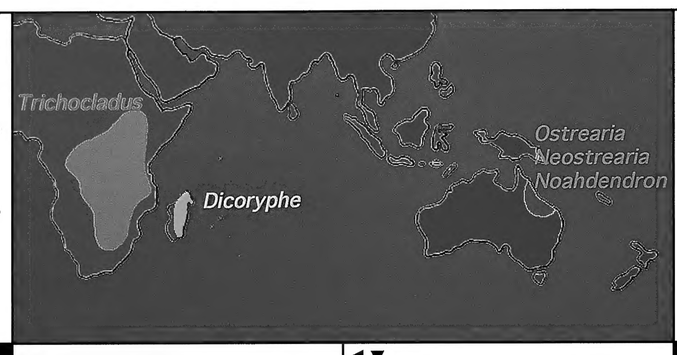
Research at the Missouri Botanical Garden

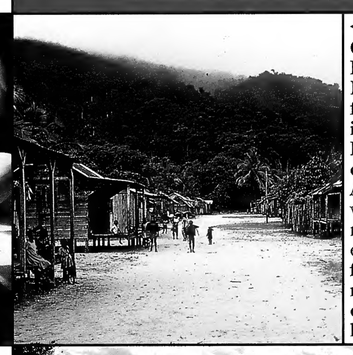
Madagascar

Plant Families—Endemism: Madagascar has nine families of plants that are found only on the island. Below, *Sarcolaena multiflora* is a showy member of the Sarcolaenaceae family. Armand Randrianasolo, a Malagasy doctoral candidate studying at MBG, recently revised the genus *Sarcolaena*. **Training future botanists is an important part of MBG's research program.** International students from countries where Garden research is conducted enroll at degree-granting universities in St. Louis. [GS]



Distribution—Biogeography: Madagascar is a living laboratory of evolution where many ancient groups have survived in isolation. At left, the distribution of genera in subtribe Dicoryphinae of the witch hazel family, Hamamelidaceae, illustrates how **Madagascar's flora is linked with that of both Asia and Africa.** Right, *Dicoryphe macrophylla*, one of 12 species in the genus, all endemic to Madagascar. The Hamamelidaceae otherwise occur throughout the northern hemisphere; several species are native to Missouri. [GS],[GS]

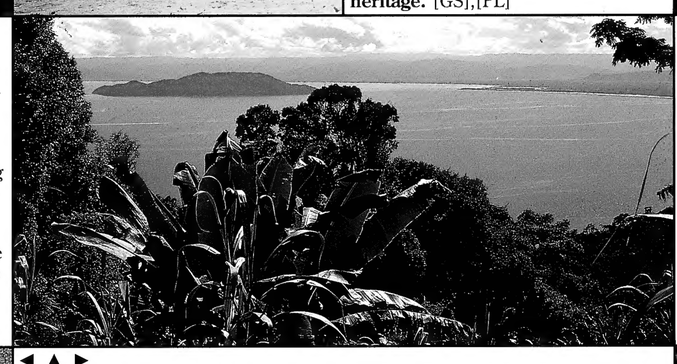
Biodiversity: The island of Madagascar off the east coast of Africa covers 587,000 km², an area about the size of California and Arizona. **Among the island's 10-12,000 native vascular plant species, about 80% are endemic, found nowhere else on Earth.** The vegetation of this micro-continent ranges from deserts and dry deciduous woodlands to lush rain forests. **Madagascar's exceptional flora is among the most highly threatened in the world.** Above, virgin rain forest at 700m in Manongarivo Special Reserve. **The world's biodiversity is concentrated in the tropics, home to 170,000 of the world's 250,000 species of flowering plants.** Pressures on natural ecosystems from growing populations, economic development, agriculture, and deforestation are greatest in tropical countries, including Madagascar. **As an island, Madagascar's native vegetation is especially vulnerable; when fragile habitats are altered and degraded, locally endemic species can quickly become extinct.** [PL]



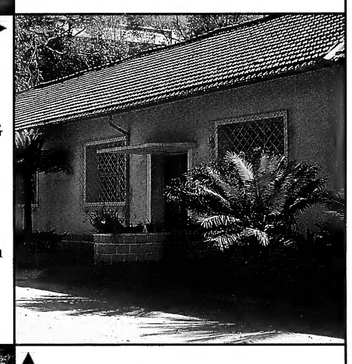
Conservation—Masoala National Park: Below, the island of Nosy Mangabe in the Bay of Antongil, seen from the Masoala Peninsula. **The island is part of Masoala National Park, Madagascar's newest protected area.** At left, the village of Ambanizana sits at the edge of the park, which preserves the country's largest remaining area of low elevation rain forest. **Madagascar is committed to finding a balance between the needs of its growing population and conservation of its priceless natural heritage.** [GS],[PL]

Medicinal Plants—Rosy Periwinkle: Most species of the genus *Catharanthus* (Apocynaceae) are native to Madagascar. The rosy periwinkle, *C. roseus*, a common horticultural species throughout the world, is the source of the compounds vincristine and vinblastine, **effective in treating childhood leukemia and Hodgkin's disease.** Left, *C. ovalis*, one of Madagascar's native species, is a close relative of this valuable medicinal plant. [GS]

Plant Families—Endemism: The Didiereaceae (*Alluaudia ascendens*, above left) **illustrate a striking example of convergent evolution.** They strongly resemble but are unrelated to members of the desert genus *Fouquieria* (Fouquiereaceae), including the ocotillo and boojum trees of southwestern U.S. and Mexico. The Didymelaceae (*Didymeles integrifolia*, left) are a primitive family related to the boxwoods (Buxaceae). Shown here are female flowers of this dioecious, wind-pollinated genus. [GS],[GS]



Collaboration: The herbarium at the Parc Botanique et Zoologique de Tsimbazaza in Antananarivo, right, houses one of Madagascar's two main botanical collections (see below). **MBG has collaborated actively with Malagasy institutions for nearly 25 years.** Dr. Porter P. Lowry II and Dr. George E. Schatz coordinate MBG's programs in Madagascar, which **focus on botanical exploration, institution building, and training of Madagascar's future generation of botanists.** [JZ]

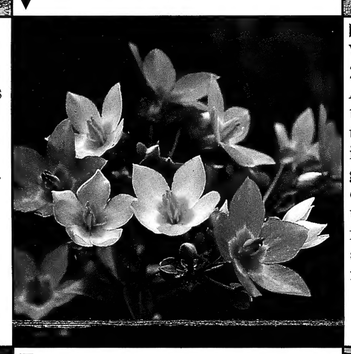


Conservation—Ranomafana National Park: This park was established in 1991, and its flora has been inventoried by local collectors in collaboration with MBG and the Parc de Tsimbazaza. At left, **rain forests in Ranomafana extend from 600 m to 1300 m above sea level.** Below, the beautiful *Exacum divaricatum* ssp. *latifolium* of the gentian family (Gentianaceae) grows in the park; a total of 38 endemic species of *Exacum* occur in Madagascar. [LM],[GS]

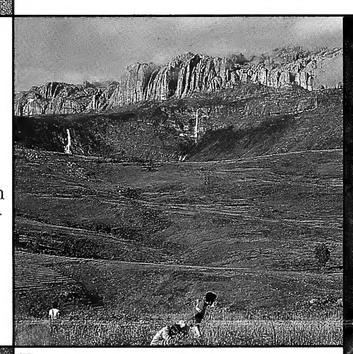
Conservation—Masoala National Park: The island of Nosy Mangabe, above, shelters an extraordinarily rich biodiversity in an area of only 520 hectares. The island has at least 24 species of *Diospyros*, the genus that includes ebony and persimmon; 12 species were found fruiting simultaneously, left. The rare species *Vitex masoalensis* (Verbenaceae), right, was described by MBG botanist Dr. George E. Schatz and is known from only two small populations in the Masoala park. **Hundreds of other species are also restricted to the remaining rain forests of northeastern Madagascar.**
In 1988, the type collection of *V. masoalensis* was the 3.5 millionth specimen added to the MBG herbarium; duplicate specimens (isotypes) are deposited at the Parc de Tsimbazaza in Madagascar and at the Natural History Museum in Paris. **Today MBG's herbarium contains over 4.6 million specimens, including the largest collection of plants from Madagascar in North America.** [GS],[DP]

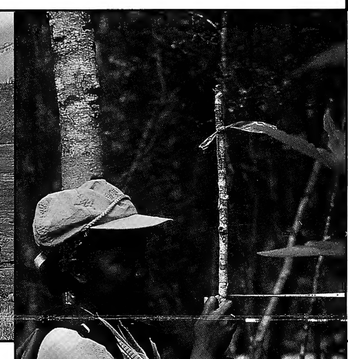
Collaboration: MBG and the Parc de Tsimbazaza, above, collaborate with Madagascar's other major herbarium at the Centre National de la Recherche Appliquée au Développement Rural (FOFIFA) in Antananarivo, and with the Natural History Museum in Paris on the *Madagascar Conspectus Project*. This international endeavor makes up-to-date information on the vascular plants of Madagascar widely accessible. **All MBG floristic projects utilize TROPICOS, the computer database developed at MBG.**

Exploitation of Resources—Tree Ferns: *Cyathea* spp. (Cyatheaceae) are abundant only in the most remote areas of Ranomafana National Park. Near villages, most trunks have now been cut to make planters, resulting in the extinction of local tree fern populations. Each container, shown below, represents a plant that took decades to grow. **More sustainable utilization of natural resources is necessary to ensure the long-term survival of Madagascar's unique flora and fauna.** [GS]

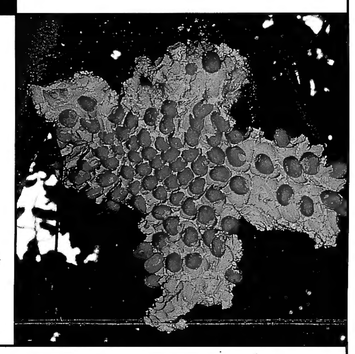


Vegetation—Montane Habitats: The 2550 m granite massif of the Andringitra Reserve, with the second tallest peak in Madagascar, is **one of the few remaining areas on the island with native high elevation grassland vegetation,** similar to that of the African highlands. Botanists from the Parc de Tsimbazaza study and carefully sample the **numerous endemic species restricted to these unique montane areas.** [GS]

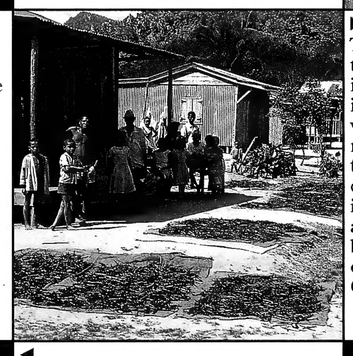




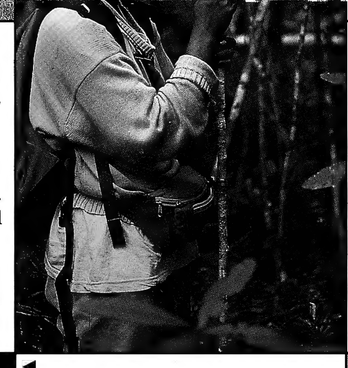
Seed Dispersal: Open fruits of *Tambourissa nicolliae* (Monimiaceae) reveal orange pulp and seeds that attract birds, which eat the fruit and in the process disperse the seeds. This species was recently described by Dr. Joël Jérémie of the Natural History Museum in Paris and Dr. David Lorence, a former MBG graduate student. *T. nicolliae* is **known from only three collections, all made by MBG botanists in eastern Madagascar. MBG researchers describe about 200 new species each year.** [PL]



Economic Plants—Vanilla: A member of the orchid family (Orchidaceae) native to tropical America, vanilla is one of Madagascar's principal cash crops, providing an important source of income to the rural population. Vanilla vines are grown on the trunks of native trees; the fruits are dried and cured before being sent to market. **Sustainable agriculture such as vanilla cultivation offers an important option for conservation efforts by reducing the pressures to clear native forests.** [GS]



Training and Education: MBG has trained over 25 Malagasy botanists in a wide range of research techniques, including plant identification, field surveys, and the establishment of permanent plots used to inventory and monitor forest diversity and ecological changes, shown at right. **MBG's training work in Madagascar has served as a model for new programs now being developed in other African countries, such as Tanzania, Gabon, Cameroon and Congo.** [GS]



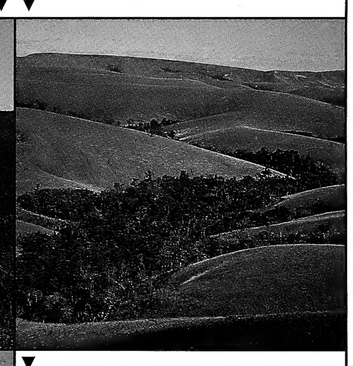
Ecological Degradation—Burning: Central Madagascar was once covered by vast areas of woody vegetation, but after 20 centuries of regular burning by humans (below, left) **only small remnants of the original forest remain** (below, right). Thin tropical soils exposed by indiscriminate burning quickly become unproductive for agriculture and cannot easily be restored. On steep slopes, **when the original vegetation is removed, torrential rains cause tremendously destructive erosion.** From outer space, astronauts can see huge sediment plumes where Madagascar's largest rivers "bleed" into the Indian Ocean. [GS],[PL]

Constantly expanding agriculture caused by unabated population growth is the leading cause of the dramatic decline of natural vegetation worldwide. **Scientists estimate that most tropical forests will be damaged or destroyed in the next 20 years if no steps are taken to protect them. MBG research supplies basic scientific information essential to planning for sustainable development.**

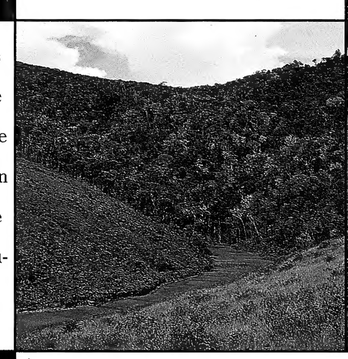
Ornamentals—*Stephanotis*: Madagascar has provided many plant species to the horticulture trade, including the fragrant *Stephanotis floribunda* (Asclepiadaceae), commonly used in bridal bouquets. An even more spectacular close relative, *S. grandiflora*, below, is a vine growing along the coast in the new Masoala National Park. **MBG is coordinating a collaborative project that will result in a treatment of the family Asclepiadaceae for the ongoing *Flore de Madagascar* published in Paris.** [GS]

Ornamentals—Impatiens: Over 100 species of *Impatiens* (Balsaminaceae) are native to Madagascar, many of which are spectacular and potentially important as ornamental plants. **This is just one of Madagascar's many poorly known groups** that still lack treatments in the *Flore de Madagascar* series. Delicate, intricately marked flowers are inadequately preserved on most herbarium specimens, necessitating field studies, photos and cultivation to understand and classify the species. [DP]

Biogeography—Links to Asia: The coastal vegetation growing along Madagascar's eastern shore has many plants that also occur in Asia, such as *Barringtonia asiatica* in the Brazil nut family (Lecythidaceae), at left. The floating fruits can be carried great distances across the ocean; their seeds germinate quickly when deposited on beaches. **Plants adapted for long-distance dispersal by wind or sea currents often have wide geographic distribution.** [GS]

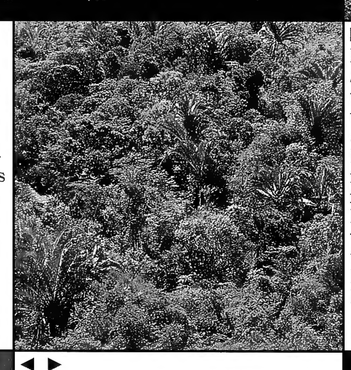


Vegetation—Desert: Tree euphorbias (Euphorbiaceae) such as *Euphorbia stenoclada*, left, are characteristic of the spiny vegetation in Madagascar's dry southwestern region. These plants have adapted to long periods of drought by evolving thick leaves and stems that can store water. In Madagascar, **large areas of spiny desert vegetation are being destroyed each year to produce charcoal for the growing population** that lives in nearby towns and cities. [PL]



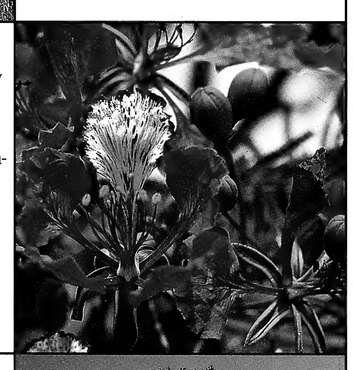
Ornamentals—Legumes: The royal poinciana, or flamboyant tree, *Delonix regia*, is **a native of Madagascar and one of the most widely planted ornamentals throughout the tropics.** It is one of about 650 members of the legume family (Fabaceae) that occur on the island and are being studied by an international team of botanists from the Natural History Museum in Paris, the Royal Botanic Gardens, Kew, and FOFIFA in Madagascar. [GS]

Native Plants—Palms: The widely cultivated triangle palm, *Dypsis decaryi*, a popular indoor landscape plant at shopping malls, **grows wild in only a few isolated populations** in the Andohahela National Park of southeastern Madagascar, right, where it was recently studied by Dr. Joelisoa Ratsirarson. A recent book by Dr. John Dransfield and Dr. Henk Beentje from the Royal Botanic Gardens, Kew, describes **the island's 171 native species of palms (Arecaceae), of which 166 are endemic.** [GS]



Native Plants: *Gladiolus horombensis*, **right, a wild relative of the commonly cultivated ornamental gladiolus,** was recently described as a new species by MBG botanist Dr. Peter Goldblatt, a specialist in the iris family (Iridaceae). **This rare plant is found only on the Horombe Plateau,** whose distinctive vegetation was studied by Prof. Philippe Morat of the Natural History Museum in Paris. Prof. Morat is an Honorary Trustee of MBG. [GS]

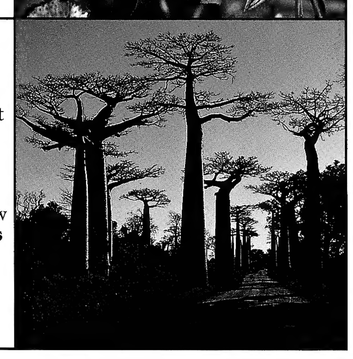
Agriculture—Food Production: The Malagasy people are among the highest per capita consumers of rice in the world. Intact forests provide a steady supply of water for sustainable paddy rice production on terraced hillsides and in valleys, above left. But paddy rice is no longer sufficient to feed Madagascar's exploding population; in eastern Madagascar over 75% of the rain forest has already been cleared and burned to produce hill rice, above right, and the remaining areas are under increasing pressure. After a few years heavy rains quickly deplete the soil, forcing farmers to abandon their land and seek new forest areas for clearing. **Three key members of the grass family (Poaceae)—rice, wheat, and corn—are the source of half of the food consumed by humans.** Of the 250,000 species of flowering plants on Earth, less than 10% have been studied for their usefulness to humans. **New species that have yet to be discovered by botanists may supply important sources of food for the world's rapidly growing population.** [GS],[PL]



Pollination—Lemurs: The traveller's tree, *Ravenala madagascariensis* (Strelitziaceae), left, has come to symbolize the plants of Madagascar. It is pollinated by the black and white ruffed lemur, *Varecia variegata variegata*, right. Recent studies by Dr. W. John Kress have documented lemur pollination, confirming the hypothesis first proposed by Dr. Robert W. Sussman and MBG's director Dr. Peter H. Raven. **There are 28 species of lemurs, an early primate group endemic to Madagascar.** [GS],[JK]

Native Fauna: Madagascar has many endemic groups of animals as well as plants. **More than 90% of the native amphibians and reptiles, including over half of the world's species of chameleons, are endemic to the island.** Other animals unique to Madagascar include more than half of the 201 native species of birds; all 28 species of tenrecs, small insectivorous animals that resemble hedgehogs; and untold numbers of insects. [GS]

Native Plants—Baobabs: Madagascar's six native species of baobabs, *Adansonia* (Bombacaceae), grow in dry areas in the south and west and can withstand long periods of drought by storing water in their swollen trunks. Recent studies by former MBG graduate student Dr. David Baum, now of Harvard University, show that the **different species of baobabs are pollinated by an amazing array of animals, including insects, bats, birds, and lemurs.** [PL]



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Research at the Missouri Botanical Garden

Over fifty Ph.D.-level scientists—many of whom live abroad—technical staff, and graduate students are devoted to studying plants. These efforts are concentrated in Mesoamerica, South America, subsaharan Africa, Madagascar, China, and North America. Individual MBG scientists are specialists in the plants of particular regions or in the classification of major plant families. MBG serves as headquarters of the Center for Plant Conservation and for the major collaborative projects *Flora of China, Flora Mesoamericana,* and *Flora of North America*. MBG floristic research and library resources are available on the Internet (http://www.mobot.org/). MBG botanists collaborate with local institutions in each country where they conduct research, providing technical expertise, assisting with fundraising, establishing better communication with the worldwide scientific community, training botanists in the field and at MBG, and helping to build infrastructure. Botanical research provides basic scientific knowledge for setting conservation policies to preserve global biodiversity.

Photo Credits / Key to Symbols

MBG = Missouri Botanical Garden
[DP] David Parks, Stanford University
[GS] George E. Schatz, MBG
[JK] W. John Kress, Smithsonian Institution
[JZ] James Zarucchi, MBG
[LM] Leslie Miller, MBG
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