# news from MO 2005

## research and conservation projects at the Missouri Botanical Garden




MISSOURI BOTANICAL GARDEN

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mission of *News from MO*

*Since 1982,* News from MO *has been published yearly by the Division of Research of the Missouri Botanical Garden (MBG). This publication is designed to share information about the projects that researchers from MBG, in collaboration with researchers from around the world, have been working on recently.* News from MO *is distributed mainly to herbaria and other institutions engaged in botanical research and conservation.*

# MBG plant science overview

The Missouri Botanical Garden (MBG) is at the forefront of the urgent struggle to discover, understand, and conserve the world's botanical diversity as species and habitats rapidly diminish. Through carefully designed programs of botanical investigation and conservation, MBG is contributing to solving the biodiversity crisis.

The Missouri Botanical Garden's work concentrates in biodiversity rich areas of the world, where MBG has established fully collaborative research and conservation programs focusing on botanical exploration, analysis of plant diversity patterns, training in botany and conservation, and sustainable development. MBG places particular importance on building capacity for the study of plants and for conservation and actively promotes networking to support scientific research and conservation worldwide. The significant contribution made by MBG in scientific research and conservation is complemented by comprehensive programs of formal and informal training, which are empowering the next generation of biologists, conservationists, and concerned citizens as they protect their own biodiversity resources. MBG's support to institution building provides needed help to conduct research and conservation in at-risk areas.

Through its TROPICOS Information System, its herbarium, and its publications, MBG continues to provide and expand access to its accumulated knowledge on plants and their ecosystems. MBG maintains a research and conservation staff of over 140, including 46 Ph.D. scientists engaged in botanical systematic research, floristic exploration, and conservation assessment. Twenty percent of these scientists are stationed overseas; the others travel extensively to tropical countries to increase knowledge of plants and of the world's ecosystems.

Given its scientific strength, its extensive collaboration network, and the plant specimen resources amassed over many years, MBG also focuses on analysis of the TROPICOS data and on marshaling efforts to assess and implement science-based conservation strategies. Only through an approach to conservation grounded in sound, scientific knowledge, together with the active participation of local institutions and trained local scientists, can we achieve protection of the fragile environment that supports us all.

Robert Magill
*Director of Research, Missouri Botanical Garden*

*El Missouri Botanical Garden (MBG) está a la vanguardia en la urgente lucha por el descubrimiento, entendimiento y conservación de la diversidad botánica del mundo en donde las especies y sus hábitats van disminuyendo aceleradamente. A través de los programas de investigación botánica y conservación cuidadosamente diseñados, el MBG está contribuyendo a la solución de la crisis de la biodiversidad.*

*El trabajo del Missouri Botanical Garden se concentra en las áreas del mundo ricas en biodiversidad, en donde el MBG ha establecido programas de investigación y conservación totalmente cooperativos y enfocados hacia la exploración botánica, el análisis de modelos de diversidad de plantas, el entrenamiento en la botánica y conservación, y el desarrollo sustentable. El MBG da importancia particular a la capacitación y al mejoramiento institucional, necesarios para el estudio y la conservación de las plantas y promueve activamente la gestión de redes de apoyo para la investigación científica y conservación mundiales. La significativa contribución que el MBG realiza en la investigación científica y en la conservación se complementa con los comprensivos programas de entrenamiento formal e informal, los cuales están invistiendo en la próxima generación de biólogos, conservacionistas, y ciudadanos interesados quienes igualmente protegen a sus propios recursos de la biodiversidad. El apoyo del MBG al mejoramiento institucional provee la ayuda tan requerida para la conducción de investigación y conservación en las áreas en peligro.*

*A través de su Sistema Informático TROPICOS, su herbario y sus publicaciones, el MBG continúa proporcionando y permitiendo el acceso a su conocimiento acumulado de las plantas y sus ecosistemas. El MBG cuenta con más de 140 personas que trabajan en investigación y en conservación, incluyendo a 46 científicos Ph.D. comprometidos en la investigación botánica sistemática, en la exploración florística y en la evaluación conservacionista. Un veinte por ciento de estos científicos reside en el exterior; y el resto viaja extensivamente a los países tropicales con el objetivo de incrementar el conocimiento de las plantas y de los ecosistemas del mundo.*

*Dada su fortaleza científica, su extensa red de colaboración, y sus especímenes de plantas acumulados durante muchos años, el MBG también se enfoca en el análisis de los datos de TROPICOS y en reunir esfuerzos para evaluar y llevar a cabo estrategias de conservación basadas en datos científicos. Sólo a través de una aproximación a la conservación basada en el conocimiento científico firme, junto con la activa participación de instituciones locales y de científicos locales entrenados, lograremos proteger al ambiente frágil que nos sostiene a todos.*

# Center for Conservation and Sustainable Development (CCSD)

The year 2004 marked a period of notable achievement for the Center for Conservation and Sustainable Development (CCSD), a Division of the Missouri Botanical Garden. We have clearly articulated CCSD's mission and are working robustly toward the five goals designed to safeguard Earth's biodiversity through the collaborative development and wise application of scientific expertise and resources:

- To analyze and interpret scientific data as a basis for conservation decision-making
- To build the capacity for conservation in tropical countries by training local people in conservation science
- To develop community programs aimed at sound local management of natural resources
- To build partnerships with public and private sector organizations and agencies to foster conservation
- To participate in and promote the international conservation endeavor

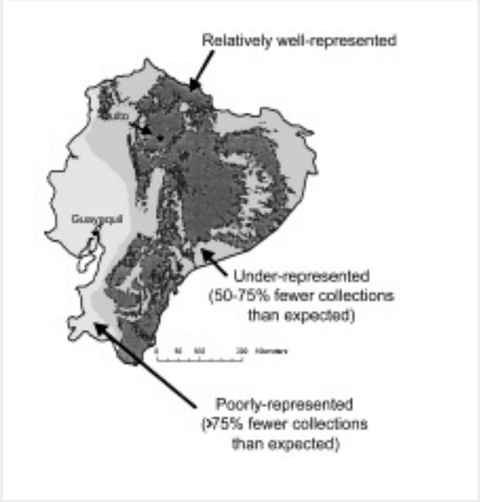
During the past year we have made significant strides in using the Missouri Botanical Garden plant data for conservation analysis. Another highlight of 2004 has been the consolidation and intensification of some of CCSD's training and community-based programs. In addition to these accomplishments, the development of the branding for CCSD, including creation of a presentation literature and launching of the CCSD Web site (www.mobot.org/plantscience/CCSD/Frontpage.html), has been of great importance in establishing a presence for CCSD among the leading forces for conservation, especially in Latin America, Madagascar, and Vietnam.

## ANALYSIS UNIT

CCSD, in collaboration with the Research Division and the International Center for Tropical Ecology at the University of Missouri-St. Louis (ICTE), has established an Analysis Unit, which uses biological data to answer questions that elucidate key issues in conservation biology. Using modern analytic tools, the Analysis Unit is modeling the geographic distribution of different species and identifying regions that contain high plant diversity, particularly regions that sustain high numbers of plant species with narrow geographic distributions. For sample projects of CCSD's Analysis Unit, see MBG GIS Lab (page 19).

To spur the formulation of testable hypotheses to guide their data analyses, CCSD scientists have developed questions such as the following:

- **Identifying areas of high plant diversity:** Spatial patterns of richness are central to identifying priority areas for conservation. Yet descriptions of such patterns are dependent on distribution maps, which are commonly affected by bias in biodiversity data. CCSD is using several analytical tools to distinguish taxa whose distribution appears restricted as a result of poor collection effort from taxa that are truly narrowly distributed.
- **Evaluating the processes that contribute to biodiversity patterns:** The conservation of biodiversity depends on the processes that determine the extinction and production of species; thus, the selection of priority areas for conservation should be informed by the study of such processes. CCSD is using data from a few plant groups to test predictions from hypotheses about the origin and maintenance of biodiversity.
- **Determining how large reserve networks need to be:** Identification of reserve networks for conservation is typically focused on minimizing the total area needed to represent a given number of taxa. CCSD is testing the effects of three variables on the area of reserve networks: 1) number of targeted species, 2) size of selection units, and 3) endemism of the targeted species.
- **Using occupancy and abundance estimates to identify reserve networks:** Reserve networks are often identified using only occurrence data and thus are likely to include populations with low probability of persistence. CCSD is using data on abundance and occupancy (portion of sites occupied across a region within the geographic range) to identify reserve networks that are resilient against temporal species turnover.




*(FIG 1) CCSD's Analysis Unit is using plant collection data and climatic remote-sensed data to evaluate the use of ecological niche modeling. The map above depicts under-represented areas in relation to climatic gradients for Ecuador. Areas in the lightest shade represent parts of the climatic gradient where plant collection intensity was less than 75% of the collections expected of equal sampling along gradients. Areas in intermediate shades represent climatic areas where sampling was from 50-75% below expectations, while the darkest areas were less than 50% below expectations or exceeded expectations in terms of collecting efforts.*

PHOTO BY MBG RESEARCH

*(FIG 2) Rodolfo Vásquez, MBG's Curator-in-Residence in Peru, pictured with the participants of the 2004 introductory field-based course in botany and conservation conducted in Yanachaga-Chemillén National Park in the Selva Central of Peru.*

## TRAINING AND CAPACITY BUILDING

In tropical countries MBG has for several years conducted tiered training programs in botany and conservation designed to strengthen the ability of local people to manage their natural resources for their own benefit and, at the same time, to enhance opportunities for employment and community development. These programs take place within the context of MBG's ongoing botanical research, linking exploration to training. The goal is to raise the level of university programs in biology, provide formal professional development, and increase the number of individuals qualified to assist with field research and herbarium work. In recent years, CCSD in collaboration with the Research Division has expanded these training programs.

**Training in Latin America:** This multi-tiered program is designed to attract students to conservation biology and botany early in their university careers. During 2004 CCSD conducted introductory short field courses, a two-month field-based course for more advanced undergraduates from several countries, mentored fellowships for the undergraduate thesis, and short-term fellowships at MBG for a total of 64 students from Bolivia, Ecuador, and Peru.

PHOTO BY MBG RESEARCH

*(FIG 3) Bolivian botanist Israel Vargas, who assisted in MBG training programs, explains plant identification techniques to students during one of the field courses in Las Yungas de Mairana.*

CCSD also conducts training for park guards (page 33) and members of local communities that is directly applicable to conservation. (FIG 78, page 33)

*Additional information:*
www.mobot.org/MOBOT/Research/training/training.shtml.
*Contact:* David Neill (Ecuador), Rodolfo Vásquez (Peru), and Steve Churchill (Bolivia)

PHOTO BY MBG RESEARCH

*(FIG 4) Park rangers receive training in proper botanical field techniques while producing data on species diversity to support conservation planning and management of Nui Cha National Park, one of the last known areas of xeric southern Vietnamese coastal forests and home to a unique flora with many endemic species.*

**Training in Vietnam:** In Vietnam, CCSD in collaboration with the Research Division is conducting a program of integrated botanical training and conservation for park rangers, forest protection officers, botanical technicians, and students (FIG 4). See page 42.

### COMMUNITY-BASED CONSERVATION

In the areas of exceptional plant richness and diversity where MBG conducts research, CCSD in collaboration with the Research Division conducts comprehensive programs to help local people conserve their natural resources. These programs help communities develop alternatives to destructive practices and acquire the tools to manage sustainably the diverse but highly threatened areas where they live.

**Ecuador:** Within the framework of CCSD's training program in conservation biology for the Shuar and Awá, interns from these indigenous groups developed conservation management plans for several of their communities. CCSD is helping them implement these management plans, develop plans for additional communities, and create a system of environmental monitoring for each community (FIG 5). See page 31.

PHOTO BY DAVID NEILL

*(FIG 5) Community of Warints in the Cordillera del Cóndor, Ecuador, where CCSD is implementing a conservation management plan developed by indigenous Shuar parabiologists during the conservation training program conducted by CCSD in 2002-2004. CCSD is developing and implementing similar plans for 22 additional communities in the Río Coangos watershed in the core area of the Cóndor. Each plan will include land-use zoning, monitoring of plant and animal use and populations, assessment the sustainability of plant harvesting and hunting, and assessment of the need for alternate food sources.*



PHOTO BY MBG RESEARCH

*(FIG 6) The community-based conservation project in Mahabo in Madagascar's eastern littoral forests aims both to save this increasingly rare but highly endangered forest type and to increase the living standard of people in neighboring villages. Community gardening activities are designed to improve the local diet and provide a source of income.*

**Madagascar:** CCSD is a collaborating partner with the William L. Brown Center and the Africa and Madagascar Department in the community conservation project at Mahabo Forest aimed at sustainable management of the forest by local people (FIG 6). See page 51.

**Peru:** CCSD is conducting environmental education programs for schoolchildren and adults in Yanesha communities in the Palcazu Valley and helping them in sustainable development projects that provide alternatives to exploitation of critically threatened forest resources (FIG 7). See page 32-33.

PHOTO BY MBG RESEARCH

*(FIG 7) In the Palcazu Valley in Peru's Selva Central, CCSD is assisting residents of three Yanesha communities in creating vegetable gardens and fruit tree nurseries as replenishable food sources and as an important nutritional component in their diet. Teachers work with schoolchildren before and after school to help cultivate the gardens.*

**Vietnam:** In buffer zone areas of Bach Ma National Park, MBG's Vietnam Botanical Conservation Program, a collaboration of CCSD and Research, is establishing a participatory model for managing conservation and for ecologically sustainable economic development activities. The Program also partners with local villagers in northern Vietnam in *ex situ* conservation (FIG 8). See page 42.

PHOTO BY MBG RESEARCH

*(FIG 8) Local H'mong villagers participate in replanting of the critically endangered Vietnamese golden cypress (*Xanthocyparis vietnamensis*) on degraded limestone areas in Bat Dai Son Nature Reserve in Ha Giang Province in northern Vietnam. The conservation program in Vietnam has established a village-level propagation facility near the native forests of the Vietnamese golden cypress with good success in getting cuttings to root and become plants. The program has trained local people in carrying out and monitoring the process.*

PHOTO BY LESLIE MILLER

*(FIG 9) The Herbarium's specimen collection increases daily thanks to the hard work of staff and volunteers. Pictured here is Aileen Bunton, who worked as a plant mounter for more than 15 years, then retired and has continued working on a volunteer basis for more than 10 years.*

# herbarium

As of January 2005, the MBG Herbarium held 5,636,160 mounted and accessioned herbarium specimens (5,185,704 vascular plants and 450,456 bryophytes). From January to December 2004, MBG sent 27,880 specimens on loan, 13,651 specimens as gifts to specialists, and 42,735 as exchange, and received 47,717 as gifts or exchange.

Curatorial and support activities at the Herbarium are carried out by more than 80 staffers, including 27 herbarium assistants, 12 plant mounters, and eight data processors. The contribution of 65 volunteers is also invaluable.

*Additional information:* www.mobot.org/MOBOT/Research/
*Contact for the Herbarium:* Jim Solomon
*Contact for volunteers:* Jackie Juras

PHOTO BY ADOLFO ESPEJO

*(FIG 10) Ana Rosa López, a Mexican researcher from Herbario Metropolitano, UAM-Iztapalapa who visited MBG as an Elizabeth E. Bascom Fellow in 2004, is pictured here scanning books related to her study group, Bromeliaceae.*

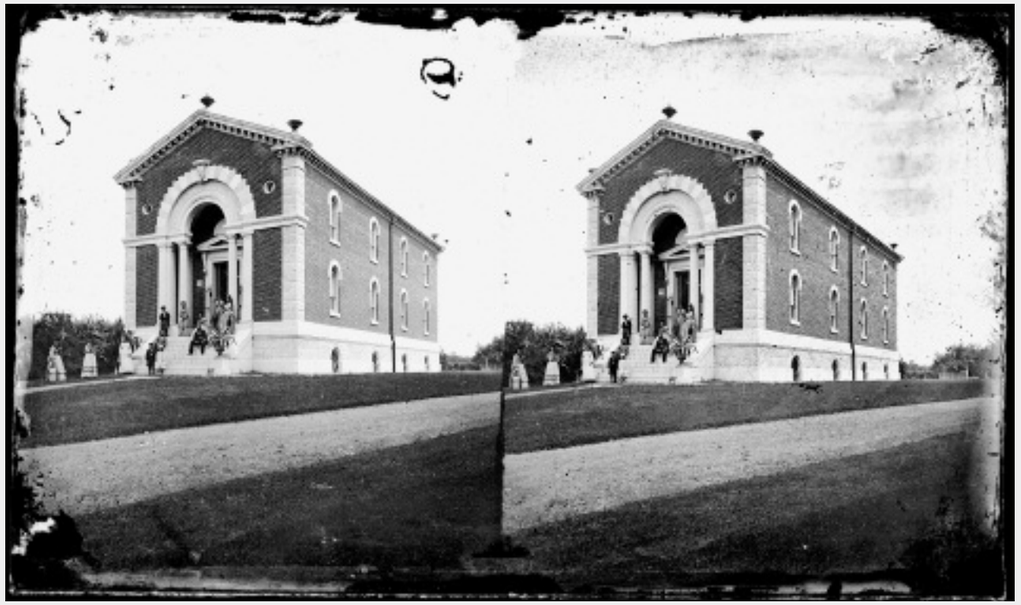


PHOTO COURTESY MBG ARCHIVES

*(FIG 11) The Museum Building (pictured here in an 1867 stereograph) was the original site of the MBG herbarium collections.*

PHOTO COURTESY MBG HERBARIUM

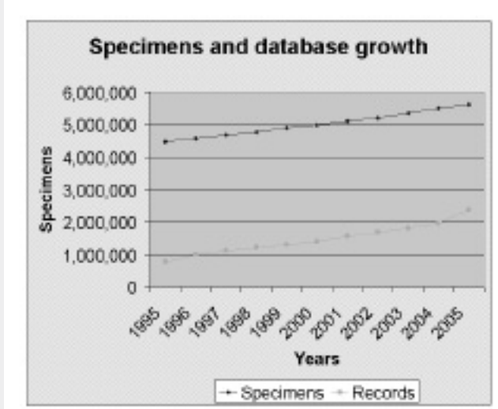
*(FIG 12) The MBG Herbarium houses many historical specimens including several pre-Linnaean collections, such as this specimen of* Rubus idaeus *(Rosaceae), which George Boehmer used in his publication* Flora Lipsiae indigena *(1750).*

PHOTO BY IVÓN RAMÍREZ

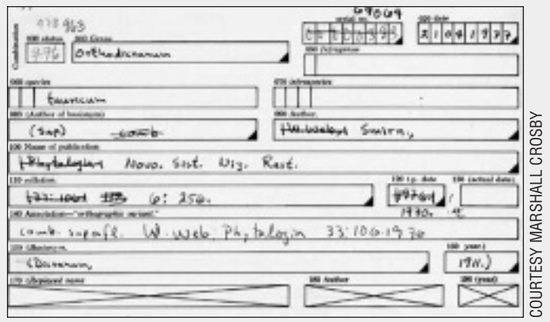
*(FIG 13) Visits to the MBG Herbarium are of great help to scientists around the world. Mexican researcher Adolfo Espejo (from UAMIZ), along with two of last year's Elizabeth E. Bascom Fellows, Ana Rosa López and Ivón Ramírez, recently visited MBG to study the extensive Bromeliaceae collection.*

# TROPICOS

MBG's botanical database, TROPICOS, had its origins in the late 1970s when Marshall Crosby collected data by hand on file cards (FIG 15), each containing about twenty-five fields for recording information on moss names. These records were initially converted to punch cards, with each card representing a single field. The cards were then fed into a large mainframe computer at Washington University for processing (FIG 19). When Bob Magill returned to MBG in the early 1980s, he wrote the original version of TROPICOS for an Osborne 01, an early personal computer. Soon after, MBG acquired its first on-campus computer for bookkeeping and membership, and TROPICOS was moved to that machine. Most of the fields from the original record cards are still part of TROPICOS.




*(FIG 14) This chart represents the growth of the MBG herbarium collection, which in January 1995 had 4,488,028 specimens. At that time, the TROPICOS database had 780,752 records.*

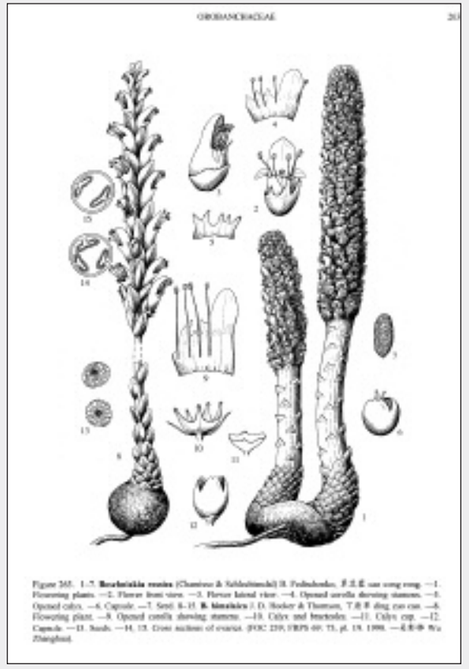


COURTESY MARSHALL CROSBY

*(FIG 15) Before the advent of computers, the TROPICOS data were captured on file cards. This example from the 1970s recorded moss names. Boxes containing xs would not be filled, while those with ticked corners must be filled. The data structure for names in TROPICOS is based on these cards.*

COURTESY MBG IMAGING LAB

*(FIG 16) This specimen of* Schisandra sphaerandra, *collected by Nick Turland in Yunnan Province, China, is one of the 2.7 million specimens databased in TROPICOS.*



COURTESY MBG IMAGING LAB

*(FIG 18) Technical drawings of species, e.g.,* Boschniakia himalaica *(Orobanchaceae), are also available from the images link in the database. These two pictures of* Boschniakia himalaica *illustrate that species in W³TROPICOS may have multiple images.*

PHOTO BY NICK TURLAND

*(FIG 17) Habit images of rare species, such as* Schisandra sphaerandra *(Schisandraceae), can be freely obtained from W³TROPICOS.*

Today, TROPICOS holds information for more than 2.7 million vascular plant specimens and more than 200,000 bryophytes. It includes significant data about plant species, such as the habits of the collected specimens, their phenology, and their distribution. In addition, TROPICOS holds botanical illustrations, photographs, literature, chromosome numbers, maps, conservation status, and related links (FIGS 15-18). TROPICOS is the largest botanical database in the world and is freely available on-line through W³TROPICOS.

*Additional information:* www.tropicos.org
*Contact:* Bob Magill

PHOTO BY GEORGE YATSKIEVYCH

*(FIG 19) Photos of plant habits, such as this example of semi-parasitic* Boschniakia himalaica *(Orobanchaceae), collected by George Yatskievych and collaborators in Yunnan, China, are available through the images links of W³TROPICOS.*

# MBG Press

COURTESY MBG PRESS

*(FIG 20)* Myriocladus paludicolus *Swallen, illustrated by Bruno Manara, is among the more than 1,200 species treated in Volume 8 of the* Flora of the Venezuelan Guayana, *released in 2004.*

COURTESY MBG PRESS

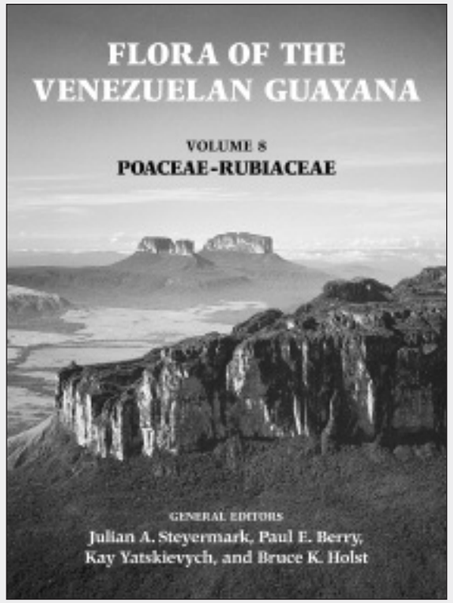
*(FIG 21) This copper engraving of a drawing of* Rhus copallina *L., published by Jacquin in 1797-1804, and deposited at MBG's Rare Book Collection, is now also available through MBG Press. The MBG Press-Library joint project hopes to raise awareness of MBG's commitment to preserving rare botanical works and making them available to the public, as well as to provide financial support to this vital endeavor.*

The Missouri Botanical Garden Press published 7,026 pages in 2004, distributed across thirteen titles and two journal series. Thirty MBG staff and associated botanists authored 130 scientific manuscripts in *Novon* and the *Annals of the Missouri Botanical Garden*. Papers arrived from every populated continent and over 68 countries. Discoveries covered 44 vascular plant families, two ferns, and three moss taxa. Among these novelties were two genera: the Asian bamboo *Sarcocalamus*, and an 8-meter-tall tree from New Caledonia, *Hooglandia* (Cunoniaceae).

In the Neotropics, Guanghua Zhu and Tom Croat revised two important aroid genera, *Dracontium* and *Dieffenbachia*. Fred Barrie and Charlotte Taylor evaluated *Plinia* and *Psychotria* in Mesoamerica. Ihsan Al-Shehbaz examined mustards (Brassicaceae) from South America, then Afghanistan and Tajikistan, into China. Of the 13 monographs published last year, the following three are of special interest: *Molecular Systematics of Bryophytes*, *Manual de Plantas de Costa Rica*, and *Icones Pleurothalidinarum XXVI*. An e-commerce site at www.mbgpress.org debuted in 2003. Site visits have grown to over 7,500 monthly, with unique hits from over 100 countries.

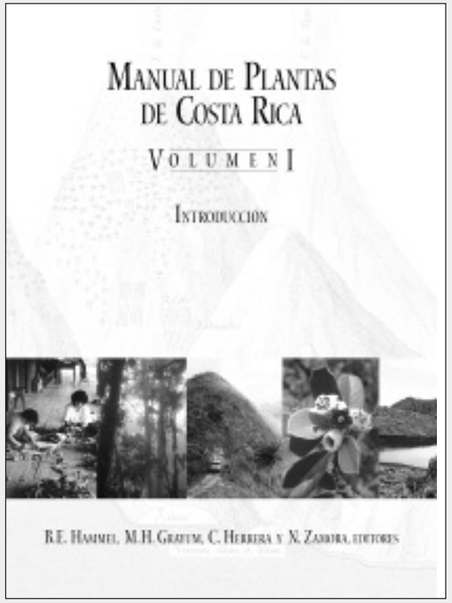
*Additional information:* www.mbgpress.org
*Contact:* Victoria Hollowell






COURTESY MBG PRESS

*(FIG 22) The study of the flora of the Venezuelan Guayana was conceived by Julian A. Steyermark in 1979. The ninth and final volume of a series that treats almost 10,000 species was completed in 2005. (Pictured, Volume 8, edited by Julian Steyermark, Paul Berry, Kay Yatskievych, and Bruce Holst, and published in 2004).*

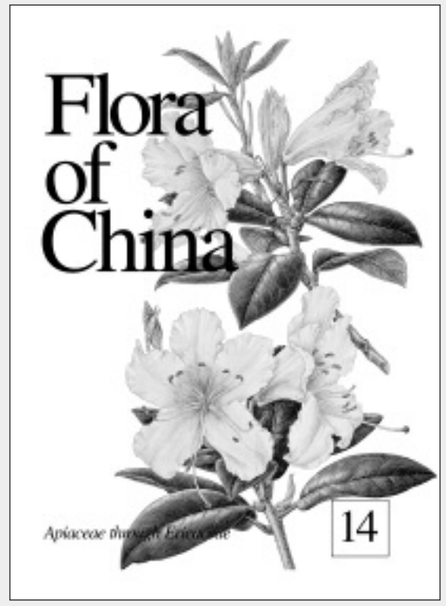



COURTESY MBG PRESS

*(FIG 23) Three volumes of the* Manual de Plantas de Costa Rica *have now been published, Vol. I (Introduction), and Vols. II & III (Gymnosperms and Monocots), treating 2,999 species, 521 genera, and 50 families. The treatments are illustrated by 595 line drawings and 140 black-and-white and 128 color photographs.*

CBOTANICAL ILLUSTRATION BY WANG JINFENG

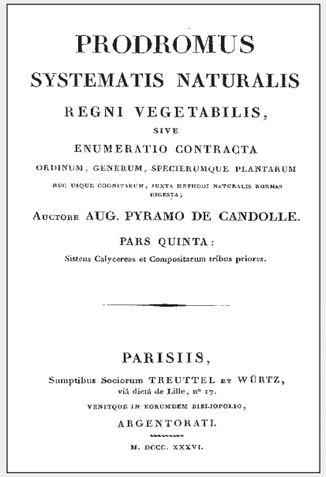
*(FIG 24)* Flora of China Illustrations, *Volume 9, is the companion to text volume 9 published in 2003. Pictured here is* Rosa kweichowensis, *a species native to Guizhou, China.*




COURTESY MBG PRESS

*(FIG 25)* Rhododendron leptocladon, *native to Yunnan, China, and Vietnam. Original watercolor by Mary Mendum, Royal Botanic Garden Edinburgh, Scotland. Its reproduction serves as the frontispiece of the* Flora of China *text volume 14, published by Science Press, Beijing, and the Missouri Botanical Garden Press in 2005.*

# library & archives



PRODROMUS
SYSTEMATIS NATURALIS
REGNI VEGETABILIS,
SIVE
ENUMERATIO CONTRACTA
ORDINUM, GENERUM, SPECIERUMQUE PLANTARUM
HUC USQUE COGNITARUM, JUXTA METHODI NATURALIS NORMAS DIGESTA;
AUCTORE AUG. PYRAMO DE CANDOLLE.
PARS QUINTA:
Sistens Calycereas et Compositarum tribus priores.

PARISIIS,
Sumptibus Sociorum TREUTTEL ET WÜRTZ,
viâ dictâ de Lille, n° 17.
VENITQUE IN EORUMDEM BIBLIOPOLIO,
ARGENTORATI.
M. DCCC. XXXVI.

IMAGE BY MIKE BLOMBERG

*(FIG 26) Title page of A. P. De Candolle's* Prodromus systematis naturalis regni vegetabilis *(printed in 1852), one of the volumes being digitized for the W.M. Keck funded project.*

PHOTO BY BRIGHAM FISHER AND CHRIS FREELAND

*(FIG 27) Brigham Fisher scanning literature for the W.M. Keck Foundation grant to create a digital library and reference system.*

PHOTO BY BRIGHAM FISHER

*(FIG 28) MBG Archivist Andrew Colligan working in the archival study area in the Lehmann Building.*

IMAGING BY BRIGHAM FISHER

*(FIG 29) This pencil and watercolor sketch drawn by Sarah Price ca. 1880, from the MBG Archives, was included in the exhibit* Women's Work: Portraits of 12 Scientific Illustrators from the 17th to the 21st Century.

The Library at MBG contains over 177,000 bound volumes. In 2004, the Library acquired 1,050 new book titles and received more than 800 journal titles by subscription and exchange. In 2004, Library staff fulfilled over 1,000 interlibrary loan requests from institutions in 24 countries and answered over 1,800 questions from researchers around the world. A catalog of the Library and Archive collections is available on-line at www.slrlc.org.

In early 2005, the Research Division received a three-year, $900,000 grant from the W.M. Keck Foundation to build an on-line reference system of 18th and 19th century plant taxonomy literature. The system will be integrated into TROPICOS and the Library catalog and will provide full text search capabilities (FIGS 26, 27).

From January to May 2005, the MBG Library collaborated with The Linda Hall Library in Kansas City, Missouri, to present the exhibit *Women's Work: Portraits of 12 Scientific Illustrators from the 17th to the 21st Century* (FIG 29). The exhibit featured the artwork of MBG staff members Bee Gunn and Yevonn Wilson. A color exhibit catalog is available at the Linda Hall Library Web site:
www.lhl.lib.mo.us/events_exhib/exhibit/exhibits/womenswork/

*Additional information:* www.mobot.org/MOBOT/molib
*Contact:* Douglas Holland

IMAGING BY BRIGHAM FISHER

*(FIG 30) This self-portrait of George Engelmann drawn in 1830 is from a notebook of documents donated to the MBG Archives by Agnus More in 2004. Engelmann was an important advisor to MBG's founder, Henry Shaw.*

PHOTO BY DOUG HOLLAND

*(FIG 31) Main reading room and reference area of the MBG Library.*

# training

## GRADUATE AND POSTGRADUATE EDUCATION

**Graduate Program:**
Students can pursue advanced study in systematic botany and/or ecology at MBG through a joint graduate program with three local universities—the University of Missouri-St. Louis (UMSL), Washington University in St. Louis (WU), and Saint Louis University (SLU). At the beginning of the academic year (August 2005), there were 26 students from 13 countries in the program. Last year, Allison Miller (FIG 34) defended her Ph.D. thesis at Washington University, and Tanya Montenegro, Hieu Quang Nguyen, and Marisol Toledo (FIG 36) completed their M.S. theses at the University of Missouri-St. Louis.

*Additional information:* www.mobot.org/gradstudents
*Contact:* Mick Richardson

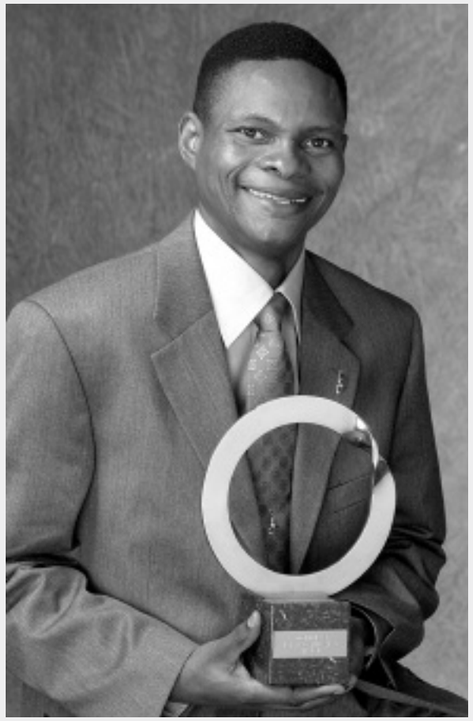


PHOTO COURTESY OF GOLDMAN ENVIRONMENTAL FOUNDATION

*(FIG 32) Graduate student Corneille Ewango of the Democratic Republic of Congo, who was a 2005 Goldman Environmental Prize Winner, is pictured here with the Ouroboros statuette. Ewango risked his life on several occasions to protect botanical specimens and data from destruction in the war that has ravaged his country for nearly a decade.*

PHOTO BY ROOSEVELT GARCÍA

*(FIG 33) Exact location site coordinates collected by Peruvian researchers using GPS in Los Amigos, Madre de Dios, Peru, were used by Roosevelt García in his graduate research on the relationship of floristic patterns to edaphic gradients in Peruvian Amazonia.*

PHOTO BY JASON KNOUFT

*(FIG 34) Mick Richardson and Allison Miller at the May 2005 hooding ceremony at Washington University. Miller's Ph.D. on* Spondias *(Anacardiaceae) domestication was supervised by Barbara Schaal and Peter Raven. Miller is now a postdoc at the University of Colorado Museum in Boulder.*



PHOTO BY GRETCHEN WALTERS

*(FIG 35) Corneille Ewango pictured here at the MBG-Smithsonian Botanical Workshop in Limbe, Cameroon. Ewango's lifetime efforts in grassroots conservation in Congo were recently recognized when he was awarded the prestigious Goldman Environmental Prize.*

*(FIG 36) Former graduate student Marisol Toledo is back in her native country, Bolivia, working with indigenous communities in Cururu, Provincia Guarayos. Toledo was recently awarded a fellowship from Wageningen University, The Netherlands, to continue her doctoral studies on spatial patterns of species composition, forest structure, and dynamics along environmental gradients in lowland forests of Bolivia.*

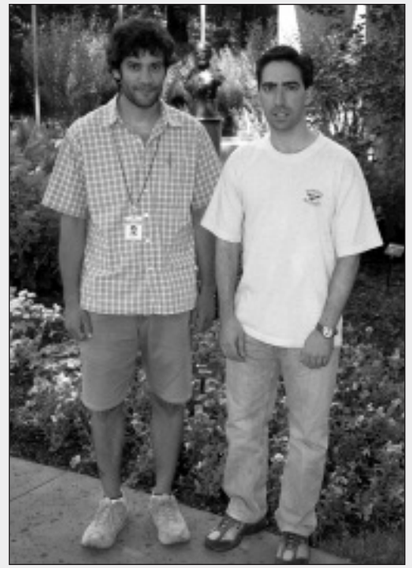


PHOTO BY KEVIN WOLF

*(FIG 37) Postdoctoral fellows at MBG: Iván Jiménez (left), now an Assistant Curator working with CCSD, and Juan Antonio Jiménez (right), who is working in Bryology.*

**Postgraduate Program**

Each year, MBG receives postdoctoral students who come to work with MBG researchers. In 2004, Fátima Pina Rodrigues, a researcher from the Universidade Federal Rural do Rio de Janeiro, Brazil, visited MBG on a postdoctoral fellowship jointly supported by the GIS lab at MBG and the University of Missouri-St. Louis. Iván Jiménez, a recent Colombian graduate from the University of Missouri-St. Louis, and then a postdoctoral fellow at CCSD, is now Assistant Curator at CCSD working with GIS on plant distributions of several Neotropical families. Juan Antonio Jiménez, a postdoctoral fellow from the Universidad de Murcia, Spain, is working on the systematics of Pottiaceae (Bryophytes) under the guidance of Curator Richard Zander. (FIG 37)

PHOTO BY JUSTIN VISNESKY

*(FIG 38) The Elizabeth E. Bascom Fellowship program, now in its seventh year, has sponsored visits to MBG by 26 Latin American botanists from 11 countries. Pictured here (sitting, clockwise): Erika Fernández (Bolivia), Joaquina Albán (Peru), Dr. Peter Raven, and Ana Lucrecia de MacVean (Guatemala); standing: Alina Freire-Fierro.*

PHOTO BY JOHN PRUSKI

*(FIG 39) Gisela Sancho, an Argentinean researcher from the Universidad de La Plata (LP) and former Elizabeth E. Bascom Fellow, pressing specimens at Irazú Volcano National Park headquarters (Costa Rica).*

PHOTO BY ADOLFO ESPEJO

*(FIG 40) Elizabeth E. Bascom Fellows Ana Rosa López (UAMIZ) and Ivón Ramírez (CICY) visited MBG last year to continue their team research (in cooperation with UAMIZ botanist Adolfo Espejo) on the taxonomic treatment of Bromeliaceae from Mexico.*

## FELLOWSHIPS

**Elizabeth E. Bascom Fellowships:** These fellowships are awarded annually to Latin American female botanists. In response to the sixth announcement made in January 2004 and closed on July 1, 2004, 40 researchers from 10 countries submitted applications. The winners for 2004-2005 were Angélica Ramírez Roa (Mexico), Irayda Salinas (Peru), Maria Ana Farinaccio (Brazil), and Ana Lucrecia de MacVean (Guatemala) (FIG 38).

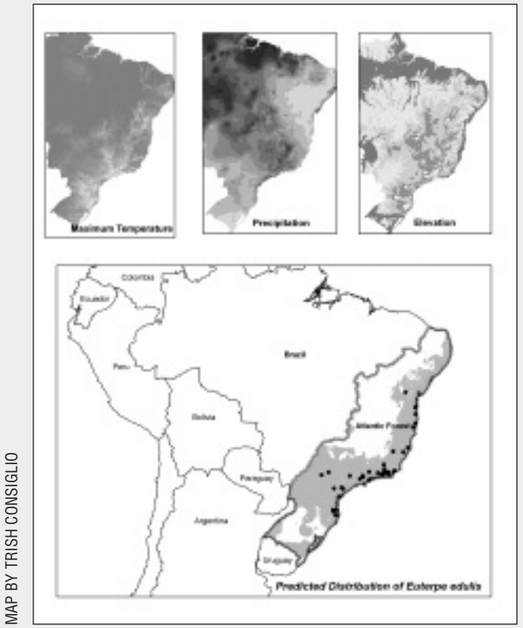
*Additional information:*
www.mobot.org/MOBOT/Research/bascom/bascom.shtml
*Contact:* Alina Freire-Fierro

**Alwyn H. Gentry Fellowships:** These fellowships are awarded to researchers from South America. The fellowship recipients visit MBG for a one- to three-month period to continue their research in plant systematics and conservation.

*Additional information:*
www.mobot.org/MOBOT/Research/jobs.shtml
*Contact:* Alina Freire-Fierro

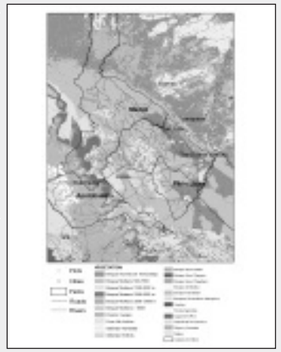


# Geographic Information Systems (GIS)




MAP BY TRISH CONSIGLIO

*(FIG 41) Predicted distribution of* Euterpe edulis *using ecological niche modeling techniques. Seven climate variables and three topography variables were used in the models. Niche modeling can help inform decisions on the conservation of the species given limited collection data.*



MAP BY TRISH CONSIGLIO, USING VEGETATION DATA FROM TIM KILLEEN (CONSERVATION INTERNATIONAL)

*(FIG 42) Madidi National Park collection and plot map used as an interactive tool via the Internet. Users can analyze collection data according to vegetation type without the need for GIS software. Map available at http://mobot1.mobot.org/website/madidi/viewer.htm.*

MAP BY TRISH CONSIGLIO

*(FIG 43) Map detailing the density of MBG collection data with respect to elevation and protected areas in the Tropical Andes. From lists of species extracted from TROPICOS, gamma diversity indexes and gaps in collection strategies can be readily produced using GIS technology.*

The GIS Lab at MBG explores innovative ways of using plant specimen data to prioritize collection strategies and inform conservation proposals. GIS technology enables us to overlay various ecological features with specimen data, protected area networks, and remaining forest cover to find areas of high value for plant conservation including those with unique geologic and bioclimatic features, as well as hotspots for endemism. Current projects include determining areas of high priority for plant conservation in Madagascar.

Within the Analysis Unit of CCSD, the GIS Lab is analyzing TROPICOS specimen data in relation to topographic and climatic variables to better understand species diversity in the Tropical Andes (FIG 43). For example, the Analysis Unit is using ecological niche modeling to identify areas of diversity and inform our evolutionary understanding of Bignoniaceae in Central and South America. The Lab is also applying ecological niche modeling to identify areas for conservation of *Euterpe edulis* in Brazil (FIG 41).

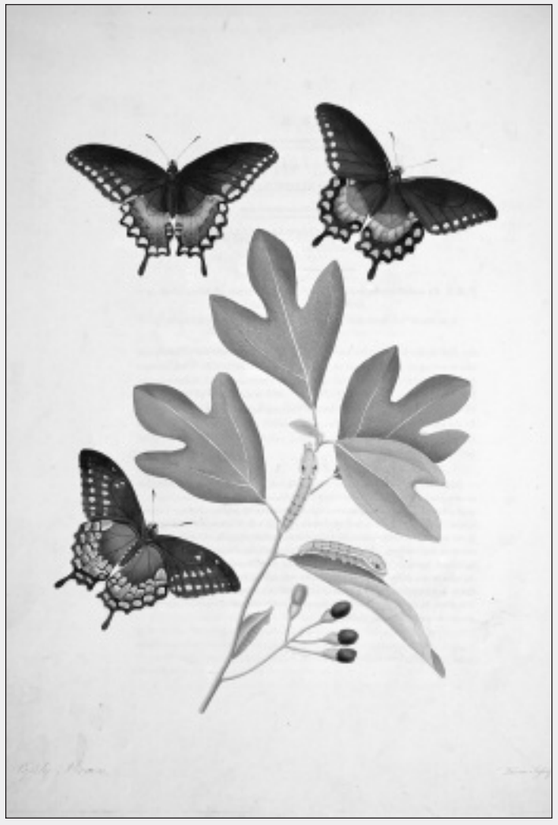
Using ArcIMS technology, we have been able to streamline data-sharing among curators and collaborators in other countries through interactive maps delivered via the Internet.

*Additional information:*
www.mobot.org/MOBOT/Research/gis/welcome.shtml
*Contact:* Trish Consiglio

# imaging lab


COURTESY MBG IMAGING LAB

*(FIG 44) Classical works from MBG's Rare Book Collection, e.g.,* Plantae Aequinoctiale *by Humboldt and Bonpland (1808-1809), are also scanned, processed, and posted on-line by the Imaging Lab. Pictured here is* Quercus mexicana, *an oak species endemic to Mexico.*



COURTESY MBG IMAGING LAB

*(FIG 45)* Sassafras albidum *(Lauraceae) is a host of a rare butterfly from the state of Georgia. This plant species appeared in a book published by J.E. Smith & J. Abbot in 1797 that illustrated North American insects for the first time. This and many other rare books from the MBG Library are now freely available on-line.*

COURTESY MBG IMAGING LAB

*(FIG 46) The Imaging Lab processes habit slides, plant specimens, and books. Pictured here is* Omphalogramma vinciflorum *(Primulaceae) as it was represented in a technical drawing in the series* Flora of China Illustrations. *Botanical Illustration by Deng Yingfeng*

PHOTO BY NICK TURLAND

*(FIG 47) Slides from specimens collected in the field, such as* Omphalogramma vinciflorum *(Primulaceae), taken by Nick Turland in China, are digitally processed and linked to W³TROPICOS by the Imaging Lab staff.*

COURTESY MBG IMAGING LAB

*(FIG 48) The images of herbarium specimens, e.g.,* Omphalogramma vinciflorum, *are digitally processed for the on-line version of TROPICOS.*

Fred Keusenkothen, Imaging Lab Coordinator, and Imaging Technicians Brigham Fisher and Mike Blomberg support the operations of MBG's imaging projects. The Imaging Lab continued to digitize herbarium specimens and rare books during 2004. Staff of the Imaging Lab also assisted other MBG staff, students, and visitors in preparing images for publications. To date, the Imaging Lab staff have linked over 60,000 images to TROPICOS, including more than 30,000 type specimens. The Lab has also digitized more than 100 volumes from the MBG Library.

*Additional information:*
www.mobot.org/MOBOT/Research/imaginglab/welcome.shtml
www.illustratedgarden.org/mobot/rarebooks/
www.mbgpress.org/rarebooks.htm
*Contact:* Chris Freeland

# regional and in-country programs

PHOTO BY GLORIA ANDRADE M. (MEXU)

(FIG 49) Flora Mesoamericana *editors from left to right: Gerrit Davidse (MO), Sandy Knapp (BM), Fernando Chiang (MEXU), and Mario Sousa S. (MEXU).*

## Mesoamerica

Mesoamerica, defined for floristic purposes as including all of the Central American republics and the five southernmost states of Mexico, is the tropical American region where MBG started its tropical research efforts and where it continues various activities to this day. In addition to *Flora Mesoamericana*, the large, multinational project to produce a modern flora for the entire region (FIGS 49-50), MBG has active programs in Costa Rica and Nicaragua.

During the past year, an intensive specimen databasing project employing 20 persons has completed databasing all of the approximately 800,000 Mesoamerican collections at MBG. This effort is supported by a grant through the U.S. Dept. of Agriculture. Once databased, these collections will be georeferenced using GIS. The initial work, which is supported by funds from GBIF (Global Biodiversity Information Facility), focuses on the collections from El Salvador and Honduras and will be completed by the end of 2005 (FIGS 51-52).

Assistant Curator John Pruski traveled to Costa Rica joining Alex Rodríguez (INBio) and Gisela Sancho (LP) on an excursion to collect DNA samples of the rare páramo-dwelling genera *Lagenophora*, *Laestadia*, and *Westoniella* from high elevations on Volcán Irazú southwards to Cerro Chirripó. There they also discovered *Iltisia*, new to Parque Nacional Chirripó. Pruski's research was funded by the Taylor Fund for Ecological Research (FIGS 53-54).

*Additional information:*
www.mobot.org/MOBOT/Research/mesoamericaprojects.shtml
*Contact:* Gerrit Davidse


IMAGE COURTESY MBG WEBSITE

*(FIG 50) Home page for the Internet version of the* Flora Mesoamericana *project.*

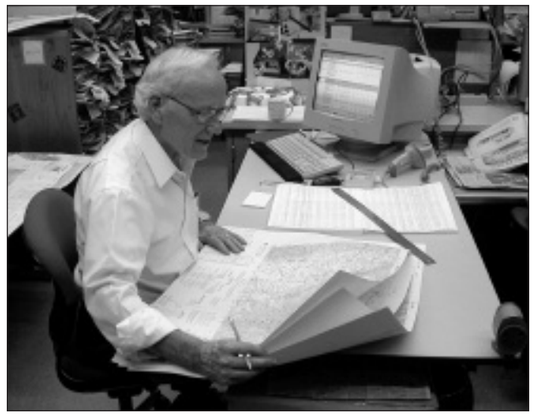


PHOTO BY GERRIT DAVIDSE

*(FIG 51)* Flora Mesoamericana *volunteer georeferencer Bruce Phillips.*

PHOTO BY GERRIT DAVIDSE

*(FIG 52)* Flora Mesoamericana *georeferencers Deby Arifiani (left) and Heidi Schmidt (right).*

PHOTO BY GISELA SANCHO (LP)

*(FIG 53) Assistant Curator John Pruski with* Gunnera insignis *(Gunneraceae), a spectacular genus capable of rapidly colonizing bare lands owing to nitrogen-fixing bacteria that grow anaerobically in the roots and petioles.*

PHOTO BY JOHN PRUSKI

*(FIG 54)* Laestadia costaricensis, *the only Central American species in this genus which is otherwise centered in the Andes. John Pruski and collaborators recently collected the species in Parque Nacional Chirripó, Costa Rica.*

PHOTO BY BARRY HAMMEL

*(FIG 55) Playa Colorados, Santa Elena Peninsula, Guanacaste, Costa Rica. In the background are the Cerros Santa Elena.*

## Costa Rica

Through ongoing botanical exploration in Costa Rica, Mike Grayum completed his NGS-funded fieldwork on the floristics of the Santa Elena Peninsula (FIGS 55, 56), which lies in the extreme northwestern and driest corner of the country and harbors its only major outcrop of serpentine soils, as well as some of oldest (ca. 85 million years), continually exposed rocks in Central America. Among the newsworthy items of Grayum's fieldwork was a new family for Costa Rica, Lennoaceae, represented by *Lennoa madreporoides*, the only species of this small family of root parasites recorded from north of South America.

A set of the first three volumes of the *Manual de Plantas de Costa Rica*, a collaborative project of MBG, INBio, and the Museo Nacional (CR), was formally presented to the Costa Rican people during a ceremony at the Museo Nacional de Costa Rica, October 2004 (FIG 58).

Our colleagues Alexander Rodríguez (INBio) and Armando Estrada (CR) are adapting IUCN methodology to apply endangered species categories to all Costa Rican plants. Their preliminary analysis of 91 species may lead to a decree that would increase the current number of timber species prohibited from harvest, from just 19 to over 40 (FIGS 57, 59).

*Additional information:* www.mobot.org/MOBOT/research/Edge/
*Contact:* Barry Hammel and Mike Grayum



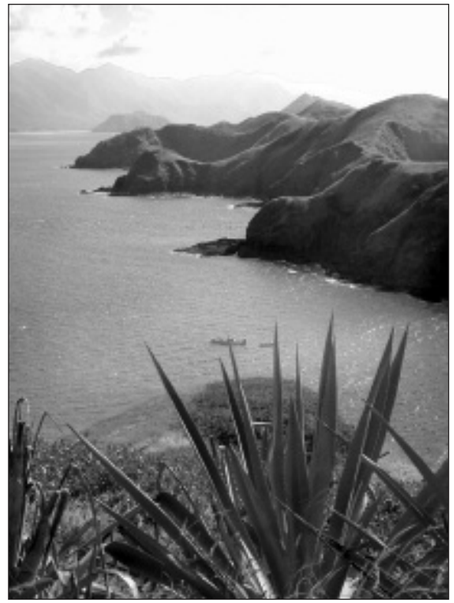


PHOTO BY BARRY HAMMEL

*(FIG 56) In the foreground is* Agave angustifolia *from the highest elevation of Isla San Pedrito, Guanacaste, Costa Rica. Stretching behind are other islands in the Murciélago Archipelago and, in the background, the Cerros Santa Elena on the mainland.*

PHOTO BY ARMANDO ESTRADA

*(FIG 58) Some of the attendees at the ceremony officially turning over the* Manual de Plantas de Costa Rica *to the people of Costa Rica; from left to right: Luis Flores, Cecilia Herrera, Cristina Formoso, Barry Hammel (below), Gerardo Herrera, Quírico Jiménez, Mike Grayum, Flor Maroto, and Rafael Ocampo.*

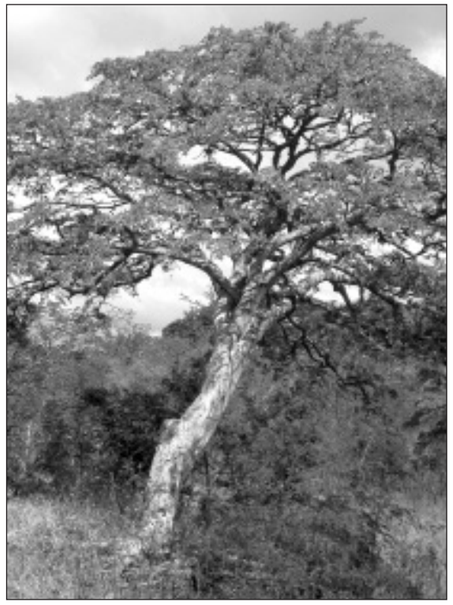


PHOTO BY BARRY HAMMEL

*(FIG 57)* Guaiacum sanctum, *a dry-forest species, is slow growing and difficult to propagate. While not endemic to Costa Rica, it has been overexploited for its hard wood (lignum vitae) and medicinal value, and is very rare and endangered. Populations of* G. sanctum, *one of 19 Costa Rican timber species whose harvest is currently illegal, are protected in two national parks.*

PHOTO BY BARRY HAMMEL

*(FIG 59)* Ceiba pentandra *is one of Costa Rica's most impressive trees. Although the species is widespread outside of the country, it has been locally overexploited, especially for plywood. A local analysis based on IUCN criteria has designated the species as endangered.*

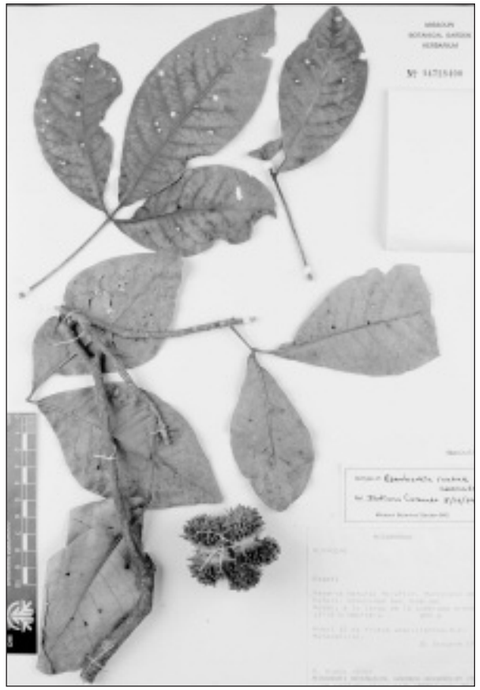


IMAGE COURTESY MBG IMAGING LAB

*(FIG 60) A new species of* Esenbeckia *(Rutaceae) is known by only two individuals and is considered endangered.*

*(FIG 61) Indiana Coronado with field assistants in the Reserva de Biósfera de Nicaragua, Bosawas, situated in the northeastern part of the country. The Government of Nicaragua established the Reserve in 1991, and the United Nations declared it a Biosphere Reserve in 1997. Bosawas is the largest intact forest in Central America and an important component of the Mesoamerican Biological Corridor, with a representation of the full elevational range of Nicaragua.*

PHOTO BY INDIANA CORONADO

*(FIG 62)* Capparis heydeana*, a beautiful and uncommon species with horticultural potential collected in Bosawas.*

## Nicaragua

The Center for Conservation and Sustainable Development (CCSD) is producing an analysis of the plant species and geographic areas of conservation concern in Nicaragua. This year, CCSD completed conservation assessments for all native plant species of Nicaragua, selected the 100 species of highest conservation importance, and began to develop an individual analysis for each selected species. The results include discovery of a species new to science—*Esenbeckia sp.* (Rutaceae), a tree that is known only from two individuals in north-central Nicaragua and is extremely endangered because it occurs in the middle of agricultural lands (FIG 60). Another endangered species brought to attention by the project is a population of *Pectis multifloculosa* (Asteraceae), which for about 100 years has been known as the only population of the species that exists in Nicaragua. CCSD's GIS studies of the possible localities where additional populations could grow and subsequent fieldwork in these localities demonstrate that the species is restricted to a single locality. The project will prepare recommendations for the preservation of both species.

CCSD is collaborating with the Saint Louis Zoo in a comprehensive study of the dynamic interaction among humans, forest structure, and animal distribution in the Bosawas Biosphere Reserve of northeastern Nicaragua, focusing in particular on the floral and faunal structure of areas used for hunting and agriculture as compared to the undisturbed conservation areas (FIG 61). The project aims ultimately to prepare a management plan for the Reserve. The current phase of the work will build on the Saint Louis Zoo's studies of faunal distribution by collecting comparable data on flora and will extend the analysis of human disturbance on animal abundance and distribution to include the effect on the vegetative structure of the forest. The project will describe vegetation along animal transects in each of the land use zones—hunting, agriculture, and conservation—and will compare animal densities and distribution to the habitat characterizations. One of the outcomes of the botanical component of the project will be a field guide to identify the most important trees of the region.

*Additional information:*
www.mobot.org/MOBOT/research/nicaragua/welcome.shtml
*Contact:* W.D. Stevens and Olga Martha Montiel



PHOTO BY ALFREDO FUENTES

*(FIG 63) A species of* Amaryllis *collected during fieldwork in dry forests in the Madidi region (Bolivia).*

PHOTO BY ALFREDO FUENTES

*(FIG 64)* Passiflora coccinea Aubl.*, a lowland liana pollinated by hummingbirds.*

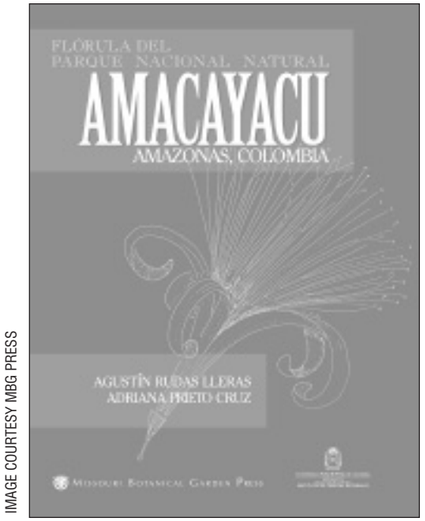



IMAGE COURTESY MBG PRESS

*(FIG 65) Thanks to intensive botanical fieldwork begun in 1991, followed by years of identification and compilation by scientists from around the world, MBG in cooperation with Colombian researchers has recently published this florula.*

## South America

MBG has major programs in the tropical Andean countries of Bolivia, Ecuador, and Peru. These programs provide an integrated approach to exploration and ecological research, capacity building for conservation, and community projects for conservation and sustainable development. MBG also has active collaborations with the principal biological institutions of almost all of the South American countries.

In Argentina, MBG in collaboration with the Instituto de Botánica Darwinion is working on a checklist of the vascular plants of the Southern Cone. MBG researchers in collaboration with the University of Antioquia are working on the Checklist for the Department of Antioquia, Colombia. MBG is also one of the collaborating institutions publishing the series *Flora of the Venezuelan Guayana.*

PHOTO BY MBG RESEARCH

*(FIG 66) Curator-in-Residence Steven Churchill, Bolivian botanist Martha Serrano, and students in La Reserva Nacional de Flora y Fauna Tariquía.*

PHOTO BY MBG RESEARCH

*(FIG 67) The Herbario Chuquisaca, Universidad San Francisco Xavier de Chuquisaca, Sucre.*

PHOTO BY STEVE CHURCHILL

*(FIG 68) Students at their field camp in the Achirales Valley at 2400 m after a day of fieldwork in RNFFT in the Cerro Aliso, a grassy puna up to 3200 m, and in surrounding areas of low trees (*Polylepis*, etc.) and shrubs.*

## Bolivia

MBG's research in Bolivia focuses on the Tucumano-Boliviano montane vegetation and on the Madidi Region in northern Bolivia, with additional general floristic studies throughout the country.

**TUCUMANO-BOLIVIANO:** From his base in Santa Cruz, Curator-in-Residence Steve Churchill continues his research in cooperation with botanists from Santa Cruz, Cochabamba, and Sucre (FIG 66). Fieldwork in 2004 focused on new explorations in the Tucumano-Boliviano forests—in particular, in La Reserva Natural Alarachi and La Reserva Nacional de Flora y Fauna Tariquía (RNFFT) in south-central Bolivia, and in two areas at the northernmost limit of the Tucumano-Boliviano, Bella Vista and Las Yungas de Mairana (FIG 68). The Tucumano-Boliviano, considered Bolivia's most endangered forest ecosystem, ranges more than 600 miles from central Bolivia south to the border of Argentina and exists in isolated fragments surrounded by dry interandean or Chaco Serrano forest. The fieldwork resulted in the collection of about 6,000 specimens, including 15 new species of Araceae, Lamiaceae, Orchidaceae, and Solanaceae. In La Reserva Natural Alarachi alone, the team collected over 300 species of vascular plants and over 120 species of bryophytes—more than double the number anticipated. In RNFFT, which encompasses several vegetation types and contains the country's largest intact Tucumano-Boliviano forest, they found vast areas of undisturbed forest on lomas surrounding high valleys and, most unexpectedly, a zone of exceptionally rich forest just below the puna that they had not thought possible so far south in Bolivia.

In conjunction with the research, MBG is collaborating with the Universidad Mayor San Simón in Cochabamba, the Universidad Autónoma Gabriel René Moreno in Santa Cruz, and the Universidad San Francisco Xavier de Chuquisaca in Sucre (FIG 67) in training students, especially by providing training to undergraduates who have finished their coursework and are conducting their research theses to earn their professional degree.

CCSD is participating in the development of the management plan for La Reserva Natural Alarachi. Steve Churchill and his team conducted a botanical inventory of the Reserve to contribute to a conservation analysis as the basis for the plan. The project also provided training in botany and conservation for local biologists who took part in the expedition.



PHOTO BY ALFREDO FUENTES

*(FIG 69)* Symbolanthus calygonus *(Gentianaceae), a showy common shrub of the pluvial montane forests near Wayrapata in the Apolobamba Reserve in Madidi.*

PHOTO BY ALFREDO FUENTES

*(FIG 70) Members of the Madidi team on an expedition to Virgen del Rosario at a stone portal connecting to a bridge over the Río Tuichi presumably constructed by the first missionaries in the area.*

PHOTO BY ALFREDO FUENTES

*(FIG 71) View of the Bala subandean ridge near San Buenaventura in Madidi. The lack of forest on the top of the ridge is natural. In the background, the Amazonian lowlands with their mixture of rain forest, savanna, and disturbed vegetation can be seen.*

PHOTO BY ALFREDO FUENTES

*(FIG 72) Project personnel pressing plants from a palm forest dominated by* Dictyocaryum lamarckianum *in the Madidi National Park.*

**MADIDI REGION:** Summarizing the status of the inventory of the Madidi Region becomes increasingly difficult as fieldwork progresses; for a fuller account, see also www.mobot.org/MOBOT/Research/madidi. The project has measured almost 50,000 trees or lianas and recorded 35,000 herbaceous or epiphytic plants in 250 inventories of different sizes and vegetation types. Project investigators estimate that they have found approximately 40 species new to science and 250 species that have never before been collected in Bolivia. The checklist we manage for the area is based on 25,000 collections and includes almost 4,000 species. One of the new species discovered, *Cuphea nivea*, was recently published. We have also published an overview of the xeric dry forest in *Revista Boliviana de Ecología y Conservación Ambiental* and have submitted 18 articles for a special issue of the journal *Ecología en Bolivia.*

The Madidi project also has a very important formal educational component. We collaborate with five universities in Bolivia, and a total of 11 thesis students have been part of the project; five have so far graduated. Four are studying for their Ph.D. or master's degree at universities outside Bolivia.

By gathering the necessary fundamental information about plant biodiversity and providing this information to the management of the park, the project plays a crucial role in park management and conservation.

*Additional information:*
www.mobot.org/MOBOT/Research/southamricaprojects.html
*Contact:* Steven Churchill and Peter M. Jørgensen


PHOTO BY DAVID NEILL

*(FIG 73) The National Herbarium of Ecuador, which has developed mainly during the past 20 years in concert with MBG's research program in Ecuador, currently holds more than 180,000 specimens and has the largest library in Ecuador specializing in botany.*

PHOTO BY PAUL BERRY

*(FIG 74) New species of* Symbolanthus *from the Cordillera del Cóndor discovered by Paul Berry and David Neill. One of the Shuar field assistants who helped with the explorations is holding the plant.*

PHOTO BY GERMÁN TOASA

*(FIG 75) An unknown species of* Herrania, *a wild relative of cacao, discovered in the lowlands of the Cordillera del Cóndor.*

PHOTO BY MBG RESEARCH

*(FIG 76) One of the Shuar interns trained as parabiologists in the CCSD-WCS conservation biology training program conducts ecological work that will provide baseline data for the preparation of management plans for the Shuar territories in the Río Coangos watershed, Cordillera del Cóndor.*

## Ecuador

**RESEARCH:** MBG's research program in Ecuador is directed by Curator-in-Residence David Neill. Research focuses primarily on two regions: the Chocó-Manabí Corridor in the northwestern and west-central part of Ecuador, along the western slopes of the Andes Mountains and the lowlands of the Pacific coastal region, and the Cordillera del Cóndor region in southeastern Ecuador, an isolated mountain range that is situated to the east of the main range of the Andes and extends into the lowlands of the Amazon basin, along the international border between Ecuador and Peru (FIGS 74-75). The Chocó-Manabí Corridor is well known to biologists and conservationists for its exceptional species richness and endemism of plants and animals. The Cordillera del Cóndor has been very little explored because of border hostilities between Ecuador and Peru that only recently concluded with the signing of a peace treaty. On the upper slopes of the Cóndor, high elevation cloud forest growing on sandstone is a very unusual habitat harboring many unique plant species. In the last two years the MBG team has conducted eight expeditions to the region and has found numerous plant species that the team had not seen before, some of which have proven to be new to science. MBG is also supporting the development and technical capacity of Ecuador's most important botanical research institution, the National Herbarium of Ecuador (FIG 73).

**TRAINING AND CONSERVATION:** During 2002-2004 CCSD collaborated with the Wildlife Conservation Society (WCS) in a conservation biology training program designed to help members of two indigenous groups who inhabit some of the most biologically diverse lands on Earth—the Shuar in southeastern Ecuador and the Awá in the northwestern coastal region—become effective, professional conservation and resource management teams in the service of their communities and ethnic organizations. During the program's second year the interns applied their training in botany, zoology, ethnobotany, forest management, land-use planning, and GIS to develop conservation and environmental management plans for villages in each group's territories. Each group of interns also compiled its research, based on extensive fieldwork and interviews with village elders, into a comprehensive text for its ethnic region including the conservation management plans, guides to the flora of the territory, lists of mammals and birds, traditional animal tales and hunting rituals, and ethnobiological information. The interns presented the results at public meetings in each community and to their respective ethnic Federations.

CCSD will continue to work with both groups, providing technical assistance and advice to the Awá but focusing on developing further the applied conservation of the extensive territories inhabited and owned by the Shuar (FIG 76). The former Shuar interns, now parabiologists, will go on to implement the conservation and management plans that they developed during their training, to develop and implement plans for a substantial number of additional communities, and to create a system of environmental monitoring for each community.

*Additional information:*
www.mobot.org/MOBOT/Research/southamericaprojects.shtml
*Contact:* David Neill

PHOTO BY MBG RESEARCH

*(FIG 77) Peruvian university students and instructor in the puna in the Yanachaga-Chemillén National Park during one of CCSD's field-based training courses.*

## Peru

MBG's work in Peru is conducted from our field station in Oxapampa in the country's Selva Central—in proximity to some of the world's most diverse and critical tropical forests. The field station includes the herbarium HOXA, which holds about 8,000 specimens, 90% of which are identified to genus. From the field station, MBG's team carries out an integrated program in plant sciences, including research, capacity building, and community conservation with the indigenous people of the area, the Yanesha.

Curator-in-Residence Rodolfo Vásquez directs MBG's program in Peru. Research focuses on the floristic and ecological aspects of the country's plant species, concentrating on biological reserves or areas of ecological importance. The MBG team is conducting exploration and ecological studies primarily in the Yanachaga-Chemillén National Park, the San Carlos-San Matías Protected Forest, and the Yanesha Communal Reserve—three Protected Natural Areas on the eastern flank of the Andes that form part of the great Amazon River basin. The results of this work will be compiled in a catalogue of the vascular plants of the area. MBG is also conducting research in southern Peru in the Valle del Vilcanota-Urubamba. Another project in progress is a floristic treatment of the more than 3,400 species native to the Río Cenepa and adjacent areas in Amazonian Peru.



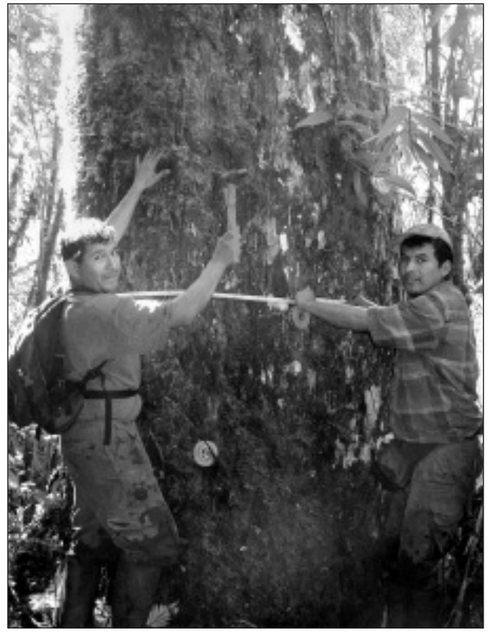


PHOTO BY RODOLFO VÁSQUEZ

*(FIG 78) Humberto and Edgar, Park rangers from Yanachaga-Chemillén National Park, measuring the diameter of a tree of* Retrophyllum rospigliosii *(Podocarpaceae) as part of their work in establishing a permanent plot in Quebrada Amistad.*

PHOTO BY MBG RESEARCH

*(FIG 79) CCSD is collaborating with three indigenous Yanesha communities in the Palcazu Valley—San Francisco, Buenos Aires, and Villa América—in a program of community-based environmental education and sustainable economic activities. Here, MBG Curator-in-Residence Rodolfo Vásquez speaks to Yanesha schoolchildren about the importance of their biodiversity and the steps needed to protect it and use it sustainably.*

PHOTO BY OLGA MARTHA MONTIEL

*(FIG 80) CCSD staff met with the Yanesha leadership in the community of San Francisco to evaluate the ongoing community program and define priorities for the work during the next few years. Above: The Yanesha welcome CCSD collaborators with one of their traditional dances.*

**TRAINING AND CONSERVATION:** MBG's field station in Oxapampa serves as a center for educational activities at many levels, including CCSD's multi-tiered training program in botany and conservation for university students and young professionals from throughout Peru (FIG 77; see also page 5); training in botanical interpretation and conservation for Park guards, managers of Protected Natural Areas, and staff of the National Institute of Natural Resources of Peru (INRENA) (FIG 78); and environmental education for schoolchildren and adults in the Yanesha villages in conjunction with community conservation (FIG 79).

To help achieve conservation in the Protected Natural Areas, CCSD is partnering with three Yanesha communities in the Palcazu Valley (FIG 80) in sustainable development projects that address their need for alternate or supplemental sources of food. Projects include creating vegetable gardens as replenishable food sources and developing fruit tree nurseries using native trees from the area. For the future, CCSD will help the Yanesha form an Environmental Unit that will provide guidance for sustainable management of both the Yanesha Communal Reserve and the Yanesha lands along the Palcazu River.

*Additional information:* www.jbmperu.org
*Contact:* Rodolfo Vásquez and Henk van der Werff

PHOTO BY GEORGE SCHATZ

*(FIG 81) Forêt d'Orangea east of Diego-Suarez*

## Africa and Madagascar

MBG's Africa and Madagascar program continues to thrive and grow, conducting a wide range of integrated research, training, and conservation activities. In Africa, MBG is working in several countries, including Tanzania, Kenya, South Africa, Gabon, Equatorial Guinea, and Cameroon—the last three in close cooperation with the W.L. Brown Center.

In Madagascar, the Assessment of Priority Areas for Plant Conservation Project (APAPC) presented a map and list of 77 key sites to a plenary session of the Durban Vision Group. Based upon the analysis of the distributions of 1,200 endemic species, as well as habitat "gaps" in the existing protected areas network, the APAPC project has made a significant contribution towards fulfilling President Marc Ravolomanana's mandate to triple the area in Madagascar managed for conservation.

Among the sites identified are several in the Diego-Suarez region in the far north of Madagascar, including the Forêt d'Orangéa (FIG 81) on coastal unconsolidated sand, and Montagne des Français, a sandstone massif capped by limestone, both currently the focus of detailed inventories and conservation assessments being conducted by staff and students working on MBG's International Cooperative Biodiversity Groups project, also in cooperation with the W.L. Brown Center. Each site harbors dozens of endemic species currently not represented in the protected areas network, so-called "gap" species (FIG 84). Prospects for their conservation have been considerably bolstered by local development activities and strong collaboration with regional authorities. Easily accessible from Diego-Suarez, and possessing dramatic vistas of the Bay of Diego-Suarez and Indian Ocean, the two sites also hold great potential for ecotourism.

*Additional information:*
www.mobot.org/MOBOT/Research/africaprojects.shtml
*Contact:* Pete Lowry



PHOTO BY GEORGE SCHATZ

*(FIG 82) A species of* Acacia *(Fabaceae) at Forêt d'Orangea*

PHOTO BY GEORGE SCHATZ

*(FIG 83)* Hilsenbergia moratiana *(Boraginaceae) at Forêt d'Orangea, a species recently described by MBG botanist James Miller.*

PHOTO BY GEORGE SCHATZ

*(FIG 84)* Thespesia gummiflua *(Malvaceae) at Montagne des Français, a "gap" species endemic to the Diego-Suarez region.*

PHOTO BY GEORGE SCHATZ

*(FIG 85) A species of* Turraea *(Meliaceae) at Montagne des Français.*

PHOTO BY TANZANIA BOTANICAL RESEARCH AND CONSERVATION PROGRAM

*(FIG 86) Women living at Nduamughanga village within the Mgori Forest Reserve in Singida Rural District, one of the best examples of community forest reserves in Tanzania. This photo was taken during ethnobotanical studies designed to compare plant uses in five surrounding villages. The information gathered is expected to help bridge communication between local communities and conservation professionals and to identify the ways in which different plant uses by different cultures in the communities may affect conservation. From the photo we can identify several different uses for plants: as mortars, cereal containers, wooden baskets, poles, etc.*

## Tanzania

MBG's Tanzania Botanical Research and Conservation Program (TBRCP), which in phase one was known as the Tanzania Botanical Training Program, involves training, botanical collections, and conservation.

*Additional information:*
www.mobot.org/MOBOT/Research/africaprojects.shtml
*Contact:* Roy Gereau



PHOTO BY TANZANIA BOTANICAL RESEARCH AND CONSERVATION PROGRAM

*(FIG 87) Traditional doctors being interviewed in the same ethnobotanical study.*

PHOTO BY TANZANIA BOTANICAL RESEARCH AND CONSERVATION PROGRAM

*(FIG 88) While making botanical collections, TBRCP personnel observed this villager in the proposed Minyughe Forest Reserve in Singida Rural District clearing forest to establish a farm. Such activities show the urgent need to heighten environmental awareness and increase training to save important remaining areas of forest.*

PHOTO BY TANZANIA BOTANICAL RESEARCH AND CONSERVATION PROGRAM

*(FIG 89) Tanzania Botanical Research and Conservation Program botanists John Mlangwa and William Kindeketa (on top of press) pressing plants for drying. The photo was taken in Chome Forest Reserve in Same District, one of forests in the Eastern Arc hotspot in Tanzania.*

PHOTO BY IHSAN AL-SHEHBAZ

*(FIG 90)* Desideria linearis, *a species belonging to the mustard family, is a tiny plant of about an inch in diameter with distribution restricted to Nepal, Kashmir, Tajikistan, and Xinjiang Province (China).*

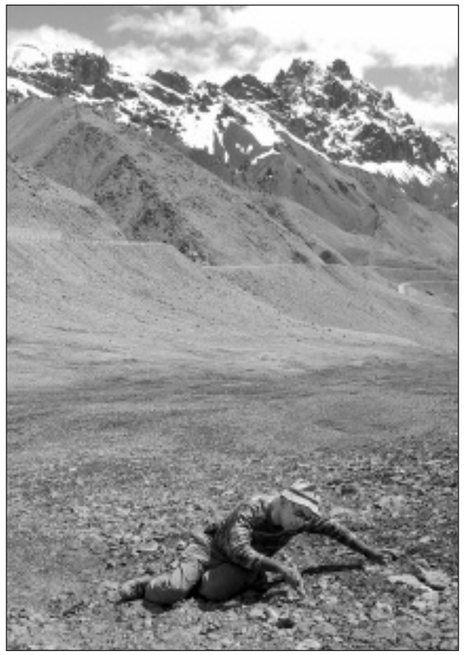


PHOTO BY BRUCE BARTHOLOMEW (CAL)

*(FIG 91) Curator Ihsan Al-Shehbaz collecting* Desideria *(Brassicaceae) specimens in western China at 5,200 m (about 17,000 feet) of altitude.* Desideria, *a genus endemic to the Himalayas and adjacent Central Asia, can grow up to 6,200 m elevation.*

## Asia

Research in Asia and Oceania, as well as in all other areas of the globe, involves cooperative efforts between MBG staff and local and international collaborators. In Asia, MBG is working primarily on the publication of the English version of the *Flora of China* (see page 40) and in botanical research, training, and conservation in Vietnam, where MBG has a Curator-in-Residence, Jack Regalado (see page 42). MBG also has an active project studying Brassicaceae in northern China (FIGS 90, 91). Additionally, MBG is working in cooperation with researchers from Kazakhstan, Korea, New Caledonia, Pakistan (FIG 95), the Republic of Georgia, Russia, and Thailand. In collaboration with the W.L. Brown Center, MBG Research personnel are also actively working in Tibet (see page 54).

*Additional information:*
www.mobot.org/MOBOT/Research/asiaprojects.shtml
*Contact:* Ihsan Al-Shehbaz



BARBARA ERTTER (UNIVERSITY OF CALIFORNIA-BERKELEY)

*(FIG 92) Mustards (*Rapistrum rugosum*), a Eurasian weed grown mainly to feed honeybees, are being collected in northwestern Iran by Al-Shehbaz.*

COURTESY OF MBG PRESS

*(FIG 93) The drawing of* Fritillaria cirrhosa *(Liliaceae) included here was recently published in the series* Flora of China Illustrations, *one of MBG's cooperative projects with international institutions. Botanical Illustrators: Feng Jinyong and Cai Shuqin*

PHOTO BY GEORGE YATSKIEVYCH

*(FIG 94)* Coniogramme intermedia, *a fern that was recently collected by George Yatskievych (Missouri Department of Conservation-MBG) and collaborators during the last expedition to China organized by the Ethnobotany Department of the W.L. Brown Center.*

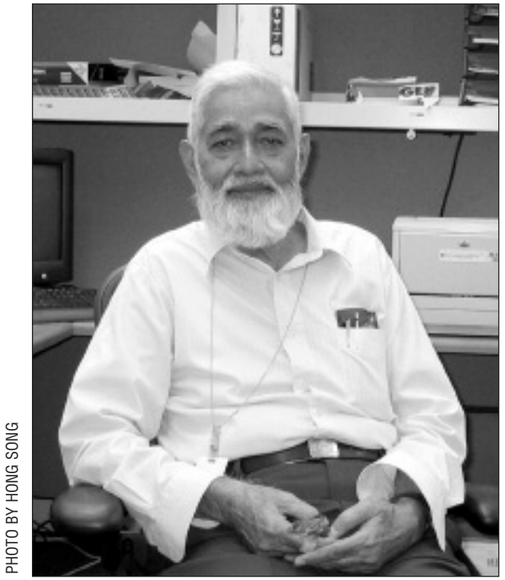


PHOTO BY HONG SONG

*(FIG 95) Professor Ali, from the University of Karachi, is co-founding editor of the* Flora of Pakistan, *the final volumes of which are now being co-published by the Missouri Botanical Garden, in part with funding from the U.S. National Science Foundation. The entire* Flora *is now being databased, with support from the U.S. Department of Agriculture, and made available on-line.*

PHOTO BY MBG RESEARCH

*(FIG 96)* Bambusa textilis *McClure forest, Guangning County, Guangdong Province, P. R. China. This is an economically important species widely used for weaving of all kinds of bamboo products, such as mats, chairs, and buckets. It is also a fast growing source of raw material for paper.*

## China

The *Flora of China* (FOC) is a revised English edition of the Chinese *Flora Reipublicae Popularis Sinicae* (FRPS), the largest published flora in the world. The 126 volumes of FRPS were published between 1959-2005, include the work of 314 botanists and 167 botanical artists from 34 research institutes, and contain 31,142 plant species with 9,000 illustrations.

The *Flora of China*, consisting of 25 text volumes with 25 accompanying illustration volumes, is scheduled to be completed in 2010. Thus far, 11 text volumes covering 13,516 species and 10 illustration volumes have been published. The newest volume, FOC Volume 14, contains 1,498 species of the Ericaceae and eight other families. The Illustrations Volume 14 and text volume on grasses will be published by the end of 2005.

The *Flora of China Checklist* provides on-line access to information concerning the ferns and seed plants of China. The information includes floristic and nomenclatural data and references to the Chinese-language *Flora Reipublicae Popularis Sinicae*, the English-language *Flora of China*, and the *FOC Illustrations* volumes.

*Additional information:*
www.mobot.org/MOBOT/Research/asiaprojects.shtml
*Contact:* Guanghua Zhu



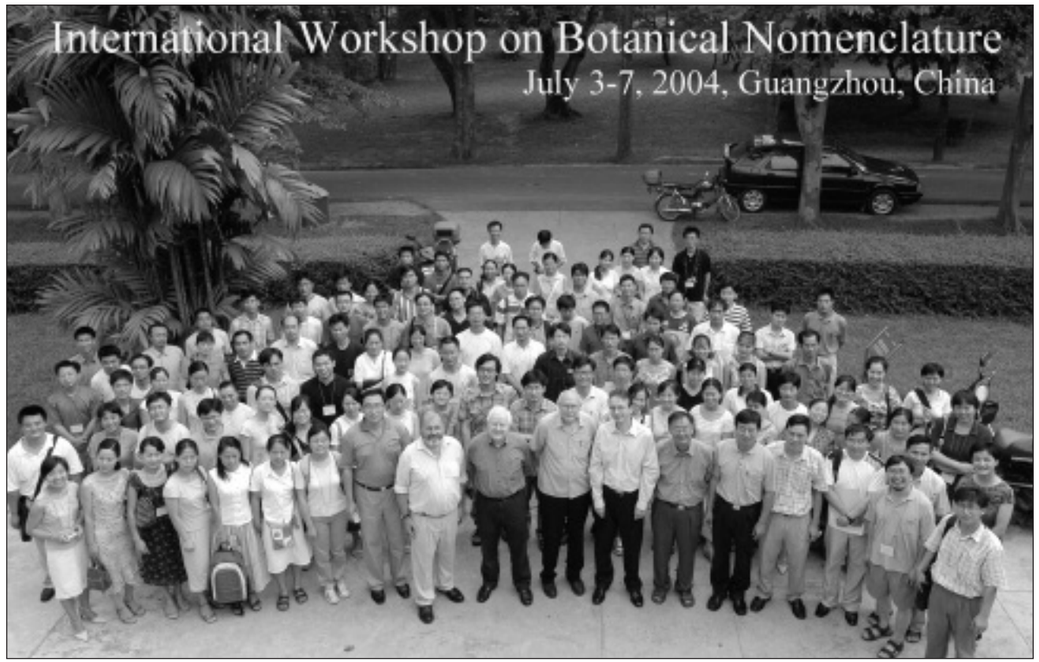



PHOTO BY MBG RESEARCH

*(FIG 97) Partially sponsored by the* Flora of China *Project, a remarkable workshop on botanical nomenclature was held at the South China Botanical Garden, Chinese Academy of Sciences, in Guangzhou, from July 3 to 7, 2004. Speakers involved four of 12 members of the Editorial Committee of the St. Louis (2000) Code: Dan Nicolson (US), John McNeill (E), Fred Barrie (F & MO), and Nick Turland (MO). Lectures were distributed on paper, shown as PowerPoint presentations with simultaneous translations in Chinese during the lectures and during discussions following lectures.*

PHOTO BY MBG RESEARCH

*(FIG 98) Left to right: Bingtao Li, Nianhe Xia and Guanghua Zhu.* The Flora of China *Project sponsors an average of six Chinese co-authors each year to work in herbaria outside of China on different groups. Li (CANT) is working on the Euphorbiaceae, and Xia (IBSC) is working on Chinese bamboos (Poaceae, which will be published by the end of 2005) and the Magnoliaceae for the* Flora.


PHOTO BY MBG RESEARCH

*(FIG 99)* Participants in a workshop on "The Role of Botanical Research and Training in Biodiversity Conservation in Vietnam," Nui Chua National Park, March 2004.

PHOTO BY MBG RESEARCH

*(FIG 100)* Training participants receive instruction in methods of plant collection, including the recording of detailed field notes to accompany herbarium specimens.

## Vietnam

MBG has worked in Vietnam for more than a decade, accumulating scientific information on the country's plants in support of biodiversity conservation, building capacity within the context of these investigations, and partnering with local people and institutions in conservation projects on threatened and endangered species of conifers and medicinal plants. In collaboration with the Institute of Ecology and Biological Resources in Hanoi, the Research Division and CCSD partner in MBG's Vietnam Botanical Conservation Program, which is funded by grants from the Henry Luce, John D. and Catherine T. MacArthur, and Conservation, Food, and Health Foundations. The Program has conducted field training courses in botany and conservation in Bach Ma, Nui Chua, and Bu Gia Map National Parks for park rangers, forest protection officers, botanical technicians, and students (FIGS 99-102). In the buffer zone of Bach Ma National Park, the Program educates and engages local communities in conservation and sustainable economic activities, helping them participate cooperatively in conserving and managing the protected areas. The Vietnam Botanical Conservation Program also provided mentoring and support for five M.S. students in Vietnam and two graduate students in the U.S.; to date, two of the students in Vietnam and one at the University of Missouri-Saint Louis have obtained their degrees. The Program, under the direction of Curator-in Residence Jack Regalado and Nguyen Tien Hiep, provided botanical data and technical support for the publication of the *Slipper Orchids of Vietnam*, the *Cycads of Vietnam*, and the *Vietnam Conifer Conservation Status Review.*

*Additional information:*
www.mobot.org/MOBOT/Research/vietnam/welcome.shtml
*Contact:* Jack Regalado

PHOTO BY MBG RESEARCH

*(FIG 101)* Two training participants conduct a survey of medicinal and useful plants of the ethnic community in Nui Chua National Park.

PHOTO BY MBG RESEARCH

*(FIG 102) Training participants work at night on specimens collected in Nui Chua National Park.*

# plant systematics

MAP BY PETER STEVENS

*(FIG 103)* Distribution map of Clusiaceae from APweb. /APweb/ contains phylogenies with possible apomorphies and family characterizations of all seed plants, the classification of flowering plants very largely following that of the Angiosperm Phylogeny Group. The site is kept as up-to-date as is possible (on-line at www.mobot.org/MOBOT/Research/APweb/welcome.html)

PHOTO BY JENS MADSEN

*(FIG 104) Floristic and taxonomic studies by MBG staff have led to the discovery of many new taxa, such as this* Arnaldoa argentea, *an Asteraceae endemic to southern Ecuador.*

Research staff at MBG continue taxonomic work on the highly diverse representatives of Araceae, Asteraceae, Iridaceae, Orchidaceae, Poaceae, and Rubiaceae as well as on 60 other vascular and nonvascular plant families.

In addition, MBG supports anatomical research on selected families, as well as research on biogeography in Latin America, research on nomenclatural issues through the *Linnaean Plant Names Typification Project*, and gathering of chromosome count data through the publication of the *Index to Plant Chromosome Numbers* (available on-line at http://mobot.mobot.org/W3T/Search/ipcn.html).

*Additional information:*
www.mobot.org/MOBOT/Research/generalprojects.shtml
*Contact:* Bob Magill



PHOTO BY CHARLOTTE TAYLOR

*(FIG 105) Studies on Neotropical Rubiaceae are under way by Curator Charlotte Taylor. Depicted here is a specimen of* Psychotria poeppigiana *collected in Costa Rica.*

PHOTO BY OLGA MARTHA MONTIEL

*(FIG 106) Curator W.D. Stevens, who studies the Apocynaceae-Asclepiadoideae and the flora of Nicaragua, has recently named this new species native to Central America as* Gonobolus incerianus.

PHOTO BY JOHN MANNING

*(FIG 107) Senior Curator Peter Goldblatt is a specialist in Iridaceae and the co-editor of the series* Index to Plant Chromosome Numbers.

PHOTO BY MBG

*(FIG 108) Curator George Schatz, a specialist in Annonaceae, doing fieldwork in Madagascar.*

PHOTO BY ALISON DIBBLE

*(FIG 109)* Bill Buck (left), from L, and Curator Bruce Allen in the field in upstate New York. They have also collaborated on the exploration of the mosses of Tierra del Fuego.

## Bryophytes

Bryology at MBG began in 1968 with the arrival of Marshall Crosby. There are now seven bryologists, all actively involved in revisionary work. Floristics includes *Moss Flora of Central America* and *Moss Flora of Maine*, both by Bruce Allen (FIG 109). Steve Churchill, who is stationed in Bolivia, works on Andean mosses. Bob Magill studies sub-Saharan and Malagasy mosses. Si He (FIG 110), who edits *Moss Flora of China*, recently submitted the fifth of eight volumes for publication. The bryophyte herbarium has grown from 60,000 to over 450,000 specimens.

Richard Zander coordinates bryophytes for *Flora of North America* (FNA). Patricia Eckel, bryophyte volumes illustrator, contributes treatments to *FNA* (FIG 113) and works on the flora of the Niagara River Gorge, the history of American botany (FIG 111), and botanical Latin.

Tardigrades—eight-legged, barely visible (<0.5 mm long) invertebrates—live among bryophytes (FIG 112). Knowledge of tardigrade distributions varies from 50 species reported from China to 500 from Europe. William Miller from Chestnut Hill College, Clark Beasley from McMurry University, and MBG collaborate on a survey of Chinese tardigrades. Undergraduates have extracted and are now mounting and identifying tardigrades from 10,000 Chinese mosses at MBG. NSF supports the work on Central American and Chinese mosses and on tardigrades (FIG 112).

*Additional information:*
www.mobot.org/MOBOT/Tropicos/most/welcome.shtml
www.mobot.org/plantscience/resbot/
*Contact:* Bob Magill

PHOTO BY MBG RESEARCH

*(FIG 110)* *Associate Curator Si He collecting bryophyte specimens in southern Taiwan.*

PHOTO COURTESY PATRICIA ECKEL

*(FIG 111)* *Ottillie Hauenstein (left) and Elizabeth Rochester were plant collectors in western New York in the mid-1800s. Patricia Eckel's checklist of that area will be published shortly; her historical studies are on the Res Botanica Web site of MBG.*


PHOTO BY WILLIAM J. MILLER

*(FIG 112)* *Tardigrades of the genus* Echiniscus *are one example of the almost invisible animals being found in the mosses preserved in the bryophyte herbarium.*

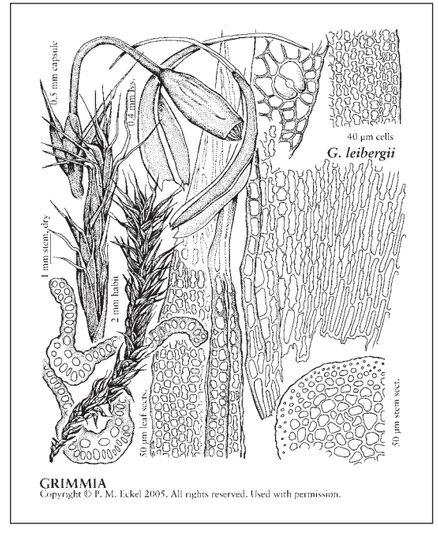



IMAGE COURTESY RICHARD LANDER

*(FIG 113)* *The first of three volumes on bryophytes for* FNA *will appear in 2006 from the Bryophyte Center at MBG, whose artist, Patricia Eckel, made this detailed illustration for the western moss* Grimmia leibgerii.

PHOTO BY JAN SALICK

*(FIG 114) George Yatskievych lecturing on how to prepare fern specimens in China, May 2004.*

PHOTO BY GEORGE YATSKIEVYCH

*(FIG 115)* Drynaria sinica, *a relative of the cultivated staghorn ferns that is used medicinally for various ailments, growing under pine trees in Yunnan Province, China.*

## Pteridophytes

Nearly ten percent of the specimens received at the MBG Herbarium each year are ferns and lycophytes—a reflection of the fact that seed-free vascular plants are a species-rich and ecologically important group. The study of these plants at MBG dates back to George Engelmann (see portrait, FIG 30 on page 15), who collected new species of *Isoetes* in the St. Louis area in the 1830s. Ferns have been a part of most of MBG's major floristic projects, and MBG has been the convening center for such major pteridofloras as *Flora of North America* and *Flora Mesoamericana*. Currently, Michele Funston is coordinating a multinational project to produce an English-language, three-volume treatment of the ca. 2,000 species for the *Flora of China* Project, with assistance from Nick Turland and George Yatskievych (FIG 114-115). An illustrated treatment of the pteridophytes of Nicaragua is being prepared by Alba Arbeláez. Other collaborations include Yatskievych's work on the ferns of Sonora, Mexico. Henk van der Werff contributed with pteridophyte data for the recently published additions to the *Catalogue of the Flowering Plants* and *Gymnosperms Plants of Peru (Diez años de adiciones a la flora del Peru: 1993-2003)*.

*Contact:* George Yatskievych and Michele Funston

## Lauraceae

The avocado family, Lauraceae, is a large family of mostly tropical trees with about 55 genera and 3000-3500 species worldwide (FIG 117). Most species grow in wet forests, and the family is rare or lacking in seasonally dry forests. Taxonomically, Lauraceae are a difficult group because genera and species are defined by small characters of the flowers. In addition to avocados, other useful products of the Lauraceae include cinnamon, bay leaves, and camphor; many species have good quality timber. MBG Curator Henk van der Werff (FIG 116) has been studying Lauraceae for more than 20 years, especially the species in the American tropics and Madagascar. His fieldwork, in which Bruce Gray from Australia often participates, continues to yield undescribed species. His most recent project, a revision of *Aspidostemon*, a genus endemic to Madagascar, is nearly finished; it will consist of 28 species, of which 18 will be newly described. His next major project will be a revision of *Ocotea* in the Andean region (Colombia, Ecuador, Peru, and Bolivia) above 1,000 m elevation. *Ocotea* is a large genus of more than 300 species, and the many recent collections from the Andean region have never been critically studied. It is likely that more than 100 species of *Ocotea* occur in the Andean region, of which an estimated 20-30 species will be new to science.

*Contact:* Henk van der Werff



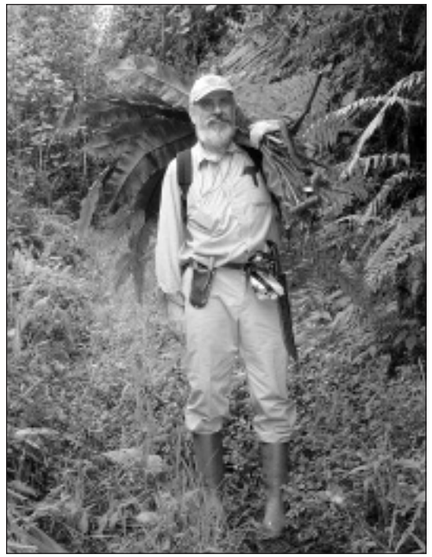


PHOTO BY RODOLFO VÁSQUEZ

*(FIG 116) In addition to his research in Lauraceae, MBG Curator Henk van der Werff also works with ferns. He is pictured here collecting ferns in the Cordillera de Yanachaga, Peru.*

PHOTO BY RODOLFO VÁSQUEZ

*(FIG 117) A species of* Pleurothyrium *from the Cordillera de Yanachaga, Peru.*

## Plant anatomy and morphological adaptations

Research Associate Richard Keating is currently working on the comparative vegetative anatomy of the Onagraceae for the Myrtales volume of the *Anatomy of the Dicotyledons*, second edition. The volume will be part of an ongoing series sponsored by the Jodrell Laboratory of the Royal Botanic Gardens, Kew, and published by Oxford University Press. The Onagraceae treatment will feature photomicrographs of all genera and will have more detailed descriptions than was true of the first edition of these anatomical reference volumes (FIG 118).

A second project carried out by Keating is on vegetative adaptations of woody plants along a climatic gradient in North America. For this project, Keating is concentrating on the widely distributed genus *Salix*. Over a ten-year period, he collected specimens of *Salix* and a few other genera on two transects from the Gulf Coast to the Arctic Ocean. This research aims to document changes in vegetative structure in increasingly stressed habitats with shorter growing seasons. It will also be possible to make comparisons between vegetative structure and growth at high elevation (timberline) habitats vs. the same structures at high latitudes. Wood anatomy as well as leaf structure and ontogeny are being investigated (FIG 119).

*Contact:* Richard Keating

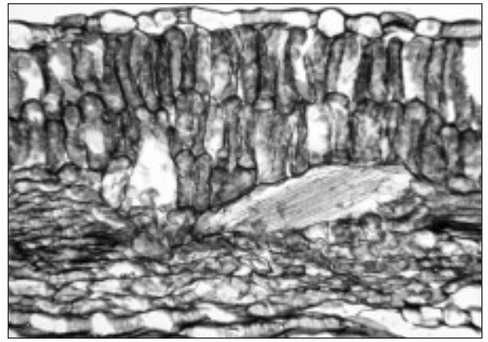


PHOTO BY RICHARD KEATING

*(FIG 118) Leaf trans-section of* Camissonia cheiranthifolia. *Note prominent raphide cell, an anatomical feature diagnostic of Onagraceae.*

PHOTO BY JODY KEATING

*(FIG 119) Research Associate Richard Keating preparing a pickled specimen of* Salix bebbiana *near timberline in the Sangre de Christo range of southern Colorado.*

PHOTO BY SHIRLEY GRAHAM

*(FIG 120)* Alan Graham in the Rhodope Mountains of Bulgaria, one of the many sites across the northern latitudes with some of the temperate trees introduced into Latin America during cool intervals of the late Tertiary Period (past 15 million years)—fir, pine, spruce, alder, beech, birch, chestnut, dogwood, elm, hickory, linden, oak, sweet gum, and sycamore.

## Biogeography

Studies of the earth's ancient vegetation start with individual fossil flora—an analytical phase. The results have to be integrated with those from fossil faunas to reveal biotic history, and eventually with geological and climatological evidence to model ecosystem evolution—a synthesis phase. Studies in the Neotropics are just entering the ecosystem phase. Curator Alan Graham's work includes contributing to and editing *Biogeography of Latin America—Causes and Effects* (MBG Press) and completing a manuscript on Late Cretaceous and Cenozoic History of Tropical American Vegetation, which will join earlier works on *Late Cretaceous and Cenozoic History of North American Vegetation (North of Mexico), Vegetation and Vegetational History of Northern Latin America*, and *Floristics and Paleofloristics of Asia and Eastern North America.* (FIG 120). The goal is to contribute information on the earth's biotas and their evolution over the last 70 million years of time.

*Contact:* Alan Graham

## Annual Systematics Symposium

The 52nd Annual Systematics Symposium, *Reconstructing Complex Evolutionary Histories: Gene-Species Trees, Historical Biogeography, and Coevolution*, coordinated by P. Mick Richardson and moderated by Richard Mayden (Saint Louis University) will take place this Fall 2005. The speakers for this year's event will be Daniel Brooks (University of Toronto), L. Lacey Knowles (University of Michigan), Richard Mayden (SLU), Luay Nakhleh (Rice University), Lynne R. Parenti (Smithsonian Institution), Richard H. Ree (Field Museum of Natural History), Jeanne Serb (Iowa State University), and Peter Unmack (University of Oklahoma).

*Additional information:*
www.mobot.org/MOBOT/research/symposium
*Contact:* Mick Richardson



# William L. Brown Center
## for Plant Genetic Resources

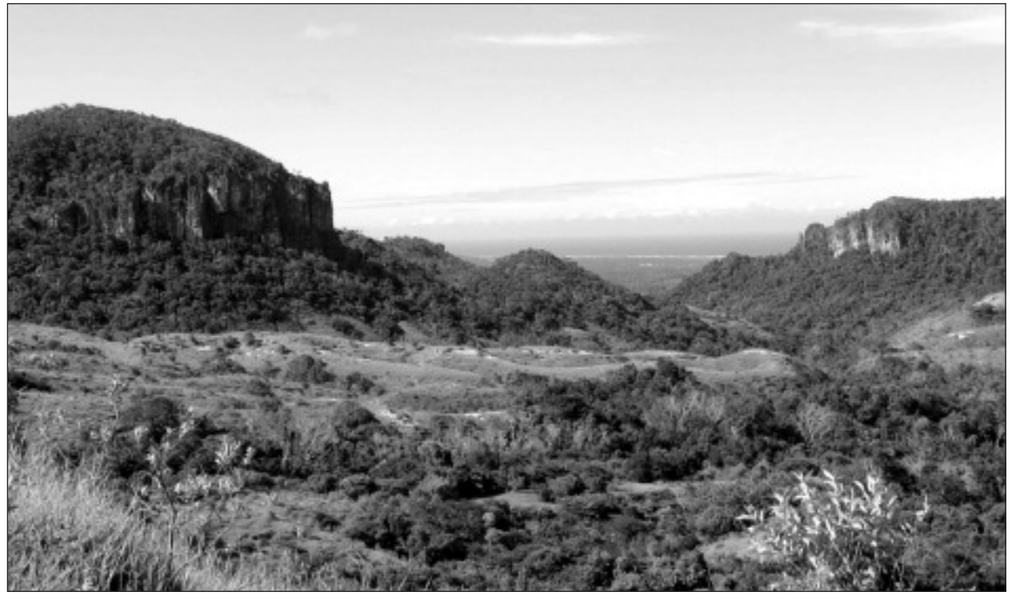


PHOTO BY CHRIS BIRKINSHAW

*(FIG 121)* The International Cooperative Biodiversity Group (ICBG) is studying plant diversity in the highly threatened remaining patches of forest that surround Montagne des Français in northern Madagascar. At the same time, ICBG has initiated several community-based conservation efforts in the area. Partners in this ICBG project include the WLBC and Virginia Tech, drug and agriculture research partners, and Conservation International.

The William L. Brown Center for Plant Genetic Resources (WLBC) is dedicated to the study and conservation of useful plants and associated traditional knowledge. Programs include partnerships to discover new bioactive compounds with promise as pharmaceutical, agricultural, or nutritional products. The International Cooperative Biodiversity Group (ICBG) in Madagascar is a partnership with Conservation International, Eisai Research, Dow Agrosciences, the Centre National d'Applications et des Recherches Pharmaceutique, and the Centre National de Recherches Oceanographiques. This cooperative combines the discovery of new drugs and agrochemicals with botanical inventory efforts that direct conservation programs in the highly fragmented and endangered remaining forests of northern Madagascar (FIG 121). The program works with the Assessment of Priority Areas for Plant Conservation Project (see Africa and Madagascar, page 34) to seek protected area status for those forests that are particularly rich in endemic and threatened plant species.

Community-based conservation efforts are combined with botanical inventory in eastern Madagascar in a partnership with the Africa and Madagascar Department and the Center for Conservation and Sustainable Development (CCSD). Armand Randrianasolo and Chris Birkinshaw work with Reza Ludovic and Fortunat Rakotoarivony to promote sustainable use of forest resources, improve human health and nutrition, and increase awareness of the importance of natural resource conservation in the village of Mahabo and communities surrounding the large, unprotected forest of Ambalabe (FIGS 122-124).

# WLBC (continued)

PHOTO BY ARMAND RANDRIANASOLO

*(FIG 122) The William L. Brown Center is conducting a community-based conservation effort at Mahabo in collaboration with the Africa and Madagascar Department and CCSD. Local villagers still rely heavily on forest resources for their livelihood, including the collection of fuel wood for cooking. The program helps them develop more sustainable alternatives.*

PHOTO BY ARMAND RANDRIANASOLO

*(FIG 123) Armand Randrianasolo is conducting an inventory, conservation analysis, and community development program at Ambalabe Forest in eastern Madagascar, with support from the Beneficia Foundation and NGS. The region has high ecotourism potential; it is only four hours from Antananarivo and an hour from the closest road. This view of the site was taken from the east, where extensive practice of "tavi" (slash and burn agriculture) has led to destruction of forest in the foreground.*

Botanists of the William L. Brown Center are also engaged in the study of medicinal plants, which are the source of primary health care for most of the developing world and an increasing market in the United States as consumers seek alternative health care options. Through collaborations with the University of Missouri-Columbia and the University of Mississippi's National Center for Natural Products Research, WLBC projects include taxonomic studies of medicinal plant groups, the development of methods that industry can use to ensure correct identity of species they use as ingredients, and programs to conserve medicinal species that face threat from overharvest. Funds from the Civilian Research and Development Fund support *ex situ* conservation efforts in the Republic of Georgia. WLB Center members Wendy Applequist, Greg Gust, and Leith Nye work with Besa Schweitzer and Scott Woodbury of the Shaw Nature Reserve to evaluate the potential of black cohosh and other medicinal plants as alternative crops suitable for small farms (FIGS 125-126).

*Additional information:*
www.mobot.org/MOBOT/Research/diversity
*Contact:* Jim Miller



PHOTO BY REZA LUDOVIC

*(FIG 124) Armand Randrianasolo, Fortunat Rakotoarivony, and members of the community are working on development and conservation at Mahabo, in southeastern Madagascar. The Mahabo Conservation Project tee shirts were given to the children for their participation in a conservation class.*

PHOTOS BY GREG GUST AND LEITH NYE

*(FIG 125) WLBC botanists Leith Nye and Greg Gust are surveying the plants of the United States in a collaborative effort with the National Center for Natural Products Research at the University of Mississippi to evaluate their pharmaceutical potential. Nye and Gust are pictured here on a recent collecting trip to the Mohave Desert.*

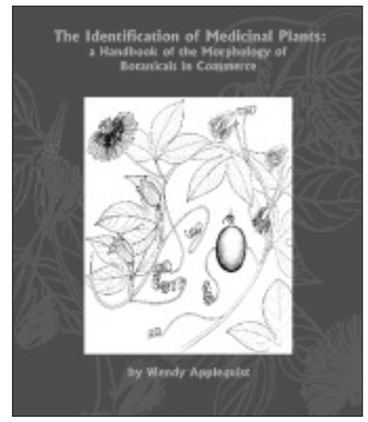



IMAGE COURTESY WLBC

*(FIG 126) Wendy Applequist has completed a guide to the plant species used to manufacture botanical dietary supplements (the legal name for herbal medicine in the United States) as part of an NIH-funded program with the University of Missouri-Columbia. The cover includes a* Passiflora *drawn by WLBC illustrator Barbara Alongi.*

PHOTO BY JAN SALICK

*(FIG 127)* Khawa Karpo, the warrior god, is among the most sacred peaks in Tibet and the highest peak in Yunnan (6,740 m). Tibetan Ethnobotany at MBG studies plants and people in the area surrounding this peak.

## Tibetan Ethnobotany in the Eastern Himalayas

The Tibetan Ethnobotany program of the William L. Brown Center focuses its research in northwestern Yunnan, China. The eastern Himalayas—verdant, snowcapped and glaciated—are renowned for their biological and cultural diversity and endemism. Tibetan people have lived for millennia in this area, conserving, using, managing, and enhancing this diversity. In the eastern Himalayas, exceptional diversity and endemism evolved with monsoonal rains, precipitous topography, and the interplay of major tropical and temperate floras. Tibetan culture flourished in this diversity and developed traditional knowledge of conservation and management. Outstanding among this biological and cultural diversity is a mountain range dominated by a peak known to Tibetans as Khawa Karpo, the warrior god, among the most sacred peaks in Tibet and the highest peak in Yunnan (6,740 m) (FIG 127). The sacred geography of this area is profound, protecting and conserving biodiversity.

Ethnobotany, the study of plants and people (FIG 128), is employed to document the useful biodiversity of Khawa Karpo and indigenous methods of conservation and management. Native plants, including foods, medicines, ornamentals, fibers, and much more, are used by Tibetans in every aspect of their lives. From the mundane to the sacred, from subsistence to ceremony, plants are an integral part of Tibetan life. Conservation and management of plants and biodiversity are equally integrated in Tibetan culture.



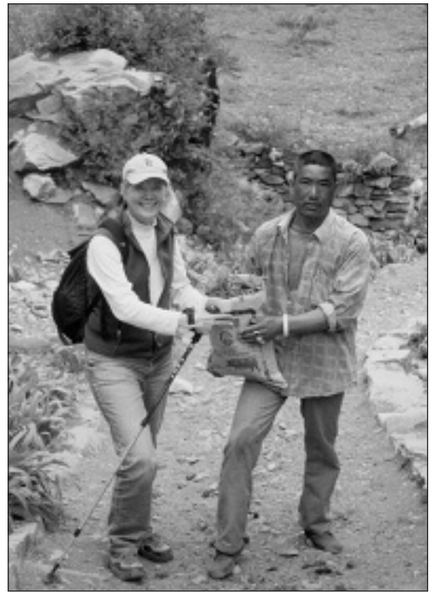


PHOTO BY GEORGE YATSKIEVYCH

*(FIG 128) Native plants, including foods, medicines, ornamentals, fibers, and much more, are used by Tibetans in every aspect of their lives. Here, a Tibetan villager shows Jan Salick, Curator of Ethnobotany, young leaves of* Aralia chinensis *eaten in early spring.*

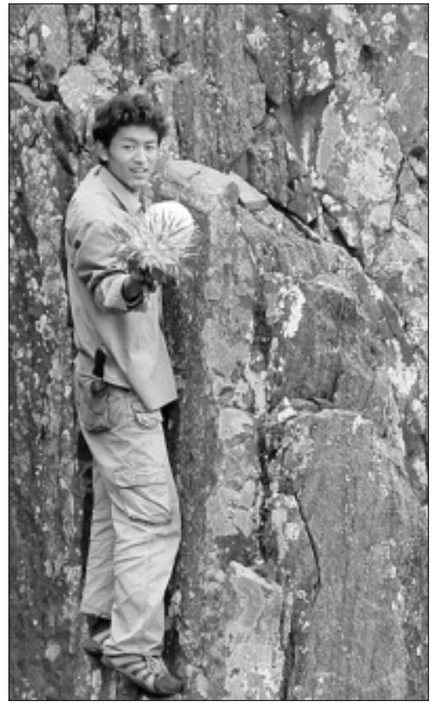


PHOTO BY WAYNE LAW

*(FIG 129) A Tibetan scales a rock precipice to harvest Snow Lotus (*Saussurea laniceps*, Asteraceae). Snow Lotus populations are threatened by the growing global market in Tibetan medicines. Wayne Law, doctoral student at Washington University, studies the population ecology of Snow Lotus to determine a sustainable harvest.*

Conservation and sustainable development can learn from and reinforce indigenous Tibetan practices at many levels from plant populations (FIG 129) to landscapes (FIG 130). Non-timber products (FIG 131) are an integral part of Tibetan indigenous subsistence and culture. Although Tibetans have been successful stewards of this plant diversity for millennia, modern pressures brought on by global warming (FIG 132), policy, and markets are threatening both biodiversity and traditional stewardship. Tibetan Ethnobotany studies traditional ecological knowledge to reinforce conservation and sustainable development and to empower the people to defend their resources and manage them for a sustainable future.

*Additional information:*
www.mobot.org/MOBOT/Research/diversity
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PHOTO BY JAN SALICK

*(FIG 130) Tibetan land management includes traditional agriculture, here shown with terraced barley and wheat fields of diverse native varieties and bordered by walnuts used for food, oil, religious ceremony, erosion control, and environmental amelioration. Additionally, traditional Tibetan land management also includes maintenance of sacred sites, natural forest management, non-timber products, pastures, and much more.*

PHOTO BY JAN SALICK

*(FIG 131) Alpine meadows are the most diverse habitat around Khawa Karpo, including many important Tibetan medicines like* Rhodiola crenulata *(Crassulaceae) in the foreground.*

PHOTO BY JAN SALICK

*(FIG 132) Global warming is the apparent cause of glacial retreat, as is obvious when we compare this view of Khawa Karpo to similar photographs of Joseph Rock from 74 years ago. Global warming is one of the factors, along with policy and market economy, that threatens Himalayan biodiversity.*



PHOTO BY GRETCHEN WALTERS

*(FIG 133) Miguel Leal (right) and Diosdado Nguema (left) press plants in Waka National Park, Gabon.*

## Central Africa

The Central Africa program of the William L. Brown Center works with IPHAMETRA (Institut de Pharmacopée et Médécine Traditionelle) in Gabon and the Instituto Nacional de Desarollo Forestal (INDEFOR) in Equatorial Guinea, and partners with the Wildlife Conservation Society, Conservation International, and the Smithsonian Institution (SI) to carry out botanical work and conservation in several national parks with support from USAID/CARPE and NGS. Miguel Leal coordinates work in these poorly known sites, and the data generated will be used to establish conservation priorities (FIG 133).

A major goal of the program is to improve regional research capacity. James Miller, Pete Lowry II, and Gretchen Walters conducted an external review of the national herbarium at INDEFOR in 2004 (FIGS 135-136). These recommendations will guide efforts in staff education and facility improvements. Additionally, MBG co-sponsors regional workshops with SI and the Réseau des Botanistes d'Afrique Centrale. Last July, graduate student David Kenfack helped organize workshops in Cameroon that focused on botanical field techniques and regional conservation initiatives (FIG 138).

Recent accomplishments of the Central Africa program include a revision of *Ancistrocladus*, co-authored by C. Taylor, R. Gereau, and G. Walters. Based on this revision, graduate student Corneille Ewango completed a predictive GIS analysis of the species distributions in Africa. Several new species have been described from recent collecting. The program is contributing to a checklist for Gabon in collaboration with LBV, WAG, P, and BR.

*Additional information:*
www.mobot.org/MOBOT/Research/diversity
*Contact:* Gretchen Walters and Miguel Leal

PHOTO BY MIGUEL LEAL

*(FIG 134)* Monts de Cristal, Gabon, contains the highest plant diversity in Central Africa. This park is currently under threat from the mining industry. Botanists make regular expeditions to this area to document the park's exceptional diversity and support its conservation.

PHOTO BY PETE P. LOWRY II

*(FIG 135) Gretchen Walters presents a new species found in the Plateaux Batéké National Park to Ludovic Ngok, Director of l'Herbier National du Gabon, and Réné Adiaheno, Director of Gabon Parks.*

PHOTO BY GRETCHEN WALTERS

*(FIG 136) Jim Miller participated in an external review of Equatorial Guinea's National Herbarium in September 2004.*

PHOTO BY T. SUNDERLAND

*(FIG 137) Thomas Nzabi and Yves Issembe, Herbier National du Gabon, participated in the MBG-Smithsonian vegetation assessment in the Monts de Cristal. This research will provide the first detailed study of this new national park.*

PHOTO BY MBG RESEARCH

*(FIG 138) David Kenfack, co-founder of the Réseau des Botanistes d'Afrique Centrale, speaks during a REBAC meeting in Cameroon.*

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