

Brazilian *Drosera* and Molecular Phylogeny of the Droseraceae

Fernando Rivadavia; Universidade de Sao Paulo, Brasil, (present address: Soshigaya Foreign Students House, 4-24-1 Kami-soshigaya, Setagaya-ku, Tokyo 157, Japan
ss66428@hongo.ecc.u-tokyo.ac.jp)

Four carnivorous plant genera occur in Brazil: *Drosera*, *Genlisea*, *Utricularia*, and *Heliamphora*. Of *Drosera*, there are circa twelve recognized species in Brazil south of the Amazon Basin, and anywhere between seven and fifteen in northern Brazil. Many more species are likely to be discovered in both these regions and several already have been, but have not yet been published.

Starting in 1990, I began studying carnivorous plants in their native habitats in Brazil south of the Amazon Basin. Except for *D. intermedia* HAYNE, all the *Drosera* taxa known to be native to this region were located and studied at innumerable natural populations. These are: *D. brevifolia* PURSH., *D. capillaris* POIR., *D. chrysolepis* TAUB., *D. colombiana* FERNANDEZ-PEREZ, *D. communis* ST. HIL., *D. graminifolia* ST. HIL., *D. graomogolensis* T. SILVA, *D. hirtella* ST. HIL. var. *hirtella*, *D. hirtella* var. *lutescens* ST. HIL., *D. montana* ST. HIL. var. *montana*, *D. montana* var. *schwackei* DIELS, *D. montana* var. *tomentosa* (ST. HIL.) DIELS, *D. sessilifolia* ST. HIL., and *D. villosa* ST. HIL.

Most of these *Drosera* grow on sandstone highlands, at 500-2500m of altitude, often in what is known as "campo rupestre" (rocky field) vegetation. This consists of herbaceous or low woody plants occurring in sandy soils, and is actually very similar to what is found on the famous Venezuelan tepuis. A few species are common in disturbed areas of rainforest-covered highlands of Eastern Brazil and three species are even found in coastal sandy swampy areas known as "restingas". Some are perennial but at least one species is annual. Several often go through a winter dormancy period (which corresponds to the dry season).

These and numerous other species of *Drosera* from around the world -- including also the closely related *Aldrovanda vesiculosa* L. and two species of *Genlisea* -- have been sequenced for rbcL, a chloroplast gene, for a phylogenetic study. The results so far obtained will be used to discuss -- together with the existing DNA sequencing data -- phylogenetic relationships of carnivorous plants, especially at the subgeneric and section level in the genus *Drosera*.

Ecology and Conservation of Bornean *Nepenthes* (Nepenthaceae)

Charles Clarke; Biology Department, Hong Kong University of Science & Technology,
Clear Water Bay Road, Kowloon, Hong Kong, Tel/fax: (852) 2554 1275

Borneo is the centre of diversity for *Nepenthes* with 31 species currently recognised (Clarke 1997, Jebb & Cheek 1997). This represents the largest assembly of *Nepenthes* for any single landmass, with 24 species endemic to the island. Diversity in Bornean *Nepenthes* is greatest in montane forests (those which generally occur above 1000 metres above sea level (a.s.l.)). The majority of the montane species persist as a few small populations isolated on mountain ridges or summits, whereas the lowland species tend to be more widespread. A small number of species are the subject of taxonomic debate and uncertainty--no opinion on these taxa is advanced here, but for obvious convenience the interpretations of Clarke (1997) are followed.

The ecology of *Nepenthes* is complex. Although generally confined to acidic, nutrient-deficient soils, they occur in a variety of habitats from maritime rocks and beaches to ericaceous scrub more than 3000 m a.s.l. Lowland habitats in which they are common include peat swamp forests, *kerangas* (heath forests), *padang* (cleared areas or those with sparse secondary vegetation) and limestone. *Kerangas* and *padang* vegetation are the strongholds for lowland *Nepenthes* in Borneo and can be used as indicators of their presence. Interactions with animals range from prey capture and digestion to the provision of habitats for invertebrates. Prey capture strategies vary among different species, but remain little-studied. The invertebrate faunas comprise a wide array of different metazoan types, the community structure of which

has been examined in detail by several authors. Contradictory observations and theories abound in this field. New research into the roles of extra-floral nectaries promises to add considerably to our knowledge in *Nepenthes* ecology.

Published surveys of the conservation status of Bornean *Nepenthes* remain few. The most thorough estimates are provided by Simpson (1995) and by Clarke (1997), whose estimates are based on recent field observations. However, inaccuracies persist due to a continuing lack of knowledge of the distributions of several taxa. The species from Sabah, Sarawak and Brunei are reasonably well understood, but information from much of Kalimantan remains scant. Moreover, the recent effects of devastating forest fires upon the lowland species there are yet to be determined. Fortunately, most of the highland taxa from Kalimantan do not seem to have been affected by the 1997 fires, but the re-occurrence of severe fires in East Kalimantan this year, coupled with an ongoing drought, poses a further, enhanced threat. From a horticultural perspective, the role of CITES and the IUCN in the conservation of *Nepenthes* remains controversial, but often this reflects a lack of understanding of the objectives and functions of these institutions. Increased public awareness of the conservation status of *Nepenthes* is therefore essential in ensuring the preservation of remaining wild populations.

References

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Nepenthaceae in their Habitats

Joachim Nerz; Arndtstr. 2, 71032 Böblingen, Germany

Nepenthaceae (pitcher plants) are distributed especially in SE-Asia. Just single species also colonize Australia, New Caledonia, India, Sri Lanka, Seychelles and Madagascar. The highest degree of diversification is registered at the islands of Borneo and Sumatra. Nepenthaceae are usually inhabitants of poor soils in the tropics. Classically two ecological types of Nepenthaceae are distinguished: lowland species and highland species. Typical members of the lowland species are e.g. *Nepenthes mirabilis*, *Nepenthes gracilis* or *Nepenthes ampullaria*, which are growing in rather sunny and hot grassland areas, at the edge of lowland forests or swamp areas. Several of the lowland species are widely distributed. *Nepenthes mirabilis* has a vast distribution. This species can be found everywhere in SE-Asia and even in China and tropical Australia. Other species have been found just at some few locations, like *Nepenthes sumatrana* near Sibolga in Sumatra; *Nepenthes bellii* at single locations at Mindanao or *Nepenthes tomoriana* in Sulawesi. Many of these endemic lowland species are coastal, other endemic lowland species are restricted to a narrow area of limestone, as can be demonstrated e.g. at *Nepenthes northiana* or even more extremely in *Nepenthes campanulata*. Typical examples for highland species are *Nepenthes lowii*, *Nepenthes macrophylla* or *Nepenthes villosa*. These species are usually growing in between shrubs and low trees at higher altitudes on tropical mountains. Frequently they are highly endemic and have so far only been found at some very few or even single montane areas. So *Nepenthes dubia* is just recorded from one montane location in Central Sumatra; another highly endemic species is *Nepenthes aristolochioides*, which has just been recorded from some few specimens in a tiny habitat. Not all species that are known just from single locations have to be such strictly endemic. *Nepenthes ephippiata* has just been recorded from four expeditions at two locations in Central-Kalimantan, but it can be presumed that it could be rather common in that area. It remains very difficult to explore these areas. It is interesting to observe that frequently the same species shows slight but constant differences at different locations. So e.g. *Nepenthes singalana* is slightly but constantly different at nearly all known locations. It makes the taxonomy of *Nepenthes* rather complex, but it is a phantastic field to observe species diversification in