



# TROPICAL DEPRESSION STORM OVER PRASLIN AND ITS SATELLITE ISLANDS IN SEYCHELLES

## UNEP/OCHA Assessment Report



November 2003

**TROPICAL DEPRESSION STORM OVER  
PRASLIN AND ITS SATELLITE ISLANDS IN  
SEYCHELLES**

**United Nations Environment Programme (UNEP) and  
UN Office for the Coordination of Humanitarian Affairs  
(OCHA)**

**Assessment Report  
Seychelles**

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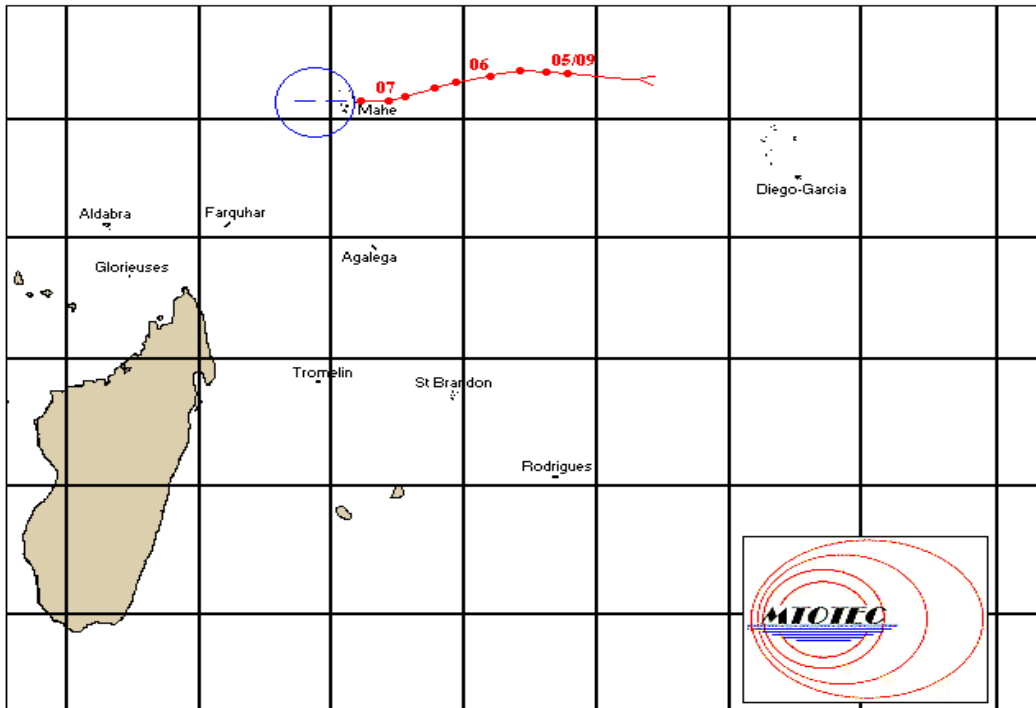
## **1 INTRODUCTION**

On 17 September 2002 the Ministry of Foreign Affairs of the Seychelles requested UNEP's assistance in the rehabilitation and recovery process from the damage caused by a storm on Praslin island and its satellite islands. On receiving the request, and in line with usual practice the Disaster Management Branch held consultations with relevant in-house Divisions and also with the Joint UNEP/OCHA Environment Unit. On the basis of the in-house consultations, UNEP responded on 1 October 2002, indicating that it was in a position to undertake an assessment of the damage done to the biodiversity and prescribe corrective measures. Following several other exchanges of correspondence with the Ministry of Foreign Affairs, UNEP and OCHA fielded a UN mission as a joint venture to undertake an environmental assessment, focussing primarily on biodiversity, and to provide an overview of existing disaster management structures/mechanisms in Seychelles and to recommend action to mitigate the impact of future events.

The mission was organized by the Disaster Management Branch of UNEP Division of Environmental Policy Implementation (DEPI). It comprised of three experts, one national expert activated by the Joint UNEP/OCHA Environment Unit through donor assistance, one from the UNEP/DGEF Biodiversity Enabling Activities office and one from the Disaster Management Branch/Environmental Emergency Unit. The mission lasted from 22 to 29 March 2003 and was conducted in two parts: the first comprising consultations with the government and relevant private sector authorities in Mahe and the second comprising of a field trip to Praslin and its satellite islands, these being the areas most affected by the storm.

## 2 THE STORM EVENT

On 6-7<sup>th</sup> September 2002, the main Seychelles islands of Mahe, Praslin, and its associated smaller islands of Cousin, Cousine and Curieuse, were hit, from the east, by a deep tropical depression. The depression was close to the islands for almost 48 hours, producing heavy rain<sup>1</sup> and thunderstorm activity over the main islands of Mahe, Praslin, and La Digue, before moving away to the west and dissipating itself over the ocean (see photo 1).



*Photo 1: Track for Tropical Depression*

Although there was some damage impact arising from the unusually heavy and prolonged rainfall, the majority of the long-term damage arose from the occurrence, for approximately two hours on Saturday afternoon, of a “microburst” windstorm which buffeted some parts of the islands with winds of up to 120 kilometres per hour (kph).

Retrospective analysis has allowed the path of the microburst to be traced, although there appears to be no practical way by which this relatively narrow path could have been predicted in advance. The

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<sup>1</sup> 327.1mm in 24 hours at Rochons, Mahe between 0700 hours on 6 September to 0700 hours on 7 September

microburst approached Praslin from the east and hit the center of the island, doing considerable damage along the Grand Anse/Amities coastline and to the Cote D'Or area. The high winds were funneled along mountain contours and particularly along the trans-island road linking the two main communities of Grand Anse and Baie St. Anne, causing extensive damage to forest cover along the road. The microburst continued on its westward path with its northern edge causing limited damage to Curieuse Island before moving directly over Cousin Island, where extensive damage was experienced. The microburst then appears to have dissipated and consequently only caused minor damage to the neighbouring island of Cousine.

Before the depression moved away from the islands late on Saturday afternoon, the combination of heavy rain and strong winds had produced the worst storm damage recorded on the islands in the past 50 years<sup>2</sup>.

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<sup>2</sup> Footage of the post storm damage is available from the Seychelles Ministry of Environment, or via UNEP. The Torrential "El Nino" rains on Mahe in 1997 probably caused more flood/landslide damage to infrastructure, but did not significantly impact biodiversity.



### 3 THE STORM IMPACTS

The Tropical Depression was first identified about 500km to the East North East (ENE) of Mahe Island on 5<sup>th</sup> September, as it tracked westwards at about 20kph towards Mahe and the inner islands, reaching the eastern parts of the Seychelles Exclusive Economic Zone (EEZ) at 1100 hours on 5 September 2002, and producing widespread moderate to heavy rain over Mahe and the inner islands.

#### 3.1 Mahe Island

Mahe is the largest island in the granitic Seychelles and is the main population base, with more than 90% of the Seychelles' population. The biodiversity of Mahe island is highly significant particularly in terms of plants, invertebrates, amphibians and reptiles. The elevation range of 900 metres has produced a diverse set of forest ecosystems, not found in the Praslin island group, and matched only partly by the neighbouring island of Silhouette. Mahe's biodiversity is under great pressure from development. This pressure is greatest on the coastal ecosystems, such as lowland woodland, dunes, beaches and lowland wetlands, including mangrove ecosystems. Mahe's most significant biodiversity is found in the mountains, with some 50% of the country's known endemic species occurring in the mid-altitude forest between 300–600 metres above sea level (asl). This area, classified predominantly as intermediate forest, has been degraded through historical timber felling and encroachment of invasive species such as Albizia (*Albizia faltacta*) and cinnamon (*Cinnamon ceyanicum*). Mahe has two Important Bird Areas (IBAs) as recognized by BirdLife International, the Mahe highlands and surrounds and the Montagne Glacis. The Mahe highlands and surrounds has an area of some 4,600 ha., harbouring virtually the entire world population of the Seychelles bare-legged Scops Owl (*Otus insularis*), and approximately 10% and 25% respectively of the world populations of Seychelles White-eye (*Zosterops modesta*) and Seychelles Kestrel (*Falco araea*). It also holds major populations of the endemic Cave Swiftlet (*Collocalia elaphra*), Blue Pigeon (*Alectroenas pulcherrima*), Seychelles Bulbul (*Hypsipetes crassirostris*) and Seychelles Sunbird (*Nectarinia dussumieri*). The Montagne Glacis is in the north mountains of Mahe and hosts the largest known colony of the Cave Swiftlet.

At 1430 on Saturday 6 September 2002, Mahe experienced sustained gale force winds of between 90-100kph in a restricted zone along a thunderstorm squall line in the eastern part of the low pressure

system. According to media reports<sup>3</sup>, these high winds did little major damage on Mahe beyond some flooding, rock/landslides, fallen trees and interruption to telephone, power and water supplies, and Mahe’s unique biodiversity escaped unscathed.

### 3.2 Praslin Island

Praslin is the second largest island in the granitic Seychelles and is also the second most populated with approximately 6,000 inhabitants. It contains less relatively undisturbed natural vegetation than is found in the mid-altitude forest of Mahe Island, but does harbour a number of globally significant species and habitats. Praslin is very important for Seychelles’ tourism, and has been subject to significant development for tourism in recent years. The biodiversity significance of Praslin Island, and especially the Vallee de Mai World Heritage Site within Praslin National Park (NP) is summarized in Boxes 1 and 2.



*Photo 2: Coco de mer female with fruits*



*Photo 3: Coco de mer adult*

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<sup>3</sup> The Nation, Monday 9 September 2002

## Box 1: Biodiversity Significance of Praslin Island

It is estimated that the total forest area of Mahé, Praslin, Curieuse, La Digue and Silhouette islands is 17,600 ha, approximately 78% of their land area. 20% of the forests are within National Parks or other protected areas. Praslin and Curieuse between them have 3,260 ha of forest land of which 11% is within the Praslin National Park.

The most important locations of biodiversity significance on Praslin Island are as follows:

### Praslin National Park (NP)

This 800 acre (330 ha.) protected area was established in 1979 by the National Parks (Praslin) (Designation) Order S/1 57/1979. The Park is divided into three sections containing around 11% of Seychelles total forest. The Park is bisected by the busy trans-island road which is Domaine Public. Praslin NP is a designated Important Bird area (IBA) because of the presence of the largest population of the Seychelles Black Parrot (*Coracopsis nigra barklyi*). Praslin NP also hosts a small population of the Seychelles Kestrel (*Falco araea*) as well as significant populations of endemics such as the Cave Swiftlet (*Collocalia elaphra*), Seychelles Bulbul (*Hypsipetes crassirostris*), Blue Pigeon (*Alectroenas pulcherrima*) and Seychelles Sunbird (*Nectarinia dussumieri*). The extremely rare Seychelles Sheath-tailed bat is still believed to have a very small population on the island. The Vallee-de-Mai World Heritage Site (see Box 2) lies within the Praslin NP.

### Fond Ferdinand and Anse Marie-Louise

The largest remaining mature Coco-de-Mer forest left in Seychelles, 150 ha in size with an altitude range of 10-300m. There is a much greater population of Coco-de-Mer than in Vallée de Mai, although less densely stocked. The growth rate of Coco-de-Mer is probably higher in Fond Ferdinand. The high canopy is still intact, up to 30m in places, although more mixed, with a range of indigenous and endemic species such as *Calophyllum inophyllum* (Takamaka), *Dillenia ferruginea* (Bwa Rouz), *Ludia mauritiana* (Prinn Maron), and *Intsia bijuga* (Gayak). but with fewer vulnerable and endangered species than in Vallée de Mai, and only four of the endemic palm species are found in Fond Ferdinand.

### Glacis Noir - Fond Azore

One of the best intermediate palm forests of the Seychelles, containing a mix of all six endemic palms. Adjacent to Vallée de Mai, it ranges to a higher altitude.

### Fond D'Albaretz

A high-quality, endemic palm forest of a drier type than Vallée de Mai, containing Coco-de-Mer as a component of reduced stature, and a wide range of other endemics. There are some similarities with the higher slopes of Vallée de Mai, but it is not identical.

Surveys have shown that the above three areas have considerably greater biodiversity significance than both the Vallee-de-Mai and Praslin National Park combined. Proposals have been made and actions undertaken to link these areas through land purchase and designation as one contiguous conservation area. Fond Ferdinand now falls under the Praslin Development Fund (PDF) for the purposes of land management, ecotourism development and conservation.

Other important areas include:

### Fond Diable

A mixed dry slope vegetation, affected by fire but containing by far the best population of the rare endemic creeper *Secamone (Toxocarpus) schimperiana*, also *Pandanus multispicatus* and *Pouteria obovata*.

### Fond Peper

Fond Peper is a similar habitat to Vallée de Mai, but more open with a ground flora of ferns such as *Bolbotis bipinnatifida* and *Sphaerostephanos sp.*

### Nouvelle Decouverte

Nouvelle Decouverte contains a good mixed stand of *Pandanus* and palms plus some riverine forest, but parts of the area are already heavily impacted by development.

### La Plaine Hollandaise

This interior valley is the site of a potentially significant upland wetland and also exhibits various plant assemblages of interest in addition to being an important area of for water catchment.

### Riviere Kerlan

Riviere Kerlan is one of the last sites of *Pandanus hornei* dominated forest.

## Box 2 Biodiversity Significance of the Vallée-de-Mai World Heritage Site

The Vallée-de-Mai was first declared a Nature Reserve in 1966 under the Wild Animals and Birds Protection Act (Chapter 247). Since 1979 it has been protected under the National Parks and Nature Conservancy Act (Chapter 141) as part of Praslin National Park, which is managed by the Forestry Section of the Ministry of Environment.

Vallée-de-Mai was designated a World Heritage Site by UNESCO in 1983 as an outstanding example of low- and intermediate-altitude palm forest characteristic of the Seychelles. The Site falls under the direct management of Seychelles Islands Foundation (SIF). This non-governmental organisation was set up by Presidential Decree in 1979, originally with responsibility for the other Seychelles World Heritage Site, Aldabra, but was later expanded to have responsibility for Vallée-de-Mai as well.

The Vallée-de-Mai has an area of 19.5ha. It extends from 150m to 310m altitude, and as is typical for the Seychelles contains slopes of 30%. It is bounded on one side by the main road used for crossing the island of Praslin, with a great deal of associated traffic.

The Vallée-de-Mai palm forest is dominated by the endemic Coco-de-Mer (*Lodoicea maldivica*) but the valley contains all 6 palm species endemic to the Seychelles (*Lodoicea maldivica*, *Deckenia nobilis*, *Nephrosperma vanhoutteana*, *Phoenixophorium borsigianum*, *Verschaffeltia splendida*, and *Roscheria melanochaetes*), each belonging to a monospecific genus. The palms grow intermixed with *Pandanus hornei* and other broadleaf endemics dominated by *Northea hornei* and *Dillenia ferruginea*.

The forests of the Vallée-de-Mai area remained relatively untouched until the 1930s and still retain some patches in a near natural state. Since then some deforestation and planting of alien exotics such as fruit trees has affected the vegetation, but attempts are currently being made to remove alien species for better conservation of endemics.

In the Vallée-de-Mai there are about 6,000 coco-de-mer trees, of which 518 are mature females, 644 are mature males and 4,920 are juvenile plants.

The area is also an important habitat for other rare and endangered species, including the Seychelles Black Parrot (*Coracopsis nigra barklyi*), the national bird of Seychelles, and *Pachypanchax playfairi*, an endemic freshwater fish.

As many as 80% of tourists who visit Praslin Island visit the Vallée-de-Mai. The record visitor numbers for one year is more than 55,000 people. Typical annual visitor number is nearer to 45,000, approximately 30% of the total number of tourists who come to the Seychelles, but it is estimated that 60% of Seychellois have never visited the Vallee. Current gate charges are US\$10 or €10 but residents of Seychelles are allowed to enter free of charge, on production of a valid national identity card.

Direct revenue from the Vallée-de-Mai to SIF including tickets, donations and sale of nuts was approximately 1.5 million Seychelles Rupees (SR) in 2000, 50% of this income is used to finance the Seychelles' Aldabra World Heritage Site. Even at conservative estimates, the wider (indirect) economic returns to the national and local Praslin economy are likely to be ten times this figure and perhaps much more.

The major threats to the Vallee de Mai are fire, introduction of alien species, including disease, and over-exploitation of coco-de-mer nuts at the expense of sustainable regeneration. At present, there are too few juvenile plants in the forest. Average figures for the last 5 years show a typical commercial harvest within the Vallée of just under 500 nuts, almost all of the total production, although around 15% are mis-shaped and maybe used for replanting. Assuming an average 300 years survival, then to sustain the present population would need a successful recruitment to full maturity of 20 trees per year with no allowance for mortality. To allow for losses, regeneration should be targeted at approx 2% of the population, i.e. 120 nuts left to germinate within the Vallée each year.

In contrast to Mahe, the second largest inhabited island of Praslin was more severely affected by the storm winds, which peaked at 130kph, although rainfall over the island was considerably lower<sup>4</sup>.

<sup>4</sup> 93.5 mm rainfall recorded at Praslin Airport and 125 mm at Fond B'Offay.

The strong (apparently) swirling winds destroyed the roofs of the Grand Anse Praslin Secondary School and the Praslin Airport control tower, whilst damaging the roof of the Airport Terminal Building. More than 50 houses at Anse Kerlan, Baie St Anne, Grand Anse and Cote D’Or had their roofs blown away and six houses were completely destroyed; over 50 electricity poles broke; several kilometres of electricity cable were damaged leaving the whole island in darkness on Saturday night; and most main roads on Praslin, especially around the Vallee-de-Mai, were closed by fallen trees until late on Sunday evening.

Damage to natural vegetation on Praslin appears to have been restricted to treefalls in a number of locations<sup>5</sup> plus a few rock/landslides caused by the rain, notably on the slopes at Pasquiare. Table 1 below documents the 471 treefalls recorded within Praslin National Park.

Table 1: Trees that have fallen down near the paths/road in the Praslin National Park

Tree Species	LOCATION					
	Agati	Aristil	Cascade	Fond Peper	Fond Azore	Midland/ Fond B’Offay
Coco-de-Mer ( <i>Loidocea maldivica</i> )			2	3		3
Other Palms (i.e. not coco-de-mer), mainly <i>Deckenia nobilis</i> )	7	5	10	25	30	
Vacoas (species not specified)			10			
Capucin ( <i>Northia seychellana</i> )						5
Bois-de-natte ( <i>Mimusops sechellarum</i> )						100
Takamaka ( <i>Calophyllum inophyllum</i> )		5				1
Indian almond ( <i>Terminalia catappa</i> )			7			18
Breadfruit * ( <i>Artocarpus altiliis</i> )						3
Santol * ( <i>Sandoricum indicum</i> )		30				40
Candle nut tree * ( <i>Aleurites moluccana</i> )				3		
Albizia * ( <i>Albizia faltacta</i> )	13	5	50	15	8	25
Agati ** ( <i>Adenantha pavonina</i> )	9		40	4		3
<b>Total</b>	<b>29</b>	<b>75</b>	<b>117</b>	<b>47</b>	<b>8</b>	<b>195</b>

Source: adapted from DOE Praslin data. \*indicates introduced species \*\* origin unknown – Robertson 1989)

<sup>5</sup> Fond Ferdinand, Salazie, Pasquiare, Midland, Fond Peper Riviere B’Offay, Vallee de Mai, Cascade



*Photo 4: Damage to biodiversity*



*Photo 5: Damage to housing infrastructure*

Early post-storm estimates by the authorities indicate that 30,000 trees had fallen as a result of the storm and this may have occurred mostly to trees in tourism development areas and to locations close to the main roads, which experienced a wind tunnel effect, rather than to areas of high biodiversity importance. The Vallee-de-Mai World Heritage Site appears to have been almost untouched by the winds, with only 11 of the approximately one thousand mature coco-de-mer palms (*Lodoicea maldivica*) falling.

With comparatively little damage to vegetation and natural habitat, it is unlikely that there will be any significant long-term impacts on other rare and endemic species on Praslin, although monitoring of the breeding success of the Seychelles Black Parrot, which may have been increasing in population numbers since 1982, should be continued.

In Cote D'Or, extensive tree loss, primarily Casuarina (*Casuarina equisetifolia*) and other introduced species, was experienced, and this has had considerable aesthetic impact on this important tourist area. However the planned replanting in a 20 metre buffer zone along either side of the road will be done utilising endemic palms and indigenous flowering tree species.

Extensive tree loss at Salazie was also noted, as was inland soil erosion damage on steep slopes at Pasquiare, which required rehabilitation through the placement of gabions. The cost of the gabion



work totaled over 225,000SR (US\$45,000) due to the need to use a helicopter to ferry materials onto the slope.

In addition to impacts on Praslin Island, three “uninhabited” islands (Cousin, Cousine and Curieuse) were also impacted by the tropical depression and the microburst.

### **3.3 Cousin Island**

Cousin was the most severely impacted of all of the islands. Cousin is a small 27 ha. island which lies approximately 3km west of Praslin. It is a designated Special Reserve and a Nature Reserve under Seychelles law, and is managed by Nature Seychelles, a local NGO. The 27ha. island is owned and managed by Nature Seychelles as a private bird sanctuary and is an important habitat for a range of sea-birds and three rare, endemic land birds – the Seychelles Magpie Robin, Seychelles Warbler and Seychelles Fody (see Box 3). The management costs of the island are covered by the fees paid by an average of 100 tourist visitors per day, totaling more than 10,000 visitors a year.



*Photo 6: Post storm tree falls on tourist path*



*Photo 7: Cousin treefall*



*Photo 8: Magpie Robin*



*Photo 9: Tropicbird nesting in fallen tree*

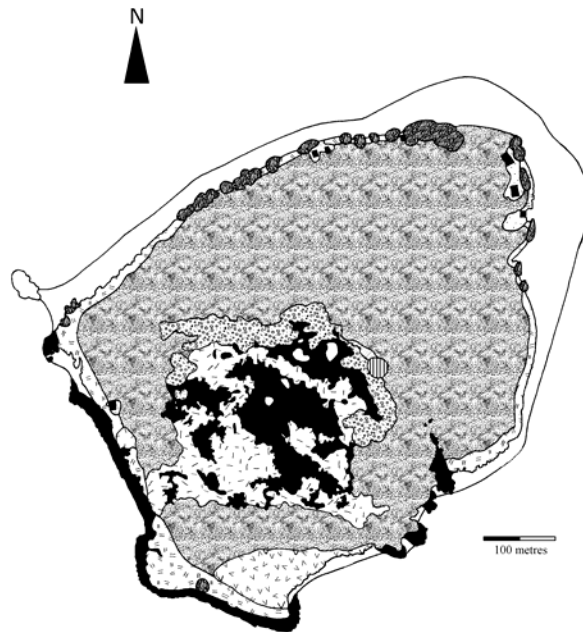
The microburst appears to have passed almost directly over the island, destroying the house of the Reserve manager and doing severe damage to an estimated 50-70% of the island tree cover (see Box 3 below). After a preliminary assessment of the damage, a decision was taken by Nature Seychelles to close the island to visitors for two weeks, but to restrict ecological restoration work to the removal of the approximately 200 trees that were blocking the paths used by the tourists.



### Box 3: Biodiversity Significance of Cousin Island

Cousin is a small 27 ha. island which lies approximately 3km west of Praslin. The island was managed for copra production until 1967, when it was purchased for £16,500 by the International Council for Bird Preservation (now BirdLife International) and subsequently managed as a nature reserve, largely to protect the population of approximately 25 Seychelles Warblers (*Acrocephalus sechellensis*), which was then known only to exist on Cousin Island. The island was designated a Nature Reserve by the Seychelles Government in 1966, and was designated a Special Reserve in 1975, this being the highest functioning level of protection status in Seychelles legislation. The Special Reserve designation includes the sublittoral zone, extending to 400m seaward of the High Water mark.

#### Vegetation Map of Cousin Island



In 1975, the island, especially the plateau, was still dominated by plantation coconut palms. The hill area, largely unsuited for cultivation, was less extensively planted with coconut. Following the island's designation as a Nature Reserve, early attempts to replant native vegetation were deemed largely unsuccessful and a process of natural succession occurred. Initially, coconuts fruits were collected and sold to prevent the island being overtaken by coconut scrub. More recently, coconuts were controlled by cutting and uprooting of coconut scrub, since there is no longer a viable market for nuts. 5 or 6 years ago a major felling of mature coconut trees was undertaken to lessen the re-current load of coconut scrub control.

Since 1967, island habitat management has allowed the regeneration of semi-natural vegetation dominated by mapou, *Pisonia grandis*. *Pisonia* is a relatively fast-growing, short-lived tree with fragile wood, but it can form climax vegetation through its ability to layer, and regenerate quickly from fallen stems, for example, in 1982 after a strong gale which affected the entire island.

A total of 94 plant species were recorded on Cousin Island in a 1999 survey, including 3 ferns and 91 angiosperms. Of these angiosperms, 42 (46.1%) species are regarded as introduced and 29 (31.9%) native. Only one of these native species (vakwa bord d mer, *Pandanus balfourii*) is endemic to the Seychelles, although the list also contains an endemic subspecies (lafous pti fey, *Ficus reflexa sechellensis*).

**(continued over)**

### Box 3: Biodiversity Significance of Cousin Island (continued)

Tree species with very high prominence values in the plateau are (in decreasing order) *Pisonia grandis*, *Ochrosia oppositifolia*, *Morinda citrifolia*, *Ficus lutea*, *Carica papaya*, *Cocos nucifera* and *Ficus reflexa*. Tree species with very high prominence values in the hill land are *Euphorbia pyrifolia*, *Ficus lutea*, *Ficus reflexa* and *Pisonia grandis*. Most species found alongside *Pisonia* on the plateau (*Ochrosia*, *Morinda a*, and *Carica*) are small trees: the only large tree species found are the introduced species *Adenanthera pavonina* and *Gliricidia sepium*. The native woodland is still in succession and although the overall species composition is unlikely to change, proportions will continue to change with time. The plateau-woodland will most likely develop to a *Pisonia-Ochrosia-Morinda* forest, whilst *Euphorbia* and *Ficus* will remain more important on the hill. A total of 54 bird species have been recorded from Cousin Island, 15 of which breed regularly on the island. Of the breeding birds, 13 are native, including 7 seabirds and 6 land birds. Five of these birds species are endemics, three of which are endangered or vulnerable species in Seychelles.

When the island was bought by ICBP in 1968, the endemic Seychelles Warbler *Acrocephalus sechellensis* population of about 30 individuals was the last one in the world. Thanks to the new management of the island which allowed a secondary native woodland to re-develop, Seychelles Warbler numbers increased to nearly 300 birds by 1982. Due to the apparent stability of the population at around 350, 29 individuals were successfully translocated in 1989 to Aride, and another 29 to Cousine in 1990. The number of warblers on Cousin is still around 350, which appears to be the current carrying capacity. Warblers are not limited to a particular vegetation type, but they reproduce better in vegetation providing many insects. Seychelles Warblers are almost completely insectivorous, usually taking their prey off the undersides of leaves. The preferred feeding height of the warblers is from ground level up to about 4 metres. On Cousin, the best warbler habitat appears to be the centre of the island, where there is less salt spray and less effect by the wind, which blows insects away, and in areas where there are many *Morinda citrifolia*, which has been found to possess the largest invertebrate population of all the native trees on the island.

The Seychelles Magpie Robin *Copsychus sechellarum* was translocated to Cousin in 1994, and the Cousin population is now the second largest of four island populations. At the end of December 2002, the total Seychelles Magpie Robin population stood at 118 birds (Fregate 57; Cousin 30; Cousine 21; Aride 10). Native forest with an open floor and abundant leaf-litter is important to the Magpie Robin, which preferably feeds on invertebrates found in open leaf-litter or bare earth habitats beneath woodland. If the shrub-layer becomes too dense it adversely affects foraging for food finding in this species – this may require management intervention to maintain a more open ground layer in some parts of the plateau.

The Seychelles fody (*Foudia sechellarum*) is currently restricted to three islands (Cousin, Cousine and Fregate), with an additional introduced population surviving on D'Arros. Fregate probably holds the major population of this species – almost 1,000 birds. The Seychelles Fody feeds extensively on seeds of *Casuarina equisetifolia* and the fruits of *Carica papaya* and also uses *Phyllanthus casticum* for its berries, its insect life and its leaves.

Cousin is also an important breeding location for 7 seabird species as shown in the Table below.

**Numbers of nesting seabirds on Cousin Island**

Seabird species	No. of pairs/year	95% confidence limits (+/-)
Lesser Noddy ( <i>Anous tenuirostris</i> )	80,962	9,069
Brown (Common) Noddy ( <i>Anous stolidus</i> )	1,317	566
White (Fairy) Tern ( <i>Gygis alba</i> )*	3,606	710
White Tailed Tropic Bird ( <i>Phaeton lepturus</i> )*	1,466	553
Bridled Tern ( <i>Sterna anaethetus</i> )**	610	306
Wedge Tailed Shearwater	14,497	4,322
Audubon's Shearwater ( <i>Puffinus lherminieri</i> )*	5,177	1,470

\*breed year round (year round breeding population of the White Terns is more than 5,000, more than 3,000, for the Tropicbirds, and more than 10,000 for the Audubon's Shearwater)

\*\* breed every 8-9 months

**Source:** Burger, A. E., Lawrence, A. D. and L. M. Davis. 1999. Census and nest distribution of Bridled Terns on Cousin Island in 1999. Unpublished report to BirdLife Seychelles; and Burger, A. E. and A. D. Lawrence. 2000. Seabird monitoring handbook for Seychelles. BirdLife Seychelles, Seychelles.

The total seabird population numbers around 150,000 pairs, including between 100 to 300 Greater and Lesser Frigate birds which occasionally roost on the island. Cousin island also hosts a globally significant nesting population of the hawksbill turtle (*Eretmochelys imbricata*).

Much of the biodiversity importance of Cousin island is due to the fact that the island has always been rat and cat free, unlike most of the other Seychelles granitic islands. Since 1968, Cousin has become one of the few islands where natural vegetation has expanded at the expense of exotic plant species and thus provides an important model for conservation management on other islands.

The island's vegetation may be divided into four major habitat types – (i) coastal vegetation along the beach; (ii) the *Pisonia grandis* forest on the plateau; (iii) the drier vegetation on the rocky granite hill dominated by *Euphorbia* and *Ficus*; and (iv) the mangroves in the south of the island. For the most part, the storm hit the *Pisonia grandis* forest on the plateau, north of the hill.

The storm opened large gaps in the canopy with only a few canopy trees left standing. Most of the uprooted or damaged canopy trees were *P. grandis* and some *Ficus reflexa*. The ground layer was covered with fallen tree stems and branches, mainly from *P. grandis* trees. By March 2003, on the open ground, either a dense herb layer has formed, or the soil is covered with creepers. In most gaps a considerable number of tree saplings, mainly *Ochrosia oppositifolia* (bwa Chauve-Souris) and *Morinda citrifolia* (bwa Torti), have survived.

*Pisonia grandis*, the dominant tree cover species, has shown remarkable regeneration capacity and, six months after the storm, has regrown from broken branches and stumps to form an almost complete mid-canopy layer that provides suitable habitat for the endemic bird species.

In addition to the immediate damage to the island vegetation, the main long-term impact of the storm has been to simplify both the structure and species composition of the main forest habitat of the island plateau, reversing a 25-year trend towards a more species diverse canopy structure. A secondary impact has been to provide greater potential for expansion of opportunistic (predominantly alien) invasive herbaceous, vine and shrub plants.

The storm appears to have had remarkably little impact on the endemic bird populations of Cousin Island. No Seychelles Magpie Robins were lost as a direct impact of the storm, and the population has subsequently increased to a maximum of 30 birds by December 2002, in spite of a number of nest boxes being destroyed and needing to be replaced.<sup>6</sup> Concerns that post-storm weed growth could seriously reduce Magpie Robin, foraging areas and food availability have not materialized, although removal of expanding invasive plant species is an ongoing process taking up more staff time than before the storm.

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<sup>6</sup> SMART News (Newsletter of the Seychelles Magpie Robin Recovery Team) No: 2 July– December 2002

Storm impacts on Seychelles Warbler and Fody populations also appear to have been negligible – only one Fody was known to be killed by the storm – and no post-storm population declines have been noted by scientists working on the islands (pers. comm. James Mallet, Birdlife International).



*Photo 10: Seychelles Warbler*

One possible residual ecological impact may be on the newly established and growing Blue Pigeon (*Alectroenas pulcherrima*) population on the island since the storm felled all of the mature *Ficus reflexa seychellensi* (lafous) trees - a major source of food for this species.

With the approach of the storm, the seabird populations mostly moved out to sea. However, a large number of nests were destroyed, especially of Lesser Noddy (*Anous tenuirostris*) reducing the potential breeding success for the year. Seabird populations are, however, characterized by large population changes, usually due to fluctuations in (sea) food availability. These populations should recover quickly through secondary breeding effort, provided that they are not hit by a sequence of similar storms and/or food availability problems.

The immediate cost of the damage to the island, including loss of revenue for two weeks, has been calculated by Nature Seychelles to be SR 250,850, equivalent to US\$50,000 (see breakdown in Table 3). With the rapid recovery of the vegetation, and the apparent lack of long-term impact on the bird populations, original estimates of indirect biodiversity losses due to the storm should perhaps be revised.

Table 2: Cost of damage to Cousin Island caused by the storm of 7<sup>th</sup> September 2002

Damage	Cost (Seychelles Rupees)
Closure of Cousin Island for 2 weeks (lost revenue)	60,000
Administrative cost associated with site visits, advertisement and transportation cost	5,000
Rebuild verandah, part of the house and reinforce infrastructure of Manager's House	70,750
Rebuild completely a pit latrine for visitors	5,000
Replacement cost for 3 BP solar panel	6,300
Replacement cost for 2 trace inverters for solar system	10,050
Cutting/removing 200 trees (e.g. <i>Ficus</i> , <i>Casuarina</i> , <i>Pisonia</i> , bwa Sousouris,) from trail	70,000
Removal of invasive plants from affected areas	15,000
Clearing of tree stumps and other debris from other affected areas	8,750
<b>TOTAL</b>	<b>250,850</b>

### 3.4 Cousine Island

Cousine Island is a small 26 ha. island situated 5km south west of Praslin and 2km from Cousin and is also highly significant for biodiversity conservation because it is rat-free. The island has been managed as a private nature reserve since 1992. The island now hosts a small high-class tourist operation that markets itself (in part) as an ecotourism destination.

Although close to Cousin Island, Cousine was almost entirely undamaged by the microburst winds. The site manger reported that the roof to one villa was slightly damaged and that the major impact was a few fallen (*Casaurina*) trees and the need to clear paths of vegetation debris (pers. comm.: Selwyn Gendron; Manager, Gondwana Limited).

#### **Box 4: Biodiversity Significance of Cousine Island**

Like Cousin, Cousine Island is classified as an IBA, and the island is considered to be a biodiversity conservation “hotspot” for the Seychelles.

Cousine Island has two thickly wooded hills of low, gnarled, mature *Morinda/Pisonia/Euphorbia/Pandanus* in the south-west and prominent *Ficus spp.* elsewhere, whilst the plateau is more dominated by a mixture of broadleaved native species such as *Terminalia.catappa*, *Thespesia populnea*, *Morinda citrifolia*, *Barringtonia.asiatica*, and *Calophyllum.inophyllum* – this reflects the reforestation planting regimes of the island management over the last 10 years, rather than the results of a natural succession. On the island, *Pisonia grandis* now shows a stable status, *Ficus reflexa* has a lot of saplings and might increase in future, whereas *Morinda citrifolia* and *Euphorbia pyrifolia* are not regenerating. The island management is propagating a whole range of native species like *C. inophyllum* (takamaka), *M. citrifolia*, *Ochrosia oppositifolia*, *Terminalia catappa* and *Thespesia populnea*, as well as the Seychelles endemics, *Lodoicea maldivica* and *Pandanus horneii*, (which probably were not part of the native island vegetation).

Buildings, including the new villas for the tourists, concrete paths and a helicopter landing pad, occupy a relatively large area, and there is a garden area where vegetable and fruits are cultivated to provide food for the hotel guests and the workers.

As a result of the planting which has been ongoing since 1994, much of the plateau area is now reforested and has undergone intensive management to remove invasive species and re-afforest with native vegetation. This, coupled with the low impact of the small tourism resort on the rest of the island, has enabled, since 1990, the expansion of the endemic Seychelles Warbler population, and the introduction of the Seychelles Magpie-Robin in 1995.

The number of nesting seabirds on Cousine is around 100,000 and the island is home to the largest population of Wedge-tailed Shearwaters in the granitic Seychelles. The nesting turtle population has also received full protection since 1992 and has shown an important synergistic relationship with the adjacent rookery of Cousin.

### **3.5 Curieuse Island.**

Curieuse Island lies about one mile north east of Praslin Island. The entire island is designated as a Marine National Park, primarily to conserve its coral reefs and turtle nesting grounds.

#### **Box 5: Biodiversity Significance of Curieuse Island**

Curieuse Island is designated a Marine National Park under the National Parks and Nature Conservancy Act, the designation incorporates the entire island and a surrounding marine area. The island has no resident population apart from the ranger staff and offers a wide variety of habitats. Curieuse has been identified as an island with considerable potential for rehabilitation and conservation and was subject of a rat and cat eradication in 2000. Cats were successfully eradicated but rats have re-occurred with some evidence to suggest a successful eradication and subsequent re-introduction.

The island is significant in that it harbours a natural population of coco-de-mer (*Lodoicea maldivica*) trees and has also been the site of a coco-de-mer replanting project with 500 nuts being planted. Curieuse also plays host to a small (4-8 birds) population of the Seychelles Black Parrot (*Coracopsis barklyii*) and is the only island apart from Praslin to harbour this species the Seychelles kestrel (*Falco araea*) is also known to breed on the island

Recent surveys indicate that Curieuse supports a much larger nesting population of hawksbill turtles than previously expected and may well represent the largest remaining rookery in the granitic Seychelles. The island also has an intact mangrove forest on the southern coast which functions as a tourist attraction with a boardwalk enabling access.

Although close to Praslin, Curieuse was only partially affected by the storm. The major impacts were as follows:

- Tree falls - One *Casuarina*, and two Coco de Mer trees fell, along with a few Takamaka – the latter also lost many branches, especially where the trees were wilt-infected. This small number of tree falls did not have any significant reduction in the canopy cover of the island.
- Causeway - This had been damaged significantly by earlier storm damage and the September 2002 storm caused some additional damage. The total cost of all restoration has been estimated by the National Park manager to be close to SR 100,000 (US\$20,000).
- Board walk - This had been closed just before the storm for reconstruction.
- Barbeque Area and Rangers Headquarters - This area was flooded and there were no barbeques for one week after the storm until the area dried. Some soil erosion into the sea also occurred from this area due to blocked drainage channels.
- Beach - No effect on the beach profile was recorded because of the short duration of the storm. No effect on turtles nesting areas observed.

There were no recorded deaths of fauna resulting from the storm. The status of the 4-8 (possibly non-resident) Seychelles Black Parrot being encouraged to use two nest boxes under the control of Praslin Island (Fond B'Offay) local government is not currently known and needs to be investigated.

This description of the impacts of the storm on Seychelles' biodiversity reveals that, with the benefits of hindsight, it can be concluded that the islands "got off lightly". Recommendations for how to cope with future similar events - which will probably occur more frequently in a climate-changed impacted world – are given in sub-section 5.1.

## **4 DISASTER MANAGEMENT**

### **4.1 Introduction**

Although the request from the Government of Seychelles for UNEP's assistance was for assessment of damage to biodiversity by the September 2002 tropical storm, this needs to be placed in the broader picture of the overall disaster management system for the Seychelles and how this system might be improved to better cope with similar environmental events which could occur in the future.

Discussions with government authorities indicate that there is growing concern in Seychelles that the frequency and severity of disasters are increasing, particularly at a time when global experts (Experts of the Inter-governmental Panel on Climate Change - IPCC 2000) are increasingly linking the current trend of greater severity and occurrence of specific disasters to the rise in global mean temperatures, and associated changes in precipitation and wind velocities. These appear to be influencing the occurrence of storms, drought and landslides in the Indian Ocean. Increased frequency and intensity of storm events that may result from climate change will have profound effects on both the economy and environment of the Seychelles because of its high dependence on tourism, which is particularly vulnerable to natural and environmental disasters. This means that the economic, social and environmental consequences can be long-lasting and that the cost of rehabilitation may also be high as a percentage of gross national product.

During the mission, government authorities highlighted forest fires, floods, landslides, oil and chemical spills as major potential disasters or threats in Seychelles and stressed that these can have severe consequences on the environment (particularly on the endemic and small species populations of fauna and flora) and economy of the country.

### **4.2 Disaster Management Structures/Mechanisms**

Seychelles has a sound overarching policy framework for environmental management as embodied in the 1997 National Biodiversity Strategy and Action Plan and the Environmental Management Plan of Seychelles (EMPS) 2000-2010. The EMPS addresses the environmental management in terms of the sustainable development of the country's biotic and physical environment. It also addresses the effect of an incremental environmental change such as that caused by climate change -- rising sea levels,



change in rainfall patterns, change in sea temperature -- which all have impacts on the environmental resources and the economy as a whole.

The Plan does not however, address in any detailed manner the requirements and modalities for the management of environmental disasters. Nonetheless, there is detailed and effective contingency measures in place for forest fires and coastal flooding as these occur relatively frequently on the three main populated islands -- Mahe, Praslin and La Digue -- and are well understood and largely seasonal or predictable in occurrence. There is also a detailed contingency oil spill plan mainly targeting small local spills in the harbour in Mahe.

Legislation for environmental management and protection in Seychelles is fairly comprehensive. The Environmental Protection Act (EPA) 1994 sets out a sound framework for sustainable environmental development. The Town and Country Planning Act (TCP) 1972 provides a good basis for planing applications to be assessed while the Planning Authority created under its auspices incorporates cross-sectoral membership. The EPA and TCP have distinct and equal standing under the law. As a result any development requires both planning approval and environmental authorization to proceed.

Seychelles has a number of structures/mechanisms for responding to disaster events. These structures are mainly in the form of emergency response plans considered to be reliable and generally have some policy and legislative statements to indicate the level of environmental awareness and protection and to some extent the rehabilitation of any damage that may occur as a result of a disaster event. The individual response plans also have some elements of political commitment, partnership arrangements as well as roles and responsibilities of the authorities but not within an overall comprehensive national emergency plan.

#### **4.2.1 Forest Fire Contingency Plan**

Seychelles experiences an average of 100 bush fires per year mainly during the dry season from April to October. Most of these fires are dealt with in a timely manner and therefore bear little significant consequences. However, some have proved in the past to surpass the national response capacities. For instance, in 1990, the richest area of Praslin island in terms of biodiversity lost two thirds of its coco de mer trees after a fire destroyed 40 hectares of its best forest. The vegetation easily burn due to the leaf litter produced by palm trees which is slow to breakdown and tends to form thick layers of flammable

material (see photo 11). This scenario can be worsened by various invasive species, notably cinnamon whose oil in leaf litter is highly flammable. The species *Chrysobalanus icaco*, planted widely to prevent soil erosion, subsequently proved to be highly invasive and the thick brush of deadwood below its leaf canopy serves to trap other litter that can help spread a fire.

The Forest Fire Contingency Plan was put in place in 1997 as a preparedness and response mechanism in the event of fire. The Plan is guided by two legislative frameworks concerning action against fire but which do not refer to the environment specifically. The Fire Protection Act of 1959 is a general law on the management of urban fires and the Fire Act on lighting of fires which stipulates that at any time and in any area of the Seychelles, the Ministry of Environment can forbid the lighting of fires (which is a licensed activity) to take place. Prior approval from the Ministry of Environment is therefore required before a fire can be lit legally.



*Photo 11: Palm forest understorey – fire risk*



*Photo 12: Fond Ferdinand making fire breaks*

However, there is no clear indication in the response plan of the rights of parties affected by accidental fires and how they can be compensated. This element is important for an effective response to forest fires.

Partnership arrangements exist between the Ministry of Environment which has the overall responsibility and the Police, Tourism, Agriculture, Coast Guards and the Army, Helicopter Seychelles, Public Utilities Corporation, Private Contractors and Non-Governmental Organizations.

The Ministry of Environment conducts training in fire fighting, and fire exercises are held twice a year to measure the response time taken by teams to reach the fire spot and their preparedness to put out the fire. However, a major problem in the execution of the plan is the regular maintenance of the equipment and upgrading of communication equipment. Part of the equipment is currently not properly functioning, primarily due to unavailability of spare parts. Some of the communication equipment is not compatible. The equipment therefore needs to be overhauled and upgraded with the state of the art technology to improve fire preparedness and response. The compatibility of communication equipment is important, particularly when acquiring new ones to ensure better, smooth and effective communication in the event of fire or other disaster events. In addition, the use of GIS meteorological models and remote sensing processed data is also important especially as the islands are scattered and the monitoring of hotspots is not easy.

Discussions with government authorities indicate that during the September 2002 tropical storm, communication between those parts of the islands directly impacted by the microburst and the main administrative centres responsible for response was rapid and occurred through a combination of radio and telephone and mobile phone communications, allowing rapid responses to be initiated by a range of individuals and organisations before regular lines of communication were temporarily lost due to storm damage. However, the need for compatible communication equipment was stressed.

#### **4.2.2 Flooding and Landslides**

There is a Wetlands Unit in the Ministry of Environment with teams on the three main islands of Mahe, Praslin and La Digue. In addition to biodiversity management issues, the Wetlands Unit also maintains wetland outlets and channels assuring adequate drainage. The Wetland Unit works in close liaison with the Meteorological Department in order to receive advance warning of periods of heavy rain so that marsh outlets can be opened to enable free drainage of water into the sea thereby limiting flooding on the coastal plain. In recent times, a number of landslides related to storm events have been experienced on Mahe island. Landslides pose great risk in Seychelles, particularly in Mahe where most of the building infrastructure is perched on or lies immediately below steep slopes. The Wetland Unit is responsible for clearing the debris from the drainage system in the event of a landslide and for alerting people about any pending landslide.

#### **4.2.3 Seychelles Police Major Disasters Plan**

This is a response mechanism provided by the Police in the event of major disasters, including those directly or indirectly impacting on the environment. Similar to the Forest Fire Contingency Plan, the Police Major Disaster Plan is guided by the Police Force Act of 1959 which stipulates the deployment of the police in time of emergency. The primary goal of this Plan is protection of human life and to ensure coordinated and better response during and immediately after a disaster event. In some cases the Police services can be withdrawn once the responsible authorities are mobilized and take full control of the event.

There is however no clear indication of partnership arrangements in the event of a disaster where the Police act as major first responders. Partnership arrangements for specific emergencies therefore need to be incorporated into the plan in order to promote synergy, not only for response action but also to enhance prevention, better preparedness, assessment and mitigation of the disaster events.

#### **4.2.4 Coast Guard (Oil Spills)**

The Coast Guard response plan was put in place in 1998, mainly focussing on protection of harbours and ships docked in the harbours against fire as well as local small oil and chemical spills within 30 to 50 nautical miles. The Coast Guard fully recognizes the potential impacts of accidental marine pollution on the environment and therefore has a limited stock of equipment and materials such as dispersants and booms to deal with oil spills. The Coast Guard works closely with the National Meteorological Services in the use of models to predict movement of oil spills in the event of a maritime related incident. However, limitations exist for the Coast Guard to handle chemical incidents, in particular, fires involving hazardous substances. An oil spill contingency plan is in place and periodic response exercises are undertaken. The response however would only be effective in terms of small localised spills. Weekly drills are also held as preparedness training to ensure a level of certain readiness and improve response in the event of an oil spill.

The main problem faced by the Coast Guard is restocking of equipment/materials, which must be done periodically for upgrading and in tune with new and emerging latest technologies and training of personnel to use such technologies.

Restocking of equipment/materials and capacity building in response to fires involving hazardous substances should be considered. Also, there is a need to extend emergency plans monitoring to fish processing plants where anhydrous ammonia (as a preservative chemical) is used, which can also pose an environmental hazard in case of a spill/leak

#### **4.2.5 The Draft National Disaster Response Plan (National Contingency Plan)**

Following the torrential rains in August 1997 (El Niño phenomenon) and related infra-structural damage experienced, a National Disaster Committee was established and the development of a draft National Disaster Response Plan was initiated but the process was not completed and the Plan was therefore not mandated. The broad aim of the Plan is to define the overall policy of response by outlining “the role and responsibilities of organizations that will be required to take emergency actions to deal with disaster situations that have resulted in deaths and/or damage to property or threatens to do so”.

The objective of the Plan is to:

- Assess the likelihood of further damage
- Save lives
- Prevent escalation of the disaster
- Relieve suffering
- Safeguard the environment
- Protect property
- Facilitate investigation
- Restore the people and area to normality as quickly as possible

To achieve this objective overall aim, the Plan serves as a framework for establishing responsibilities, organization and coordination requirements to respond to specific disaster events and for providing special functional measures and rapid response capability.

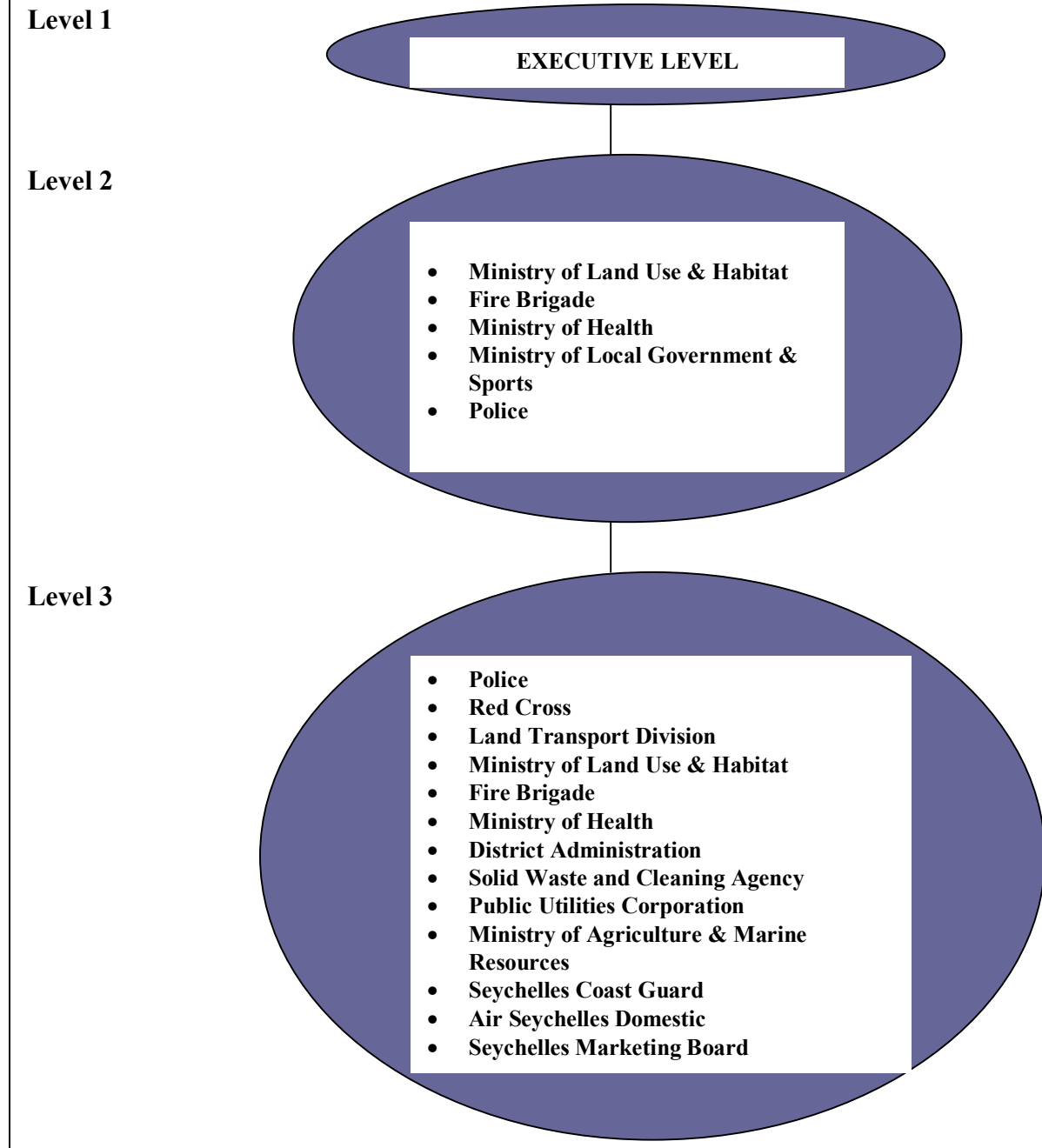
The draft Plan identifies potential disasters that could strike Seychelles, namely: fires (industrial and forest), landslides, aircraft accidents, marine accidents, epidemics, strong winds, floods, tidal waves, serious road traffic accidents, toxic chemicals/hazardous substances and explosions, food poisoning

and oil spills. The draft Plan provides a general command and control structure which can be rapidly put in place in the event of a disaster or a threatening situation. Three levels of actions are considered in the Plan:

- i) **Level 1** consisting of the President, Vice President of the Republic and cabinet ministers;
- ii) **Level 2** consisting of the primary organizations (governmental, private sector, non-governmental and private volunteers) involved in the response depending on the nature of disaster event or situation. Key function at this level is to set up and operate an Emergency Response Centre (ERC) to effectively coordinate rescue and salvage efforts. It also collects, compiles, analyzes information and reports on the emergency to Level 1 and seeks assistance and/or decisions. Also this level mobilizes resources. Although it is not clear what this information should entail, it should be expected to involve general information on the humanitarian and environmental effects of the emergency resource needs and availability, the response activities, the achievements, the constraints and the gaps as well as the national and external unmet needs and potential secondary threats such as the release of hazardous substances from flooded or damaged chemical storage facilities;
- iii) **Level 3** consisting of specific organizations -- depending on the nature of disaster event -- that will operationally respond to protection of human life and minimize damage to property.

Further, the draft Plan provides for the management structures of each of the identified disaster events. For instance, the management structure to respond to floods and landslides disaster events is shown in Box 6 below.

### Box 6: Management Structure for Floods and Landslides



Although the Ministry of Environment is not shown in the diagram above, discussions with authorities in the Ministry indicate that it would play a central role in the management of floods and landslides with support of the Wetland Unit which mitigates against lowland floods, and the MET office which gives out weather warnings and potential occurrence of landslides.

Furthermore, the draft Plan provides a list of the stock-pile of existing equipment that would be provided by the various governmental organizations to serve as a strategic reserve which would be tapped into in the event of a disaster. It is however not clear how the equipment will be restocked and the Plan does not indicate the pool of human resources capacity available and training requirements needed to enhance readiness at all times which are key for effective environmental emergency response.

#### **4.2.6 Gaps in the Disaster Contingency/Response Plans**

The preparation of a draft national disaster plan is in the context the government's recognition of the importance of disasters, their perceived increasing frequency and severity, potential damage to the environment and economy and the need for strengthened response. The Environmental Management Plan of Seychelles (EMPS) 2000 – 2010 provides for all elements of disaster prevention by promoting best practices in environmental management. However, there is no clear strategy for the implementation of actions on all the elements of disaster management, namely: prevention, preparedness, response and mitigation aimed at eliminating or reducing occurrence. The draft plan mainly focuses on response.

In order for Seychelles to fully address the issues relating to disaster management, there is need to link the draft response plan with EMPS and other portfolio responsibilities and its revision must include the development of a comprehensive national disaster management strategy. The strategy will provide the current state of disaster management, establish a framework for the development of national disaster management, explicit and implicit linkages between disaster management and national development initiatives and an action plan covering different phases of implementation. The strategy and the national disaster response plan should be backed up by legislative frameworks which will serve as key guiding principles and which should be placed up front and cross-referenced with any existing relevant legislation to enhance complementarity of portfolios (mandates and responsibilities). These should be developed taking into account any overarching national frameworks that will promote inter-linkages, unique focus and also allow for decentralization of emergency powers and operational contexts.

The draft National Disaster Response Plan and those for Forest Fires, Oil Spills in ports do not seem to recognize fully the unique differences between the three main islands, Mahe, Praslin and La Digue, in terms of the environment, biodiversity, institutional capacity and infrastructure. The unique



peculiarities of each of these islands need to be taken into account to enhance effective preparedness and response to disasters.

Another gap in the current sectoral response mechanisms and in the draft National Disaster Response Plan (National Contingency Plan) is the use of information generated from activities on national land use and zoning systems which provide maps of both high biodiversity importance and fire, landslide, hotspots or risks and building code requirements. National land use and zoning systems are quite important in the prevention of disasters and they need to be fully integrated in a comprehensive disaster management strategy. In addition, integration of vulnerability and risks assessments is useful in the development of effective prevention, preparedness, response and mitigation of disasters and potential threats to the environment.

The National Disaster Fund was established to enhance rapid access to resources for effective response to emergencies. However, availability of the resources from the fund is not clearly indicated in the current sectoral response plans as well as in the draft National Disaster Response Plan. Given the importance of this fund in the event of a disaster or potential threat, it should be integrated in all disaster response and other disaster management actions on which the fund can be utilized, for example, strengthening and maintaining disaster contingency capacity for storms and floods or oil spills.

### **4.3 Environmental Education for Environmental Emergencies Management**

Seychelles has an environmental education policy to promote and support an understanding, valuing, respect and appreciation of the environment. This policy is reflected in all the activities of the Ministry of Education and Youth (MEY). The Ministry therefore strives to enable the people to develop a sense of caring and respect for the environment as a whole and to promote understanding and knowledge, skills, values and commitment needed to participate in the conservation and sustainable management of a healthy environment. The Ministry seeks to infuse this through six broad themes, which are closely inter-related, namely: the sea, freshwater, the atmosphere, land, ecology and humans and the environment. These themes are adapted to all levels of education, including primary and secondary schools, with the curricula and materials tailored to the interests and needs of end-users. The themes also enhance public awareness of the environment and encourage participation in the implementation of effective solutions.

Although each of these themes covers a wide range of areas, neither environmental emergency nor disaster management aspects are included in spite of the important role these can play in the development of the environment and economy of the country. However, the Ministry fully recognizes this fact and the need for integration of some aspects of disaster management into the curricula, particularly those relating to prevention and preparedness.

## 5 RECOMMENDATIONS

### 5.1 Biodiversity Management

This storm event and the following damage assessments raise a number of important issues for the future management of biodiversity in an increasingly changeable world, especially on small islands with globally significant biodiversity constrained to small effective population size and thus perennially vulnerable to extinction or genetic erosion through random events.

Although it is likely that this kind of storm event may become more frequent over the next 50 years, the current relatively low frequency and the spatio-temporal unpredictability of the actual events presents a classic problem in how best to allocate scarce resources (human, institutional and financial) between mitigation, adaptation and restoration activities.

Biodiversity planning and management in the Seychelles is well-developed, as seen in the 1997 National Biodiversity Strategy and Action Plan (NBSAP), and its update within the Environmental Management Plan of the Seychelles (EMPS) 2000-2010. If the recommendations and activities contained in these reports were to be fully implemented, it would go a considerable way towards reducing the scale of likely impacts of future storm events on globally significant biodiversity in the islands. In particular, it would lead to, for example:

- enhanced control of invasive plant species in particular large canopy forming exotic trees, reducing the risk of secondary damage from treefalls;
- increased capacity to produce native seedlings for re-planting and to underplant exotic-canopied woodland to promote an eventual native succession;
- promotion of the linkages between storm damage and the occurrence/prevalence of Alien Invasive Species (AIS) which need to be highlighted to decision makers, AIS management plans should emphasis the benefits they bring in terms of promoting long-term ecological resilience.

It is clear that, wherever globally significant plant and animal species remain restricted to just one or a few locations/sites, then they will be potentially vulnerable to stochastic events like the September 2002 storm. A key principle for increasing the resilience of the Seychelles' globally significant

biodiversity is to continue the existing policy of establishing, as rapidly as possible, a minimum of five viable ( $N > 100$ ), spatially-separate populations of these species, as is being successfully achieved with the existing conservation programme for the Seychelles Warbler, for example.

This strategy of cultivation of ecological resilience will require the replication/recreation of suitable habitat in a number of different locations, including the removal of predators, etc., as is being successfully achieved for the Seychelles Warbler and Magpie Robin<sup>7</sup>. This kind of conservation management strategy has already produced a “skill base” on the islands that could also prove useful for emergency response to a natural disaster by allowing the capture, *ex situ* care and translocation of impacted species following a disaster event.

A judicious blend of targeted species level interventions, such as those ongoing for the endemic Seychelles bird species, coupled with an overall approach to biodiversity management which adheres to the “ecosystem approach” endorsed by the Convention on Biological Diversity, where steady investment in ecological research is used, guide adaptive management on the ground.

One example of this may be seen in the 1997 Seychelles National Biodiversity Strategy and Action Plan (NBSAP) recommendation that Fond Ferdinand, Praslin National Park (NP) and the Vallée de Mai should be seen as complements for conservation planning. Although at the time, this argument was made mainly to mitigate against the possible loss of one area through fire, it applies equally well to promoting resilience against potential storm damage.

Resilience management would also require the following interventions:

- removal of large alien trees from roadsides would decrease the wind-tunnel effect with a concomitant decrease in the likelihood of uprooting and damage to physical infrastructure which runs along the roads; these roadside trees are also the most liable to fall, causing extensive damage to adjacent vegetation;
- a shift to more mixed species in plantations and a more irregular planting pattern to help prevent wind-tunneling effect;

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<sup>7</sup> Captive Management Handbook for a Critically Endangered Species: the Seychelles Magpie-Robin. Nature Seychelles, Victoria.

- reassessment of planning requirements for urban developments in close proximity to native trees (Note: if trees need to be felled, a system should be put in place to enable the re-planting of smaller native trees such as *Cordia subcordata*, *Thespesia populnea* etc.);
- incremental burying of electric and telephone cables to avoid utilities and services damage from falling trees; and,
- reassessment of building standards and design to incorporate resistance to high winds.

The planning required to put in place the above recommendations is already a part of management thinking within the Ministry of Environment (MoE) and other “biodiversity” agencies, and could be further strengthened using existing funding windows, such as those available under the GEF Biodiversity Enabling Activities<sup>8</sup>. Use of this funding window to more carefully assess the capacity needs to increase biodiversity resilience in the Seychelles would be an important “next step” to reducing the ecological risk from future events of this kind.

## 5.2 Disaster Management

In light of recurrent disaster events and their environmental and economic impacts there is need for a comprehensive disaster management strategy that will provide the current state of disaster management, establish a framework for the development of national disaster management, explicit and implicit linkages between disaster management and national development initiatives and an action plan covering different phases of implementation. This should cover the overall disaster management cycle, that is, prevention, preparedness, response and mitigation. The draft National Disaster Response Plan therefore needs to be revised and the process of its elaboration and finalization reinitiated because it will fit into the strategy as an element of the disaster management cycle in Seychelles. The revised plan should be geared towards a process and structure for systematic, coordinated and effective delivery of preparedness and response services to address the consequences of any major disaster event or threat.

In preparing the strategy the issue of integrating information generated from activities on national land use and zoning systems which provide maps of both high biodiversity importance and fire, landslide,

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<sup>8</sup> For more information on this GEF funding window, contact Mr Selby Remie in MoE, or David Duthie (UNEP/DGEF) via <david.duthie@unep.org>

hotspots or risks and building code requirements should be considered and incorporated in the comprehensive disaster management strategy.

Development of specific policy and legislative frameworks for disaster management should be considered and cross-referenced with existing relevant ones to enhance complementarity of mandates and responsibilities. The specific policy and legislative frameworks should be placed up front in developing the comprehensive disaster management strategy and revising the National Disaster Response Plan (National Contingency Plan). The plan should include the already existing sectoral disaster response plans and should be linked with the disaster management elements in the EMPS and other current portfolio responsibilities.

The National Disaster Response Plan should have specific local scale disaster contingency plans for each of the three main islands (Mahe, Praslin and La Digue) to conform with their unique environmental, institutional and capacity peculiarities. The localized plans should have disaster scenario's specific to each island and with pre-positioned basic disaster response equipment (for example, chain saws, machetes, earth moving tools, protective clothing, water pumps, diving equipment, etc) and maintained to meet the minimum emergency requirements set by the disaster scenarios.

The issue of regular maintenance, upgrading and restocking of equipment needed for effective response to disaster events and at the same time enhance preparedness should therefore be given due attention.

The current sectoral disaster contingency/response plans need to be reviewed to incorporate clearly defined partnership arrangements with potential stakeholders that can play key roles in preparedness and response to disaster events and in leveraging resources.

Once finalized, the revised Plan should be endorsed by the Cabinet of Ministers. Every effort should be made to ensure that the plan is a lawful government instrument which will reflect the duties of each envisaged component of the Plan and their mutual relations.

The link between local and thematic plans such as those for forest fires, oil spills, coastal flooding with the national disaster plan is an important element for a complete preparedness system especially from an operational point of view. It is important that the national disaster plan is not viewed as the sum of local/sectoral plans but provides for a concerted response when the emergency cannot be dealt with one sector alone.

Although the Ministry of Environment personnel receive training in fire fighting this needs to be extended to the other agencies within the partnership arrangements. Also, training on the use of new tools and latest technologies, for example, use of GIS to map areas of high fire risk should be considered. Awareness raising and capacity building of the local populations should be considered to create understanding and promote enforcement and compliance of the rules and regulations on fire prevention and preparedness, particularly during the dry season. The establishment and maintenance of a database on fire and other hazards should also be considered.

Establish standing national disaster body with localized sub-bodies for the three main islands, which are clearly incorporated into the hierarchy of disaster response governance. Differentiation between technical and "political" roles in disaster management should be clearly defined and clarified. Review of legal powers should be considered with a view to giving certain emergency response powers, for example, power to commandeer vehicles and equipment or to remove/damage private property as necessary if it is impeding an emergency response to key field staff in order to facilitate their disaster response.

Strengthening of the National Disaster Fund as a major financing mechanism for disaster management should be considered to promote effective prevention, preparedness and response to disaster events and potential threats. The Fund should be sustained through fines of those liable by law for environmental damage or taxes from the tourism industry.

Human resource capacity in each of the three main islands and secondary training needs should be assessed consonant with the implementation requirements of the comprehensive disaster management strategy and the National Disaster Response Plan (National Contingency Plan) and funding requirements for capacity building to support the strategy and plan.

Although environmental education is given great attention, the issue of incorporating environmental emergency or disaster management aspects into the curricula should be considered as key in promoting understanding and values for disaster risk reduction and overall prevention, preparedness for and response to disaster events and potential threats.



## ANNEX 1

### Provisional Programme

#### Monday, 24 March 2003

- 10:00 hrs Meeting with the Ministry of Foreign Affairs  
Mrs. Jeannette d'Offay, Technical Adviser  
Mrs. Lalatiana Accouche, Second Secretary
- 11:30 hrs Meeting with officials of the Ministry of Environment  
Mr. Maurice Loustau-Lalanne, Principal Secretary  
Mr. Michel Vielle, Director, Forestry  
Mr. Rolph A. Payet, Director, Policy Planning and Services Division (PPS)  
Mr. Jude Florentine, Director, EAPC  
Mr. Didier Dogley, Director, Botanical Gardens  
Mr. Basil Esther, Project Officer  
Ms. Elvina Henriette, Senior Project Officer, Conservation Section
- 15:00 hrs Meeting with officials Responsible for Disaster Management, State House  
Mrs. Françoise Shroff, Principal Secretary, President's Office and Chairperson  
National Disaster Committee  
Mr. Tite M.B. Morin, Assistant Commissioner of Police  
Mr. Pat Nanty, Principal Secretary, Ministry of Local Government & Sports  
Mr. Alone Edmond, Coordinator, National Disaster Response Plan

#### Tuesday, 25 March 2003

- 09:00 hrs Meeting with Director, Cousine Island Co. Ltd.  
Dr. Selwyn Gendron
- 10:30 hrs Meeting with the Seychelles Island Foundation  
Mr. Lindsay Chong-Sen, Executive Director  
Mr. Ronny Renaud, Executive Officer
- 12:30 hrs Travel to Praslin Island
- 15:00 hrs Meeting with Praslin Restoration Committee - Praslin Development Fund at Baie  
St. Anne, Praslin  
Mr. Michael Gardet, Chairman, Praslin Development Fund  
Mr. Michel Vielle, Director, Forestry, MoE  
Mr. Joseph François, Focal Point, Ministry of Environment  
Mr. Aterville Cedras, Manager, Vallee de Mai  
Mr. Brian Orr, Rotary Club  
Mr. Michel Adam, Landscape Management  
Mr. Mervin Joubert, District Administrator  
Mr. Julien Suzette, Land Transport Division  
Mr. Patrick Brioche, Forester  
Ms. Shirley Joubert, Forest Ranger  
Mr. Mason Valentin, Forest Ranger  
Mr. Marcel Dufresne, Forest Ranger  
Ms. Pamla Payet, Forest Ranger/Supervisor  
Mr. Jose Triant, Takamaka Supervisor

### **Wednesday, 26 March 2003**

- 09:00 hrs Meeting with Praslin Airport Manager  
Mr. Darell Pouponneau
- 10:00 hrs Site visit to Cousin  
Meeting with Mr. James Mallet, Warden, Cousin Nature Reserve
- 14:00 hrs Site visit to Curieuse  
Meeting with Mr. Kevin Hoareau, Warden, Marine Parks Authority

### **Thursday, 27 March 2003**

- 08:30 hrs Meeting with the Public Utilities Corporation (Water and Sewerage Division)  
Mr. S.H. Rousseau, Managing Director  
Mr. Srilal Wijegonewardene, Chief Engineer
- 10:00 hrs Meeting with the Electricity Corporation  
S. Banerjee, Manager  
A. K. Singh, Chief Engineer  
S. Vishwavarma, Division Engineer
- 11:00 hrs Meeting with the Environmental Health Division of the Ministry of Health  
Mr. Antoine P. R. Poiret, Director, Environmental Health Division
- 12:00 hrs Meeting with the Coordinator for Environmental Education in the Ministry of  
Education and Youth (MEY)  
Ms. Jeanette Larue, Coordinator, Environmental Education
- 15:00 hrs Meeting with the Ministry of Tourism and Transport  
Mr. Terry Jones, Director General, International Cooperation

### **Friday, 28 March 2003**

- 09:00 hrs Meeting with the Ministry of Planning  
Mr. Terry Biscornet, Director General, Land Use Planning
- 10:30 hrs Meeting with the Coast Guard  
Major Michael Rosette, Adjutant, Coast Guard  
Lieutenant Colonel Donald Gertrude  
Captain Jeffrey J. Benoiton, Port and Marine Services
- 12:00 hrs Lunch Meeting with the National Meteorological Services and Policy, Planning  
Division of the Ministry of Environment  
Mr. Rolph A. Payet, Director, Policy Planning and Services Division (PPS)  
Mr. Wills Agricole, National Meteorological Services
- 14:00 hrs Meeting with the Coordinator of the Environment Trust Fund (ETF)  
Mr. Bernard Ciseaux
- 16:00 hrs Wrap up meeting with the Ministry of Foreign Affairs (MFA) and the Ministry of  
Environment (MoE)  
Mr. Maurice Loustau-Lalanne, Principal Secretary, MoE  
Mr. Michel Vielle, Director, Forestry, MoE  
Mrs. Jeannette d'Offay, Technical Adviser, MFA  
Mr. Didier Dogley, Director, Botanical Gardens  
Mr. Selby Remie, Director, Conservation Section

Mr. Basil Esther, Project Officer  
Mr. Rolph Payet, Director General, PPS

**Saturday, 29 March 2003**

09:00 hrs Meeting with some members of the National Disaster Committee  
Mr. Alone Edmond, Coordinator, National Disaster Response Plan  
Mr. Tite M.B. Morin, Assistant Commissioner of Police

