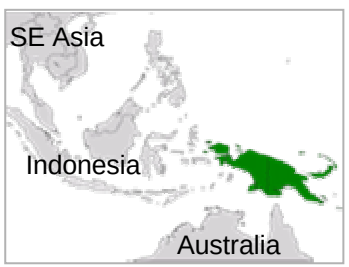
The New Guinea Challenge

Development and conservation in societies of great cultural and biological diversity



The Conservation Atlas

An introduction to the natural history, societies, conservation and sustainable development of the New Guinea region prepared by CSIRO Australia for the Moore Foundation, 2003

This pictorial review will show:

- how Earth history has given these islands immense biological and mineral riches;
- why the plants and animals are of outstanding value for science and natural history;
- the enormous diversity of human cultures developed over the last 30,000 years;
- the footprints of human society and infrastructure that lie over the entire landscape;
- agricultural and industrial developments that impact on many ecosystems; and
- the combined footprints of the widespread developing human societies and conservation areas (both existing and proposed) forming a complex mosaic of residential, development and conservation interests, even at a broad scale.

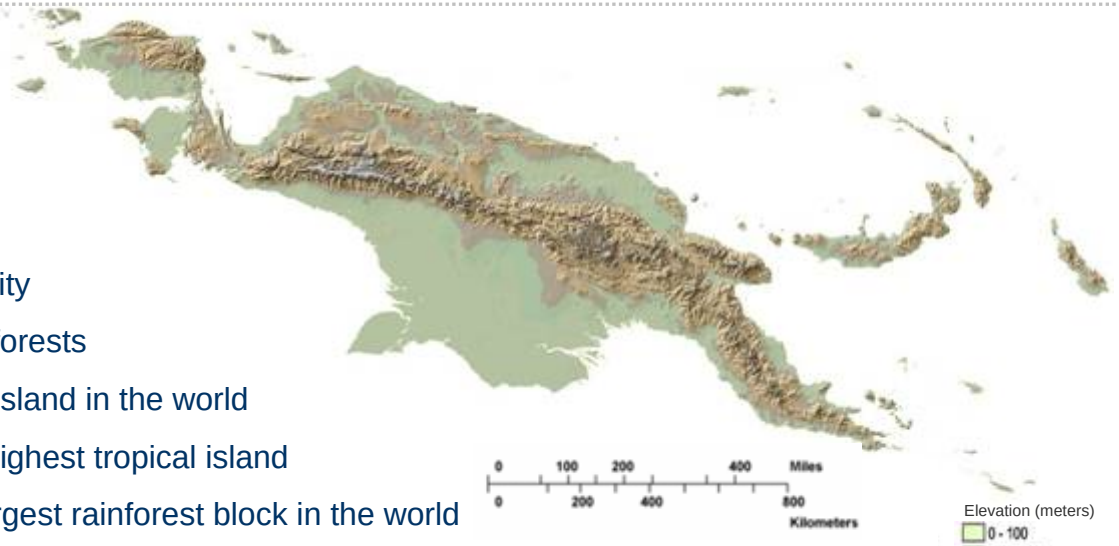
Any successful strategy to maintain viable communities of the fascinating and valuable plants and animals of the New Guinea region will require (1) the best scientifically-based landscape management plans for both conservation and production, and (2) feasible plans for economic and social developments that meet the needs and aspirations of local landowners and residents.

CSIRO

An Amazing Island

5% of the world's biodiversity in less than 1% of the world's land area

Equator



Tropical glaciers

Great language diversity

Largest mangrove forests

Second biggest island in the world

Largest and highest tropical island

Third largest rainforest block in the world

A remarkable concentration of endemic animals

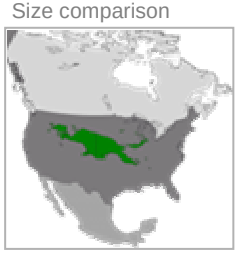
Largest block of rainforest in the Asian region

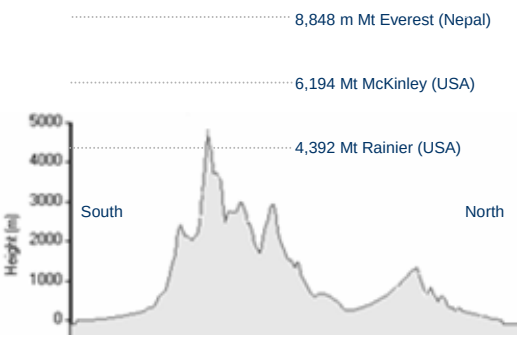
Highest mountains between Himalayas and Andes

Richest goldmine in the world

Some of the poorest people in the Western Pacific

Size comparison





Profile through Mt Carstensz (4,884 m)

100 Million Years of Earth History

Earthquakes & volcanoes

Present day

Assembly & mountain building

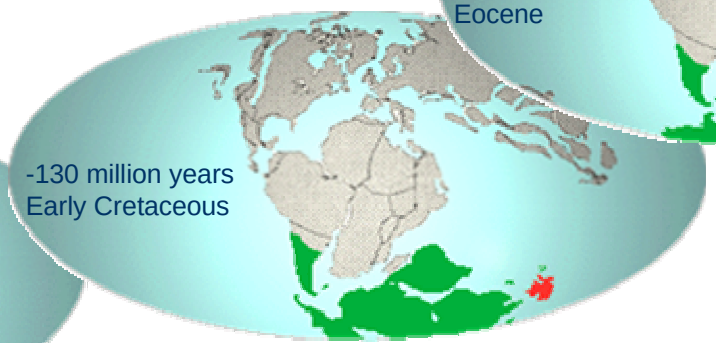
4 Million years ago (Pliocene)

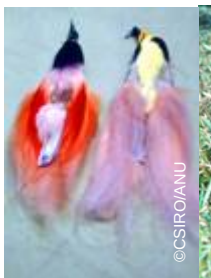
12 Million years ago (Miocene)

The history of New Guinea started about 130 million years ago with the break-up of the great southern landmass called Gondwana. The Australian continental plate then drifted northwards somewhat isolated from other lands and carrying a unique collection of plants and animals. The present form of New Guinea developed as the leading edge of the Australian plate crumpled on impact with a complex of smaller plates and volcanic islands near the equator. Much of New Guinea formed far to the east in the Pacific Ocean before being swept west and welded onto the northern coastline.

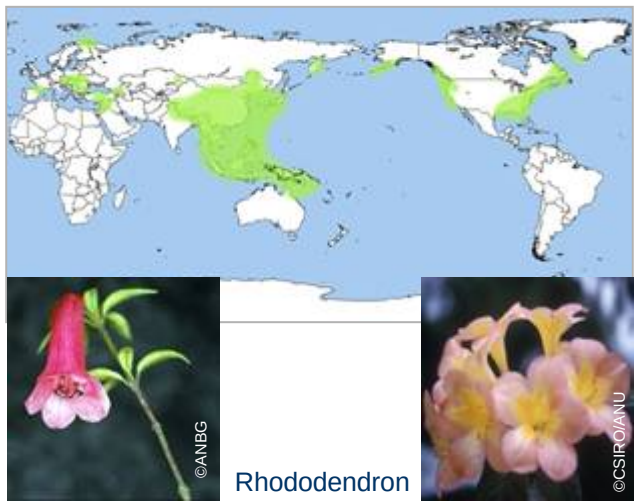
Each added area had a different evolutionary history and their amalgamation into a single but extremely mountainous landmass created one of the most biogeographically complex areas on earth. Biogeographers are just beginning to appreciate the complexity of New Guinea.

Conservation planning and implementation lag far behind.

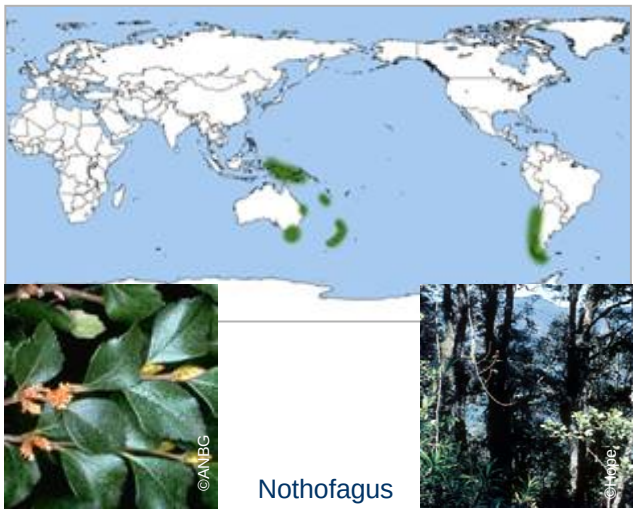




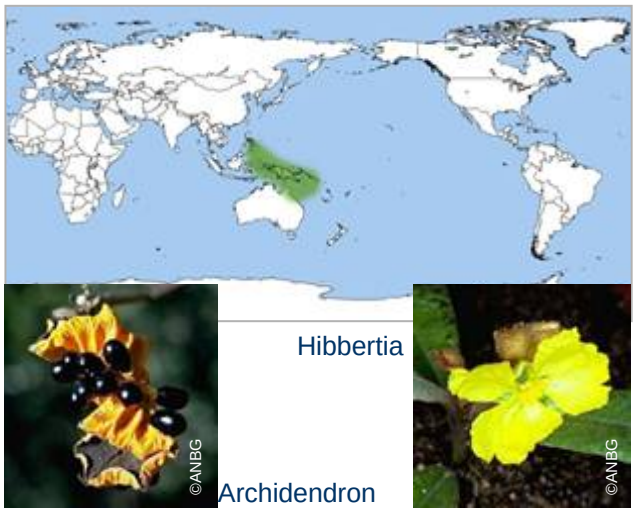
Mixing of the Floras



Rhododendron



Nothofagus



Hibbertia

Archidendron

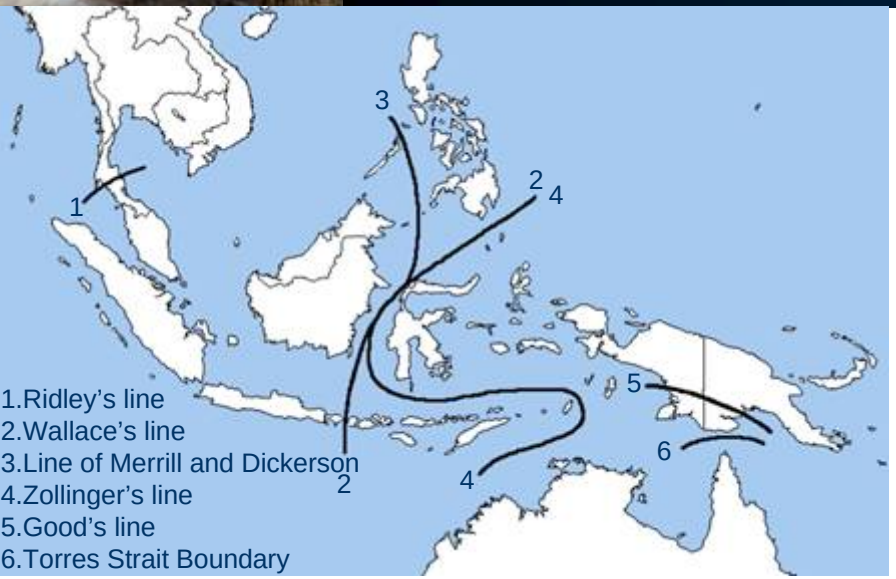
The complex history and geological features of New Guinea landmass have strongly influenced the nature and composition of its vegetation, and the rugged topography, widely differing climates and contrasting soils provide great variation in habitats for plant communities.

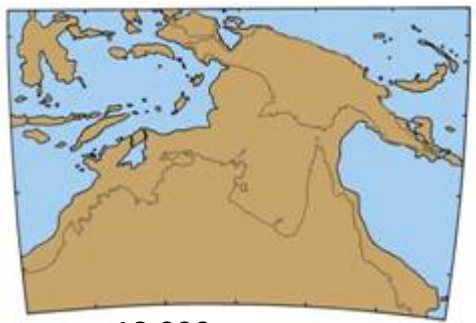
Once the vegetation of the New Guinea region became relatively well known, several key patterns of distribution and relationships at a global scale became evident. Firstly, the montane rainforests showed strong relationships with the ancient floras of Australia, New Zealand and South America (center map). At family and generic levels, the 'false' oaks, perhaps better known as the southern beeches (*Nothofagus* species), and the Araucarian conifers (the Monkey Puzzle Tree group) have global distributions that reflect the separation of the ancient landmass of Gondwana and the long, slow journey north by sections of the New Guinea landmass and adjacent lands. There are many other plant and animal groups in the montane habitats of New Guinea with similar southern origins and distributions.

In the elevated and moist upper foothill, montane and subalpine environments, there are appropriate habitats for plant groups that occur widely in the Northern Hemisphere, particularly in temperate habitats. Rhododendrons provide perhaps the best-known example (left map). Oak family representatives, the New Guinea Chestnut, *Castanopsis,* and the New Guinea Oak, *Lithocarpus*, show a somewhat similar pattern of distribution. Well-known North American representatives of these genera are the Golden Chinkapin (*Castanopsis chrysophylla*, native to the Pacific coastal slopes from California to Washington) and Tanoak (*Lithocarpus densiflora*, found along the coastal range from California to Oregon).

While a great many plant groups in New Guinea also occur widely around the tropics, some are restricted only to the region (right map).

Meeting of the Faunas

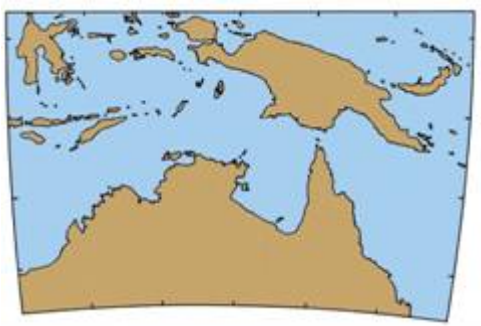




18,000 years ago

Over the last 2 million years, sea level was lowered during the great 'Ice Ages'. At the Last Glacial Maximum (LGM), 18,000 years ago, the sea level was 115 meters below the present surface. To the south and south-west of New Guinea, large areas of land were exposed for thousands of years.

Low sea levels allowed many plants and animals to disperse to New Guinea from both Asia and Australia by land bridges or 'island hopping' over small distances of ocean. However, the endemic species of the New Guinea highlands were 'locked in' with little access to suitable new habitats.



Present day coastlines

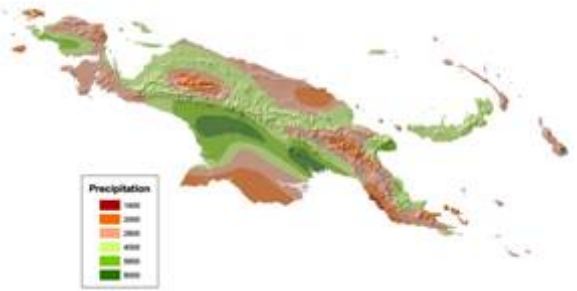
REGIONAL BIOGEOGRAPHIC DIVISIONS

Ridley's line (1) separates the Indochinese and Indo-Malayan biogeographic regions. Wallace's Line (2) was named for the 19th century English explorer and naturalist Alfred Russel Wallace who identified two distinct faunas on either side of this line. With the alternative boundary of Merrill and Dickerson (3), it separates the Papuan and Pacific flaunas from the Indo-Malayan region. Zollinger's line (4) accounts for the Timor subregion, and with Wallace's Line, for the Phillipines subregion. Good's line (5) or the Torres Strait boundary (6) separate the Northern Australia and Southern New Guinea fauna and flora. The characteristic animals with a Gondwanan heritage, the marsupials and monotremes, do not extend west of the New Guinea region.

Biophysical Environments

Soils

Data source: ESRI



Precipitation

Data source: ESRI

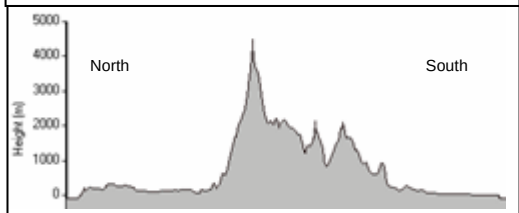
Temperature

Data source: PNG DEC

In the New Guinea region, the extreme contrasts in landscapes and climates are driving forces maintaining the amazing richness of plant and animal species. The environmental diversity is best portrayed by computer-aided analysis. (See BIORAP box). From flat coastal plains to the rugged cordillera, with soils varying from infertile to extremely rich, climates from tropical to glacial, and with rainfalls ranging from seasonally dry to persistently wet (up to 15 meters of rain per year), there are variations in environments on a scale unparalleled in the Pacific region.

Although broad lowland, montane, subalpine and alpine biotic zones have been based on altitude, procedures to identify representative areas for conservation are often confounded by the complex biogeographic history of the region.

The 608 BioRap environmental domains of Papua New Guinea (Nix *et al*. 2000)



The Mt Wilhelm - Crater Mt. topographic profile. The high and rugged mountains strongly influence regional rainfall patterns.

Three major climatic systems control regional weather patterns. The Inter Tropical Convergence Zone (ITCZ) passes over the region twice a year with its main influence from January to April. Cyclones often bring heavy rain and high winds at this time. Trade winds dominate from May to August.

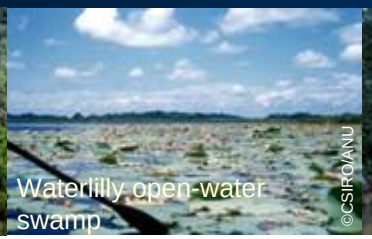
Ecological Communities

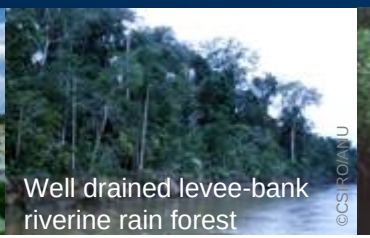

Apline grassland ©CSIRO/ANU

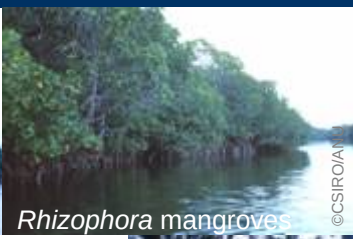

Subalpine treefern savannah ©Hope


Campnosperma swamp rain forest ©CSIRO/ANU

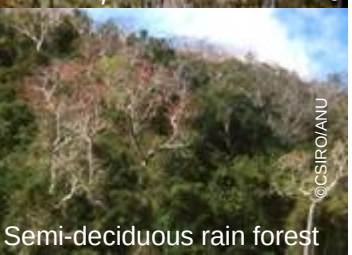

Nypa and coconut palm swamp rain forest ©CSIRO/ANU


Waterlilly open-water swamp ©CSIRO/ANU


Well drained levee-bank riverine rain forest ©CSIRO/ANU


Rhizophora mangroves ©CSIRO/ANU


Subapline mosaic with *Podocarpus* rain forest ©CSIRO/ANU

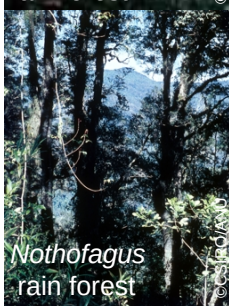

Semi-deciduous rain forest ©CSIRO/ANU


Eucalyptus savannah forest ©CSIRO/ANU


Waria-Waria oil-tree forest ©CSIRO

A generalised map of the plant communities map of the New Guinea Region (simplified from the WWF Ecoregions Map)


Klinki pine araucarian rain forest ©CSIRO/ANU


Nothofagus rain forest ©CSIRO/ANU


Montane mossy rain forest ©CSIRO/ANU

Grasslands may be *lowland* (seasonally dry, regularly burnt), *low to mid-elevation* (mostly below 2,900 m, largely man-made) or *mid- to upper and subalpine (*above 2,900 m, largely natural having a characteristic endemic mammal fauna) with *treefern savannahs* at 2,700 to 3,300 m. **Mangroves** and **lowland alluvial plain rain forests** occur as vast mosaics along the coastal lowlands. While structurally and floristically rich (including the important sago palm forests) they support few endemic mammals. **Foothill rain forests** on unstable steep slopes to 1,000 m altitude include *Araucaria* pines to 50 m tall and northern oaks, *Lithocarpus* and *Castanopsis,* with a few mammal species restricted to the zone. From 1,000 to 3,000 m, the **lower montane forest** has abundant litter, mosses, fallen stems, tree ferns and epiphytes. Here plants of Gondwanan origin (*e.g.* southern 'beech', *Nothofagus,* or southern conifers, *Podocarpus*) are very common and the mammal assemblage is the most diverse found in New Guinea, with many endemics. **Upper montane rainforests** (3,000 to 3,900 m) appear dominated visually by mosses. A few mammals are most abundant in or restricted to this habitat.

Biodiversity and Endemism

The New Guinea Region has 5% of the world's biodiversity in 1% of its area.

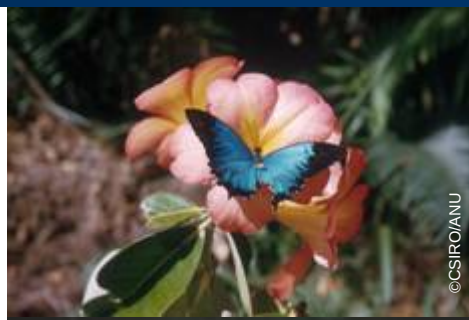
Plant species. The New Guinea Region (NGR) holds an estimated 20,000 to 25,000 species of ferns and flowering plants (perhaps 7.5% to 10% of the global total). There are 93 endemic plant genera and about 70% of the NGR species are thought to be endemic. Some plant groups have extraordinary levels of species richness. The region has 3,200 orchid species (nearly 10% of the global total) and 14 endemic genera of orchids. Descriptions of 567 *Dendrobium* species have just been published. Over 150 species of *Rhododendron* (right panel) occur throughout the NGR representing about 20% of the global total, and over 90% of these species are endemic.

Forest tree diversity. The species richness of the rainforests can be easily appreciated even when only trees larger than 10 cm diameter are considered. A typical lowland one-hectare plot may hold 600 trees representing approximately 50 families, 100 genera or 180 species. Yet nearly half the species may be represented by only a single tree on the plot. Forests at higher elevations may have more than 220 tree species present on a one hectare area.

Animal groups. The NGR has about 190 mammal species (more than 80% endemic) including the largest egg-laying mammal (monotreme) in the world, the Long-beaked Echidna. There are over 70 marsupials (80% endemic) represented by kangaroos, possums, cuscuses *etc*. with 10% of the kangaroo species in the world, and 8 endemic tree-kangaroos (upper left panel).

Other key animal groups include more than 750 bird species (49% endemic), around 500 reptile and amphibian species (46% endemic), some 300 freshwater fish species and perhaps 400,000 insect species.

Threatened Animals. Animal species placed on the Red List of Threatened Animals (International Union for the Conservation of Nature) include 38 mammals, 22 birds, 8 reptiles and 26 invertebrates in Papua New Guinea alone.



Culture and Politics

National boundary

Data source: DEC PNG

District and provincial boundaries (2002)

Data source: DEC PNG & digitized

Languages

Data source: SIL International

Humans settled in New Guinea at least 40,000 years ago. By 30,000 years ago, they reached the Highlands where farming and trading were in place some 10,000 years before now. Complex settlement patterns and the rugged terrain allowed about 1000 languages to develop. Portuguese mariners 'discovered' the land in 1512, naming it "Ilhos dos Papuas" or *Island of the Fuzzy Hairs*. The true nature of this culturally diverse, rich and rugged land was to remain hidden for another 400 years.

Dutch interests in western New Guinea date from 1660. In the east, formal British and German claims were made in 1884, and Australia established administrations in 1906 and 1914 (World War I). After Japanese invasion in World War II, the Dutch left the region and the Republic of Indonesia was declared in 1949. With the 1969 'Act of Free Choice', the former Dutch territory was named Irian Jaya, becoming the 26th Province of Indonesia. In the east, the nation of Papua New Guinea gained full independence from Australia in 1975 but has been dogged by continuing political and economic instability. In Irian Jaya, now Papua Province, there is continuing civil unrest from some indigenous people over Indonesian governance, transmigration and resource use policies.