

## World Heritage Sites

Protected  
Areas and  
World  
Heritage



## PITONS, CIRQUES AND REMPARTS OF RÉUNION ISLAND FRANCE

*Réunion Island in the southwest Indian Ocean is a mountainous subtropical island of great beauty, composed of two shield volcanoes, one dormant and the other one of the world's most active volcanoes. The island has been isolated so long and so far from other land that the rich vegetation of its rugged and varied topography, graded both altitudinally and from rainforest to savanna, is more than a third endemic.*

### COUNTRY

France

### NAME

Pitons, cirques and remparts of Réunion Island

### NATURAL WORLD HERITAGE SERIAL SITE

2010: Inscribed on the World Heritage List under Natural Criteria vii and x.

### STATEMENT OF OUTSTANDING UNIVERSAL VALUE

The UNESCO World Heritage Committee adopted the following Statement of Outstanding Universal Value at the time of inscription:

#### Brief Synthesis

The area of Pitons, cirques and remparts of Reunion Island coincides with the core zone of La Réunion National Park. The property covers more than 100,000 ha or 40 % of La Réunion, an island comprised of two adjoining volcanic massifs located in the south-west of the Indian Ocean. Dominated by two towering volcanic peaks, massive walls and three cliff-rimmed cirques, the property includes a great variety of rugged terrain and impressive escarpments, forested gorges and basins creating a visually striking landscape. The property harbours the most valuable natural habitats and the species assemblages they support remaining on the Mascarene Island group. It protects key parts of a recognized global centre of plant diversity and features a remarkably high level of endemism across many taxa. Thereby, Pitons, cirques and remparts of Reunion Island is the most significant and important contribution to the conservation of the terrestrial biodiversity of the Mascarene Islands.

**Criterion (vii):** The combination of volcanism, tectonic landslide events, heavy rainfall and stream erosion have formed a rugged and dramatic landscape of striking beauty, dominated by two towering volcanoes, the dormant Piton de Neiges and the highly active Piton de la Fournaise. Other major landscape features include "Remparts" - steep rock walls of varying geological age and character, and so-called "cirques", which can be described as massive natural amphitheatres with an imposing height and verticality. There are deep, partly forested gorges and escarpments, with subtropical rainforests, cloud forests and heaths creating a remarkable and visually appealing mosaic of ecosystems and landscape features

**Criterion (x):** The property is a global centre of plant diversity with a high degree of endemism. It contains the most significant remaining natural habitats for the conservation of the terrestrial biodiversity of the Mascarene Islands, including a range of rare forest types. Given the major and partly irreversible human impacts on the environment in the Mascarene archipelago, the property serves as the last refuge for the survival of a large number of endemic, threatened and endangered species.

#### Integrity

Building upon earlier forest and nature conservation efforts, La Réunion National Park was established in 2007. This status provides an adequate legal framework to ensure the protection of the property, whose boundaries coincide with that of the national park. The boundaries of the property encompass the exceptional features of the natural landscape, as well as almost the entire remaining natural or close-to natural ecosystems remaining on La Réunion and thus the key biodiversity values.

The integrity of the property is subject to a range of threats. Despite ongoing management efforts, invasive alien species are a permanent management challenge posing a very real threat to the biodiversity values of the property.

Evidence of past losses of many native species on La Réunion and on other islands of the Mascarene archipelago underlines the severity of this threat.

### **Protection and Management Requirements**

The property benefits from effective legal protection through its designation as a National Park. Ensuring the Outstanding Universal Value of the property requires an effective and adaptive implementation of the evolving management plan for La Réunion National Park, and adequate long-term staffing and financial resources. The management of the national park draws on comprehensive consultation with governmental and civil society stakeholders and benefits from structured on science, research, socio-economics and cultural issues. Meaningful and effective consultation with all of the concerned stakeholders, including communities who live within its buffer zones and surrounding areas, is indispensable.

Actions are required in response to a number of specific threats, to ensure the maintenance and enhancement of the Outstanding Universal Value. Efforts to reduce invasions, permanent monitoring, and the implementation of a comprehensive strategy to control and eradicate invasive alien species are indispensable and will require long-term and continuing efforts and significant ongoing funding. While the rugged terrain provides a degree of natural protection against encroachment and human economic activities, such as agriculture, forestry, energy production and tourism; must be managed both in the property and its buffer zone in a way that is not in conflict with the integrity of the property.

The development and effective implementation of a comprehensive tourism development strategy addressing the strong demand is also necessary. There is fine balance between positive economic and educational effects and destructive impacts from excessive numbers of tourists and inappropriate activities, and thus tourism strategies will clearly need to prioritise the protection of the values of the property, alongside economic goals.

### **IUCN MANAGEMENT CATEGORY**

Unassigned. The National Park includes areas individually categorised as follows:

Cilaos Integral State Biological Reserve:	Ia Strict Nature Reserve
Bras Bemale-Bras des Merles State Biological Reserve:	Ib Wilderness Area
Several sites classified:	IV Habitat/Species Management Area

### **BIOGEOGRAPHICAL PROVINCE**

Mascarene Islands (3.25.13)

### **GEOGRAPHICAL LOCATION**

Réunion is one of the Mascarene Island groups in the southwestern Indian Ocean, 750 km east of Madagascar and 200 km southwest of Mauritius. The centrepiece of the site is 21°05'58"S by 55°28'48"E.

### **DATES AND HISTORY OF ESTABLISHMENT**

1872: A Forest Service and protective forest regulations introduced;  
1971: The *Société Réunionnaise pour la Protection de la Nature* created;  
1992: The *Direction de l'Environnement* established;  
1995: The *Schéma d'Aménagement Régional* established by the Regional Council;  
1981-2002: Constituent protected areas created;  
2007: The *Parc Nationale de La Réunion* created.

### **LAND TENURE**

State: Réunion is an overseas *department* of metropolitan France. Both the World Heritage site and its buffer zone are entirely within Réunion National Park. 87.87% of the property is state domain, 1.88% is regional or departmental land, 1.71% is private domain, 1.03% is military land and 9.39% is in various other forms of ownership. It is managed by the *Direction Régionale de l'Environnement* (DIREN).

### **AREA**

The property covers 105,838 ha with a buffer zone of 11,729 ha which encircles the property and includes settled areas within the cirques of Salazie and Cilaos. The total area covers 40 % of the island.

### **ALTITUDE**

Sea level to 3,071m (Piton des Neiges), 2,632m (Piton de la Fournaise).

## PHYSICAL FEATURES

Réunion measures 63 by 45 km, and at 251,200 ha is a quarter of the area of Hawaii Island which it resembles in being one of an isolated oceanic island group which is also an active and double volcano formed over a hot spot in the earth's crust. It is composed largely of two forested and dissected shield volcanic massifs: the rugged much weathered dormant Piton des Neiges covering two-thirds of the island in the north and the very active Piton de la Fournaise in the southeast. The World Heritage site covers both volcanoes and a link between the two mountains, excluding a settled plain, the Plaine des Palmistes. The northern peak and neighbouring Gros Morne (3,019m) are at the intersection of the scarp-rimmed cirques or calderas of Salazie, Mafate, Cilaos and the infilled palaeocirque of Bébou, respectively southwest, northwest, northeast and east of the summit. In the south, the summit crater of La Fournaise is encircled by the barren 8 km scarp-edged caldera of l'Enclos Fouqué, and extends - and often flows - to the sea to the east over a forested and periodically renewed nine-kilometre apron of lava called the Grand Brulé (great burn), a slope which rises 2,600m in 10 kilometres. From these two rugged summits the island slopes evenly northeast, west and southwest to the sea most of the way round.

The Mascarene Islands are a dispersed young island chain formed by the slow movement northeastward of an under-lying lithospheric plate over a mantle plume, forming a succession of volcanic islands, the oldest island formed 65 mya being furthest north and the southwesternmost island, Réunion being the most recent (3 million years old) and most active. Past lava flows reveal five major volcanic phases on the island occurring 530,000, 450,000, 150,000, 65,000 and 5,000 years ago when the present Piton de la Fournaise was formed. This is a large, flat-domed shield volcano with two craters, Dolomieu, much the larger, and Bory. Its base on the sea floor is 4,000m deep. Although a relatively gentle peak, it is one of the world's most continuously active volcanoes, regularly extruding streams of basaltic lava. It has erupted over 100 times since 1640, the last being from August 2006 to April 2007. There have been 27 effusions in the last ten years, six reaching the sea. Most lava eruptions occur within the caldera, a collapsed earlier dome. The long escarpments both linear and curvilinear known as ramparts rise 1,000m in places, encircling the summits, surrounding each cirque, or paralleling the radiating streams. There are numerous dykes and sills. Around La Fournaise is a circle of high scarps, breached only on the east, which capture the tradewind rains. Other volcanic features of the Park include pit craters, cinder cones, solfataras, lava flows and basaltic sea cliffs.

The cirques or calderas surrounding the Piton de Neiges, dormant some 12,000 years, are covered with a variety of more easily eroded pyroclastic rocks, and their ramparts being older are more weathered. The three cliff-rimmed cirques approximately 10 km wide with floors in places over 1,000m deep which lie symmetrically around the summit peak are neither glacial nor volcanic in origin but are the result of tectonic activity which collapsed an original dome and were then scoured out by torrential erosion, which left their floors jumbled and chaotic. They are separated by walls of rock honed by headwater erosion from both sides. Gorges occur where rivers break through the cirque walls and the high rainfall on steep slopes has carved many ravines, which emphasize the steepness of the cliffs. The two peaks, with their great variety of rugged terrain of differing heights and aspects harbor an intricate range of microclimates and habitats. In addition, the visual impact of the escarpments, forested gorges and basins is highly dramatic. 30% of the land is bare rock, lithosols and very erodable lavas. 55% of the soils have poor productivity; only the alluvial soils of the lowlands, basins and valleys are fertile.

## CLIMATE

The climate is oceanic subtropical, subject to cyclones and intense storms between November and April, which is a hot and rainy season; May to November is dry and cool. The side of the island facing the southeast tradewinds and storms can be very wet: an annual total of 12,000mm falls on the east face of La Fournaise. In 1952 Cilaos recorded 1,869.9mm in 24 hours. But on the western half of the island on the coastal plain in the rain shadow of the mountains, precipitation falls from 2,000mm to less than 1,000mm. The varied topography of the mountains creates many microclimates. The coasts are tropical with average annual temperatures between 18° and 31°C. The climate of the mountain sides between 300m and 1,800m is subtropical and of the summits, above a frequent sea of clouds, temperate, averaging 12°C with a minimum of -5°C. The east coast is very humid and fogs often form at high level.

## VEGETATION

Réunion is a global Centre of Plant Diversity, where a third of the vegetation is still primary forest. This has persisted because of the lack of human settlement before 1650, the volcanic hazards, the lack of water and cultivable land and the precipitous terrain. Its variety is due to its topographic complexity, to heavy rainfall to windward but dry conditions in the lee of the mountains, to the abrupt altitudinal gradient within 20km from tropical sea level to subalpine heath over 2,000m, and to the island's oceanic isolation

which has resulted in speciation and a 50% level of endemism. Nevertheless, a great number of species, especially in the lowlands have been lost to human settlement.

There are 19 main ecosystems with 110 types of vegetation, six of which are dominant, graded altitudinally but growing 200-400m lower on the wet eastern side than in the dry east. Overall, lowland forests cover 8.2%, mid-level forests 15.6%, high level forests 43.1%, half of both being tropical rainforest, and the highland vegetation 16.3%, predominantly ericoid. There are 1,712 species of vascular plants, and of the 840 indigenous species, 389 (46.3%) are endemic, 236 being locally and 153 regionally endemic, in 8 genera endemic to Réunion, and 5 more endemic to the Mascarenes. 599 (71.3%) are spermatophytes, 241 (28.7%) pteridophytes. There are also 754 species of bryophyte, 86 being endemic, comprised of 449 mosses and 302 liverworts. There is also one endemic monospecific family the Psiloxylaceae with *Psiloxylum mauritianum*. The density of forest endemics is 41 tree species per hectare, three times that of Hawaii and five times that of the Galapagos. Natural propagation has been mainly by wind and birds from Madagascar and Africa. More recent introductions have come via storms and ocean currents from Australia and the Pacific. Alien species number almost as many as indigenous and have taken hold in many of the cultivated areas and fields. In addition, between 1960 and 1985 much native forest was altered or destroyed by forestry management, which is now confined to secondary woodlands and *Cryptomeria* plantations (Fishpool & Evans, 2000). The nomination lists 124 species as Critically Endangered (CR), among them are *Acanthophoenix rubra*, *Badula crassa*, *Ficus lateriflora*, *Hibiscus fragilis*, *Olx psittacorum*, *Polyscias aemiliguineae*, *Poupartia borbonica*, *Weinmannia tinctoria* and *Zanthoxylum heterophyllum*. It lists 61 species as Endangered (EN), among these are *Hernandia mascarenensis*, *Hyophorbe indica*, *Latania lontaroides*, *Ochrosia borbonica* and *Tabernaemontana persicariifolia* are listed, and 73 species as Vulnerable (VU).

The semi-dry zone including palm savannas on the west coast, very little of which occurs in the site, retains rare vestiges of its pre-settlement condition. The dry ravines are important as floristic refuges of some of the last semi-dry species from the more accessible terrain around them. The semi-dry cirque floor vegetation is transitional between the semi-dry, the medium altitude and montane forests and though very fragmented it still contains many rare and threatened plants. The low and medium altitude wet forests between 400-900m in the east and 600-1100m in the west possess many rare species, often dominated by the Sapotaceae and *Labordonnaisia callophyloides*. The lowland forest is the type most endangered and encroached on for agriculture. The dense montane forest between 400m/600m on windward slopes and 600m/800m on leeward slopes, up to 1,800-1,900m is the best preserved ecosystem on Réunion. It is cool and humid and higher up becomes a cloud forest with some 30 tree species, dominated by the Sterculiaceae and liberally draped with mosses, ferns, epiphytic orchids, with the conspicuous red marron *Astelia hemichrysa* and Canne marron *Cordyline mauritiana*. Other noticeable epiphytes are the birdsnest fern *Asplenium nidus* and ribbon fern *Ophioglossum pendulum*. Higher up it becomes a mosaic with pandanus scrub which grows densely on the wettest mountain slopes of La Fournaise as a brush of *Pandanus montanus* and tree ferns *Cyathea glauca*. Three species of both genera are endemic to Réunion. In the humid often cloudbound belt between 1,500 and 1,900m is an elfin forest dominated by the endemic upland *tamarin des hauts*, *Acacia heterophylla*, interspersed with *calomet*, an endemic bamboo, *Nastus borbonicus* and *Erica montana*. The inaccessible rampart crests and cliffs preserve many of Réunion's rare endemics, ferns and lycopods. Above the cloud belt, between 1,800-2,000m, is a temperate treeless zone of high meadows, ericoid heath and rock with some 60 species of which 55 species and three genera are endemic: *Eriotrix* (Asteraceae), *Faujasia* (Asteraceae) and *Heterochaenia* (Campanulaceae). These plants are either prostrate, low scrub, high scrub or thickets, dominated by *Ericaceae*, *Asteraceae*, *Poaceae* and *Cyperaceae*, with species of *Erica*, *Helichrysum*, *Stoebe*, *Carpha*, *Festuca*, *Poa*, *Panicum* and *Helictotrichon*.

## FAUNA

Despite its location the fauna is not particularly African. Typically for a remote island, the vertebrate fauna is poor having less than 50 indigenous species. At least 50% of the pre-existing animals are known to have become extinct since human settlement began in 1650, including a giant tortoise. However, the birds escaped further degradation of their habitat since monkeys and mongooses were never introduced. There are today 78 species of birds, 10 mammals and 6 reptiles (plus 4 marine species). Of the wild mammals, only two are indigenous: the lesser yellow bat *Scotophilus borbonicus* and Mauritian tomb-bat *Taphozous mauritanus*. The greater Mascarene flying fox *Pteropus niger* (EN) comes from Mauritius. One of the two other bat species is the Mauritian flying-fox *Mormopterus acetabulosus* (VU). Other mammals are the introduced hedgehog-like insectivore common tenrec *Tenrec ecaudatus*, the house shrew *Suncus marinus*, and the brown and black rats *Rattus norvegicus* and *Rattus rattus*.

Out of the 78 birds, 9 are native land birds, 8 native water and sea birds, and 32 are regular migrants; 18 are indigenous, 22 having been exterminated since 1650 mainly by introduced livestock and hunting,

and many are now of restricted range. The island is an Endemic Bird Area. Seven species are endemic to Reunion: Mascarene petrel *Pseudobulweria aterrima* (CR: >30 pairs), Barau's petrel *Pterodroma barau* (EN: 4,000), Réunion harrier *Circus maillardi* (EN: 200 pairs), Réunion cuckoo-shrike *Coracina newtoni* (CR:<30 pairs), Réunion bulbul *Hypsipetes borbonicus*, Réunion stonechat *Saxicola tectes* and Réunion olive white-eye *Zosterops olivaceus*. Three subspecies are endemic to Reunion: Mascarene paradise flycatcher *Terpsiphone bourbonnensis*, Réunion grey white-eye *Zosterops borbonicus* and Audubon's shearwater *Puffinus lherminieri bailloni* (>1,500). Two species are endemic to the Mascarene Islands: Mascarene swiftlet *Collocalia francica* and Mascarine martin *Phedina borbonica*. Other notable birds are Madagascar pond-heron *Ardiola idae* (EN), and white-tailed tropic bird *Phaethon lepturus*. Several of the rare species survive, like many rare plants, on the ravine and rampart cliffs.

Of the 6 reptiles, 3 are endemic: two geckoes, *Phelsuma borbonica* and *P. inexpectata* and snake-eyed skink *Cryptoblepharus ater* rediscovered in 1990 after 130 years. Another is the Madagascar ground boa *Acrantophis dumerili* (VU). There are 5,000 insects of which only 2,000 have been described. Half are Afro-Ethiopian and half Indo-Pacific in origin. 40% of the beetles are endemic as are 25% of the 500 spiders. The 500 species of butterfly include the endemic meadow swallowtail butterfly *Papilio phorbanta* (VU). Of 54 molluscs, 20 are endemic to Réunion, and 24 more to the Mascarenes. There are also 21 freshwater fish, 9 freshwater crustaceans and 20 freshwater molluscs all of which are endemic.

Not more than 10km of the site meets the shore, but the surrounding seas contain hawksbill turtle *Eretmochelys imbricata* (CR), green turtle *Chelonia mydas* (EN), sei whale *Balaenoptera borealis*, dwarf sperm whale *Kogia sima*, Blainville's beaked and Gray's beaked whales, *Mesoplodon densirostris* and *M. grayi*, and, among larger fish, great hammerhead *Sphyrna mokarran* (EN), great white shark *Carcharodon carcharias* (VU), oceanic whitetip shark *Carcharhinus longimanus* (VU), black-spotted stingray *Taeniura meyeri* (VU), big-eye tuna *Thunnus obesus* (VU) and giant grouper *Epinephelus lanceolatus* (VU).

## CONSERVATION VALUE

Réunion is an island of great beauty composed of two shield volcanoes, one dormant and the other one is one of the world's most active. The island has been isolated for so long and so far from other land that the rich vegetation of its rugged and varied topography is more than a third endemic. The Park lies within a Conservation International-designated Conservation Hotspot, a WWF Global 200 Eco-region, a WWF/IUCN Centre of Plant Diversity and a BirdLife-designated Endemic Bird Area.

## CULTURAL HERITAGE

In 1507, Portuguese explorers found the island uninhabited. France claimed it as a colony in 1638, naming it Ile Bourbon, and began to kill off the wildlife. It was renamed La Réunion to commemorate a reunion of revolutionaries in 1792, and the name was finally adopted in 1848. It was a traders' port of call developed first with coffee and from 1807 with sugar plantations for which labor came from Africa, Madagascar, India, Malaya and China, soon relegated to the status of slaves. The Cirque de Cilaos was cultivated for nearly 100 years by escaped slaves known as *marrons* whose leaders' names are commemorated in the landscape of the cirques. The blend of people developed Réunion creole, based on French. Slavery was abolished in 1848 and since 1946 Réunion has been an overseas *department* of metropolitan France.

## LOCAL HUMAN POPULATION

The island is heavily populated with a highland population in 1999 of 140,000, increasing by 1.9% a year. But, except for the cirques, most of the interior has never been colonised and three-quarters of this area is now National Park. This is mainly due to the difficulty of the terrain around the Piton des Neiges and the impossibility of settlement on the Piton de la Fournaise. In 2005, the property had 700 inhabitants and the buffer zone 50, mostly in the Cirque communes of Salazie and Cilaos where there are several village exclosures. There is an established industry in forest products but much of the island has come to depend on tourism for its main income.

## VISITORS AND VISITOR FACILITIES

In 2002, there were 15,131 overnight visitors to the Piton des Neiges, and 13,692 to the Piton de la Fournaise and by 2005, tourist visitors to Réunion numbered 603,000 (many of whom come for the beaches). Tourism is well provided for by a wide variety of activities: aircraft and helicopter over-flights, hang-gliding, paragliding, 4WD driving, riding, rafting, whitewater kayaking, mountaineering, rock climbing trekking a dense network of forest tracks, trails and paths, camping and picnicking. Sightseeing and trekking to the volcano via the road to the Pas de Bellecombe viewpoint is very popular. There is ample overnight accommodation in both the highland core and buffer zones: 18 hotels with 723 beds, 199 rooms, 33 overnight lodgings and 68 mountain huts and a youth hostel, with a total of 1,720 beds.

There is a visitors' centre at la Grande Chaloupe at the northernmost end of the Park near the coast and the capital, St. Denis.

## SCIENTIFIC RESEARCH AND FACILITIES

Réunion has one of the best and earliest known tropical floras known through the work of Commerson (1771), the description of the volcano by Bory de Saint-Vincent (1802) and of orchids by Du Petit-Thouars (1820). Recent botanical studies by Theresien Cadet included extensive field work, a flora and herbarium of Reunion and raising political awareness of the need for research. An inventory of natural zones of ecological interest was made between 1985 and 1999 and a study of plant succession over 300 years on the lava flows around La Fournaise; also censuses of birds. In recent years researchers from 23 universities and 21 other institutions from all over the world have conducted studies on aspects of the island supplementing ongoing programs of work by the University of La Reunion, the National Botanic Conservatory, the Insectarium and the Museum of Natural History. Over the last 15 years, an average of 22 scientific studies a year were published on aspects of the island, especially the volcanoes. 407 publications are cited in the nomination compared with 560 for the Galapagos. Volcanic activity is constantly monitored and the data studied at the Vulcanological Observatory at Bourg-Murat by the Global Geophysics Institute of Paris

## MANAGEMENT

The Park is administered by an Administrative Council, drawing on comprehensive consultation with local, regional and state stakeholders, collectives and mayors. Park management is delegated to a Bureau and is advised by two Councils, Scientific and Socio-Economic/Cultural. Management is by the Direction Regionale de l'Environnement (DIREN) following a management plan. 90.21% of the World Heritage site is in the National Park; the rest is in potential extensions to the Park. It is composed of Natural Zones of Geological Interest (ZNIG) and Natural Zones of Ecological, Faunistic and Floristic Interest (ZNIEFF) preserved within several previously designated protected areas. With two exceptions, their existing categories and regulations were abrogated with the creation of the Park. All vertebrate species are legally protected. There is strict control over construction and infrastructure, mining, dumping and areas of fire risk, on hunting, fishing, plant and wildlife collection, and harvesting of fruit, medicinal plants (90 species), flowers and wood. There are plantations of *Cryptomeria japonica* in the cirques and l'Enclos Fouque and the possibilities for geothermal energy are being explored. A detailed National Strategy for Biodiversity is followed, at two levels: urgent action plans to research rare and threatened species, and operational action plans to assemble data, then evaluate and prioritise species for treatment. Two Nature Reserves are included within the site: Le Mare Longue (68 ha), the last lowland rainforest in the Mascarenes, with 200 species, 30% of Reunion's indigenous plants, including the endemic whitewood *Hernandia mascarensis* (EN); and La Roche Ecrit (3,643 ha), set up to protect the habitat of the Critically Endangered Réunion cuckoo-shrike *Coracina newtoni* (CR). Indicators of the state of conservation monitor the number and force of volcanic eruptions, the effects of unusual climatic events, land and mud slides, habitats and biological invasions, numbers and populations of rare species, tourist numbers, amount of research and educational publications and public awareness.

## MANAGEMENT CONSTRAINTS

Now that large-scale forestry in the mountains has been stopped and hunting is controlled, the main threats to the integrity of the site are exotic plants and animals, new roads and paths, which facilitate poaching and the collection of rare plants and birds, fire, and flooding on the cirque floors. Landslides, mudflows and erosion are especially likely in the cirques, the ravines and the steep southwest of the site; and of course, the frequent eruptions from La Fournaise some of which cut the coast road. Intense cyclonic storms can cause destructive floods. Disruptive invasions by at least 27 exotic plants have proved almost impossible to eradicate despite constant efforts, though they are countered by the reintroduction of native plants to degraded areas. They are most intrusive in the semi-arid, lowland and mid-level forests. The most invasive species are giant bramble *Rubus alceifolius*, hardy fuchsia *Fuchsia magellanica*, guava *Psidium cattleianum*, Mauritius hemp *Furcraea foetida*, she-oak *Casuarina equisetifolia*, Indian laurel *Litsea glutinosa*, gorse *Ulex europeus*, lantana *Lantana camara*, rose apple *Syzygium jambos*, hiptage *Hiptage benghalensis*, ginger lily *Hedychium gardnerianum*, privet *Ligustrum robustum*, *Strobilanthus hamiltonianus* and white popinac *Leucaena leucocephala*. Eight alien mammals have invaded the wild: hare *Lepus capensis*, two deer, rusa and red *Cervus timorensis* and *C. elaphus*, goats *Capra aegagrus hircus*, the two common rats, dogs and cats. Other invasive species include six species of bird, four fish, one reptile, 18 insects including the beetle *Hoplochelus marginalis*, and six molluscs, including the giant snail *Achatina fulica*. Another source of threat is petrel chick mortality due to their attraction to lights.

## COMPARISON WITH SIMILAR SITES

The main bases for comparison with similar World Heritage forested volcanic islands are:

- (vii) Its concentration of dramatic and precipitous forested cliff-walled scenery in the ramparts, peaks and unique cirques, encircled by the sea;
- (viii) The presence of an easily accessible very active volcano, and of a nearby strikingly dissected dormant one with a complex geological history. They provide natural geological and botanical laboratories and have inspired a high level of research into volcanic and erosional processes.
- (ix) The expanse of exceptionally undisturbed montane primary forest over a third of the island preserved by inaccessibility and recent careful management; Its concentration of a wide range of altitudinal and climatic gradients from littoral to subalpine 2,500m high within 20 km of the sea, resulting in 19 distinct major ecosystems and a very wide variety of microhabitats; including lava flows studied for comparative plant succession—
- (x) The very high level of endemism and floristic diversity, largely in good condition, due to long isolation; and the presence of rare endangered species.

Réunion is the largest, least ecologically disturbed and most scenic of the Mascarene Islands, with a very active and a strikingly rugged dormant volcano, a highly endemic flora, and endangered birds. Comparable volcanic, floristically rich tropical, subtropical or warm temperate World Heritage island sites are Hawaii, Galapagos, Morne Trois Pitons (Dominica), Pitons St. Lucia (Caribbean), Isole Eolie (Italy), Teide (Canary Is.), Jeju (South Korea) and Cocos Island (Costa Rica). Other less comparable sites worth noting include Krakatoa (Java) and Surtsey (Iceland) and which are equally active and well studied volcanoes but barren. Among biodiverse forested dormant volcanic sites are the Azores (Pico, a cultural landscape site), and the cooler Inaccessible Island (south Atlantic) and the Lord Howe Islands (Australian Pacific). The Indian Ocean sites are tropical and biodiverse and five of the six Madagascan sites are mountainous but none are volcanic as well: Tsingy de Bemaraha is dissected karst, the Atsinanana sites spread along an island of continental scale, Vallée de Mai by contrast is only 19 hectares, and Aldabra, also in the Seychelles, is basically an atoll. The Pacific island sites also have tropical rainforest though both are designated chiefly for their marine reefs.

## STAFF

A staff of 99 is proposed with 28 senior administrators, 32 assistant staff and 39 technical staff, in four divisions: Administration (15), Education & Communication (8), Science (6) and Maintenance (6) and in four geographic sectors south (10), east (16), north (17) and west (15).

## BUDGET

A provisional budget of €6,458,244 is required, of which €5,288,244 will be a state subvention through the Ministry for the Protection of Nature and €2,170,000 is expected to come from revenues, donations, and other sources. In 2009, the total is expected to reach €8 million.

## LOCAL ADDRESSES

M. le Directeur du Parc National de La Réunion, 112 rue Ste-Marie, 97400 St. Denis, La Réunion, France.

Direction Régionale de l'Environnement de La Réunion (DIREN Réunion), 12 allée de la Forêt, 97400 St. Denis, La Réunion, France.

Website: [www.reunion-parcnational.fr](http://www.reunion-parcnational.fr)

## REFERENCES

The principal sources for the above information were the original World Heritage nomination, IUCN's evaluation report and Decision 34 COM 8B.4 of the UNESCO World Heritage Committee.

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