17.03
<i>Canthium bibracteatum</i>	700	0.060	21.94	1002	0.042	15.21
<i>Euphorbia pyrifolia</i>	0			100	0.140	59.67
<i>Gastonia sechellarum</i>	50	0.520	8.54	0		
<i>Paragenipa wrightii</i>	0			50	0.480	71.02
<i>Premna serratifolia</i>	650	0.503	78.41	500	0.218	28.94
<i>Scaevola sericea</i>	0			50	1.980	262.08
<i>Tarennia sechellensis</i>	50	0.040	15.29	0		
<i>Tabernaemontana coffeoides</i>	0			100	0.010	1.30
<i>Terminalia catappa</i>	50	0.12	16.77	50	1.240	119.98
?Status unknown						
<i>Morinda citrifolia</i>	400	8.510	725.80	300	0.756	123.01

Malaise Trapping

Malaise trapping was carried out in native woodland and former plantation habitats. Four Malaise traps (two in each habitat) were run in October 1999 and three (one in mixed former plantation, two in native woodland) in March 2000. Assemblages were slightly larger in March (mean number of individuals (NI) = 430) than in October (mean NI = 398), but there was no consistent pattern between habitats. Malaise trap assemblages included members of 13 invertebrate orders. The dominant orders were the Lepidoptera (43.7% of all individuals) and Diptera (28.7% of individuals). The majority of taxa collected have yet to be identified to species level: Hymenoptera (excluding ants) are currently being identified by Dr John Noyes of the Natural History Museum, London.

Observation

A list of species observed or collected is given in Table 6. Invertebrates of the highly disturbed areas of the plateau tended to be introduced or cosmopolitan species. Inland a greater number of endemic species were found. In general, the mixed woodland and scrub of abandoned plantation areas appeared richer than the native hill woodland on Estel Hill and the north of the island. Notable species included the endemic cricket *Seychellesia longicercata* normally found associated with endemic palms (Matyot, 1998).

At Pointe Grande Glacis, freshwater pools were present in October, when the marsh area was dry. Live mosquito larvae and dragonfly larvae were present. One adult dragonfly was observed flying over the pools, but could not be caught. Two dead insects were collected here: *Myriochile melancholica perplexa* (Coleoptera, Cicindelidae) and *Perissosoma grande* (Coleoptera, Scarabaeidae). This is apparently the first record of *M. m. perplexa* in Seychelles since the 1908-9 Percy Sladen Trust expedition (Scott, 1912). The species is widespread, occurring as a variety of different forms in Africa. The endemic chafer *P. grande* was formerly only known from Praslin, where it is often found in endemic palm forest. Due to the exposed position of this site, these insects could have originated outside Marianne.

In early March, the plateau marsh varied greatly in size from a small area of damp mud to a wide pool of freshwater with a depth of several centimetres covering much of the plateau (following heavy rain). Several dragonfly species were observed at this time. Specimens of one water beetle (unidentified) were collected and a species of water boatman (Hemiptera: Notonectidae) observed.

Table 6. Insects observed, Marianne Island.

Order	Family	Species
Arachnida		
Araneae	Tetragnathidae	<i>Nephila inaurita</i> (Walckenaer, 1841)
Crustacea		
Decapoda	Coenobitidae	<i>Coenobita brevimanus</i> Dana, 1852
	Gecarcinidae	<i>Cardisoma carnifex</i> (Herbst, 1784)
	Grapsidae	<i>Grapsus tenuicrustatus</i> (Herbst)
	Ocyropodidae	<i>Ocyropode ceratophthalma</i> (Pallas, 1772)
Mollusca	Cyclophoridae	<i>Cyathopoma blanfordi</i> Adams, 1868
	Streptaxidae	<i>Streptosele</i> sp.
	Subulinidae	<i>Subulina octona</i> Bruguière, 1792
Myriapoda		
Chilopoda	Scolopendridae	<i>Scolopendra subspinipes</i> (Leach, 1918)
Diplopoda	Spirostreptidae	<i>Seychelleptus seychellarum</i> (Desjardins, 1834)
	Sphaerotheridae	<i>Cyliosomella furciparum</i> (Brölemann, 1896)
	Trichopolydesmidae	<i>Cylindrodesmus hirsutus</i> (Pocock, 1888)
	Trigoniulidae	<i>Spiromanus ?braueri</i> (Attems, 1900)
Insecta		
Blattodea	Blattidae	<i>Periplaneta americana</i> (Linnaeus, 1758)
		<i>Periplaneta australasiae</i> (Fabricius, 1775)
Coleoptera	Cerambycidae	<i>Olenecamptus bilobus</i> (Fabricius)
	Cicindelidae	<i>Myriochile melancholica perplexa</i> (Dejean, 1825)
	Curculionidae	<i>Cratopus griseovestitus</i> Linell, 1897
		<i>Cratopus aurostriatus</i> Fairmaire, 1892
		<i>Callirhipis philiberti</i> Fairmaire, 1891
	Rhipiceridae	<i>Oryctes monoceros</i> (Olivier, 1789)
	Scarabaeidae	<i>Perissosoma grande</i> (Scott, 1912)
		<i>Protoetia maculta</i> (Fabricius, 1775)
<i>Antankaria (Chremistica) pulverulenta</i> (Distant, 1905)		
Hemiptera	Cicadoidea	<i>Xylocopa caffra</i> (Linnaeus, 1767)
Hymenoptera	Anthophoridae	<i>Apis mellifera adansoni</i> Latreille, 1804
	Apidae	<i>Anoplolepis gracilipes</i> (Smith, 1857)
	Formicidae	<i>Cardiocondyla emeryi</i> Forel, 1881
		<i>Monomorium ?fossulatum</i> Emery, 1894
		<i>Monomorium floricola</i> (Jerdon, 1851)

Table 6 (cont.)

Order	Family	Species	
Hymenoptera (cont.)	Formicidae (cont.)	<i>Odontomachus troglodytes</i> Santschi, 1914	
		<i>Plagiolepis ?alluaudi</i> Emery, 1894	
		<i>Tapinoma melanocephalum</i> (Fabricius, 1793)	
		<i>Technomyrmex albipes</i> (Smith, 1861)	
	Megachilidae	<i>Chalcidoma disjuncta</i> (Fabricius, 1781)	
	Sphecidae	<i>Trypoxylon</i> sp. (<i>T. errans</i> or <i>T. scutifrons</i>)	
	Vespidae	<i>Delta alluaudi</i> (Perez, 1895)	
		<i>Polistes olivaceus</i> (de Geer, 1773)	
	Lepidoptera	Lycaenidae	<i>Rhynchium brunneum</i> (Fabricius, 1773)
			<i>Leptotes pirthous</i> Linnaeus, 1767
<i>Zizeeria knysna</i> (Trimen, 1862)			
Noctuidae		<i>Zizula hylax</i> (Fabricius, 1775)	
		<i>Achaea mercatoria</i> (Fabricius, 1775)	
		<i>Anticarsia irrorata</i> Fabricius, 1781	
		<i>Trigonodes hyppasia</i> (Cramer, 1780)	
Nymphalidae		<i>Hypolimnas misippus</i> (Linnaeus, 1764)	
		<i>Hypolimnas ?bolina</i> Drury, 1773	
		<i>Melanitis leda africana</i> (Linnaeus, 1758)	
Pyralidae		<i>Spoladea recurvalis</i> (Fabricius, 1787)	
		<i>Diaphana indica</i> (Saunders, 1851)	
Sphingidae		<i>Endotricha mesenterialis mahensis</i> Whalley	
	<i>Acherontia atropos</i> (Linnaeus, 1758)		
Neuroptera	Myrmeleonidae	<i>Cephnodes hylas virescens</i> (Wallengren, 1865)	
Odonata	Libellulidae	<i>Myrmeleon obscurus</i> Rambur, 1842	
		<i>Orthetrum stemmale wrightii</i> (Selys, 1877)	
		<i>?Pantala flavescens</i> (Fabricius, 1798)	
Orthoptera	Gryllidae	<i>Tramea limbata</i> Selys, 1878	
		<i>Grylloides supplicans</i> (Walker, 1859)	
	Mogoplistidae	<i>Ornebius elegantulus</i> (Boliver, 1912)	
	Phalangopsidae	<i>Seychellesia longicercata</i> (Boliver, 1912)	
	Tettigonidae	<i>Ruspolia differens</i> (Serville, 1838)	
		<i>Conocephalus iris</i> (Serville, 1838)	

VERTEBRATES

Reptiles

Four species were recorded, all lizards: two day geckos (*Phelsuma sundbergi* and a smaller species, possibly *P. astriata*), a third gecko (a pink-bodied juvenile, observed on ruined buildings on the plateau: probably a young Pacific house gecko *Gehyra mutilata*), and one skink, *Mabuya sechellensis*. A fifth species, bronze-eyed gecko *Ailuronyx sechellensis*, has been recently recorded (Shah and Parr, 1998) although not observed during the current study. Both *A. sechellensis* and the large skink *Mabuya wrightii* were collected on Marianne by Lantz in 1877 (Cheke, 1984) and *M. wrightii* now appears to be extinct, probably due to the introduction of rats since 1877. No snakes were recorded, although the introduced fossorial snake *Ramphotyphlops braminus* is likely to be present as it was commonly spread to agricultural islands (Nussbaum, 1984a). Giant tortoises, presumably an endemic taxon of the granitic islands, were recorded in 1787 but had become extinct before 1875 (Bour, 1984).

Birds

Birds were surveyed by observation and using tape playback. In October 1999, playback of taped calls was used in locations around the island to give an indication of the number of individuals of the endemic Black Paradise Flycatcher. Tape playback of Scops Owl *Otus insularis* was carried out on one night (27/10/99).

The endemic Black Paradise flycatcher was observed on several occasions in three locations:

- 1) In mango trees at/near plot D10, once spontaneously (22/10/99) and once to tape (26/10/99);
- 2) At the northern end of the island, to tape (26/10/99);
- 3) Peak of Estel Hill, to tape (27/10/99, 28/10/99).

All responding individuals were females. It is possible that these were multiple records of the same bird, but seems more likely that there were at least two individuals.

Among the granitic islands, Marianne is unique in the quality of records of its bird fauna. Because plantation development occurred later here than on other islands in the group, naturalists of the 19th century were able to record the extant fauna, at a time when endemic species were extinct, or were being lost, on most other islands. The most complete records are those of Newton (1867). Abbott collected specimens on Marianne (and other islands) in 1890 (Ridgway, 1895). The past and present endemic avifauna of Marianne Island are summarised in Table 7.

Table 7. Past and present endemic land birds, Marianne Island.

Species		Late 19 th – early 20 th century	1999-2000
<i>Falco araea</i>	Seychelles kestrel	Present 1866 ¹	
<i>Streptopelia picturata</i> <i>rostrata</i>	Seychelles turtle dove**	Present 1866 ¹	Subspecies effectively extinct
<i>Alectroenas pulcherrima</i>	Seychelles blue pigeon	Present 1866 ¹	Present
<i>Coracopsis nigra barklyi</i>	Seychelles black parrot**	Reported numerous prior to 1866, but locally extinct by then ¹	
<i>Hypsipetes crassirostris</i>	Seychelles bulbul	Present 1866 ¹	
<i>Copsychus sechellarum</i>	Seychelles magpie-robins	Present 1866 ¹ and 1890 ²	
<i>Acrocephalus</i> <i>sechellarum</i>	Seychelles warbler	(?) Recorded 1936 ³	
<i>Terpsiphone corvina</i>	Seychelles black paradise flycatcher	Present 1890 ² , 1936 ³	Present, rare
<i>Nectarinia dussumieri</i>	Seychelles sunbird	Numerous 1866 ¹	Present
<i>Zosterops mayottensis</i> <i>semiflava</i>	Chestnut-flanked white- eye**	Present 1866 ¹ (first described from Marianne specimen) and 1890 ²	Seychelles subspecies extinct
<i>Foudia sechellarum</i>	Seychelles fody	Present 1866 ¹ (first described from Marianne specimen) and 1890 ²	

** Endemic subspecies

¹ Newton, 1867 ² Ridgway, 1895 ³ Vesey-Fitzgerald, 1936

In total, 12 land birds and waders were observed on the island during the current survey (Table 8), including three endemic species. Seabirds observed included fairy terns *Gygis alba* (common in breadfruit trees around the settlement, where they probably breed), common noddy *Anous stolidus*, white-tailed tropicbird *Phaeton lepturus* and frigate birds *Fregata* spp. (all observed occasionally offshore). In March 2002 a wedge-tailed shearwater *Puffinus pacificus* was heard calling in flight over the plateau at 8pm.

Table 8. Land birds and waders recorded on Marianne.
M = migrant species; E = Seychelles endemic species.

Species		Notes
<i>Butorides striatus</i>	green-backed heron	Up to three individuals regularly observed in rocky shallows near La Cour; one (abandoned) nest in <i>Euphorbia</i> .
<i>Gallus gallus</i>	domestic chicken	Several feral individuals, both sexes and young.
<i>Dromas ardeola</i> M	crab plover	One individual on beach, 18/10/99
<i>Numenius phaeopus</i> M	whimbrel	One individual on beach, 21/10/99. Two individuals regularly on beach, March.
<i>Actitis hypoleucos</i> M	common sandpiper	One individual on beach, 25/10/99
<i>Arenaria interpres</i> M	ruddy turnstone	Seen on two occasions, on glacis at the southern tip of the island. Seen regularly on beach, March
<i>Streptopelia picturata picturata</i>	Madagascar turtle dove	Observed fairly regularly around La Cour in <i>Tabebuia</i> forest.
<i>Geopelia striata</i>	barred ground dove	A few individuals observed, in disturbed or open habitats.
<i>Alectroenas pulcherrima</i> E	Seychelles blue pigeon	In October, only one individual observed 26/10/99, feeding on <i>Canthium</i> berries. In March seen more frequently, especially in fig trees.
<i>Terpsiphone corvina</i> E	Seychelles paradise flycatcher	October: at least three individual female birds found in an extensive survey of the island using tape playback of calls. March: several females observed.
<i>Nectarinia dussumieri</i> E	Seychelles sunbird	Very common everywhere. Several nests found, March.
<i>Acridotheres tristis</i>	common mynah	Common.
<i>Foudia madagascariensis</i>	Madagascar fody	Apparently rare: one male in breeding plumage observed 21/10/99. Females occasionally seen in <i>Tabebuia</i> forest near La Cour.

Mammals

Table 9 shows mammals observed in the course of the survey. In addition, rodent trapping was carried out in October 1999 and March 2000 (Table 10). Two trap-lines were established, both in hill woodland/scrub (former plantation). Only one species of rodent, the ship rat *Rattus rattus*, was trapped. Trapping rates were relatively low, although slightly higher in October than in March. Marianne has abundant fruit trees (especially mangoes and oranges) with fruit in season on both visits, and the availability of alternative food sources could influence the readiness of rats to enter traps.

Table 9. Mammal species observed, Marianne.

Species		Notes
<i>Bos taurus</i> L.	Cattle	One individual
<i>Felis catus</i> L.	Domestic cat	Rarely observed
<i>Pteropus seychellensis</i> Milne-Edwards	Seychelles fruit bat	Abundant, observed travelling between Marianne and other nearby islands (including La Digue, Félicité)
<i>Rattus rattus</i> L.	Ship rat	Abundant

Table 10. Results of rat trapping.

Dates	Trap-nights	No. of rats	Rats per 100 trap-nights (uncorrected)	Rats per 100 trap-nights (corrected)*
23 – 28/10/99	140	31	22.14	25.20
10 – 14/3/00	112	20	17.86	19.80
Total (SE)			35.34	
Total (NW)			25.56	

*Corrected to account for the effect of closed traps: Cunningham and Moors, 1996

CONSERVATION RECOMMENDATIONS

Given Marianne's documented history, it is of great conservation interest. Perhaps less than 100 years ago the island supported a greater range of endemic birds than any other of the central Seychelles islands. The loss of habitat, combined with the introduction of predators, caused the local extinction of most species. In addition, the presence of phosphatic rocks suggests that substantial colonies of seabirds existed.

Marianne is obviously capable of supporting viable populations of endemic land birds, but two major factors have to be addressed before re-introductions could be considered: introduced predators and habitat suitability. Specific actions that need to be taken include the control or eradication of introduced predators (particularly rats and cats) and the removal of introduced plant species and coconut scrub regenerating under the former coconut plantation. The introduced crazy ant *Anoplolepis gracilipes* is a potential threat on the island. Areas of the forest were dominated by this ant species which can have extreme effects on plant and invertebrate communities (Hill *et al.*, in prep.) with probable higher-order effects for vertebrates. At present, there are no instances of established populations of crazy ants being eradicated in the Seychelles.

The presence of Seychelles black paradise flycatchers on the island is of particular interest, given that the bird was thought to be restricted to La Digue prior to 1999. Records of the species by Shah and Parr (1998) and the current survey suggest that the number of individuals on the island is small; no adult males were recorded on visits in 1999 and 2000, although it is possible that juvenile males (with plumage similar to the female) were present. Even if males occur there, the small population on Marianne is undoubtedly vulnerable to extinction, especially given the presence of predators (rats and cats) on the island. However, these predators should not necessarily preclude the survival

of the paradise flycatcher on Marianne; on La Digue, a large, established population of the bird survives alongside a range of predators (including Seychelles bulbul, absent from Marianne). In order to encourage the paradise flycatcher to establish a viable population on Marianne, thus extending the species' range and reducing the possibility of extinction, the population of birds on Marianne could be enhanced by managed translocations, preferably in combination with attempts to reduce populations of introduced predator species.

Appendix 1. Plant species recorded from Marianne

Taxonomy of dicotyledons as given by Friedmann (1994). Of monocotyledons, as in Robertson (1989). Families arranged in alphabetical order.

Status: E = Endemic; N = Native; I = Introduced.

Abundance: A = Abundant (>1000 individuals observed); C = Common (100 - 1000 individuals observed); F = Frequent (10 - 100 individuals observed); Occasional (3 - 10 individuals observed); R = Rare (1 or 2 individuals observed).

Habitats: Cu = Cultivated area; Ma = Marsh; PG = Plateau Grassland; HW = Hill Woodland/scrub; HG = Hill Grassland; Gl = Glacis; BC = Beach Crest.

	Species	Status	Abund.	Habitats	Notes
PTERIDOPHYTA					
Adiantaceae					
1	<i>Acrostichum aureum</i> L.	N	O	BC	
2	<i>Pityrogramma calomelanos</i> (L.) Link.	?I	R	HW	
Davalliaceae					
3	<i>Davallia denticulata</i> (Burm.) Mett.	N	O	HW	
4	<i>Nephrolepis biserrata</i> (Sw.) Schott	N	A	HW, HG	
Polypodiaceae					
5	<i>Phymatosorus scolopendria</i> (Burm. f.)	N	A	HW	
Psilotaceae					
6	<i>Psilotum ?nudum</i> Sw.	N	F	HW	
ANGIOSPERMAE: Dicotyledons					
Acanthaceae					
7	<i>Asystasia</i> sp. B (<i>sensu</i> Friedmann)	?I	A	HW, Gl	
Amaranthaceae					
8	<i>Achyranthes aspera</i> (L.) DC.	I	O	HW	
9	<i>Alternanthera sessilis</i> (L.) DC.	I	O	Ma	
Anacardiaceae					
10	<i>Anacardium occidentale</i> L.	I	O	HW	
11	<i>Mangifera indica</i> L.	I	A	HW, PG	
12	<i>Spondias cytherea</i> Sonn.	I	O	HW	
Annonaceae					
13	<i>Annona muricata</i> L.	I	A	HW, PG	
14	<i>Annona reticulata</i> L.	I	F	HW	
15	<i>Annona squamosa</i> L.	I	O	HW	
Apocynaceae					
16	<i>Catharanthus roseus</i> (L.) G. Don.	I	C	HW, Gl	
17	<i>Ochrosia oppositifolia</i> (Lam.) Schum.	N	R	HW	
18	<i>Tabernaemontana coffeoides</i> Boj. ex A. DC.	N	C	HW	
Araliaceae					
19	<i>Gastonia sechellarum</i> (Baker) Harms. var. <i>sechellarum</i>	E	C	HW	
Asclepiadaceae					
20	<i>Sarcostemma viminale</i> (L.) Alton	N	O	HW, Gl	
Avicenniaceae					
21	<i>Avicennia marina</i> (Forssk.) Vierh.	N	R	BC	
Bignoniaceae					
22	<i>Tabebuia pallida</i> (Lindl.) Miers.	I	A	HW	

	Species	Status	Abund.	Habitats	Notes
Boraginaceae					
23	<i>Cordia subcordata</i> Lam.	N	O	PG, BC	
Caesalpiniaceae					
24	<i>Caesalpinia bonduc</i> (L.) Roxb.	N	F	HW	
25	<i>Senna occidentalis</i> (L.) Link	I	O	PG, HW	
26	<i>Tamarindus indica</i> L.	I	O	HW	
Capparidaceae					
27	<i>Cleome viscosa</i> L.	I	O	Gl	
Caricaceae					
28	<i>Carica papaya</i> L.	I	O	Cu, HW	
Casuarinaceae					
29	<i>Casuarina equisetifolia</i> J. R. & G. Foster	I	O	BC	
Combretaceae					
30	<i>Terminalia catappa</i> L.	?N	C	BC, PG, HW	
Compositae					
31	<i>Emilia sonchifolia</i> (L.) Wight	I	C	PG, Gl	
32	<i>Synedrella nodiflora</i> (L.) Gaertn.	I	A	PG	
33	<i>Tagetes patula</i> L.	I	R	Cu	Only in garden
34	<i>Vernonia cinerea</i> (L.) Less.	I	A	PG	
Convulvulaceae					
35	<i>Ipomea batatas</i> (L.) Lam.	I	F	Cu	
36	<i>Ipomoea macrantha</i> Roem & Schult.	N	F	HW	
37	<i>Ipomoea pes-caprae</i> (L.) R. Br.	N	A	BC, PG	
Cucurbitaceae					
38	<i>Cucurbita moschata</i> (Lam.) Poir.	I	F	Cu	Only in garden
39	<i>Lagenaria siceraria</i> (Molina) Standl.	I	F	Cu	Only in garden
Euphorbiaceae					
40	<i>Acalypha indica</i> L.	I	A	PG	
41	<i>Euphorbia hirta</i> L.	I	A	PG, Cu	
42	<i>Euphorbia pyrifolia</i> Lam.	N	F	HW, Gl	
43	<i>Euphorbia thymifolia</i> L.	I	C	PG, Cu	
44	<i>Jatropha curcas</i> L.	I	O	HW	
45	<i>Manihot esculenta</i> Crantz	I	O	Cu, HW	
46	<i>Pedilanthus tithymaloides</i> (L.) Poit.	I	R	HW	
47	<i>Phyllanthus amarus</i> Schumach. & Thonn.	I	A	PG	
48	<i>Phyllanthus pervilleanus</i> (Baillon) Müll. Arg.	N	F	HW	
Flacourtiaceae					
49	<i>Flacourtia jangomas</i> (Lour.) Räscher	I	F	HW	
Goodeniaceae					
50	<i>Scaevola sericea</i> Vahl.	N	A	BC, HW	
Guttiferae					
51	<i>Calophyllum inophyllum</i> L.	N	A	HW, BC	
Labiatae					
52	<i>Ocimum basilicum</i> L.	I	O	Gl	
53	<i>Ocimum ?tenuiflorum</i> L.	I	O	Gl	
54	<i>Plectranthus amboinicus</i> (Lour.) Spreng.	?I	F	Gl, HG	
55	<i>Plectranthus prostratus</i> Gürke	I	R	Sc	
56	<i>Solenostemon scutellarioides</i> (L.) Codd	I	R	Cu	Only in garden
Lauraceae					
57	<i>Cinnamomum verum</i> Presl.	I	R	HW	
58	<i>Persea americana</i> Mill.	I	O	HW	
Lecythidaceae					
59	<i>Barringtonia asiatica</i> (L.) Kurtz	N	O	BC	

	Species	Status	Abund.	Habitats	Notes
Malvaceae					
60	<i>Abutilon indicum</i> (L.) Sweet	?I	R	HW	
61	<i>Hibiscus tiliaceus</i> L.	N	O	HW	
62	<i>Sida acuta</i> Burm. F.	I	A	PG, HW	
63	<i>Sida cordifolia</i> L.	?N	C	GI	
64	<i>Thespesia populnea</i> (L.) Soland. Ex. Correa	N	F	BC, PG	
65	<i>Urena lobata</i> L.	?I	A	PG, HW	
Meliaceae					
66	<i>Xylocarpus moluccensis</i> (Lam.) Roem.	N	F	BC	
Mimosaceae					
67	<i>Adenanthera pavonina</i> L.	I	O	HW	
68	<i>Leucaena leucocephala</i> (Lam.) de Wit	I	F	HW	
69	<i>Pithecolobium unguis-cati</i> (L.) Benth.	I	O	HSc	
Moraceae					
70	<i>Artocarpus altilis</i> (Parkins.) Fosb.	I	O	PG	
71	<i>Ficus lutea</i> Vahl.	N	C	HW	
72	<i>Ficus reflexa</i> Thunb. ssp. <i>seychellensis</i> (Baker) Berg	E (ss)	F	HW, PG	
73	<i>Ficus rubra</i> Vahl.	N	C	HW, PG	
Moringaceae					
74	<i>Moringa oleifera</i> Lam.	I	O	HW	
Myrtaceae					
75	<i>Psidium guajava</i> L.	I	C	PG, HW	
76	<i>Syzygium wrightii</i> (Baker) A. J. Scott	E	O	HW	
Onagraceae					
77	<i>Ludwigia octovalvis</i> (Jacquin) Raven	?I	C	Ma	
Papilionaceae					
78	<i>Abrus precatorius</i> L.	?N	A	HW	
79	<i>Desmodium incanum</i> DC.	I	A	HW	
80	<i>Desmodium triflorum</i> (L.) DC.	I	C	HW	
81	<i>Teramnus labialis</i> (L.) Spreng.	I	C	HW	
82	<i>Vigna marina</i> (Burm.) Merr.	N	F	PG, Ma	
Passifloraceae					
83	<i>Passiflora foetida</i> L.	I	F	HW	
84	<i>Passiflora suberosa</i> L.	I	C	HW	
Portulacaceae					
85	<i>Portulaca oleracea</i> L.	?N	F	PG, GI	
Rubiaceae					
86	<i>Canthium bibractatum</i> (Baker) Hiem.	N	A	HW, GI	
87	<i>Guettarda speciosa</i> L.	N	O	BC	
88	<i>Morinda citrifolia</i> L.	?I	A	HW	
89	<i>Paragenipa wrightii</i> (Baker) F. Friedmann	E	F	HW	
90	<i>Pentadon pentandrus</i> (Schumach. & Thonn.) Vatke	I	R	GI	
91	<i>Tarenna sechellensis</i> (Baker) Summerh.	E	C	HW	
Rutaceae					
92	<i>Citrus aurantifolia</i> (Christm.) Swingle	I	O	HW	
93	<i>Citrus medica</i> L.	I	O	HW	
94	<i>Citrus reticulata</i> Blanco	I	F	HW	
95	<i>Citrus sinensis</i> (L.) Osbeck	I	A	HW	
96	<i>Murraya koenigii</i> (L.) Spreng.	I	R	HW	
97	<i>Murraya paniculata</i> (L.) Jack	I	F	HW	

	Species	Status	Abund.	Habitats	Notes
Sapindaceae					
98	<i>Allophyllus pervillei</i> Blume	N	R	HG, HW	
99	<i>Cardiospermum halicacabum</i> L.	?N	F	HW, GI	
Sapotaceae					
100	<i>Mimusops sechellarum</i> (Oliv.) Hemsl.	E	F	HW	
Scrophulariaceae					
101	<i>Striga asiatica</i> (L.) O. Kuntze	?I	O	HG	
Solanaceae					
102	<i>Capsicum frutescens</i> L.	I	R	Cu	Only in garden
103	<i>Datura metel</i> L.	I	C	PG	
104	<i>Physalis angulata</i> L.	I	O	PG	
105	<i>Solanum melongena</i> L.	I	F	Cu	Only in garden
Tiliaceae					
106	<i>Triumphetta rhomboidea</i> Jacq.	I	C	GI, PG	
Turneraceae					
107	<i>Turnera angustifolia</i> Miller	I	A	HW	
Verbenaceae					
108	<i>Phyla nodiflora</i> (L.) Greene	I	O	PG	
109	<i>Premna serratifolia</i> L.	N	A	HW	
110	<i>Stachytarpheta jamaicensis</i> (L.) Vahl.	I	O	HG, PG	
111	<i>Stachytarpheta urticifolia</i> (Salisb.) Sims.	I	A	HW	
112	<i>Vitex trifolia</i> L.	I	C	PG, Ma	
ANGIOSPERMAE: Monotyledons					
Agavaceae					
113	<i>Furcraea foetida</i> (L.) Haw.	I	O	HW	
Amaryllidaceae					
114	<i>Hymenocallis littoralis</i> (Jacq.) Salisb.	?I	F	PG	
115	<i>Zephyranthes rosea</i> Lindl.	I	R	PG	
Araceae					
116	<i>Alocasia macrorrhiza</i> (L.) G. Don.	I	O	HW	
Bromeliaceae					
117	<i>Ananas comosus</i> (L.) Merr.	I	O	HW, GI	
Commelinaceae					
118	<i>Commelina</i> sp.	?	O	HW	
Cyperaceae					
119	<i>Cyperus compressus</i> L.	?	O	PG, GI	
120	<i>Fimbristylis cymosa</i> R. Br.	?	C	GI	
121	<i>Fimbristylis dichotoma</i> (L.) Vahl.	?	A	PG	
122	<i>Fimbristylis</i> sp. (glacis sedge)	?	C	GI	
123	<i>Kyllinga alba</i> Nees	?	F	HW	
124	<i>Kyllinga polyphylla</i> Willd. ex Kunth	N	C	HW, GI	
125	<i>Mariscus dubius</i> (Rottb.) Fischer	N	C	HW, PG, GI	
126	<i>Mariscus pennatus</i> (Lam.) Domin.	N	C	Ma	
127	<i>Pycneus polystachyos</i> (Rottb.) P. Beauv.	?	C	Ma, GI	
128	<i>Thoracostachyum floribundum</i> (Nees) C. B. Cl.	E	O	HW	
Gramineae					
129	<i>Bambusa vulgaris</i> Scrad. ex Wendl.	I	R	HW	
130	<i>Brachiaria umbellata</i> (Trin.) W. D. Clayton	N	A	HW, GI	
131	<i>Cenchrus echinatus</i> L.	?	O	PG	
132	<i>Chloris barbata</i> (L.) Sw.	?	O	GI	
133	<i>Dactyloctenium ?ctenoides</i> (Steud.) Bosser	?	A	PG	
134	<i>Digitaria ?didactyla</i> Willd.	N	A	HG	
135	<i>Digitaria ?horizontalis</i> Willd.	?	F	PG	

	Species	Status	Abund.	Habitats	Notes
136	<i>Enteropogon sechellensis</i> (Baker) Dur. & Schinz	N	A	PG, GI	
137	<i>Eragrostis ?tenella</i> (L.) P. Beuv. <i>insularis</i> Hubb.	?	O	GI	
138	<i>Oplismenus compositus</i> (L.) P. Beuv.	N	O	HW	
139	<i>Paspalum ?scrobiculatum</i> L.	?	O	HW	
140	<i>Pennisetum polystachyon</i> (L.) Schult.	?	O	GI	
141	<i>Sporobolus virginicus</i> (L.) Kunth.	N	C	BC	
142	<i>Stenotaphrum dimidiatum</i> (L.) Brogn.	N	C	HW	
143	<i>Stenotaphrum micranthum</i> (Desv.) C. E. Hubb.	?	A	HG	
144	sp. indet. (? <i>Brachiaria</i> sp.)	?	C	HW	
	Liliaceae				
145	<i>Dracaena reflexa</i> Lam. var. <i>angustifolia</i> Baker	N	A	HW	
	Musaceae				
146	<i>Musa sapientum</i> L.	I	F	Cu, HW	
	Orchidaceae				
147	<i>Disperis tripetaloides</i> (Thouars)Lindl.	N	F	HW	
148	<i>Vanilla planifolia</i> Andrews	I	A	HW	
	Palmae				
149	<i>Cocos nucifera</i> L.	N	A	HW, HG, PG, BC	
	Pandanaceae				
150	<i>Pandanus balfourii</i> Mart.	E	O	BC, HW	
151	<i>Pandanus utilis</i> Bory	I	C	HW	
	Taccaceae				
152	<i>Tacca leontopetaloides</i> (L.) O.Kuntze	?	F	HW	