

The Plant Press



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National Museum of Natural History

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Island Explorations and Evolutionary Investigations

By Vinita Gowda

For over a century the Caribbean region, held between North and South America, has been an active area of research for people with interests in island biogeography, character evolution, speciation, as well as geology. Most research have invoked both dispersal and vicariance processes to explain the distribution of the local flora and fauna, while ecological interactions such as niche partitioning and ecological adaptations have been used to explain the diversity within the Caribbean region. One of the biggest challenges in understanding island colonization in the Caribbean, however, has been its complex, dynamic and variable geological history, which varies both along a North-South and an East-West axis.

The Caribbean region is divided into the Greater Antilles (northern islands) and the Lesser Antilles (southern islands). The Lesser Antilles archipelago, the focus of my research interests, is 850 kilometers long with a radius of curvature of 450 kilometers, and consists of 19 islands. The Lesser Antilles stretches from South American continental margin (eastern Venezuela) to the Anegada Passage, which marks its boundary with the Greater Antilles (Puerto Rico-Virgin Islands platform).

Geologically, the Caribbean region is estimated to have formed in the Cenozoic era (65 million years ago), following the separation of North and South America during the Mesozoic era. The volcanic islands, today's Lesser Antilles, are proposed to have emerged from the tectonically active Aves Arc after a series of subsiding volcanic islands migrated

eastward after the Aves Ridge was formed to the West. Although the Lesser Antilles is commonly referred to as a volcanically active chain of islands, not all of the Lesser Antilles is volcanic. Based on geological origin and elevation all the islands of the Lesser Antilles can be divided into two groups: a) Limestone Caribbees (outer arc: calcareous islands with a low relief, dating to middle Eocene to Pleistocene), and b) Volcanic Caribbees (inner arc: young volcanic islands with strong relief, dating back to late Miocene).

For over more than a decade John Kress, Ethan Temeles (Amherst College) and their team of researchers have been investigating mutualistic interactions between heliconias (*Heliconia*: Heliconiaceae) and their sexually dimorphic hummingbird pollinators the Purple-throated Caribs (Trochilidae: *Eulampis jugularis*) throughout the Eastern Caribbean Islands. Based on their studies they proposed the Caribbean *Heliconia*-hummingbird system as a case for adaptive evolution between the beak morphology of the Purple-throated Caribs and the floral morphology of the two native heliconias (Temeles et al. 2000 *Science*; Temeles and Kress 2003 *Science*). My involvement in this project started in September 2002, or more appropriately from July 2002 when I first met Kress at the Association of Tropical Biology and Conservation (ATBC) meeting in Bangalore, India. At the time, I was investigating a *Mussaenda frondosa*-insect interaction in the Western Ghats, India, and I was ready for new and bigger research challenges.

On joining the graduate program at The George Washington University in Washington, D.C., in the Fall of 2002, I decided to investigate adaptation in plant-pollinator interactions using a 'multi-island' comparative approach using the Caribbean *Heliconia*-hummingbird interactions as the study system. Since I was interested in understanding factors that could influence plant-pollinator mutualistic interactions between the geographically distinct islands, I chose three strategic islands of the Lesser Antilles: St. Kitts in the north, Dominica in the center, and St. Vincent to the south of the Lesser Antilles, respectively.

On all three islands only two native species of *Heliconia* occur in varying abundance: *Heliconia bihai* (L.) L. and *H. caribaea* Lam. However, floral polymorphism and abundance of these two species are completely reversed on these islands. On St. Kitts, *H. caribaea* is common and *H. bihai* is rare; on Dominica, both the species are common, but are mostly allopatrically distributed (commonly *H. bihai* can be found above 800 meters and *H. caribaea* below 800 meters with a small overlapping zone around 800 meters); and a reversed distribution is observed on St. Vincent where *H. bihai* is common and *H. caribaea* is rare. Both species have distinct color polymorphisms that vary among islands and serve as the primary nectar source for the Purple-throated Caribs.

The Purple-throated Caribs are sexually dimorphic birds that vary in their

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Travel

Walter Adey traveled to Woods Hole, Massachusetts (4/16 – 4/19) to present several papers at the North East Algal Society meeting; to Charlottesville, Virginia (5/12 – 5/13) to meet with colleagues at the University of Virginia; and to Steuben, Maine (6/17 – 9/15) to collect an ecological array of the coralline alga *Clathromorphum compactum* from the northern Labrador Coast and the Quebec shore of the Gulf of St. Lawrence.

Barrett Brooks traveled to Curacao (6/24 – 7/6) to collect marine algae by snorkeling, scuba diving and submarine for the Smithsonian's Deep Reef Observation Project (DROP).

Laurence Dorr traveled to Philadelphia, Pennsylvania (4/29) to attend a doctoral defense exam at Drexel University.

Vicki Funk traveled to Durham, North Carolina (5/17 – 5/20) to participate in a cyber-infrastructure meeting held at the National Evolutionary Synthesis Center (NESCent); and to Honolulu, Hawaii (5/24

– 6/6) to attend a meeting on the Evolution of Life on Pacific Islands and Reefs.

Carlos Garcia-Robledo traveled to Costa Rica (6/25 – 7/29) to collect Zingiberales and Cephaloleia beetles for his postdoctoral fellowship project, and to teach the graduate level course "Tropical Biology: An Ecological Approach" for the Organization for Tropical Studies.

Linda Hollenberg traveled to San Francisco, California (5/22 – 5/30) to attend the annual conference of the Society for the Preservation of Natural History Collections and the Natural Science Collections Alliance.

Carol Kelloff traveled to Georgetown, Guyana (4/25 – 5/3) to help set up the new library at the Centre for the Study of Biodiversity, University of Guyana; and to Honolulu, Hawaii (5/25 – 6/3) to participate at the conference Evolution of Life on Pacific Islands and Reefs.

Nancy Kahn traveled to Honolulu, Hawaii (5/24 – 6/3) to participate at the conference Evolution of Life on Pacific Islands and Reefs.

W. John Kress traveled to Dominica (5/4 – 5/17) to conduct field work on *Heliconia*-hummingbird interactions; to Arusha, Tanzania (6/8 – 6/19) to attend the annual meeting of the Association for Tropical Biology and Conservation as the Executive Director; and to Nairobi, Kenya (6/19 – 6/21) to conduct field studies.

Sonoe Nakasone traveled to Manhattan, New York (5/17 – 5/20) to attend a workshop at Columbia University.

Paul Peterson traveled to throughout western Maryland (5/9 – 5/12) to collect grasses.

Rusty Russell traveled to San Francisco, California (5/23 – 5/27) to give two presentations at the annual conference of the Society for the Preservation of Natural History Collections; and to the San Jacinto Mountains in southern California (6/18 – 7/5) to lead an Earthwatch Program studying changes in plant species composition.

Robert Soreng traveled to western Turkey (6/13 – 7/2) to collect grasses for collaborative research on the taxonomy of Alopecurinae, Phleinae, and Poinae, with Lynn Gillespie (CAN) and Musa Doğan and Evren Çabi (Middle East Technical University, Ankara).

Alice Tangerini traveled to Pittsburgh, Pennsylvania (5/19 – 5/21) to meet with colleagues at the Hunt Institute.

Alain Touwaide and **Emanuela Appetiti** traveled to Oxford, Mississippi (4/11 – 4/14) to deliver a paper on the history of medicinal plants at the 10th Annual International Conference on the Science of Botanicals (ICSB); to Rome and Piombino, Italy (5/6 – 5/19) to present their research on the DNA analysis of the ancient medicines found in a shipwreck off the coast of Tuscany, and to take new samples from the discoids to continue the analysis; and Touwaide traveled to Irvine, California (5/14 – 5/16) to deliver a lecture on Greek and Roman gardens at the Orange County Great Park, and to meet with the director of the Greek Digital Texts Program at the University of California Irvine.

Warren Wagner traveled to Honolulu, Hawaii (5/24 – 6/10) as the organizer of the conference Evolution of Life on Pacific Islands and Reefs, followed by field work on the islands of Hawaii and Kauai; and to Fort Collins, Colorado (6/23 – 6/26) to attend a thesis defense at Colorado State University.

Jun Wen traveled to Chicago, Illinois (4/24 – 4/27) to conduct research at the Field Museum; and to Alabama, Arkansas, Louisiana, Mississippi, Tennessee, and Texas (6/17 – 6/25) with interns **Ryan Moraski** and **Matt Chansler** to collect Vitaceae.

Elizabeth Zimmer traveled to New York City, New York (6/28 – 6/29) to meet with colleagues at the New York Botanic Garden and at the American Museum of Natural History.



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Chair of Botany

Warren L. Wagner
(wagnerw@si.edu)

EDITORIAL STAFF

Editor

Gary Krupnick
(krupnickg@si.edu)

Copy Editors

Robin Everly, Bernadette Gibbons, Rose Gullledge, Dail Laughinghouse

News Contacts

MaryAnn Apicelli, Robert Faden, Rusty Russell, Alice Tangerini, and Elizabeth Zimmer

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If you would like to be added to the hard-copy mailing list, please contact Dr. Gary Krupnick at: Department of Botany, Smithsonian Institution, PO Box 37012, NMNH MRC-166, Washington, DC 20013-7012, or by E-mail: krupnickg@si.edu.

Web site: <http://botany.si.edu/>

Visitors

Mike Martin, Johns Hopkins University; *Ambrosia* (Compositae) (1/1/09-6/30/11).

Carlos García-Robledo, University of Miami; Plant-herbivore interactions (7/20/10-7/19/11).

Vinita Gowda, Indian Institute of Science, Bangalore, India; *Alpinia* (Zingiberaceae) (11/15/2010-3/31/2012).

Genise Freire, Universidade Federal Rural do Rio de Janeiro, Brazil; Sapindaceae (12/1/2010-12/31/2011).

Plant Conservation has 2020 Vision

In October 2010, in Nagoya, Japan, the 10th Conference of the Parties of the Convention on Biological Diversity (CBD) adopted a Decision incorporating a consolidated update of the Global Strategy for Plant Conservation (GSPC) for the period 2011-2020. Over 180 countries backed the Global Strategy when it was first introduced to the CBD in April 2002. They recognized that up to two thirds of the world's plant species could be threatened by the end of this century unless urgent steps are taken to safeguard tens of thousands of species.

The original strategy set 16 targets in plant conservation to be achieved by 2010. These 16 outcome-oriented targets fall into five categories: understanding and documenting plant diversity, conserving plant diversity, using plant diversity sustainably, promoting education and awareness about plant diversity, and building capacity for the conservation of plant diversity. The new GSPC has revised targets set for 2020 <www.cbd.int/gspc>.

The ultimate and long-term objective of the Strategy is to halt the current and continuing loss of plant diversity. The mission of the Strategy is a catalyst for working together at all levels – local, national, regional and global – to understand, conserve and use sustainably the world's immense wealth of plant diversity while promoting awareness and building the necessary capacities for its implementation.

To help nations meet the targets, a consortium of international and national plant and conservation agencies have formed the Global Partnership for Plant Conservation. The Partnership brings together international, regional and national organizations in order to contribute to the implementation of the GSPC and provide tools and resources on how each country can plan and act to meet the targets. The National Museum of Natural History is a member of the Partnership.

Botanists, plant taxonomists, ecologists, and conservation biologists in the Department of Botany at the Museum are playing a significant role in contributing to achieve the 16 targets, specifically Target 1 (an online flora of all known plants) and Target 2 (an assessment of the conservation status of all known plant species, as far as possible, to guide conservation action). The GSPC provides an international mandate for taxonomists to pursue these assessment activities.

Editor's Note

Target 1 is well under way towards completion. *The Plant List* <www.theplantlist.org/> is a working list of all known plant species. Version 1, released in December 2010, aims to be comprehensive for species of vascular plants and bryophytes. Version 1 contains 1,244,871 million scientific plant names of which 298,900 are accepted species names. Development of *The Plant List* has been a collaborative venture coordinated at the Royal Botanic Gardens, Kew and Missouri Botanical Garden, and rely on the generosity of many collaborators who manage significant taxonomic data resources. One significant resource is the *Global Compositae Checklist* <www.compositae.org/checklist/>, an integrated database of nomenclatural and taxonomic information for the second largest vascular plant family in the world. This checklist is published by the International Compositae Alliance (which includes members **Vicki Funk** and **Harold Robinson**) and is compiled from many contributed datasets. More than 100,000 records derived from the *Global Compositae Checklist* are included in *The Plant List*.

A leader in plant taxonomy and evolution, NMNH's Department of Botany and the U.S. National Herbarium (USNH) together have made great strides in contributing and addressing many of the 16 GSPC targets (see *The Plant Press* 10: 1, 9-15; 2007). These contributions take the form of scientific papers and books, electronic publications, symposiums and informal lectures, new species descriptions, conservation assessments, and internet-accessible herbarium specimens and collections. Much more work needs to be done towards reaching the targets, and the Department of Botany will play an active part in achieving these goals by the year 2020.



Gary Krupnick
Editor of *The Plant Press*
Head of the Plant Conservation Unit

Allen Dawson, University of Maryland, and **Camila Uribe-Holguín García-Reyes**, Pontificia Universidad Javeriana, Bogotá, Colombia; Plant conservation internship (1/10-4/15).

Omokafe Ugbogu, Ibadan Herbarium Forestry Research Institute of Nigeria; Plant DNA barcodes (3/14-4/22).

Charles Zartman, Instituto Nacional de Pesquisas da Amazônia (INPA), Brazil; Brazilian plants (4/1-4/30).

Fred Barrie, Missouri Botanical Garden; Flora Mesoamericana (4/4-4/8).

Jeremy Berlin and **Deirdre Read**, National Geographic, Washington, DC; Interview (4/7).

Richard Rabeler, University of Michigan; Caryophyllaceae and Scrophulariaceae (4/11-4/12).

Nuri Benet-Pierce, San Diego State University; Chenopodiaceae (4/28-4/29).

Albrecht Berger, University of Koln, Germany; Scientific collaboration (5/2).

Andy Woo, University of Louisville; GIS project (5/2-8/26).

Rodrigo de Stefano, Centro de Investigación Científica de Yucatán, Mexico; *Pithecellobium* (Fabaceae) (5/6-5/20).

Janelle Burke, Cornell University; Polygonaceae and Plumbaginaceae (5/9-5/11; 5/15-9/2).

Janelle Winters, Yale University; Arizona project internship (5/9-6/24).

William Aley, Animal and Plant Health Inspection Service (APHIS); APHIS Controlled Import Permits (5/11).

Continued on page 5

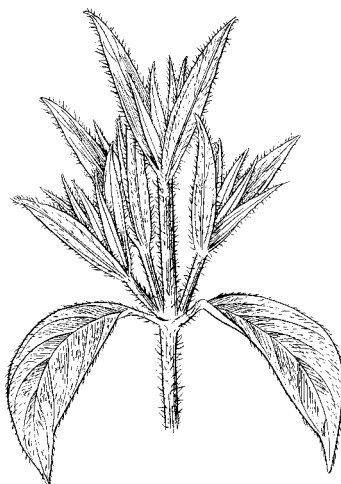
Staff Research & Activities

Gary Krupnick hosted a special “Scientist Is In” booth at the National Museum of Natural History on 18 May, to celebrate Plant Conservation Day. He also participated in the Endangered Species Day Fair on 20 May, at the U.S. Botanical Garden (USBG). The event, hosted by USBG, the U.S. Fish & Wildlife Service, and the Endangered Species Coalition, included tours of USBG’s endangered and native plants, talks on endangered plants, visits with exhibitors from federal agencies and conservation organizations, and demonstrations about what can be done at home to protect native plants. In addition to hosting a booth displaying herbarium specimens of rare and endangered species from the U.S. National Herbarium, Krupnick presented the talk “Losing Paradise? Endangered Plants Here and Around the World,” featuring stories, specimens, and illustrations from the past NMNH exhibition of the same name.

American History TV <www.c-spanvideo.org/program/SEExpl> visited the Smithsonian’s Museum of Natural History to see plant specimens collected between 1838 & 1842 by a U.S. government funded expedition. In the video, **Rusty Russell** presents several specimens and explains the history of the United States Exploring Expedition. The 19th century government expedition commanded by Lieutenant Charles Wilkes circumnavigated the globe, charted unknown Pacific islands, and discovered Antarctica. The 40 tons of animal, plant, and ethnographic specimens collected by the expedition’s six naval vessels became the foundation for the Smithsonian Institution collections, and are still used for scientific research. In the video, several locations of the National Museum of Natural History were toured, including the Joseph F. Cullman 3rd Library of Natural History in Washington, D.C., and the Museum Support Center in Suitland, Maryland. Topics included the evolution of the Smithsonian and preservation of the specimens.

On 20 April, **Alain Touwaide** delivered the Annual Library Lecture at the U.S.

Naval Research Laboratory in Washington, D.C., on “The History of the Book: from Papyrus to E-Book.”



Faust Honored with Tyge Christensen Prize

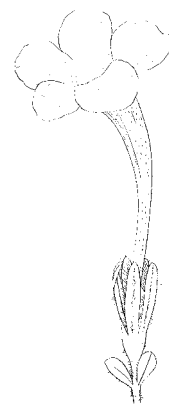
The International Phycological Society (IPS) has awarded the Tyge Christensen Prize to the monograph “Taxonomy of *Gambierdiscus* including four new species, *Gambierdiscus caribaeus*, *G. carolinianus*, *G. carpenteri* and *G. reutzleri* (Gonyaulacales, Dinophyceae)” by R. Wayne Litaker, Mark W. Vandersea, **Maria A. Faust**, Steven R. Kibler, Mireille Chinain, Michael J. Holmes, William C. Holland and Patricia A. Terster (*Phycologia* 48: 344-390; 2009).

The Tyge Christensen Prize is awarded annually for the best paper published in *Phycologia*. The prize consists of a cash award as well as commemorative certificates for each author. Judging of the awards is based on scientific significance, originality in subject matter or techniques, comprehensiveness, and clarity of presentation.

Dinoflagellate species in the genus *Gambierdiscus* have a pantropical distribution and are found throughout the Caribbean, the Hawaiian Islands, French Polynesia, Australia and the Indian Ocean. Recently, *Gambierdiscus* has been found in the Gulf of Mexico off of Texas and North Carolina. The impetus for studying species in the genus *Gambierdiscus* is the production of precursor toxins, bioaccumulation in fish, and the cause of ciguatera fish poisoning. This monograph represents the first comprehensive overview of the morphology of the toxicologically impor-

tant species belonging to the genus *Gambierdiscus*. Consequently, a major goal of this study was to provide the research community with detailed morphological differences and phylogenetic analyses of the species within this important genus.

“The research by Litaker *et al.* highlights the utility and importance of alpha taxonomy in biological research, and a premier journal like *Phycologia* specializing in the description of internationally significant algal species is the appropriate venue to recognize this importance,” said Giuseppe C. Zuccarello, Chair of the Christensen Prize committee and IPS Vice President. “This work shows the heights that careful descriptive research can reach, both aesthetically and practically, and deserves this year’s Tyge Christensen Prize.”



James J. White, 1941–2011

On 12 April, James J. White died from a degenerative neurological disease. He was supervisor of the Herbarium Services Unit in the Department of Botany at the Smithsonian Institution (1969–1978), where he often found original botanical artworks in the same drawer as herbarium specimens. He joined the Hunt Institute for Botanical Documentation staff in 1978 as Assistant Curator of Art and became Curator of Art in 1982. After 32 years at the Hunt Institute, he retired due to medical reasons in 2010 as Curator of Art & Principal Research Scholar, Emeritus.

A native of Johnson City, Tennessee, White received his B.A. (1963) and M.S. (1968) at East Tennessee State University. After moving to Washington, D.C., in 1969, he took courses in botany and art at George Washington University and the Corcoran School of Art.

At the Hunt Institute he worked

alongside Curator of Art John V. Brindle (1911–1991) to augment the botanical art collection and to curate a regular schedule of exhibitions. As Curator of Art, White refined the triennial international series (begun in 1964) into one of the most important exhibitions of contemporary botanical art and illustration in the world. He was involved with the curation of over 50 exhibitions and contributed many articles about items in the Art collection to the *Bulletin of the Hunt Institute for Botanical Documentation* and articles on botanical art in India to *Huntia*, a journal of botanical history. White oversaw the cataloguing of the entire Art collection, making the information available first in a nine-part print edition (1985–1998) and in 2001 as a database on Hunt's Web site. In the early 1990s he began compiling the Register of Original Botanical Art, a guide to the location of mostly public collections of original botanical paintings and drawings from any time period done in traditional media, such as watercolor, pastel, ink or pencil, and added the database to Hunt's Web site in 2002.

In 2007 he received the American Society of Botanical Artists (ASBA) Award for Excellence in the Service of Botanical Art in recognition of his outstanding work in support of botanical art, and in 2010 this award was renamed in his honor.



Visitors

Continued from page 3

Walter Holmes, Baylor University; *Mikania* (Asteraceae), ferns and fern allies (5/11-5/13).

Brad Oberle, Washington University, St. Louis; *Dodecatheon* (Primulaceae) (5/13).

Jack Folsom, University of Mary Wash-

ington; Plant conservation internship (5/16-8/19).

Esa Sclafani, St. John's College; U.S. Exploring Expedition internship (5/16-8/19).

Rachel Bouchillon, University of Florida; Plant conservation internship (5/23-6/17).

Sophia Lee, Baltimore County, Maryland; Seagrasses (5/23-8/29).

Sarah Miller, St. John's College; U.S. Exploring Expedition internship (5/23-8/19).

Casey Perkins, Beloit College; Plant conservation internship (5/23-8/19).

Hanno Schaefer, Harvard University; Cucurbitaceae (5/23-5/25).

Katie Scussel, New College of Florida; Seeds of Success collection (5/23-7/1).

Lillian Waller, William & Mary College; U.S. Exploring Expedition internship (5/23-7/29).

Nicholas Woodbury, University of Missouri; Maps project internship (5/23-8/26).

Steve Muzos, University of Texas, Austin; *Bambusa* (Poaceae) (5/25-5/26).

Theodore Search, Skipta Pharmacist Society; History of pharmacy (5/26-5/26).

Richard Fischer, City University of New York, and **Jennifer Mathias**, Pratt Institute; Field Book project internship (5/31-8/29).

Sarah Gardner, Tulane University; Arizona project internship (5/31-8/26).

Robbie McInness, George Mason University; Maps project internship (5/31-8/29).

Kerri Morrison, McDaniel College; Curation internship (5/31-8/18).

Jenna Zukswert, Smith College; Plant DNA Barcode internship (5/31-8/6).

Paul Durham, Missouri State University; Scientific collaboration (6/2).

Christine Rounds, School for the Visual Arts, New York; Plant Image Collection (6/3-7/29).

Emily Afflitto, Temple University; U.S. Exploring Expedition internship (6/6-7/29).

Colton Collins, University of Portland; *Heliconia* (Heliconiaceae) (6/6-8/12).

Gracie Benson Martin, University of California, Berkeley; *Heliconia* (Heliconiaceae) (6/6-7/29).

Kathryn Fenster, University of Maryland, College Park, and **Zach Guttendorf**, Cornell University; Historical Expeditions website (6/6-7/29).

Michael Tims, Montgomery College; History of botany and ethnobotany (6/8-6/8).

Michelle Cho, James Madison University; Plant conservation internship (6/13-8/19).

Sarah Geinosky, University of Chicago; San Jacinto project internship (6/13-8/19).

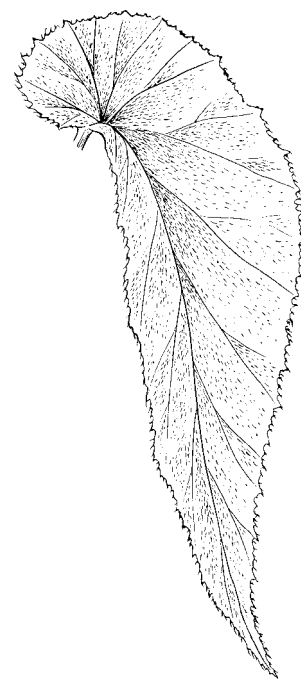
Emily Hunter, University of Maryland, College Park; Field Book project internship (6/13-8/29).

Nancy Ogden, Florida Institute of Oceanography; Algal herbarium (6/22-6/24).

Cassandra Quave, University of Arkansas for Medical Sciences; History of botany and ethnobotany (6/22).

James Bollinger, Alexandria, Virginia; Plant conservation internship (6/27-7/29).

Alexandra Berthiaume, Washington, DC, and **Carolina Panzardi**, McLean, Virginia; Youth Engagement through Science (YES) internship, Zingiberaceae (6/30-8/5).



Computer Science and Biology Come Together to Make Tree Identification a Snap

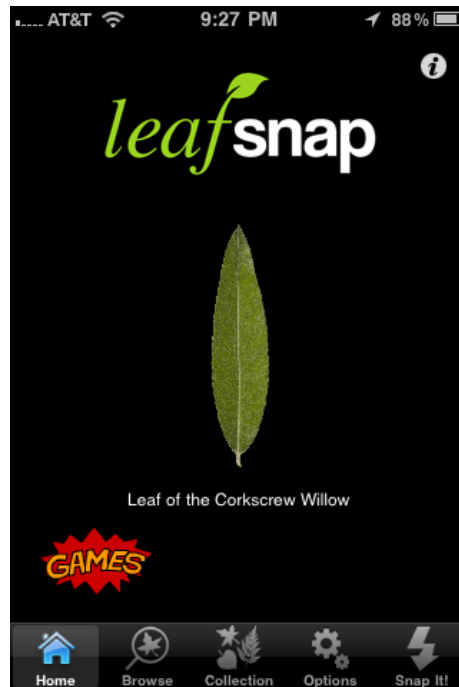
Columbia University, the University of Maryland and the Smithsonian Institution have pooled their expertise to create the world's first plant identification mobile app using visual search—Leafsnap. This electronic field guide allows users to identify tree species simply by taking a photograph of the tree's leaves. In addition to the species name, Leafsnap provides high-resolution photographs and information about the tree's flowers, fruit, seeds and bark—giving the user a comprehensive understanding of the species.

"We wanted to use mathematical techniques we were developing for face recognition and apply them to species identification," said Peter Belhumeur, professor of computer science at Columbia and leader of the Columbia team working on Leafsnap. "Traditional field guides can be frustrating—you often do not find what you are looking for. We thought we could redesign them using today's smartphones and visual recognition technology."

David Jacobs of the University of Maryland and Belhumeur approached **John Kress** to collaborate on remaking the traditional field guide for the 21st century.

"Leafsnap was originally designed as a specialized aid for scientists and plant explorers to discover new species in poorly known habitats," said Kress, leader of the Smithsonian team working on Leafsnap. Kress was digitizing the botanical specimens at the U.S. National Herbarium when first contacted by Jacobs and Belhumeur, so the match between a botanist and two computer scientists came at a perfect time. "Now Smithsonian research is available as an app for the public to get to know the plant diversity in their own backyards, in parks and in natural areas. This tool is especially important for the environment, because learning about nature is the first step in conserving it."

Users of Leafsnap will not only be learning about the trees in their communities and on their hikes—they will also be contributing to science. As people use

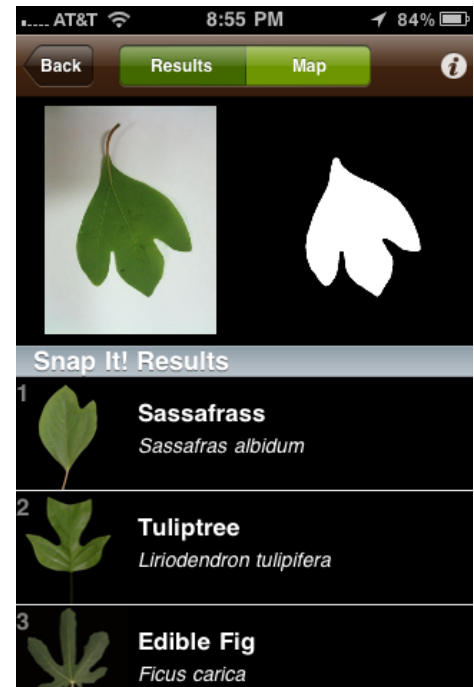


Leafsnap, the free mobile app automatically shares their images, species identifications and the tree's location with a community of scientists. These scientists will use the information to map and monitor population growth and decline of trees nationwide. Currently, Leafsnap's database includes the trees of the Northeast, but it will soon expand to cover the trees of the entire continental United States.

The visual recognition algorithms developed by Columbia University and the University of Maryland are key to Leafsnap. Each leaf photograph is matched against a leaf-image library using numerous shape measurements computed at points along the leaf's outline. The best matches are then ranked and returned to the user for final verification.

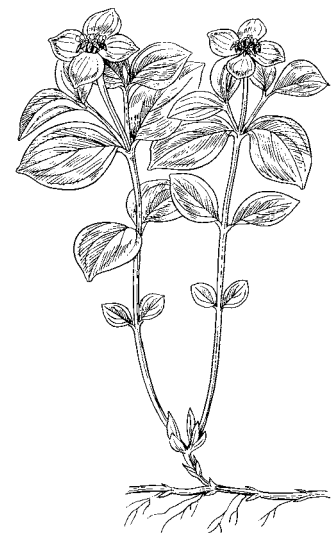
"Within a single species leaves can have quite diverse shapes, while leaves from different species are sometimes quite similar," said Jacobs, a professor of computer science at the University of Maryland. "So one of the main technical challenges in using leaves to identify plant species has been to find effective representations of their shape, which capture their most important characteristics."

The algorithms and software were developed by Columbia and the University of Maryland, and the Smithsonian supervised the identification and collection of leaves needed to create the image library used for the visual recognition in Leafsnap. In addition, the not-for-profit



organization Finding Species was hired and supervised by the Smithsonian to acquire the detailed species images seen in the Leafsnap app and on the Leafsnap.com website.

The app is available for the iPhone and iPad, with an Android version to be released later.



Correction

In "A New Look Inside Palms" (*The Plant Press* 14(2): 6; 2011), the authors of the article were listed incorrectly. The byline should have read "By James W. Horn, Jack B. Fisher, and P. Barry Tomlinson." The editor of *The Plant Press* regrets the error.

Flower Guide of Tibet

The Flower Guide of Tibet website <botany.si.edu/tibet> presents photos of plants taken during the three main expeditions in 2006, 2007 and 2009. The mountains of southern Tibet (Xizang Autonomous Region) and its adjacent regions in China form the eastern extent of the Himalayan range. Across this rugged landscape, high ridges uplifted from the collision of India with Asia shift from an east-west orientation to run primarily north-south; to the northwest, they give way to the highest plateau on Earth. It is a region of extreme elevational ranges compressed in short distances, with a corresponding diversity of habitats ranging from nearly untouched lowland subtropical forests (with tree ferns) in the Yarlongtsangpo River Valley, to montane tree *Rhododendron* cloud forests, to areas of alpine and cold desert vegetation at the highest elevations.

The flora of southern Tibet is rich and contains many endemic species. However, biodiversity in this region has in general been little studied and poorly documented, and historically this politically sensitive, geographically remote region has received few non-Chinese biologists. A paucity of botanical collections exist in western



“San qi long dan,” *Gentiana trichotoma* Kusnezow (Gentianaceae), grows on rocky slopes, 3000-4600 meters, in Qinghai, northwestern and western Sichuan, and Xizang. Copyright Smithsonian Institution.

herbaria, and those tend to be over sixty years old, made primarily by Griffith, Rock, and Kingdon-Ward in the early part of last century.

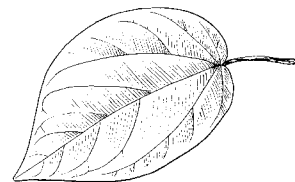


The recently discovered “mi la zi jin,” *Corydalis milarepa* Lidén & Z.Y. Su (Fumariaceae), from Xizang (Mi La, east of Lhasa). Copyright Smithsonian Institution.

The website has a gallery of photographs, as well as a search function to find images by plant family, genus, species, and common name. The results provide a selection of photographs, scientific name, common name, a description of the species, phenology, distribution, and habitat.

The John D. and Catherine T. MacArthur Foundation supported the project on the floristics and conservation research of the Himalayan part of western China, with the following principal investigators: **Jun Wen** (Smithsonian Institution), Rick Ree and Greg Mueller (the Field Museum), and Hang Sun (Kunming Institute of Botany). The treatments on the website have been contributed primarily by participants of the project as well as close associates.

All images are properties of the research team of the Plants of Tibet, a collaborative effort of the Field Museum, Smithsonian Institution, and Kunming Institute of Botany of the Chinese Academy of Sciences.





Female Purple-throated Carib (*Eulampis jugularis*) tagged with a unique band for individual identification. Male and female Purple-throated Caribs were monitored over multiple years to understand their dependence and interaction patterns with native heliconias. (Photo by Vinita Gowda)

Profile

Continued from page 1

body size and bill morphology: males are 25 percent heavier than females, while females have bills that are 30 percent longer and 100 percent more curved than males (Temeles et al. 2000 *Science*). Males also display territorial behavior while females trap-line. The male Purple-throated Caribs allow only conspecific females to occasionally feed on their territories in exchange for mating.

Since the breeding system of the two heliconias was not known at the time one of the main focus of my dissertation research was to investigate pollination, breeding system, and phenology of the two heliconias on each island. To further understand the role of hummingbirds in promoting outcrossing within the two species on each of the islands I also measured the inbreeding rates in both *H. bihai* and *H. caribaea* on each island using microsatellite markers that were developed specifically for both the species, and also measured pollinator effectiveness using manipulative field experiments.

The following are some interesting results of my research on the three islands: a) male Purple-throated Caribs were indeed found to be important and effective pollinators of *H. caribaea*, however their

territorial displays showed significant difference among the three islands, varying from a specialized interaction on Dominica to a more generalized interaction on St. Kitts, and almost no interaction on St. Vincent; b) female Purple-throated Caribs were the sole pollinators of *H. bihai* on all three islands; c) inbreeding rates were significantly lower in *H. bihai*, which was pollinated by traplining females, when

compared to inbreeding rates in *H. caribaea*, which was pollinated by territorial males, supporting the ecological hypothesis that traplining pollinators promote outcrossing, while territorial pollinators assist in reproductive success at the cost of higher inbreeding; and d) marked territorial male Purple-throated Caribs were observed to defend the same patch of heliconias for at least 5 to 6 years on the island of Dominica and St. Kitts, which was not known for this species or for any other territorial species of hummingbird.

Although there is much to say about each of these three islands, the northern island of St. Kitts (or St. Christopher and Nevis) warrants special discussion because, despite its small size and easy access, it is biologically under-explored and offers much in terms of biodiversity and evolutionary questions. The Federation of Saint Kitts and Nevis is comprised of two volcanic islands that are separated by a 3 kilometer wide channel called The Narrows. Comparatively, the size of St. Kitts is 1.5 times that of Washington, D.C. The island is comprised of a wet rainforest on the Atlantic side, while the Caribbean side tends to have a drier and more xeric habitat. Mount Liamuiga (formerly Mount Misery) stratovolcano is the highest point on the island standing at 3,793 feet (1,156 meters), and one of its summits is topped by a crater lake known as Dos d'Ane pond. The mountain sides above 800 meters and the top is covered in an



Collecting *Heliconia* rhizomes in Dominica for the *Heliconia* experimental garden with Mike Bordelon in 2005. (Photo by John Kress)



The two native heliconias: *Heliconia bihai* (left) and *H. caribaea* (2 color forms; middle and right) from the island of Dominica. (Photos by Vinita Gowda)

elfin woodland that is laden with moss, epiphytes, orchids, bromeliads, and aroids. Some of the unique plants that can be seen on hiking to the top of the Dos d'Ane pond are: *Podocarpus coriceus* Rich. & A. Rich, *Hillia parasitica* Jacq., *Prestoea montana* (R. Graham) G. Nicholson, *Miconia mirabilis* (Aubl.) L.O. Williams, *Miconia laevigata* (L.) D. Don, *Anthurium cordatum* (L.) Schott, *Philodendron giganteum* Schott, *Begonia retusa* O.E. Schulz., and *Heliconia bihai*. The color form of *H. bihai* on St. Kitts and Nevis is unique to these islands, and a population was discovered on the edge of the Dos d'Ane pond in 2005 with the help of a local tour guide, Gregory Pereira. Interestingly, the *H. bihai* on this island are restricted to the mountaintops and have a very narrow distribution. Only three accessible areas were found where they were present, and even among these areas the number of individuals was restricted from four to about 27 individuals.

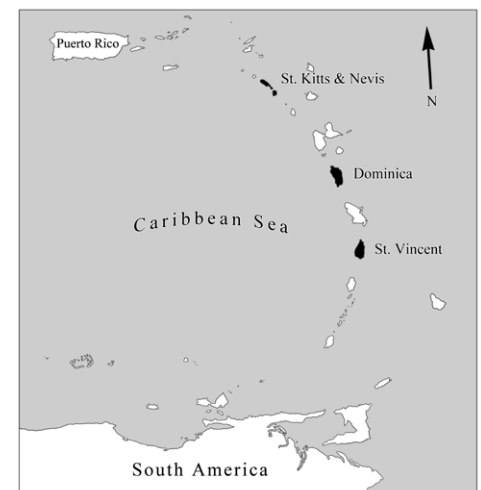
Despite the low population sizes of *H. bihai*, pollinator observations showed that the Purple-throated Carib females were visiting and pollinating these few widely scattered plants at least two to three times a day and against all odds of the strong cloud cover at the mountaintops for most of the day. Often the female Caribs managed to find the opportunity to visit

the heliconias whenever the cloud cover broke; sometimes this meant a mere five to 10 minutes break between cloud covers. On the island of Nevis, the scattered and very restricted population of *H. bihai* was found on the trail leading to the top of the Nevis peak between 800 and 1,200 meters. Both the climb to the top of Dos d'Ane pond and Nevis peak is a treacherously steep trail that can get quite slippery due to the moist cloud cover that is persistent throughout the day.

The largest distribution of *H. caribaea* on the island of St. Kitts was found in two localities around the town of Molineaux: the rainforest trail on the south-east side of Mt. Laamuiga or the Phillips level, and behind the Ottley's plantation trail. On Nevis, *H. caribaea* was most easily found around the trail leading to the Nevis peak, although the plants were also reported from other sides of the peak. *Heliconia caribaea* are abundant on both islands and both red and yellow morphs are found. Despite the small sizes of both islands, the high relief (especially St. Kitts) and significant difference in weather from the Caribbean to the Atlantic sides results in a world of difference in flora and fauna, and thus provides an ideal natural experimental garden where one can investigate adaptive differences in plants colonizing these islands.

Although my doctoral dissertation research focused on only three of the Lesser Antillean Islands, from 2004 to 2009, I along with Kress and other colleagues also had the opportunity to collect and study heliconias on a number of other islands such as St. Eustatius, Saba, Montserrat, Guadeloupe, Martinique, and St. Lucia. In general, strong efforts were

Continued on page 10



Map showing the locations of St. Kitts & Nevis, Dominica, and St. Vincent within the Lesser Antillean chain of islands. Field work and study sites were set up at all three islands to study heliconias and their interactions with the native hummingbirds.

Profile

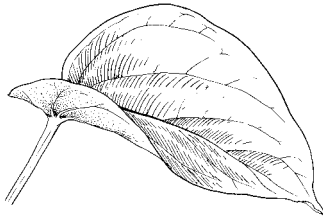
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invested in collecting vouchers, observational data, population samples, and morphological data on all heliconias from the other Caribbean Islands too. This has resulted in a very extensively collected, fine-scale meta data of variations in morphological characters in the two heliconias throughout the Caribbean Islands, and has great potential in future investigations of character evolution (especially floral) and adaptations between plants and their pollinators.

Ecological studies of this kind is not common among scientists in the Natural History Museum; however, the results from this study highlights the importance of exploring ecological studies along with population genetic and taxonomic studies to understand the diverse tropical interactions that define a tropical rain forest. One of the broader outcomes of this study has also been the research exchange between the local forestry divisions on the islands of St. Kitts, Dominica, and St. Vincent and the Smithsonian Institution where the local hosts have been significantly important partners in facilitating our research in the Caribbean Islands. The local forestry divisions and concerned citizens not only view the unique *Heliconia*-hummingbird inter-

action as a source of national pride unique to their island, but have also included it as part of their conservation programs in the wake of concerned developments within the islands.

Two websites proved to be useful in my research: (1) a catalogue of plants on each of the Caribbean Islands, <botany.si.edu/Antilles/WestIndies/catalog.htm>; (2) The Global Volcanism Program database for the Caribbean Islands, with thermal activity for 17 volcanoes, <www.volcano.si.edu/world/region.cfm?rnum=1600>.



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The fresh fruit and vegetable splendor commonly found at the Saturday market of Dominica. All produce are locally grown all around the island. (Photo by Vinita Gowda)

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Art by Alice Tangerini

***Prestoea montana* (R. Graham) G. Nicholson**

Endemic to the West Indies, *Prestoea montana* (Arecaceae) can be found while climbing Mount Liamuiga, the highest mountain on St. Kitts (see cover story, "Island Explorations and Evolutionary Investigations"). This illustration of *P. montana* was part of the exhibit, "Palms of the Lesser Antilles," on display in the Rotunda of the National Museum of Natural History from 24 May to 20 July 1980. The exhibit featured 15 illustrations by Alice Tangerini and three palm herbarium specimens from the U.S. National Herbarium. The exhibit was the idea of Robert Read who had the drawings previously published in *Flora of the Lesser Antilles* for which he contributed the section on palms. The exhibit traveled to the Hunt Institute at Carnegie-Mellon University in Pittsburgh, Pennsylvania in November 1980, at the invitation of their Curator of Art, James White.



Smithsonian
National Museum of Natural History

Department of Botany
PO Box 37012
NMNH, MRC-166
Washington DC 20013-7012

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