

The Plant Press



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National Museum of Natural History

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April-June 2008

Botany Profile

Ocean Literacy at the Microscopic Level

By Maria Faust

Dinoflagellates are profoundly important microscopic single-celled marine plants found throughout the oceans of the world. The first evidence of dinoflagellates in the fossil record dates back to the Silurian (443 to 417 million years ago), a period when previously erratic climate fluctuations stabilized and sea levels rose. Coral reefs made their first appearance and fishes underwent remarkable change. The fossil record indicated that the prevailing conditions during this time period favored dinoflagellates whose diversity and abundance dramatically increased.

Since that time, dinoflagellates have continued to evolve and now constitute one of the great lineages of Eukaryota – the kingdom which also includes animals, plants, fungi, and protists. As in ancient times, these dinoflagellates form much of the plant productivity in the sea and as a result are a critical food source at the base of the food chain. They play a critical role in sustaining life of the oceans, including commercial and recreational fish stocks.

Though most dinoflagellate species are harmless, some have evolved toxic compounds to deter grazing or inhibit the growth of co-occurring organisms. Many of these toxins can accumulate in the food chain causing either amnesic, diarrhetic, neurotoxic or paralytic shellfish poisoning or ciguatera fish poisoning (CFP). CFP, which is caused by the accumulation of toxins produced by certain tropical dinoflagellates, is particularly important because it is the leading cause of nonbacterial food poisoning associated

with fish. Worldwide CFP causes more death and illness than from all the other toxic species combined. It also constitutes a significant public-health threat to uninformed tourists visiting these areas. The adverse affects due to toxic dinoflagellates occur when their populations form into great abundances causing algal blooms. Such blooms frequently cause bird, fish and marine mammal mortalities, adverse human health effects, and economic losses due to increased health care costs, lost fisheries harvests, and reduced tourism. Despite these harmful effects, comparatively little is known about the diversity and ecology of harmful dinoflagellate species relative to their toxicities.

In an effort to address this lack in our knowledge, there has been a long-standing research program in the Department of Botany at the National Museum of Natural History to study dinoflagellates, and particularly tropical toxin producing species. This research effort seeks to advance our knowledge of the taxonomy, biodiversity, ecology, and distribution of these organisms, one of the fundamental missions of the Department. Expanded knowledge of dinoflagellates diversity will also increase our understanding of how marine microorganisms have evolved and the origins of marine diversity throughout the world. What we discover may also prove important in efforts to manage and protect marine biodiversity—an area we are only beginning to explore.

Marine dinoflagellates were first recognized by Christian Gottfried Ehrenberg in

1834. The identification of these microscopic organisms is based on cell shape and size, the morphology of the plates which cover the surface of the cell, surface ornamentation and cytology. These single-celled organisms are propelled by two dimorphic flagella. Dinoflagellates contain chloroplast pigments chlorophylls a and c and the accessory pigment peridinin. Given their small size, and frequent lack of distinguishing characteristics, identification of dinoflagellates is often challenging.

Only a small percentage of living dinoflagellates have yet to be properly identified. Evolutionary biologists who study organisms such as birds or mammals are often surprised that phycologists are far from answering two fundamental questions concerning biological diversity in oceans – how many species are there and how are these species related from an evolutionary standpoint? This is particularly true in tropical regions, such as the coral reef-mangrove habitats of the Caribbean Sea where sampling has been extremely limited. Over the past 20 years my research has consequently focused on understanding the species diversity in the coral reef-mangrove systems in the Mesoamerican Barrier Reef system of Belize.

The mangrove habitats, in particular, are of interest because they parallel the geographical distribution of coral reefs and dominate the shorelines of tropical and subtropical oceans. These mangroves, and their associated offshore reefs, create highly diverse and produc-

Continued on page 9

Walter Adey traveled to Kennett Square, Pennsylvania (2/29) to meet with Exelon Energy staff with regard to establishing an Algal Turf Scrubber (ATS) test facility at the Conowingo Hydroelectric Plant.

Vicki Funk traveled to Copenhagen, Denmark (1/14 – 1/17) to serve as the outside examiner for a dissertation defense; to London, England (1/17 to 1/20) to work on the Global Compositae Checklist at the Royal Botanic Gardens Kew; to Philadelphia, Pennsylvania (2/14, 2/21, 2/25, 2/28) to serve on a committee at the Philadelphia Academy of Natural Sciences; and to Stony Brook, New York (3/4 – 3/6) to present a departmental seminar at the State University of New York, Stony Brook.

W. John Kress traveled to Durham, North Carolina (1/18 – 1/20) to meet with the Organization for Tropical Studies to discuss plant barcoding and genomic investigations at La Selva Biological Station in Costa Rica; to Vienna, Austria (1/22 – 1/27) to deliver the Darwin Lecture on Plant DNA Barcoding and a department lecture at the University of Vienna; to Dominica, West Indies (2/8 – 2/13; 3/14 – 3/27) to continue research on *Heliconia* and hummingbird interactions; and to Santa Cruz, California (2/19 – 2/21)

to give a lecture on plant-animal coevolution at the University of California Santa Cruz.

Paul Peterson and Robert Soreng traveled throughout Peru (3/3 – 4/9) to collect grasses.

Rusty Russell traveled to Riverside County, California (2/11 – 2/15) to meet with colleagues at the U.S. Forest Service and Bureau of Land Management in preparation for this summer's Earthwatch Institute sponsored fieldtrip.

Laurence Skog traveled to Sarasota, Florida (2/12 – 2/19) to attend the board meeting of the Gesneriad Society and to work in the herbarium at Marie Selby Botanical Gardens.

Alain Touwaide and Emanuela Appetiti traveled to Australia (1/10 – 2/2) to attend the 32nd Conference of the International Committee of the History of Art in Melbourne and to conduct research throughout the country; and to Mexico City, Mexico (2/27 – 3/2) to deliver the plenary lecture for the opening of the 429th academic year of the medical faculty of the Universidad Nacional Autonoma de Mexico (UNAM).

Warren Wagner traveled to Cape Town, South Africa (1/5 – 1/18) to attend the council meeting of the International Association for Plant Taxonomy and to present a talk at the annual meeting of the South African Association of Botanists; and to Kauai, Hawaii (2/22 – 3/21) to work on the Marquesas Islands flora project with David Lorence, to give a presentation on the progress of research using

the McBryde Endowment to the national board of trustees of the National Tropical Botanical Garden, and to teach a course at a plant conservation workshop organized by the Center for Plant Conservation and sponsored by the Department of Defense.

Jun Wen traveled to Cape Town, South Africa (1/5 – 1/18) to attend the council meeting of the International Association for Plant Taxonomy and to present a talk at the annual meeting of the South African Association of Botanists; to Kunming, China (1/20 – 1/28) for herbarium work and collaborative research; and to Claremont, California (2/21 – 2/24) to give a seminar at the Rancho Santa Ana Botanic Garden.

Kenneth Wurdack traveled to San Diego, California (1/12 – 1/17) for an invited talk on Euphorbiaceae at the Plant & Animal Genome XVI conference; and to Gainesville, Florida (1/25 – 1/27) to present a Malpighiales update at a participant meeting at the University of Florida, Gainesville, for the angiosperm Tree of Life grant (NSF-AToL).

Elizabeth Zimmer traveled to Baltimore, Maryland (2/12) to deliver a seminar at Johns Hopkins University; and to Rochester, New York (3/6 – 3/10) to serve as a judge for a FIRST science competition.



The Plant Press

Reu Series - Vol. 11 - No. 2

Chair of Botany

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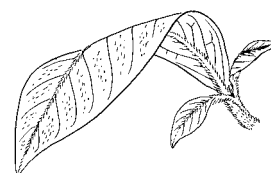
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The Plant Press is a quarterly publication provided free of charge. If you would like to be added to the mailing list, please contact Dr. Gary Krupnick at: Department of Botany, Smithsonian Institution, PO Box 37012, NMNH MRC-166, Washington, DC 20013-7012, or by E-mail: krupnickg@si.edu.

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



Visitors

Lei Xie, Chinese Academy of Sciences; *Clematis* (Ranunculaceae), and *Circaea* and *Fuchsia* (Onagraceae) (1/1/07-12/31/08).

Tieyao Tu, Kunming Institute of Botany, China; *Nolana* (Solanaceae) (1/18/07-1/17/08).

Ling Zhang, Xishuangbanna Tropical Botanic Garden, Chinese Academy of Sciences; Instant Identification System (1/22/07-1/21/08).

Mauricio Bonifacino, Universidad de la Republica, Montevideo, Uruguay; Compositae (2/1/07-6/1/08).

Yunjuan Zuo, Beijing Institute of Botany, China; *Panax* (Araliaceae) (5/7/07-5/6/08).

Melissa Luckow, Cornell University; Leguminosae (7/16/07-6/30/08).

Blanca Leon, Universidad Nacional Mayor de San Marcos, Lima, Peru; Peruvian *Tillandsia* (Bromeliaceae) (10/18/07-10/18/09).

Beata Paszko, W. Szafer Institute of Botany, Polish Academy of Sciences, Krakow; *Calamagrostis* (Poaceae) (12/2/07-3/2/08).

Under the Sea

The National Museum of Natural History is going “blue” this year. At the end of September, the museum will open Ocean Hall, a one-of-a-kind interpretive exhibit, extraordinary in scale, presenting the global ocean from a cross-disciplinary perspective, highlighting the biological, geological, and anthropological expertise and unparalleled scientific collections of the museum, as well as ongoing research in marine science.

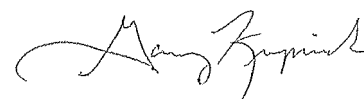
The Department of Botany has a very rich history in aquatic botany. The first historical cryptogamic collections of the U.S. National Herbarium date back to the U.S. Exploring Expeditions and were initially maintained by curator Mason Hale. In 1965, Elmer Yale Dawson (1918-1966) came to the Smithsonian Institution to accept the newly established position of Curator of Cryptogamic Botany. He brought with him thousands of specimens. Dawson’s research specialties included benthic marine algae, especially Rhodophyta of the tropical and subtropical Pacific. Unfortunately, his position was short-lived due to a fatal diving accident in the Red Sea a year and a half into his career at the Smithsonian.

When the Smithsonian Oceanographic Sorting Center (SOSC) was terminated in 1992, Ernani G. Meñez, the director of SOSC (1988-1992), was transferred to the Botany Department. An expert on Philippine seaweeds, he recently served several years as Emeritus Research Botanist. In 1970, after a transfer from the SOSC, Arthur Dahl joined the Department as a Curator of Algae for five years. Dahl had special interests in coral reef ecology, marine algae, and island environments. Currently, Botany has four curators conducting research on aquatic botany: Walter Adey (coralline algae), Maria Faust (dinoflagellates), Mark Littler (coral reef plants), and James Norris (marine macroalgae; Curator of the U.S. Algal Collection).

Algae are photosynthetic organisms that occur in most habitats. They vary from small, single-celled forms to complex multicellular forms, such as the giant kelps that grow to 100

meters in length. The U.S. Algal Collection is represented by almost 400,000 accessioned and inventoried herbarium specimens (and over 4,900 type specimens) preserved on herbarium sheets, microscope slides and liquid preparations. The collection is comprised of marine, estuarine, freshwater, terrestrial (including cave) and airborne algae and is worldwide in origin, with a strong representation of tropical and subtropical marine algae. Major holdings include the following regions: Gulf of California, Pacific Mexico, southern and central California and the Channel Islands, the Galapagos Islands, Aldabra Atoll, and the Caribbean (especially Florida, Belize, Bahamas and Panama). Also contained in this collection but maintained at the physically separate Museum Support Center (MSC) are the complete Francis Drouet Cyanophyta collection and a separate diatom collection of freshwater and marine materials, both recent and fossil.

This issue of the *Plant Press* highlights some of the Department’s recent research, explorations, and publications in aquatic botany. Our cover story features the research of Maria Faust on microscopic dinoflagellates. Her recent research with DNA barcoding technology will help shed light on the impressive numbers of dinoflagellate species globally. On page 5, you can read about Mark Littler’s fascinating discovery of a new algal community off the coast of Panama. Also featured is a new publication by Mark and Diane Littler on an Indian River Lagoon field guide of aquatic plants (page 7). Finally, for his contribution to marine science, Ernani Meñez was recently honored with an award from Silliman University in the Philippines (page 4).



Gary Krupnick, Editor

Maria Camila Gómez, Universidad de Los Andes, Merida, Venezuela; Flora of the Colombian Paramos (12/14/07-1/14/08).

Beatriz Baker, University of Missouri; *Chamaecrista desvauxii* (Caesalpiniaceae) (12/19/07-1/3/08).

Joe Kirkbride, United States Department of Agriculture; Rubiaceae (12/21/07-1/10/08).

Mark Newman, Royal Botanic Garden Edinburgh; Zingiberaceae (1/5-1/13).

Douglas Daly and John Mitchell, New York Botanical Garden; Anacardiaceae (1/14-1/18).

Susan Pell, Brooklyn Botanic Garden; Anacardiaceae (1/14-1/18).

Wesley Knapp, Maryland Natural Heritage Program and Delaware State University; *Juncus* (Juncaceae) and *Rhynchospora* (Cyperaceae) (1/14; 1/23).

Todd Lee and six students, Elon University; Herbarium tour (1/17).

William McAvoy, Delaware Natural Heritage Program; Ferns and gymnosperms of the Delmarva Peninsula (1/23).

Marina Cortes, Columbia University; *Heliconia* (2/1-5/30).

Jannel Nolasco, Northern Virginia Community College; Volunteer interview (2/7).

Ann Dix, United States Agency for International Development (USAID); Serpentine floras of the world (2/19).

John Cotton, George Washington Uni-

versity; *Historia Plantarum* Collection (2/19-5/16).

Emily Gillespie, Wake Forest University; Ericaceae (2/21-2/22).

Jenica Baty, University of Michigan; Plant conservation (2/25-2/29).

Johannes Kretschmann, Mary Shoop, Jody Spink, and Maren Wilbur, Earthwatch Institute; Pacific Island ethnobotany (2/25-2/29).

F. Javier Fernandez Casas, Real Jardin Botanico, Madrid, Spain; *Cnidoscolus* (Euphorbiaceae) and *Spigelia* (Loganiaceae) (2/25-3/16).

Bruce Holst, Selby Botanical Garden; Myrtaceae and Bromeliaceae (2/27-3/7).

Continued on page 5

Staff Research & Activities

Walter Adey had several meetings and presentations related to the Algal Turf Scrubber (ATS) Energy Project. This project develops solar/algal methods for nutrient removal from waste and surface waters with accompanying algal biomass production for biofuels. He gave a presentation to the Environmental Protection Agency Nutrient Trading Group in Washington, D.C., on 10 January; to the Chesapeake Bay Foundation (CBF) in Annapolis, Maryland, on 22 January; and to the World Resources Institute in Washington, D.C., on 31 January. Adey also traveled to the Richmond, Virginia, office of CBF to attend a meeting on 14 February and to give a presentation on algae-based biofuels on 20 March.

On 13 February, **Gary Krupnick** gave a presentation on “A Natural History Approach to Plant Conservation” to the Potowmack Chapter of the Virginia Native Plant Society in Annandale, Virginia.

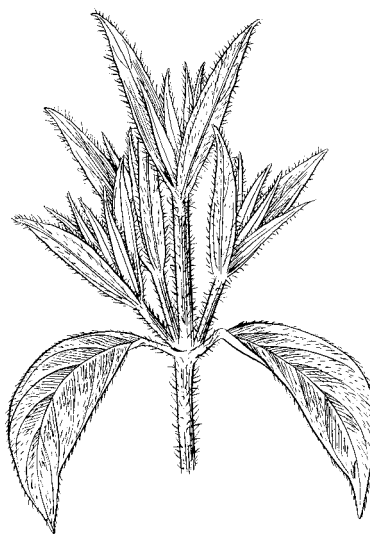
On 5 March, **Alice Tangerini** participated in “The Big Draw,” an all-volunteer effort at North Chevy Chase Elementary School, aimed at inspiring students’ imaginations through art — from abstract portraiture to detailed scientific drawing. The event was organized by fourth grade teacher Jacqueline Moore who had volunteer artists come from the National Building Museum, the National Portrait Gallery, and the National Postal Museum, with Tangerini representing the Smithsonian Institution. Tangerini supplied sample outlines of plants for the 320 students that attended and instructed them on how to add their own version of stippling.

At the invitation of public programs staff at the National Museum of American Art, Tangerini was the featured artist as part of the “Draw and Discover” series of programs organized by the Luce Foundation for American Art. The series is a spring into summer program with once a month sketching in the afternoon at the Kogod Courtyard. The drawings are made from live plants by the art enthusiasts who attend and Tangerini gave pointers on techniques used in botanical illustration.

The 24-member group that attended on 21 March was one of the largest that the NMAA staff had seen at these sessions.

Tangerini and **Alain Touwaide** presented “Botanical Illustration: Past and Present” at the session of the Washington Botanical Society during the Capital Science 2008 conference (March 29-30) organized by the Washington Academy of Sciences in collaboration with NSF and AAAS.

Elizabeth Zimmer attended the 50th Maize Genetics Meeting in Washington, D.C., from 28 February to 1 March.



Congressional Family Night at the Museum

For the first time since 1999, Smithsonian scientists hosted a Congressional Family Night on 1 March. Approximately 200 guests attended, including U.S. Senator Patrick Leahy and other key Congressional staff. Over 100 Smithsonian scientific staff participated (including **Michael Butts, Laurence Dorr, John Kress, Gary Krupnick** and **Ida Lopez**), showcasing Smithsonian science in 52 different stations covering a wide array of scientific topics as well as collections, exhibits, and education. In addition to National Museum of Natural History staff, stations were set up by representatives from the National Air and Space Museum, National Zoological Park, Smithsonian Astrophysical Observatory, Smithsonian Environmental Research Center, and Smithsonian Institution Libraries. The night included a raffle of a behind-the-scenes tour at the National Museum of Natural History.

Smithsonian Botanist Honored

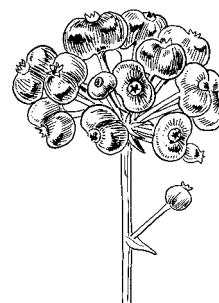
Ernani G. Meñez received a special recognition from Silliman University in the Philippines in a simple ceremony held recently. Meñez was recognized for his contribution to the University’s Marine Science program during the last 30 years.

Meñez first visited the city of Dumaguete in the 1960s when he was a student at the University of Hawaii. His first introduction to Silliman University was when he was a member of the Smithsonian Institution Expeditions to the Philippines in 1978 and 1979.

He popularized the study of seaweeds in the Philippines by holding phycology symposia-workshops, giving short courses on phycology at various universities, training Filipino students at Smithsonian, assisting Philippine scientists with references and specimen identification, publishing on Philippine seaweeds, and facilitating the exchange of information between U.S. and Filipino scientists. He has also hosted Sillimanians visiting the Smithsonian.

Among those from Silliman who trained and collaborated with him are Institute for Environmental and Marine Sciences (IEMS) Director Hilconida Calumpang, with whom he co-authored papers, including the “Field Guide on Common Mangroves, Seagrasses and Algae of the Philippines”, which won the National Book Award (for Science), IEMS Assistant Director Janet Estacion, IEMS researchers Pablina Cadiz and Jacinta Lucañas, and former Chemistry faculty member Chester Dumangcas.

Meñez, who holds a Ph.D. in Botany from the University of New Hampshire, an M.S. in Botany from the University of Hawaii and a B.S. in Botany from the University of the Philippines, is a recipient of the Pamana Award, the highest award given to a Filipino by the President of the Philippines.

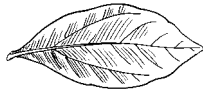


A Newly Discovered Algal Community in Pacific Panama

Mark and Diane Littler and their research team, consisting of **Barrett Brooks**, **Donald Hurlbert**, Jennifer Dorton, and Irving Bethancourt, discovered vast maërl expanses of calcareous red algal rhodoliths covering sedimentary bottoms between island groups throughout the Gulf of Chiriqui, Pacific Panama, during their September 2007 expedition. These predominant coralline algal communities, mostly between 10-30 m deep, consist of numerous crustose coralline algal species (e.g., *Lithophyllum divaricatum*, *Lithophyllum alternans*, *Lithothamnion indicum*, *Lithothamnion australe*, *Fosliella fertilis*) and serve as microhabitats and primary substrates for a high diversity of relatively small animals and fleshy red algae (e.g., *Hypnea* spp., *Gelidium* spp., *Halymenia* spp., *Sebdenia* spp., *Peyssonnelia* spp.).

The instability/mobility of the fist-size rhodolith spheres inhibits the development of highly-structured macroalgal or macrofaunal communities. On the other hand, the rhodolith community provides a hard-substrate refuge for smaller algae from the intense herbivory (limpets, chitons,

sea urchins, and fishes) characteristic of Pacific Panama and present throughout the heterogeneously structured coral reefs and broad (7m tidal amplitude) rocky intertidal zones of the islands and outcrops studied.



Update to the Catalogue of New World Grasses

The Catalogue of New World Grasses [CNWG] is continuously revised and updated (<http://mobot.mobot.org/W3T/Search/nwgc.html>) post publication in the *Contributions from the United States National Herbarium* volumes 39, 41, 46, & 49 (2000–2003). Recently, the classification of subfamily to subtribe was updated to cover all accepted genera of the world in subfamily Pooideae, and some newer genera published in other subfamilies. These updates are available at <http://mobot.mobot.org/W3T/Search/nwgclass.html>. The CNWG tracks taxonomy of New World Poaceae, original publications of names, authorships, types and typifications, nomenclatural changes, secondary literature references, specimen images, and distribution by country (lists by country can be viewed and downloaded),

along with specimens lists and data with mapping utilities. The online data are generated from world-wide coverage for grass names (over 80,000 records) in TROPICOS, the Missouri Botanical Garden's taxonomic database (<http://mobot.mobot.org/W3T/Search/vast.html>).

Visitors

Continued from page 3

John Skvarla, Oklahoma University; Compositae (2/29-3/1).

Ataefiok Etukeren, Georgetown University; Plant conservation (3/3-3/7).

Ami Watanabe, University of Victoria, Vancouver Island; *Historia Plantarum* Collection (3/3-3/14).

Silvia Nicolè, University of Padova-Agripolis, Italy; Plant DNA barcoding (3/3-8/31).

Andrew Clark, Independent researcher; Volunteer interview (3/5).

John Townsend, Natural Heritage Program, Virginia; Flora of Virginia (3/6).

David Clarke, University of North Carolina; Biological Diversity of the Guianas (3/6-3/9).

Mary Schultz, University of North Carolina; Herbarium visit (3/6-3/9).

Denise Costich, United States Department of Agriculture and Cornell University; *Tripsacum*, *Phalaris*, and *Andropogon* (Poaceae) (3/11-3/13).

Carol Prentice, College of Idaho; *Lesquerella* (Brassicaceae) (3/13).

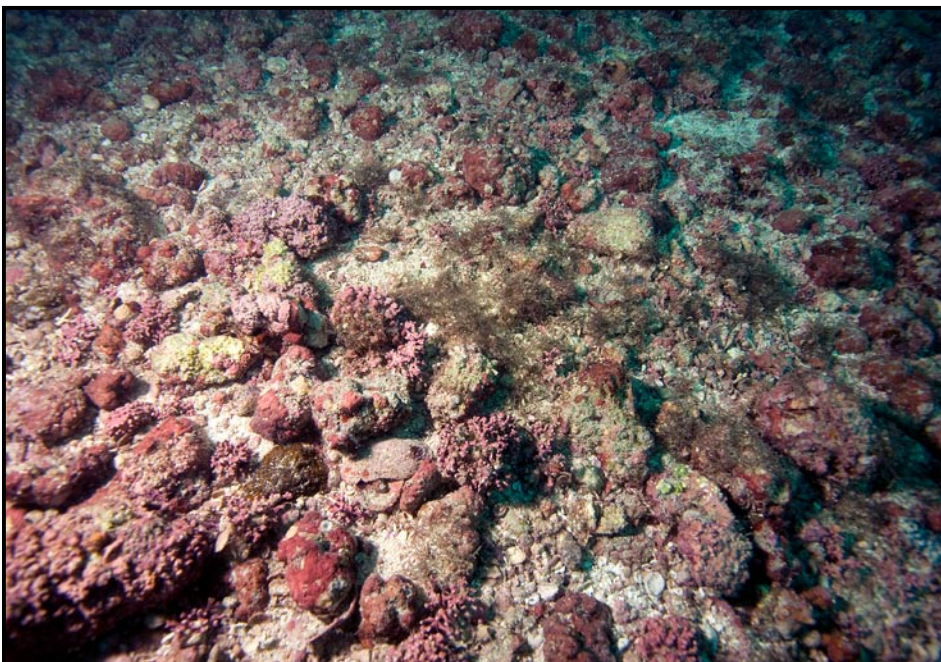
Brian Scheutz, California Academy of Sciences; Ecuadorian Melastomataceae (3/13-3/14).

Scott La Greca, Natural History Museum, London; Bermudian lichens (3/14-3/15).

Melanie Fortin, Free University, Berlin; *Historia Plantarum* Collection (3/17-5/30).

Chris Frye, Maryland Department of Natural Resources; *Amelanchier* (Rosaceae) (3/18).

Kathryn Mauz, University of Arizona; Arizona historical and C.G. Pringle collections (3/31-4/4).



Fleshy algal epiphytes attached to coralline algal nodules (rhodoliths). Observations were made during a cruise aboard the R/V Urraca. (Photo by Donald Hurlbert)

An Online Collection of Plant Images

Ten years ago, faced with ever increasing external requests for images of plant species, Botany Collections Manager **Rusty Russell** began a project to digitize photographic slides within the Department of Botany. A decade later, the Plant Image Collection (PIC) delivers more than 20,000 digital images via an online link <<http://botany.si.edu/PlantImages/>> on the Department's public website. But it all started rather small.

With an initial grant from the Smithsonian's Women's Committee and assistance from Payal Dharia, a student from Thomas Jefferson High School, the first set of one thousand color slides were organized, cleaned and sent to a digitizing vendor. These slides had been collected from more than thirty different photographers by former Curator and Chairman **Edward Ayensu** in preparation for a book on endangered species that never materialized. After Ayensu departed, they were left in the custody of **Jane Villa-Lobos**, former Head of the Plant Conservation Unit, who collaborated closely with Russell to obtain releases from each of the photographers.

The criteria for inclusion were simple but strict. Each slide had to be identified to species and the image had to be clearly in focus. Pretty soon, more than 3,000 images had been selected and digitized by the vendor in the Photo CD (PCD) format, a Kodak proprietary image format. The experience working with an external ven-

dor made two things obvious. It became clear that a more open source image format was needed, and that we needed more hands-on control of the digitizing process. There had been too many errors in scanning order, slide orientation, and image numbering. So Russell conceived a two-prong approach to improving quality and increasing production. First, volunteers would be solicited to work on-site to database, clean and digitize color slides. Second, collaborations would be sought with other organizations who shared an interest in digital scanning and providing plant species images. Both initiatives proved successful.

Scores of volunteers have participated in this project over the years, but none more importantly than **Fran Pitlick** whose organizational skills, attention to detail, and commitment to quality has made the PIC a reality. For more than five years, Pitlick has supervised every aspect of digital image production and database management, and has worked closely with **Ellen Farr** to develop the public web presentation you see today. Two other volunteers require special note. **Andrea Walk** (State Department) and **Cecelia Rogers** (Library of Congress), found employment elsewhere after they began volunteering in the Department but structured their work schedules to allow themselves one day a week to continue scanning for us. They continue to work on the Howard and Cooper collections respectively (see below).

Two institutional agreements have also proved extremely valuable to this project. The U.S. Department of Agriculture maintains a website dedicated to native and introduced plant species of the United States and its Territories <<http://plants.usda.gov>>. They have provided significant resources to support color slide digitization in exchange for permission to use those same images on their website. Visitors to their website are then directed to the Department of Botany to obtain permission to use the images for which we still hold the rights. Another, more recent and still active, agreement with the U.S. Geological Survey's National Biodiversity Information Infrastructure (NBII) follows the USDA model and has already produced more than 3,000 images for their Digital Image Library <<http://images.nbii.gov/>> as well as our Plant Image Collection. They are working exclusively with the Niehaus Collection (see below).

More than 200 photographers are represented in the PIC, but a small number constitute the larger percentage and are worthy of note. Gustav A. Cooper was a Smithsonian Paleontologist whose avocation was photographing wildflowers during down times in his fieldwork around the world. After he died, his son donated his entire collection to the Department of Botany. More than 9,800 Cooper images are currently posted. Richard A. Howard, former Director of the Arnold Arboretum and Curator in the Harvard University Herbaria, was also a veteran photographer and applied this skill during his botanical fieldwork and visits to gardens and arboreta worldwide. His posted images total almost 6,000. Ted Niehaus is a retired California botanist, co-author with Roger Tory Peterson, photographer friend of Ansel Adams, and scaler of Mt. Everest. Two years ago he donated his entire collection of almost 20,000 slides to the Department. Although we are still sorting and organizing this vast assemblage, almost 3,000 images are currently online at both NBII and PIC. An agreement with the West Virginia University Herbarium has produced a set of 1,878 images.

Many current Botany staff members have also contributed. The most significant to date is that of **Pedro Acevedo**, whose 1,549 images from Puerto Rico, are an extremely useful contribution. Others include **John Boggan**, **Leslie Brothers**, **Laurence Dorr**, **Christian Feuillet**,



Heliotropium gnaphalodes (Boraginaceae) (Photo by R.A. Howard)



Carnegiea gigantea (Cactaceae) (Photo by G.A. Cooper)

Elaine Haug, Linda Hollenberg, John Kress, Carol Kelloff, Paul Peterson, Rusty Russell, and Laurence Skog.

The PIC images are definitely being used. During January 2008 alone, images were requested for two online newsletters (North Carolina Native Plant Society and Maryland Department of Natural Resources), three non-profit websites, two wildlife trade magazines, two commercial nurseries, *Phoenix Home & Garden Magazine*, three electronic fact sheets for exotic species (Mohave National Preserve, Greensweep Alliance, Louisiana Natural Heritage Program), as graphics in the design of a new elementary school in Charlottesville, Virginia, and as theme graphics in an Alaskan treatment center for teenagers with mental health problems.

Botany Web Site Update

The Department of Botany Web site has a new address and a new look. Visit <http://botany.si.edu/> and you will find checklists and floras for the Guiana Shield, Hawaii, the Marquesas Islands, Puerto Rico and the Virgin Islands, Myanmar, and the Washington-Baltimore area. Nomenclatural resources include *Index Nominum Genericorum* (ING), a list and details for generic or specific names considered confusable under the Botanical Code, and a searchable database of conservation/rejection proposals and their disposition for scientific names of plants. The databases behind many of our research presentations are updated frequently and the new

content is immediately available. A special search feature is also offered, which can look for a generic name in 13 of our online research database and provide a list of links for all of the species in that genus. The new center column of the home page will change frequently and will announce new presentations and provide a quick link to selected features.

"Partners in Evolution" Opens at NMNH

On February 15, "Partners in Evolution: Butterflies + Plants" opened to the public at the National Museum of Natural History. This unique, immersive exhibition gives visitors the opportunity not only to observe the ways in which butterflies, plants, and other animals have evolved, adapted, and diversified over tens of millions of years but to walk through the enclosed, climate-controlled, tropical garden and interact with these beautiful butterflies as they flutter around the pavilion.

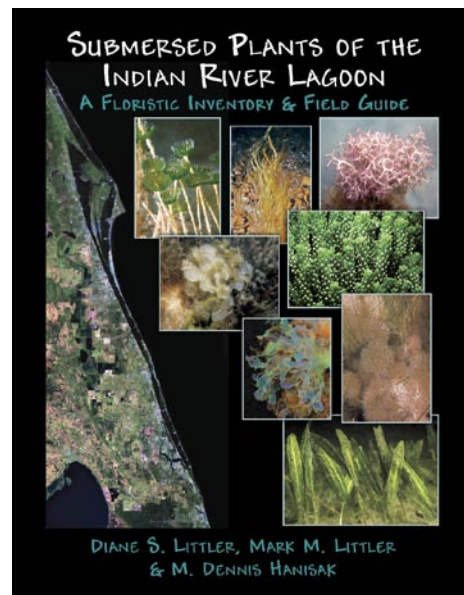
At any one time, the 1,200 square foot pavilion houses approximately 400 butterflies made up of 30 to 40 different species from Africa, Asia, the Americas, and Australia. A staff of 4 receives butterfly chrysalides from suppliers in Costa Rica, Florida, Malaysia, and Kenya. They make sure the butterflies emerge properly from their chrysalides, are released into the butterfly pavilion, and that the plants are maintained. The average lifespan of the butterflies is from 2 to 4 weeks so new

butterflies must be purchased on a regular basis. Horticulture staff works full-time to procure and propagate pesticide-free plants for use in the pavilion.

The exhibition was curated by **John Kress** and **Ken Wurdack** (Botany), Ted Schultz and Robert Robbins (Entomology), and Conrad Labandiera (Paleontology). Other core members of the team were Bill Donnelly (Horticulture), Nate Erwin (Education), Sally Love, Elizabeth Musteen, and Sharon Barry (Exhibits). Access to the exhibit is through timed tickets which are available at any of the IMAX ticket counters.

A Floristic Field Guide of the Indian River Lagoon

A new guide, *Submersed Plants of the Indian River Lagoon: A Floristic Inventory & Field Guide*, co-authored by **Diane** and **Mark Littler**, presents a floristic compendium for seaweeds from the Indian River Lagoon in Florida. It documents 227 species of marine algae [127 (56%) new records] from seven diverse groups and 7 seagrasses, illustrated with nearly 1,365 images, including 565 underwater color photographs, 492 photomicrographs and 305 anatomical line drawings. This field guide provides critically needed baseline inventories to resource managers, conservationists and the broad scientific community, and serves as an educational and recreational guide for the interested public, who now have a usable means to accurately identify the organisms that form the basis of the marine food web.



Studying the Espeletiinae

Mauricio Diazgranados spent 10 weeks in the Department of Botany during the summer of 2007. A graduate student from St. Louis University, Diazgranados was the recipient of both a graduate student award from the Smithsonian Office of Fellowships and a 2007 Cuatrecasas Travel Award. During his time as a fellow he worked in the herbarium continuing his study of the Asteraceae subtribe Espeletiinae. Major accomplishments include (1) databasing the Espeletiinae collection present at the US National Herbarium, (2) using Google Earth to plot the distributions of various taxa, and (3) planning his field work to Colombia. Using the data he collected, Diazgranados designed a poster for the June 2007 Botany meetings in Chicago, which won an award as the best poster in the Ecology section.

In December and January Diazgranados visited several páramos across the western Colombian cordillera, and collected ca. 200 specimens of 25 species of frailejones (subtribe Espeletiinae Cuatrec., family Asteraceae). This was Diazgranados' first collection trip during his dissertation about phylogenetic and biogeographic relationships between these plants, and his collections include duplicates for the US National Herbarium.

In total he visited 13 páramos between 9,000 and 14,500 ft of elevation in the

areas of Boyacá and Cundinamarca: Tablazo, Sumapaz, Cruz Verde, Chingaza, Guerrero, Guacheneque, Iguaque, Ocetá, La Rusia, Guántiva, Huina, Cocuy and Guicán. Some of these areas were risky five years ago, but now are safe to visit. He found some pristine locations, such as the páramos of the eastern slope of the Sierra Nevada del Cocuy, for which it is needed to travel 12 hours by bus from Bogotá to the Cocuy town, then three hours in a truck and hike for five days passing snowed peaks in trails that easily reach the 14,000 ft. In this area he found a spectacular relict of a very dense population of *Espeletiopsis guacharaca* forming a forest-like community of more than 10 m tall, with an understory dominated by *Pentacalia*, *Diplostephium* and *Dryopteris*. In the Guantiva páramo he photographed 9 m tall individuals of *Espeletia incana*, and in Chingaza some 10 m tall *E. uribei*.

Unfortunately, the accelerate deforestation and the burning practices for introducing cattle and potato crops are transforming most of these páramos. The "Alto de Canutos" páramo (type locality for *Espeletia boyacensis*, *E. nemekenei*, *E. discoidea* and *Paramiflos glandulosa*) does not exist as páramo anymore: grasslands and crops dominate the landscape, without any track of the previous frailejones populations. Another cause of landscape transformation is climate change, which is leading to a rapid melting of snow in the tropical

Andes, affecting several plant communities restricted to the superpáramos.

Diazgranados plans to conduct at least three more expeditions to collect most of the ca. 145 species of frailejones in Venezuela, Colombia and Ecuador, visiting type localities as well as the most remote and uncollected páramos.

"The Lost Amazon" Opens at NMNH

Harvard botanist Richard Evan Schultes (1915-2001) spent twelve years in the Colombian Amazon during the 1940s and early 1950s with the goal of exploring territory previously untraveled by any modern naturalist. He spent these years mapping uncharted rivers, living among two dozen Indian tribes and collecting some 25,000 botanical specimens, including 300 new species and more than 2,000 medicinal plants. Schultes was able to capture some of his discoveries and observations on camera. His photographs and memorabilia are the focus of a temporary exhibition at the National Museum of Natural History entitled, "The Lost Amazon: The Photographic Journey of Legendary Botanist Richard Evans Schultes," on view April 17 through October 31.

"Richard Evan Schultes is a towering figure in the field of ethnobotany," said Cristián Samper, acting secretary of the Smithsonian Institution. "As a former student of Dr. Schultes, I am gratified that the Smithsonian is honoring his legacy with this tribute to his extraordinary life."

The exhibition is based on the biographical essay "The Lost Amazon: The Photographic Journey of Richard Evans Schultes" written and produced by ethnobotanist Wade Davis and Chris Murray. Thirty-eight black-and-white photographs by Schultes are on view, as well as his Rolleiflex camera, several herbarium specimens from the museum's collection that he collected and personal items from the Schultes family. The exhibition highlights Schultes' journey through the Amazon that led him to become the world's botanical authority on natural rubber and medicinal, toxic and hallucinogenic plants. His photographs evoke a lost era when the tropical rainforests stood immense, and the peoples of the forest relied on plants not only for sustenance, but also for their medicinal and spiritual needs.



Mauricio Diazgranados in a field of *Espeletia murilloi* Cuatrec. at the Iguaque Fauna and Flora Sanctuary. (Photo by Camilo Cadena)

The exhibition was curated by **John Kress**, with guest curators Wade Davis, explorer-in-residence at the National Geographic Society and author of "The Lost Amazon" and "One River," and Chris Murray, founder and director of the Govinda Gallery in Washington, D.C. The photographs were printed by Adamson Editions.

"Richard Evans Schultes' travels in the Colombian Amazon during the 1940s and 1950s opened our eyes to the vast environmental and cultural riches that existed in that area of our country," said Carolina Barco, ambassador of Colombia to the United States. "He raised alarms that the rain forests and their native cultures were in danger of disappearing. Those alarms have not been sufficiently heard and the knowledge that he documented is rapidly being lost. We must join efforts to preserve the cultures and environment of the rainforests."

The exhibition was made possible by The Embassy of Colombia in the United States and the Latino Initiatives Pool, administered by the Smithsonian Latino Center.

Profile

Continued from page 1

tive habitats at the land sea interface. The results of the field expeditions and subsequent scanning electron microscopy examinations in the 1980s and early 1990s resulted in the description of numerous new dinoflagellate species, many of which proved to be toxic. One of these species which I have identified in coral reef-mangroves in Belize, *Gambierdiscus belizeanus*, was only the second species to be described in the genus which is known to cause CFP.

Publication of the *Gambierdiscus belizeanus* led to a collaboration with Mireille Chinain, from the Institut Louis Malardé in Tahiti, French Polynesia, which resulted in the description of three new CFP causing dinoflagellate species, *Gambierdiscus polynesiensis*, *G. australes* and *G. pacificus*. One of the novel aspects of this publication was that the new species were distinguished not only using traditional morphological criteria based on detailed scanning electron microscopy, but also on molecular analyses. The molecular analyses included isozyme electrophoresis, which examines protein differences

between species, and phylogenetic analysis of variation in the DNA sequences. The latter analysis is based on the fact that during the evolution of new species the DNA sequence of certain genes diverges. In this study, DNA sequence divergence in variable region of the large subunit ribosomal RNA gene was specifically examined. The results of both the protein and DNA analyses supported the morphologically defined species. This work represented one of the first instances where both morphological and molecular data, and not just morphological differences alone, were used in describing dinoflagellate species. In that paper we concluded that "besides opening a huge new vista for systematics, [the use of] molecular taxonomy is expected to expand significantly over the next decade because it offers practical applications." (*Journal of Phycology* 35: 1282-1296; 1999).

The utilization of both morphological and molecular approaches in describing new dinoflagellate species was continued over the past six years in collaboration with Patricia A. Tester and R. Wayne Litaker, both from the National Oceanic and Atmospheric Administration's (NOAA) National Ocean Service (NOS) in Beaufort, North Carolina. By combining cutting edge DNA research tools and detailed

morphological analyses, we were able to establish a DNA barcoding procedure that distinguishes most dinoflagellate species, including those which produce toxins. This research is also pertinent to another major project being supported by the Smithsonian Institution which is the creation of a "Tree of Life." The long range goal of this project is to genetically identify all the species on the planet. Our research revealed that for the dinoflagellates, the genes which are being successfully used to identify most other species in the Tree of Life did not work well. Instead, the ribosomal internal transcribed spacer region is more reliable and can be used to barcode this important group of organisms.

The development of a reliable way to genetically identify potential new species now makes it possible to rapidly screen dinoflagellate cultures started from single cells isolated from water samples collected from various coral reef and mangrove systems in Belize. Once the cultures reach sufficient density DNA from each isolate is extracted, amplified and sequenced in the Litaker and Tester laboratory. The resulting DNA sequences are then examined to determine if it is sufficiently different to suggest the existence

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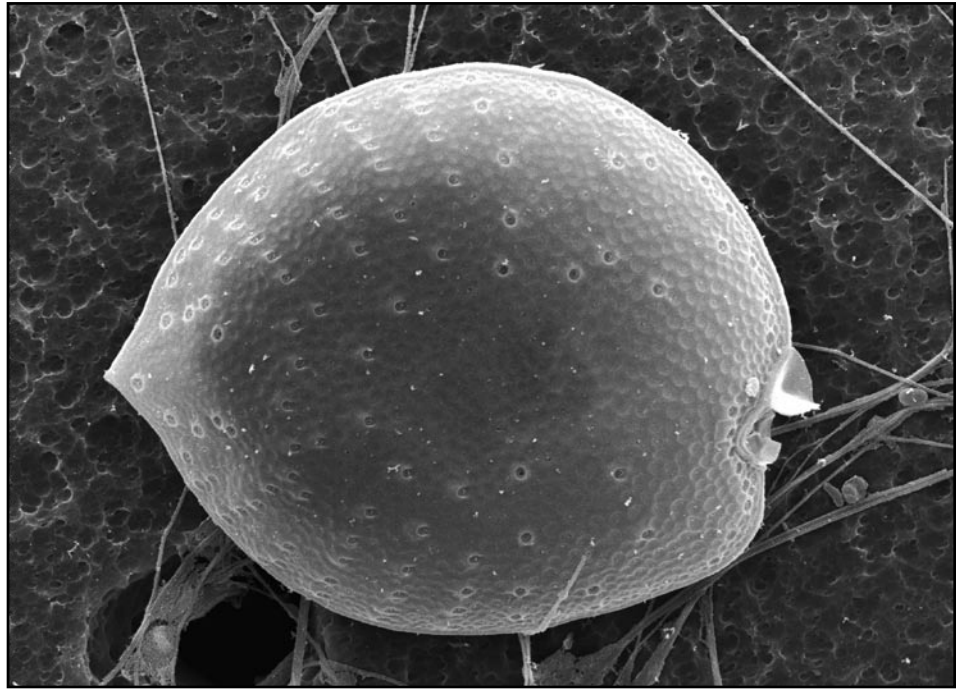
Gambierdiscus toxicus is a benthic dinoflagellate that attaches to macroalgal surfaces.

Dinoflagellates

Continued from page 9

of new species. A subsample from those cultures which are genetically unique are then preserved and prepared for shipment to my laboratory where its morphology can be examined in detail using scanning electron microscopy. Because cloning and sequencing is fast and inexpensive compared to the long preparation times and hours needed to take scanning electron micrographs of each culture, the molecular approach is much more efficient at identifying potential new species. To date over 90 dinoflagellate cultures established from single-cell isolates have been cloned and sequenced. Many of the isolates turn out to be new species, but others are unique. The combined sequencing and morphological analyses have lead to the identification of four new *Gambierdiscus* species present in coral-reef-mangroves in Belize, which may be involved in CFP as well as other new species belonging to the genera *Coolia*, *Prorocentrum*, and *Ostreopsis*.

Once the species are identified and published, it is possible to design rapid species-specific molecular assays which can be used to assess their abundance and distribution. This is important in the case of CFP because toxic events are highly variable in time and space. We do not

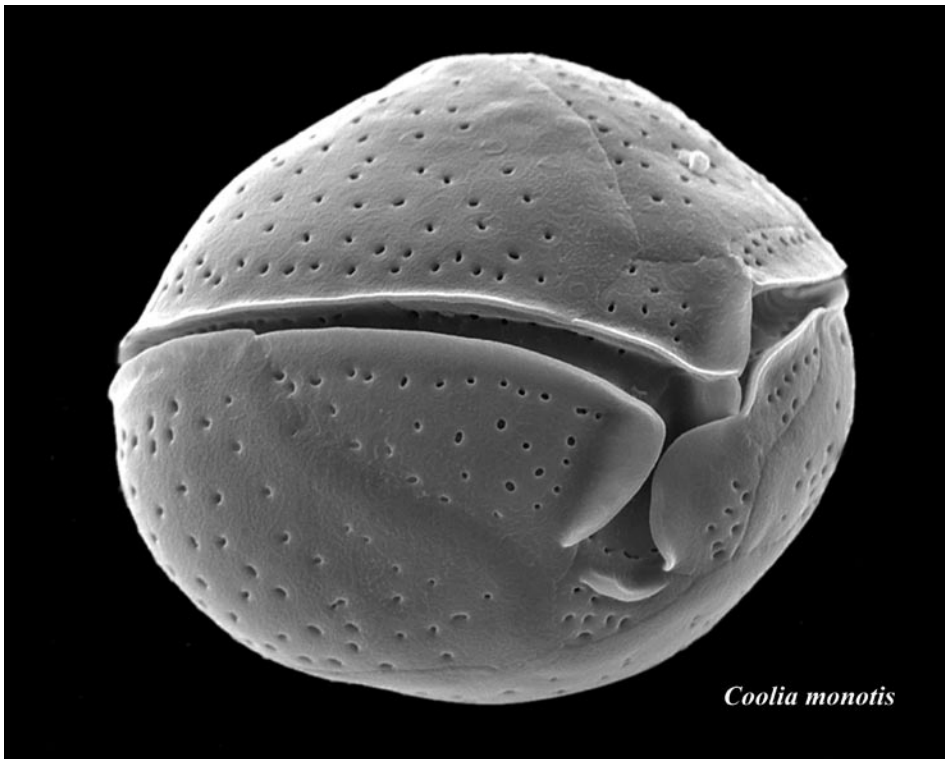


***Prorocentrum rhathymum* is present in coastal shallow marine waters and forms red tides.**

know whether this variability is due to an increase in the abundance of the toxic species, to an environmental trigger, or some other mechanism. The detailed morphological and molecular work on the *Gambierdiscus* species over the past six years is allowing us to develop accurate assays which will be used to monitor whether

or not ciguatera events are preceded by increases in the abundance of specific toxic dinoflagellate species. The assays will also be used to investigate basic research questions regarding these toxic species such as habitat preference, whether increasing nutrient inputs associated with increasing populations and development in the Caribbean is fostering the growth of toxic dinoflagellate species, and species are related to one another evolutionarily. The rate at which we are identifying new species indicates that ancient single-celled dinoflagellates still remain poorly characterized in marine waters and that much exciting new discoveries remain to be made.

Our research indicates that the emergence of DNA sampling and sequencing methods, coupled with advances in bioinformatics, will make accurate and globally accessible identification of dinoflagellate species possible. By building upon existing collections of harmful dinoflagellate in the U.S. National Herbarium, and with the new use of a barcode labeling system, it is now possible to more fully address critical scientific, taxonomic and public health questions concerning dinoflagellates, particularly to toxin producing species which disrupt fisheries, kill seabirds and marine mammals, and adversely affect human health.



***Coolia monotis* is associated with floating muck in coral reef-mangrove protected habitats.**

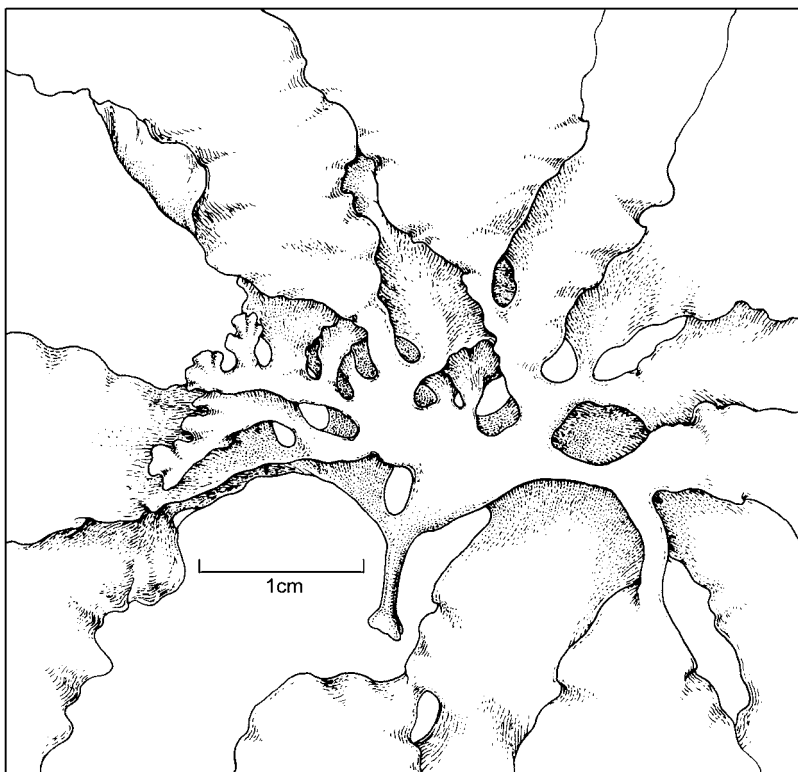
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Art by Alice Tangerini

***Platoma abbottiana* J.N. Norris & Bucher**

While Alice Tangerini has primarily focused her illustrations on terrestrial plants, she has drawn a few aquatic plants. Tangerini illustrated the intricate branching pattern of *Platoma abbottiana* (Gymnophylaeaceae) for Jim Norris and Katy Bucher's description of the species in the *Journal of Phycology* (1977). This benthic red algae was encountered subtidally by Norris while SCUBA diving off Isla Mejía in the Gulf of California, Mexico. It differs from other *Platoma* species in branching pattern and from all but one in possessing a stipe. Incidentally, Tangerini's illustration was also selected to be published in the 1989 edition of *The Guild Handbook of Scientific Illustration*, edited by Elaine R.S. Hodges.



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