

There are also considerable ethical issues regarding the impact of change and movements on humans and land use conflicts. Approaching these complex and interrelated issues from a wide range of different perspectives is a start to understanding and acting upon climate change adaptation.

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## Protection of the Cloud Forests and Their Biodiversity in the Coastal Cordillera of Venezuela

Winfried Meier



Avila National Park seen from the south east of Caracas (900-1,000 metres). The highest peak is about 2,600 metres. Photo: W. Meier.

The Coastal Cordillera of Venezuela stretches from east to west in a narrow band alongside the Caribbean Sea. The Cordillera principally consists of two mountain chains separated by high valleys, of which the best known is the Caracas valley. Generally the mountains are between 1,000 and 2,500 m.a.s.l. high. Moisture laden winds allow the growth of evergreen cloud forest islands within a mainly dryer vegetation. Additionally, more than half of the total precipitation may be caused by the cloud interception of the vegetation. Depending on the local conditions, cloud forests can be encountered between 600 and 2,200 m.a.s.l. The coastal mountains are among the most populated areas of the country.

The cloud forests of the Coastal Cordillera harbour an interesting mixture of plant species with different phytogeographical affinities (Andean, Caribbean, Amazonian and Guayanan elements). The mountain peaks with cloud forest are the major centres of endemism in northern Venezuela.

We are far from knowing all the species of this area, as the investigations of the author over the last years have shown. For instance the description of the tree species *Ampelozizyphus guaquirensis* (Rhamnaceae) showed that the genus was not monotypic but that the *liana A. amazonicus* of the coastal area of Venezuela has a sister species in the Coastal Cordillera (Meier and Berry 2008).

The Avila mountain region with the Avila national park, separated from the urban area of Caracas by a four-lane highway, is one of the floristically best known areas of Venezuela. In the "Flora del Avila" by Steyermark and Huber (1979) there are listed 1,892 vascular plant species. Approximately twenty years later, an additional 370 species have been registered, of which nearly 120

belong to (large and common) tree species and up to ten species are new to science (Meier 1998). Recent explorations have resulted in more than 250 additional species (Meier in preparation). It is possible that the area of this mountain range of approximately 100,000 hectares may harbour more than 3,000 different vascular plant species, nearly 20 percent of the total flora of Venezuela.

In the herbaria there are many botanical specimens from cloud forests still undescribed and there are even more to be discovered in the field. *Clusia* is a very important genus in the neotropics. It has many species, many of them still undescribed and forming dominant stands (especially at the forest/páramo border). In nearly all the herbaria most of the specimens are undetermined and a big part of the determined material is incorrectly identified. In many cases, the systematic revisions have not been transferred to the collections, thus there may be type material, a treasure, hidden within undetermined material. Many times the material is difficult to determine because of the inadequate conditions of the material, the dioecism of many species and the change of relevant taxonomic characteristics of specimens by the drying process. Another problem is that many herbaria are insufficiently staffed to be able to work on the taxonomic revisions to the specimens. Direct access to the internet and the availability of the relevant taxonomic literature in their libraries are often lacking, thus making effective work within the herbaria difficult. Furthermore, the floristic work is severely hampered by the absence of specialists in the relevant groups.

Cloud forests are the last frontier in the northern part of Venezuela. It is a difficult area to access because a lack of infrastructure such as roads, problems with the facilities and transport of the research institute and the inaccessibility during days or weeks in the rainy season. In many instances the main phenological periods of many important species are missed. In the planning and implementation of investigative projects, one has to allow time for failed expeditions because of bad weather conditions. Bureaucratic barriers (read permits) also make investigations difficult (permits by the environmental ministry, permits by the national park office, permits for regions with indigenous people, permits to enter private properties, CITES permits, etc.).



*Clusia* is a species probably new to science, from Avila National Park. Photo: W. Meier.

The precious cloud forest areas are threatened in different ways. The traditional practice of shifting slash and burn subsistence cultivation is still the predominant agricultural method. In some regions this practice is used for cash income near the bigger cities. A high percentage of the destruction is caused by people from outside the region. The cutting of the forest in order to create pasture land has increased dramatically in the last years, as has illegal logging, poaching, and collecting of ornamental plants such as orchids and bromeliads. Urbanisation and the construction of antennas and roads are other serious problems. In general in the Coastal Cordillera, the forests are not appropriate for sustainable agriculture and cattle raising because of the steep slopes, the acid soils and infertility. The best use is to preserve the forests as water reservoirs, thus indirectly protecting biodiversity. Huge areas are being destroyed without benefit for anyone due to deliberate or accidental fires and ignorance. Water will become a most precious good and Venezuela is lucky that the mountains still have forests that can capture the moisture. Without forested mountains, the northern part of Venezuela would be an arid land like many Caribbean islands without any pronounced elevations. Public and private campaigns should be created informing the people of all social strata, from farmers to policy decision makers, about the importance, beauty and fascination of the cloud forest ecosystems.

There are many areas of cloud forest protected within national parks and natural monuments, but there still remain many other areas under threat. The time during which extensive areas could be protected has passed. The biodiversity is now concentrated in relatively small areas, and therefore what is needed to protect this biodiversity are many small reserves and measures to protect these areas effectively.

There is an urgent need for a systematic investigation of the cloud forests of the coastal cordillera (distribution, species inventories) in order to prevent anonymous extinctions and anonymous loss of these ecosystems. More and financially attractive jobs for taxonomists and for experienced floristically orientated botanists should be created. Scholarships should promote interchanges with foreign institutions. Many relevant collections are housed in herbariums outside the host countries for historical reasons.

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