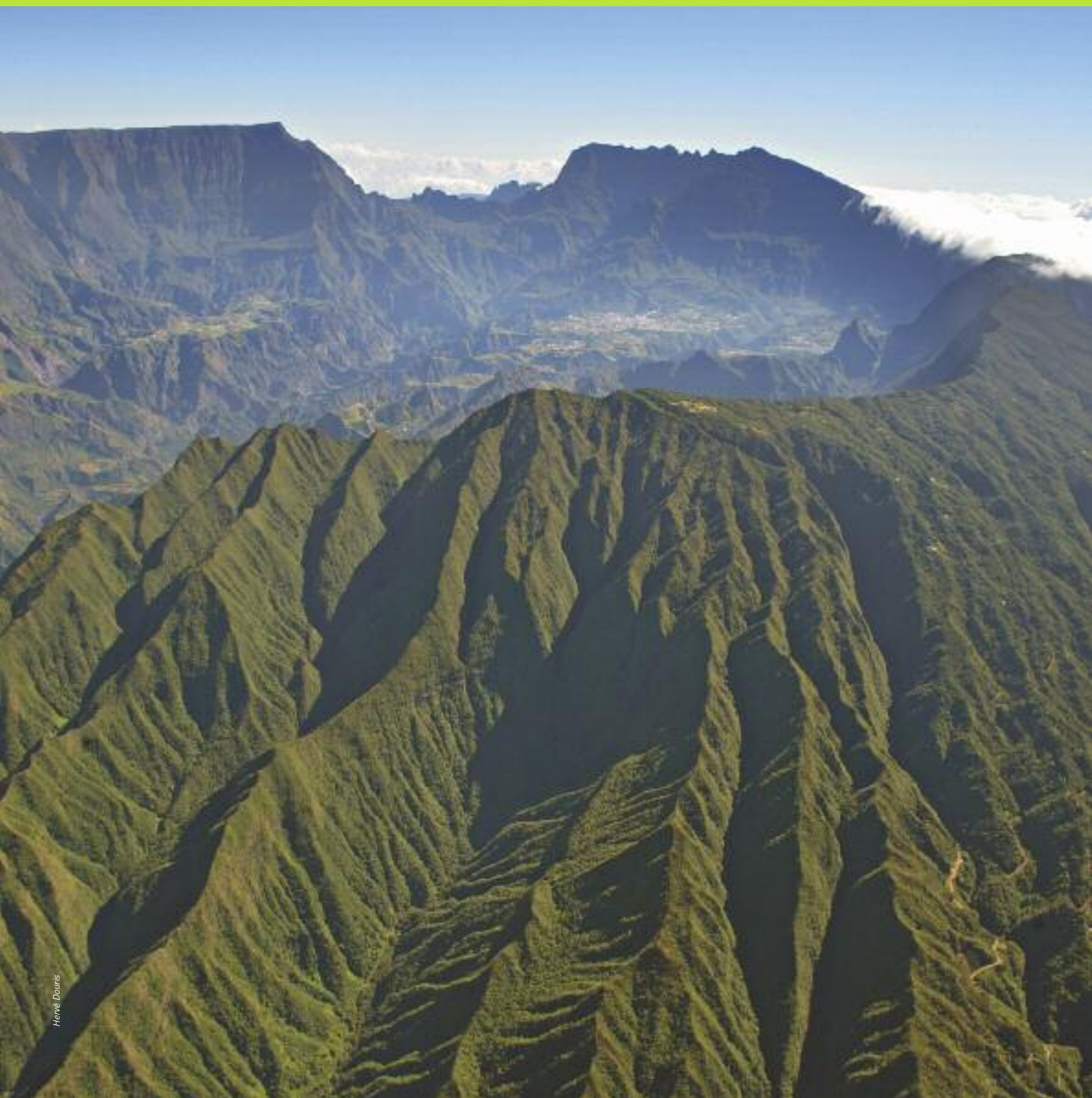
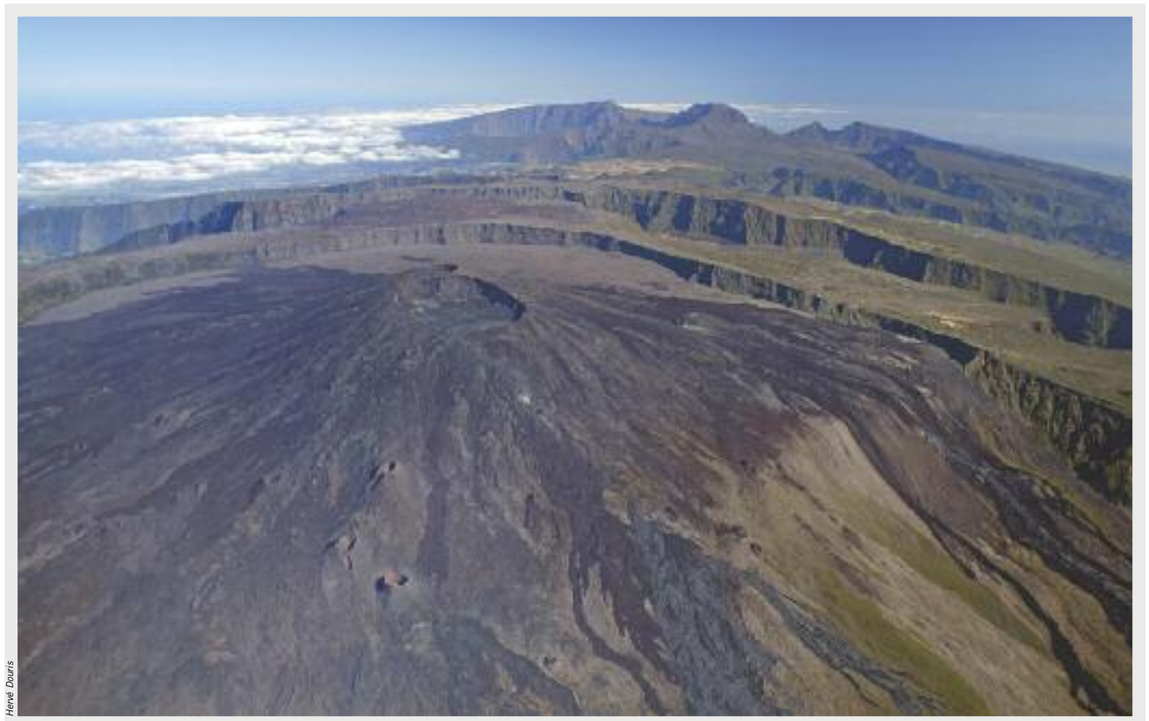
Pitons, Cirques and *Remparts* of Reunion Island

Aiming at World Heritage Status



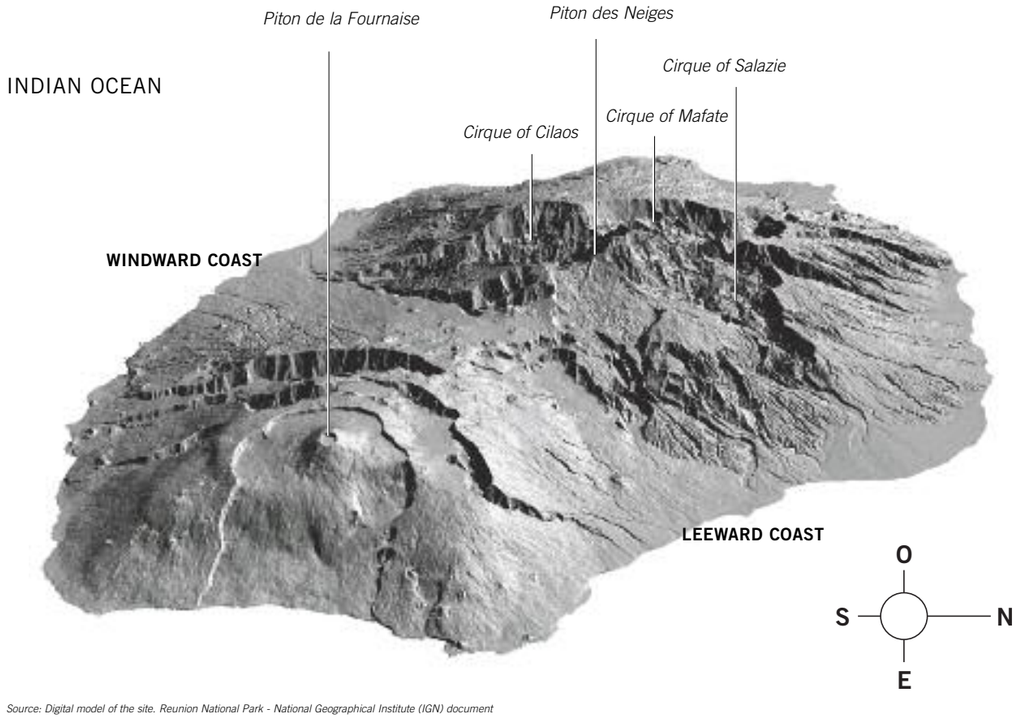
Hervé Douris

Reunion Island



Hervé Douris

An insight into the history of Earth



Source: Digital model of the site. Reunion National Park - National Geographical Institute (IGN) document

Reunion is an exception among the numerous tropical oceanic islands. Its mountain core is home to awesome landscapes crowned by two volcanic massifs not far from each other but of different ages, and three cirques where men settled only recently. High remparts with spectacular dimensions carve an often inaccessible relief rich in preserved natural habitats. This small piece of land with volcanic bouts is also well-known as one of the world's biodiversity hotspots: it is home to rare flora and fauna types with a high number of endemic species. An epitome of natural history, the island's center provides a rare insight into dramatic examples of evolution.

With less than four centuries of human settlement, Reunion Island is an experiment ground of life forms; its scientific and tourist potential is only waiting to be known the world over a bit more. In March 2007 the value of that heritage was confirmed by the creation of the ninth French National Park covering more than 40% of the island's surface area and most of its mountain core. Today the National Park is organizing the application of "Pitons, Cirques and Remparts of Reunion Island" to the Unesco World Heritage list as a Natural Property. The preparation of this project supported by the French Government, the Regional Council, the Department Council, the Mayors' Association and local authorities has mobilized the whole of the local scientific community.

Reunion's heritage is outstanding and universal at the same time. It must be studied, protected and enhanced even more. Being part of the World Heritage list will naturally contribute to meeting this objective. Once it has joined the planet's other 851 Properties listed since 1978, Reunion Island will become an environmental reference, where the world can gain an insight both into the history of the Earth and the dynamics of Life.

Jean-Cyrille Notter

The central summits of the massif of Piton des Neiges (3,071 m) seen from the east coast of Reunion.
The massif probably reached an altitude of 3,400 m during its highest volcanic activity, which stopped 12,000 years ago.
The island looks like a mountain placed on the surface of the sea, and its relief strongly conditions the climate.

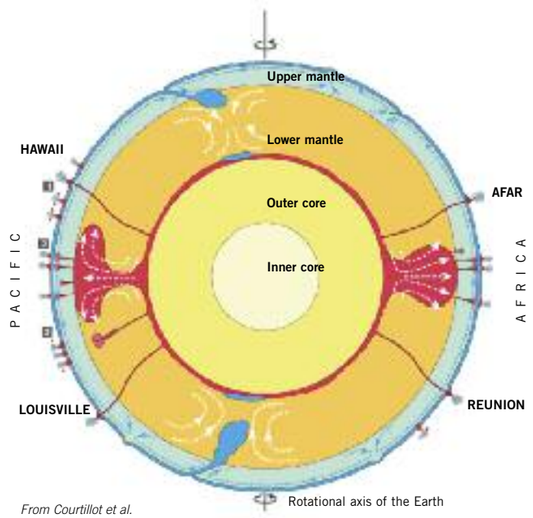
The island with two volcanoes

Located in the south-west of the Indian Ocean, 800 kilometers from the coasts of Madagascar and 200 kilometers north of the Tropic of Capricorn, Réunion Island sprung from the sea three million years ago. Generated by an oceanic “hot spot” situated 2,400 kilometers under the earth’s surface, the island has a secret birth story shared by only six other places in the world, of which Big Island (Hawaii) is one. Reunion Island has constantly been in construction and transformation ever since.
Today, a third of this natural environment is still intact, preserved from human settlement that is concentrated along the coast.
Three volcanic massifs have shaped the island’s relief in succession. The oldest – the Piton des Neiges – is the highest peak in the Indian Ocean (3,071 m).
The existence of the second volcano was discovered only very recently: called “Volcan des Alizés” (Trade Winds Volcano) by scientists, it collapsed at one point of time and nearly all its remnants have been covered by Piton de la Fournaise (2,632 m). Today La Fournaise is one of the most active volcanoes on earth. Its frequent eruptions contribute to Reunion’s reputation as a highly spectacular island.

The existence of two large volcanic massifs on a land of reduced size (2,500 sq km) is a rare asset. This particularity makes it possible to study the history of volcanic landscapes like hardly anywhere else.
By their dimensions, the two volcanoes also condition the island’s climate. They form a mountainous barrier to trade wind circulation, thus generating two very different climatic flanks. In the east, the “windward” coast is under the influence of sea winds and rains: the east side of Piton de la Fournaise is one of the wettest regions in the world by reason of its exposition and steep slopes.
An annual world rainfall record of over 18 meters has been registered on its south-east slope at an altitude of 1,600 m.
Conversely, the island’s west side called the “leeward coast” is relatively protected from trade winds and rain by high relief. Of course this can be seen in many mountainous islands, but Reunion is special as a result of its summit regions, where the temperate climate has generated a belt of altimontane vegetation that is extremely rare in the tropical island world.

Hervé Douris

The summit of Piton de la Fournaise (2,632 m), an active volcano.
As the crow flies La Fournaise is 20 kilometers from its elder brother Piton des Neiges.
The closeness of two volcanic massifs of different ages is a highly original feature of Reunion Island geography.



From Courtillot et al.

Reunion Island is one of the seven world volcanic sites generated by a deep hot spot directly connected to the center of the Earth.
The other hot spots (some 40 throughout the planet) originate from more superficial areas of the Earth’s mantle or crust.

Cilaos

The Cilaos cirque (opposite)
was dug in the south-west
of Piton des Neiges.
In its higher part,
it contains several plateaus
that have made human settlement possible.
The relief is more chaotic in its lower part.
Each of Reunion's three cirques
presents a specific morphology.

Mafate

The gorges of the Rivière des Galets
(bottom of right page)
go deep inside the cirque of Mafate,
typical with its large ridges located along an
upstream-downstream line.
A signature landscape of Reunion Island,
Mafate is totally included
in the Property nominated
for World Heritage application.

Spectacular cirques

The relief of Reunion Island is in constant evolution. In the area of Piton de la Fournaise the island is still being built by lava flows or spectacular collapses like that of April 2007 in the Dolomieu crater, whose floor dropped by 300 meters. The cirques also have been shaped by large-scale collapses and landslides around the Piton des Neiges massif. Violent and heavy cyclonic rains largely participated – and still participate – in carving the vast amphitheaters of the Salazie, Mafate and Cilaos cirques.
Cirque landscapes are exceptional in that they are hardly seen anywhere else in the world. Each cirque is pear-shaped and delimited by high remparts (cliffs) forming deep gorges downstream that open close to the seaside.
The floor of cirques is chaotic, constantly gnawed at by torrential erosion. Rare flat and unstable areas allow settlement by men who live in a typically organized habitat system; the areas and hamlets are called "îlets".
The three cirques have an "ace of clubs" layout around Piton des Neiges and a family air, but each has its specific features: in its heart, Salazie has a giga-block, Piton d'Anchain, brought down with a major landslide from central Gros Morne.
Mafate is the only cirque with a series of parallel ridges following an upstream-downstream direction: the ridges of La Marianne, Aurère, Calumets and Orangers. In its higher part, Cilaos has relatively extensive flat areas – Bras-Sec, Cilaos Village, Ilet-à-Cordes – found nowhere downstream.
The ace of clubs has not always been three-lobed. In the east of the island a fourth cirque was created then disappeared: the cirque of Bébour, filled up by the last lava flows from Piton des Neiges over 12,000 years ago. In the very long run, current relief evolution should generate new cirques in the Piton de la Fournaise massif.

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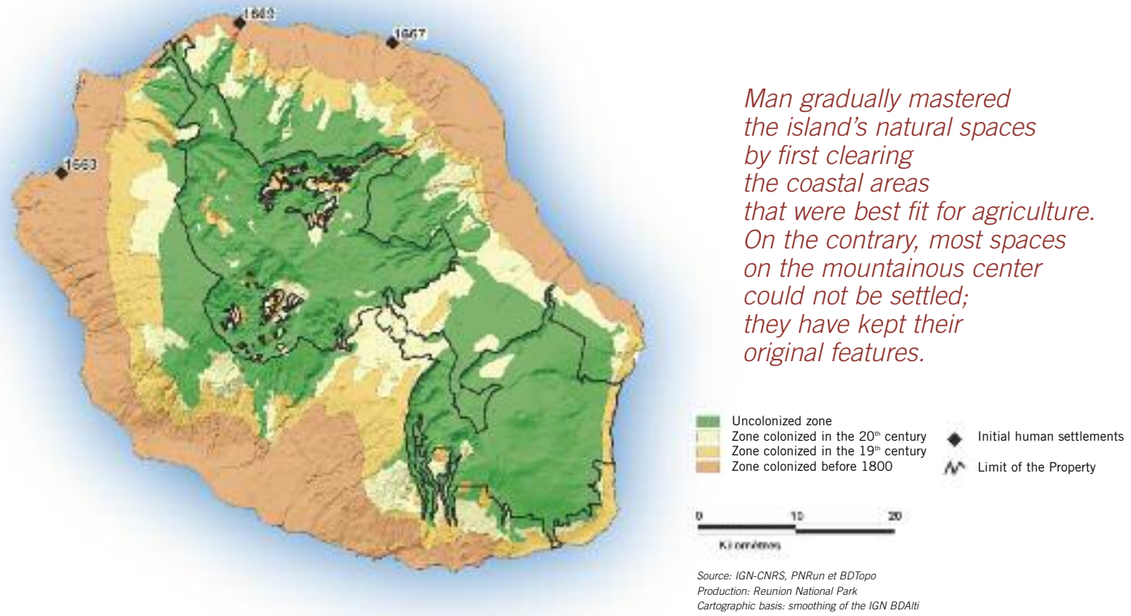
Salazie

The Piton d'Anchain sits in the middle of the Salazie cirque.
Torrential erosion action is extreme in this cirque
facing the east and therefore receiving heavy rainfall.
Rains feed innumerable waterfalls on the sides of vertical remparts.

History of Reunion land colonization



Source: IGN-CNRS, PNRun et BDTopo
Production: Reunion National Park
Cartographic basis: smoothing of the IGN BDAlti

Man gradually mastered
the island's natural spaces
by first clearing
the coastal areas
that were best fit for agriculture.
On the contrary, most spaces
on the mountainous center
could not be settled;
they have kept their
original features.

Human impact limited by relief

Reunion Island is three million years old, but it has been occupied by man for less than four centuries. Coming in successive waves from several continents, settlers gradually extended their habitat on coastal areas, while the island's mountainous heart, protected by its formidable relief, long remained Terra incognita.
The Uplands first served as a refuge for runaway slaves. Then, in the 19th century, intensive sugar cane cultivation pushed the more modest colonists away to the stubborn lands of the interior.
Traces of such diverse settlement can still be found in many place-names today, as well as in the handicraft and medicinal activities such as herbal tea lore. Strong relations bind men and Nature in the Uplands, places of freedom where the single social life model of the Lowlands gives way to a rural, many-faceted identity. This is where people come to find their roots and recapture an authentic art de vivre.
In the course of time, Reunion islanders have become aware of the richness – but also the fragility – of this double natural and cultural heritage.

Exotic species introduced by man, sometimes invasive, actually threaten the island's original nature even into the least accessible areas.
Societies for the defense of Nature started forming in the 1970s. At the end of the preceding decade, coordinated efforts by the French Government, the Regional and Department Councils and local authorities made considerable environmental progress possible: adoption of a Regional Land Development Plan (SAR), creation of Sensitive Natural Areas, inventory of ZNIEFFs (Natural Areas of Particular Interest in Terms of Ecology, Fauna and Flora), etc.
The creation of the National Park, launched in 2001, became effective on March 5th, 2007 after all actors of Reunion had a far-reaching discussion on the issue, and consensus was arrived at on the Park's territorial limits and objectives.
The core of the Park covers 42% of the island's surface area and the best part of natural spaces in its mountainous center.

Remparts *in Jean-Petit (opposite) (massif of La Fournaise), between Rivière Langevin (left) and Rivière des Remparts (right). When two gorges are close to each other, their* remparts *are gradually gnawed away by erosion. They form a residual partition topped by a narrow ridge.*

Collapsed rempart *in Grand Bassin (bottom of the page) (south of the island) as a result of heavy rains during cyclone Gamede in February 2007. Gorge* remparts *are regularly modified under weather action.*

The *remparts*, structuring landscape lines

Constructed by the volcanoes, sculpted by collapses and the work of elements, the core of the island owes its design to spectacular *remparts* that can reach 1,000 meters in height. Practically vertical, these structuring landscape lines delimit the interior spaces.
The shapes of *remparts* differ according to their origins: it is simple when they result from collapse, double between two cut valleys.
Upstream *remparts* are against central summits while downstream *remparts* form deep gorges in the shape of defiles channeling cirque water out towards the ocean.
By reason of its age, the Piton des Neiges massif offers a wide variety of *remparts*: those found in gorges (Bras de Caverne, Rivière des Marsouins, Rivière des Pluies) and the outlets of the three cirques of Salazie, Mafate and Cilaos (Rivière du Mât, Rivière des Galets and Bras de Cilaos respectively).
The main *remparts* in the massif of La Fournaise, which is more recent, surround the calderas, vast rocky “cauldrons”.

The L’Enclos caldera, which receives nearly all lava flows from La Fournaise, is limited by high horseshoe-shaped *remparts* channeling flows towards the sea. The Sables caldera gradually drives water streams to the Rivière de l’Est or the Rivière Langevin southwards. Though deluges of rain fall on these high altitudes, rainfall-linked erosion is minimal: water percolates through the extremely permeable volcanic soil before it has time to gouge its way off on the surface and change the relief.
Largely inaccessible to man because of their verticality, rempart sides are colonized by plants and are used as habitat by various bird species. They are a sanctuary for Reunion’s biodiversity.

Hervé Douris

Hervé Douris

Sources: UICN

The islands of the southwest of the Indian Ocean (Reunion island, Madagascar, Comoro islands, Seychelles, Mauritius, and Rodrigues) are a part of the 34 hot spots of the world biodiversity listed by the environmental organization International Conservation.

Stéphan Szymanzera

Above 1,900-2,000 m, altitude tempers the tropical climate.
Plants have adapted to hard conditions.
Trees have disappeared and been replaced with shrubs and a discontinuous grass cover.
This altimontane vegetation includes a high number of endemic species.

Hervé Douris

The papangue (Harrier) is the island's only bird of prey. Here a young male is seen hunting. This bird is threatened with extinction and monitored.
Other species are protected, such as the petrels, seabirds that nest in the remparts.

Jean-Cyrille Notter

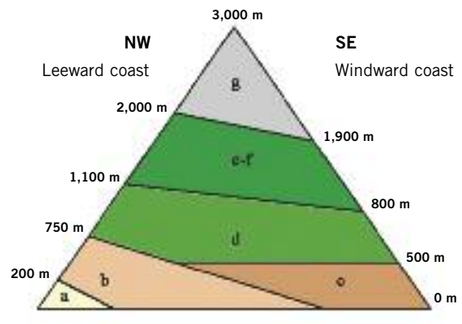
Papilio phorbanta, *one of Reunion's rarest endemic butterflies.*
Knowledge of the island's insect world remains incomplete.
Out of 5,000 indigenous species, only 2,000 are relatively well described.

A unique and fragile biodiversity

Sprung from the ocean, the island was originally a lifeless world. Gradually, fauna and flora from various regions, near or far, settled on the island. Once there, animal and plant species either adapted or disappeared.
Reunion's remoteness accounts for the absence of big mammals which were incapable of accessing it. On the contrary, birds and insects were numerous when man arrived, as well as a rich local flora whose seeds, carried by the wind, ocean streams and birds, had colonized the whole surface of the island.
Reunion's isolation, diversity of natural habitats and micro-climates have led many indigenous species (present on the island before man arrived) to differentiate and therefore become endemic (specific to the island and unique in the world).
230 plant species strictly endemic to Reunion are currently registered, of which half are threatened. Unique, precious and fragile, this biodiversity is found at all levels of the natural environment from the lowland savannah to the altimontane vegetation.

The state of conservation of natural environments improves with altitude, since men, present since 1665, have relatively spared the Uplands.
Above 1,900-2,000 meters, one can find an exceptional area, covered by an extremely original vegetation of thickets called "branles".
Another specific feature: this tempered region is fed in seeds, according to air streams, not by Madagascar, the large neighboring island, but the East African high mountains (Mount Kilimandjaro, Mount Kenya).
Among the island's fauna, birds are the most remarkable. Out of the 18 species still nesting in Reunion, more than half are endemic, sometimes rare and endangered. For instance, the *remparts* in the island center are home to the nests of two large seabirds: the Barau's Petrel and the Black Petrel. Most land bird species are endemic: the Reunion Olive White-eye, the Reunion Harrier (the island's only bird of prey), the Reunion Cuckoo-shrike and the Reunion Gray White-eye, which are endangered.

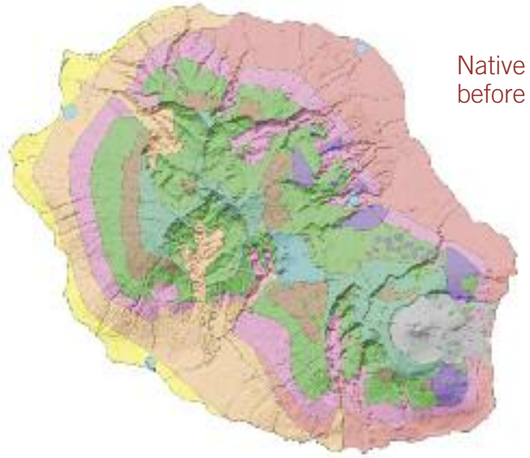
Insects are very numerous, and many are still unknown by scientists. Certain species are remarkable – but also endangered – like the *Phorbanta* and *Salamis augustina* butterflies. Some small reptiles like the phelsuma, a green lizard with red spots, are also endangered.



From the coast to the summits, the following forest types were found originally:
a: savannah
b: semi-dry forest
c: lowland rainforest
d: submontain rainforest
e-f: Acacia heterophylla forest and upland rainforest
g: subalpine heathland

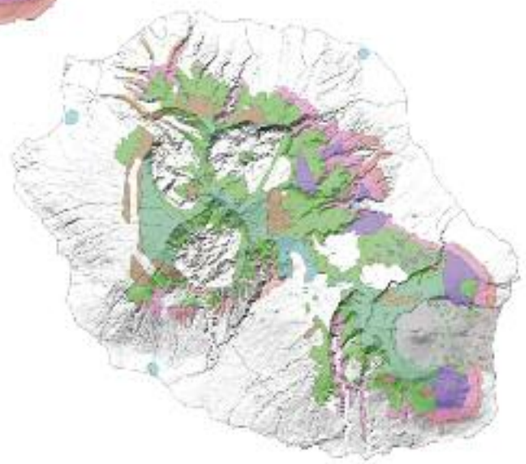
Sources: Th. Cadet

Native vegetation



Native vegetation
before man's arrival

Native vegetation remnants



0 10 20
kilometers

Absence of vegetation areas with human activities
Swampy vegetation
Lave flows

Tropical type warm (megathermal) belt
Lowland open woodland
Semi-dry lowland forest
Lowland rainforest
Mid-altitude rainforest

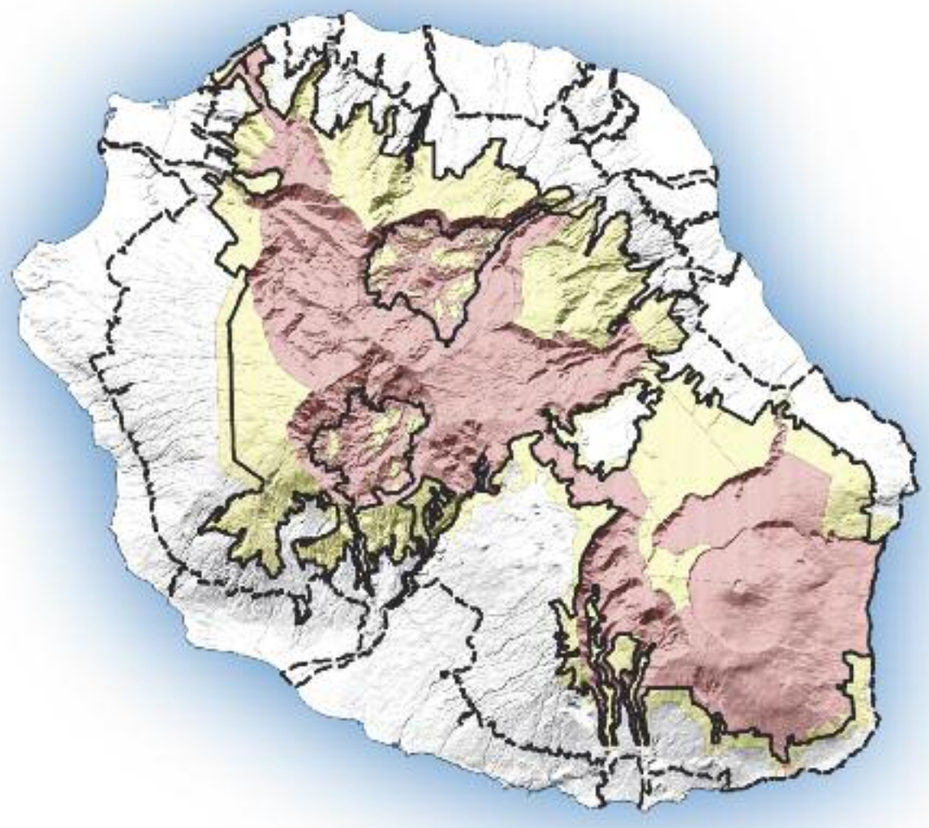
Subtropical cool (mesothermal) belt
Upland rainforest
"Avoune" type *Philippia* tree fern thickets
Acacia heterophylla forest
wet *Pandanus* forest

Subalpine cold (oligothermal) belt
Subalpine heathland (at various density),
altimontane grassland and *Sephora denudata* groups

Source: Thérésien Cadet, Joël Dupont - Production: Reunion National Park - Cartographic basis: smoothing of the IGN BDAlti

The original vegetation quickly receded as soon as man settled ont the island. However certain areas have escaped his influence : Piton de la Fournaise zone, vertical remparts *of valleys and cirques, high summits. About 30% of Reunion's primary végetation is preserved today.*

Map of the Property



Property buffer zone
Limit of World Heritage Property
National Park core
National Park membership zone

0 10 20
kilometers

Source: Reunion National Park - Production: Reunion National Park - Cartographic basis: smoothing of the IGN BDAlti

The Property nominated for inscription as a Unesco World Heritage site includes the two volcano massifs and the three cirques, where the best part of the original natural environments and insular biodiversity are found.

The Unesco World Heritage

The Unesco (United Nations Education, Science and Culture Organization) manages several international programs such as "Man and Biosphere" (MAB) or the convention on the protection of the World Cultural and Natural Heritage signed in 1972. Opened in 1978, the World Heritage list is extended each year. To date it includes 851 sites located in 141 countries: 660 cultural sites, 166 natural sites and 25 mixed sites.
Some examples of cultural sites are the temples of Angkor (Cambodia), the site of Abu Simbel (Egypt) or the Mont Saint-Michel (France).
Among the natural sites are the Great Coral Reef (Australia) or the Grand Canyon National Park (USA). There are several listed sites in the south-west Indian Ocean: the Aldabra atoll (Seychelles), the Tsingy de Bemaraha natural reserve (Madagascar), the Aapravasi Ghat (Mauritius), etc.

The sites nominated by the 185 member states of the World Heritage convention must have universal outstanding value. Natural properties must correspond to at least one of the four following criteria:
- to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;
- to represent major stages of Earth's history;
- to be outstanding examples representing significant ongoing ecological and biological processes;
- to contain the most important and significant natural habitats for in-situ conservation of biological diversity.

The "Pitons, Cirques and Remparts of Reunion Island" application was submitted by France on January 31st, 2008 under all four criteria. Unesco's decision is expected in July 2009.

Reunion's full application file can be viewed on the website:
http://reunion.unesco.free.fr/version-imprimee

Reunion National Park President and World Heritage application project manager Daniel Gonthier extends his warmest thanks to Patrick Bachelery, Dominique Strasberg, Prosper Eve (Université de La Réunion Professors) and Vincent Boullet (Mascarin National Botanical Research Institute Scientific Director), Marie-Pierre Hoarau and Philippe Berne, Regional Councillors.

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