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NEW CALEDONIA, BIOLOGY

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Because of its extremely diverse biology, New Caledonia is one of few islands to be designated a biodiversity hotspot. The long isolation of the territory (since the breakup of Gondwana 80 million years ago), in conjunction with its climatic stability, was often proposed as an explanation for its outstanding biodiversity. Recent evolutionary studies are more in accordance with submersion of the territory from 65 to 45 million years ago, establishing a new paradigm for the origin of biodiversity in this island.

GEOGRAPHY OF THE TERRITORY

New Caledonia is a Melanesian archipelago comprising two sets of islands (Fig. 1). The first includes the main island (Grande Terre, approximately 500 km long and 50 km wide), the Belep Islands to the north, and the Isle of Pines to the south. The second includes more recent volcanic islands (Ouvéa, Lifou, Tiga, and Maré), called the Loyalty Islands. The inclusion of other small dependencies (Chesterfield, Matthew, and Hunter) brings the total land area to 18,972 km².

The climate is subtropical, and the mean annual temperature varies between 22 and 24 °C. There are two major seasons: a hot season from mid-November to mid-April and a cool season from mid-May to mid-September. The Grande Terre harbors an asymmetric mountain chain. The eastern part is abrupt, whereas the western part ends

in long plains. The culminating points are Mont Panié (1629 m) in the north and Mont Humboldt (1618 m) in the south. The mean annual rainfall is 1700 mm, but precipitation is also uneven, mainly because of the mountains. Eastern parts of the island can receive five times more rain than their western counterparts.

Different soils are found in New Caledonia. Among them, ultramafic soils cover one-third of the territory (mainly in the south). Their richness in metal and poverty in nutritive elements makes that area a very particular environment for the flora and its associated fauna.

BIOLOGICAL CHARACTERISTICS

Compared to other islands, New Caledonia, despite its small size, exhibits an extraordinary species richness and rate of regional endemism (Fig. 2). In addition, several groups are considered relictual. Local endemism to restricted areas is a general characteristic of groups such as terrestrial squamates or some insects and can also be found in some plants. New Caledonia has long been seen as a distinctive floristic and faunal entity and, as mentioned, is now recognized as a biodiversity hotspot.

The dense evergreen rain forest is the richest vegetation type. It is mainly located on the east coast of the island because of the high precipitation there. This forest is present on every kind of substrate, from 300 m to the highest altitudes.

The sclerophyll forest is the most endangered vegetation type. Including small-sized trees (10 to 15 m), this dry forest is located on the west coast between the altitudes of 0 and 400 m. Twenty-four percent of its plant species are locally endemic.

The scrubland, or *maquis*, because it is mostly associated with ultramafic soils, is often referred to as *maquis minier* (“mining maquis”). High-altitude maquis covers 100 km², and low- to mid-altitude maquis covers 4400 km².

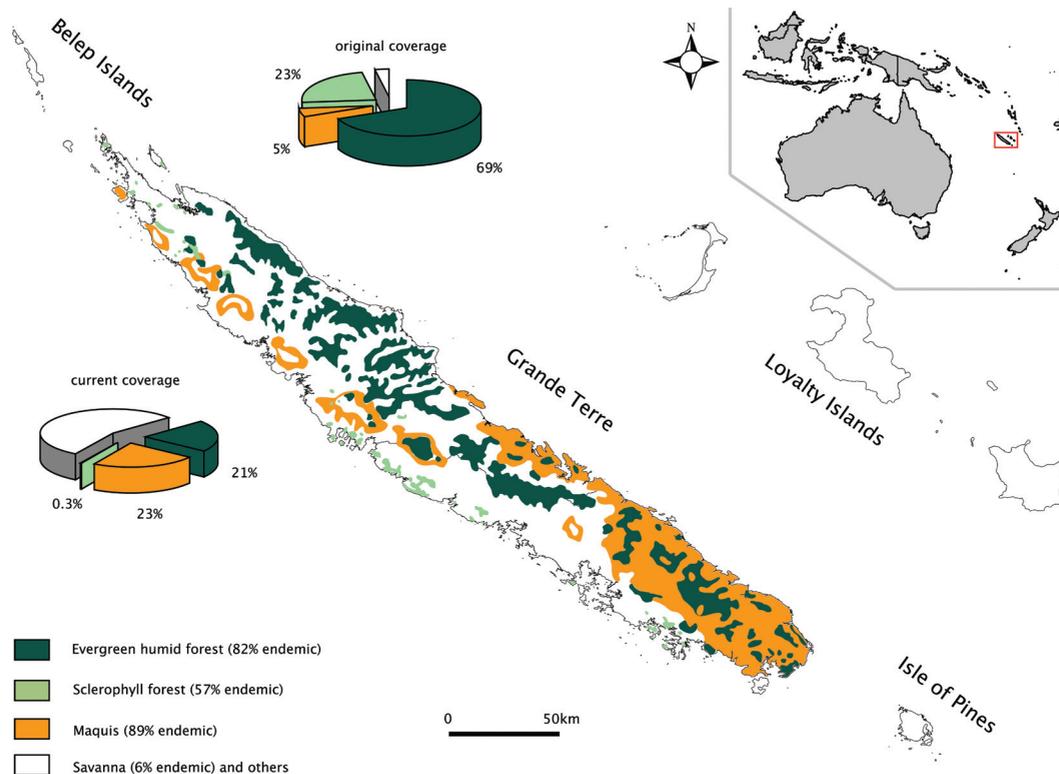
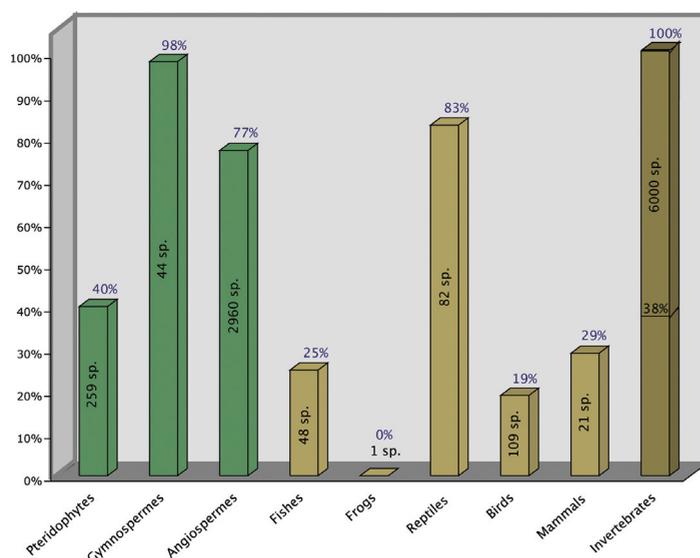


FIGURE 1 Principal types of vegetation found in New Caledonia Grande Terre (current coverage). Plant rates of endemism are noted in the legend. Diagrams represent the evolution from the original to the current coverage.

The savanna covers 6000 km², and its major tree component is the niaouli, *Melaleuca quinquenervia*. Other types of land include mangrove forests, swampland, and secondary shrubland.

New Caledonia presents a very distinctive flora and fauna. Thirteen endemic species of coniferous trees in the genus *Araucaria* are found in this territory, out of only

19 worldwide species. Illustrating the unique nature of the island, the endemic *Amborella trichopoda* is the sole member of the family Amborellaceae, which is a sister group to all the remaining flowering plants. Likewise, the kagu (*Rhynochetos jubatus*), an emblematic, almost flightless forest bird, is the sole representative of the endemic family Rhynochetidae, an additional lowland species endemic to the island having gone extinct in the Holocene.



ORIGIN OF THE BIODIVERSITY

New Caledonia has often been described as a “museum” in which its tremendous biodiversity has been explained by a long accumulation of species in ancient groups since Gondwanan times. The geological history of the region, however, contradicts this classical view. The total submer- sion of the territory between 65 to 45 million years ago (subsequent to separation from Gondwana) was either unrecognized or disregarded because of the presence of the “relictual” groups.

FIGURE 2 Rates of endemism in different groups. Common names have been used even though they do not always represent mono- phyletic groups. Numbers for plants include only native species. Endemism in invertebrates varies between 38% in the butterflies to 100% in the less mobile groups.

The recent use of molecular phylogenetic methods has enabled the investigation of the origin of the biodiversity in New Caledonia in an evolutionary framework. Most studies on plants, vertebrates, and invertebrates show that for supposedly Gondwanan groups, their origin in New Caledonia is never older than 40 million years ago and can involve multiple dispersal events from the neighboring regions. Additionally, their diversification can be extremely recent (a few million years), especially in insect groups. A new paradigm has now emerged that presents a more balanced view, with either single or multiple dispersal events and possibly different tempos of evolution inside New Caledonia. The potential existence of refugium islands during submersion times could explain the presence of “relictual” groups in New Caledonia.

On a local scale (inside New Caledonia) the high heterogeneity of the territory, rather than its long isolation, is certainly an important factor of diversification. The presence of ultramafic soils (toxic and poor in nutrients) could have also been involved in some process of adaptive radiation.

THREATS TO THE BIODIVERSITY

Fire is an important factor in the degradation and the transformation of the vegetation. Because of the fire resistance of the niaouli tree, the expansion of the savanna (to the detriment of the primary vegetation) has been significant. Even though fires are attested as a natural process before human arrival, recent fire is mainly due to human activities.

Invasive species constitute a major threat to the biodiversity. Among plants, around 1300 species are non-native, and 67 taxa are considered invasive. The rusa deer, *Cervus timorensis*, was introduced less than 150 years ago and retards the regeneration of the forest. With its fierce sting, the little fire ant, *Wasmania auropunctata*, was introduced in 1960. In addition to harming humans, cattle, and cultures, it induces a serious ecological problem by competing with other arthropods (it is known to use its venom against other ant species) and potentially affecting the entire food web.

Even though open-pit mining is better managed than in the past, it is still a concern. The high international demand for nickel has led to the development of new projects that may threaten some relictual forests. The necessary economical development of the island (mining representing the major source of income) needs to better integrate the question of the preservation of New Caledonia’s exceptional biodiversity.

Numerous protected areas exist, but their impact on the conservation of plant diversity has proven to be relatively

low. Perhaps the most urgent and promising initiative has been the creation in 2001 of the “dry forest conservation program.” This program groups ten different partners (including national and local agencies and international NGOs) that join together to put a stop to the erosion of the most endangered New Caledonian ecosystem.

SEE ALSO THE FOLLOWING ARTICLES

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NEW CALEDONIA, GEOLOGY

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The New Caledonia archipelago is a group of islands that form the emergent northern part of the Norfolk Ridge in the Southwest Pacific Ocean. The archipelago consists of six major islands as well as numerous smaller islands. The closest neighboring island group is Vanuatu, 500 km to the northeast, while New Zealand and Australia are situated 1500 km to the south and west, respectively. The New Caledonian territorial boundaries are approximately between latitude 18° and 23° S and longitude 158° and 172° E, and the land area of the archipelago is in the order of 18,600 km².