

Research

Getting Warmer? Prehistoric Climate Can Help Forecast Future Changes

By Harry Dowsett, Marci Robinson, and Jessica Robertson

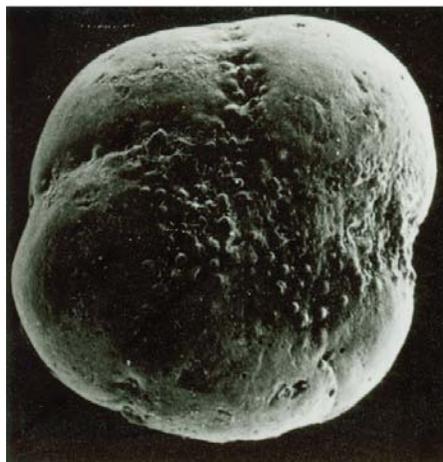
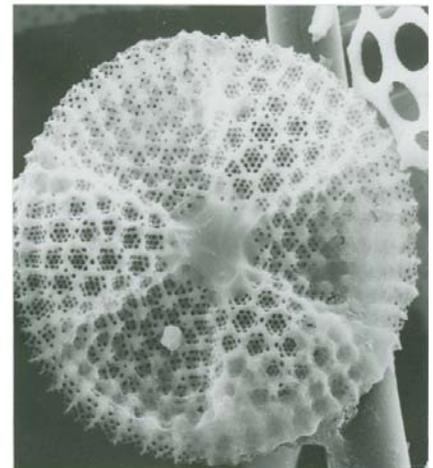
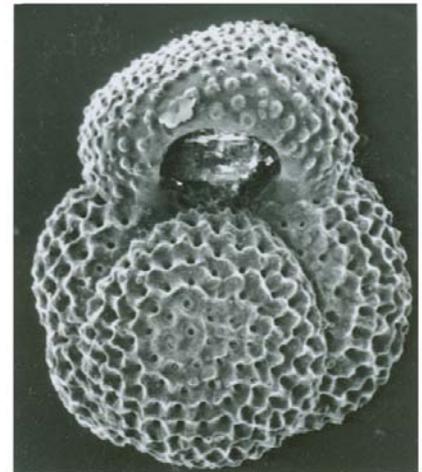
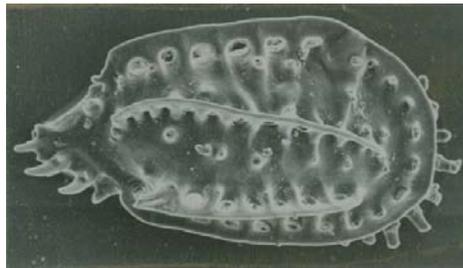
Using fossil animals, plants, and pollen, U.S. Geological Survey (USGS) scientists and collaborators around the world have reconstructed climate conditions that existed on the Earth during a period 3.3-3.0 million years ago, known as the mid-Pliocene warm period. This global reconstruction is the first of its kind for a period as warm as that predicted for the end of the 21st century. It will improve understanding of today's warming and, more importantly, assist testing and refinement of climate models that estimate future warming.

The new reconstruction shows the sensitivity of the climate system to changes in carbon dioxide (CO₂) levels, as well as the strong influence of ocean temperatures, heat transport from equatorial regions, and greenhouse gases on Earth's temperature. It was created through research led by the USGS Pliocene Research, Interpretation, and Synoptic Mapping (PRISM) group (see URL <http://geology.er.usgs.gov/eespteam/prism/>).

"PRISM's research provides data for climate modelers to better understand the environment in which we live, and for decision makers to develop informed adaptation and mitigation strategies that yield the greatest benefits to society and the environment," said Senior Advisor to USGS Global Change Programs **Thomas Armstrong**. "This is one of the most comprehensive global reconstructions for any warm period and emphasizes the importance of examining the past state of Earth's climate system to understand the future."

Past warm periods provide valuable data on climate change and serve as natural laboratories for understanding the global

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Microfossils used in mid-Pliocene paleoclimate research. Clockwise from top left: ostracode, planktic foraminifer, diatom, benthic foraminifer, and pollen grain. One way scientists reconstruct past climate is by comparing the spatial distribution of these microfossils with the distribution of their relatives living in today's climate. Calcareous microfossils (foraminifera and ostracoda) carry additional climate information in their elemental ratios; for example, the ratio of magnesium to calcium varies with ocean-water temperature, and the ratios of different isotopes of oxygen vary with global ice volume and, therefore, sea level.

Sound Waves

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Submission Guidelines

Deadline: The deadline for news items and publication lists for the April issue of *Sound Waves* is Thursday, February 12.

Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.

Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator® files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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Can't find the answer to your question on the Web? Call 1-888-ASK-USGS

Want to e-mail your question to the USGS? Send it to this address: ask@usgs.gov

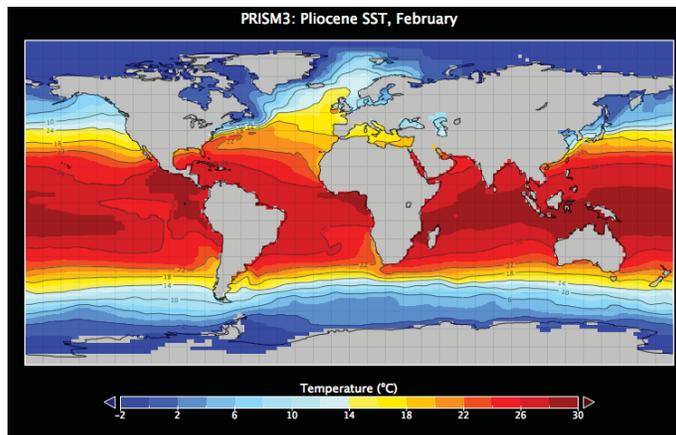
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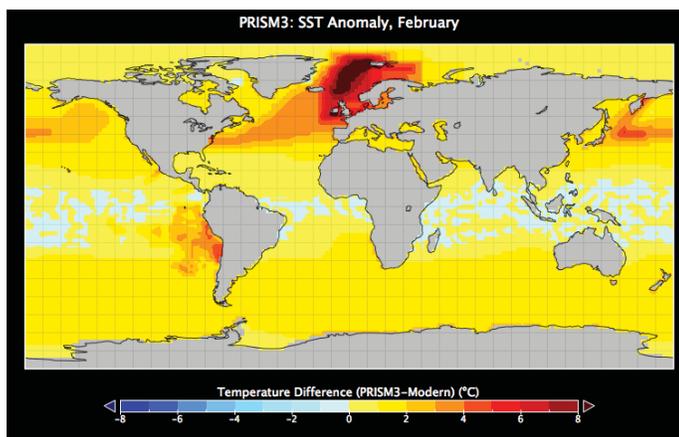
climate system. The mid-Pliocene warm period is particularly useful because—in contrast to earlier warm periods, such as the Late Cretaceous (approx 100-65 million years ago)—the mid-Pliocene was a time when many conditions on Earth were similar to those of today: the continents were in virtually the same positions, and most of the plant and animal species alive

then are still extant. Temperatures, however, were considerably higher: global average temperatures were 2.5°C (4.5°F) greater than today, placing them within the range projected for the end of the 21st century by the Intergovernmental Panel on Climate Change (IPCC; see URL <http://www.ipcc.ch/>).

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Average February sea-surface temperatures during the mid-Pliocene, derived from the PRISM3_SST_v1.0 dataset (URL http://geology.er.usgs.gov/eesteam/prism/prism_data.html). Sea-surface temperature is key to paleoclimate work because it is the temperature at the interface between air and sea—where sea ice forms (which affects Earth's albedo, or surface reflectivity), where cold upwelling cells or warm surface currents affect the climate of nearby coastal zones, and where wind interacts with the water surface to create such phenomena as El Niño. Sea-surface-temperature maps show scientists how well or how poorly ocean currents distribute heat from the tropics to the poles.



Mid-Pliocene versus modern sea-surface-temperature anomaly for the month of February. Yellow, orange, and red colors indicate areas where average sea-surface temperatures were warmer during the mid-Pliocene than today. Note warm temperatures along the west coast of South America, a pattern similar to modern El Niños, and warm temperatures in the high latitudes of the North Atlantic and Arctic Oceans.

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“Exploring the mid-Pliocene will further our understanding of the role of ocean circulation in a warming world, the impacts of altered storm tracks, polar versus tropical sensitivity, and the impacts of changes in atmospheric CO₂ and oceanic energy-transport systems,” said USGS scientist **Harry Dowsett**, lead scientist for PRISM. “We used fossils dated to the mid-Pliocene to reconstruct sea-surface and deep-water ocean temperatures, and will continue research by studying specific geographic areas, vegetation, sea-ice extent, and other environmental conditions that existed during the Pliocene.”

Because CO₂ levels during the mid-Pliocene were only slightly higher than today’s, PRISM research suggests that a slight increase in our current CO₂ level could have a large impact on temperature change. Research also shows warming of as much as 18°C in the high latitudes of the North Atlantic and Arctic Oceans during the mid-Pliocene, raising average temperatures there from -2°C to 16°C. Also characteristic of the mid-Pliocene was warming in the eastern Pacific, similar to a present-day El Niño (a periodic change in atmospheric circulation that affects ocean temperatures and weather patterns; see URL [http://www.pmel.noaa.gov/tao/elnino/el-](http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html)

[nino-story.html](http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html)). Global sea-surface and deep-water temperatures were determined to be warmer than those of today, affecting the ocean’s circulation system and climate. Data suggest that the likely cause of mid-Pliocene warmth was a combination of several factors, including increased heat transport from equatorial regions to the poles and increased greenhouse gases.

The synthesis of paleoenvironmental data—such as PRISM’s new reconstruction for the mid-Pliocene warm period—and the modeling of Earth’s climate have been evolving in tandem. Paleoenvironmental studies provide new data that climate modelers can use to test their models, and unexpected model results commonly lead paleoclimatologists to important new research topics. This mutually beneficial relationship continues to expand; for example, the mid-Pliocene reconstruction by PRISM has been chosen by the Paleoclimate Modelling Intercomparison Project Phase II as the dataset against which to run and test the performance of climate models for the Pliocene.

The use of PRISM data to refine climate models and reduce the uncertainty in future climate projections is the most important impact of the research for **Dowsett**, who said: “Climate change is happening; it’s something our children are going to have to

deal with in a very real way. Knowing that what we’re doing is making a difference is extremely rewarding.”

Marci Robison, who joined the USGS as a Mendenhall Postdoctoral Fellow to work with **Dowsett** on the PRISM project, agreed and added, “I also want to note how exciting it’s been to bring together scientists from so many disciplines to work on a problem on such a global scale.”

Robinson is lead author of a report about the new reconstruction, titled “Pliocene Role in Assessing Future Climate Impacts,” published in the December 2, 2008, issue of *Eos* (v. 89, no. 49, p. 501-502). Her coauthors are **Dowsett** and **Mark A. Chandler**, of the National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies at Columbia University. Columbia is one of PRISM’s primary collaborators; others are Duke University, the University of Leeds, and the British Antarctic Survey.

To hear a podcast interview featuring **Dowsett** and **Robinson** discussing the new climate reconstruction, listen to episode 77 of USGS CoreCast at URL <http://www.usgs.gov/corecast/>. For additional information and to view the compiled data, visit URL <http://geology.er.usgs.gov/eespteam/prism/>. ❁

Silent Streams? Escalating Endangerment for North American Freshwater and Diadromous Fish: Nearly 40 Percent Now At Risk

By Catherine Puckett, Hannah Hamilton, Howard Jelks, Noel Burkhead, and Stephen Walsh

Nearly 40 percent of fish species in North American lakes, rivers, and streams are now in jeopardy, according to the most detailed evaluation of the conservation status of freshwater and diadromous fish (those that migrate between rivers and oceans) in the past 20 years. Salmon that live along the Pacific Coast are among the groups most at risk.

The 700 fishes now listed represent a staggering 92-percent increase over the 364 listed as “imperiled” in the previous 1989 study published by the American Fisheries Society. Researchers classified each of the 700 fishes listed as either vulnerable (230), threatened (190), or en-

dangered (280); in addition, 61 fishes are presumed extinct.

The report, published in the August 2008 *Fisheries Journal*, was conducted by a U.S. Geological Survey-led team of scientists from the United States, Canada, and Mexico, who examined the status of continental freshwater and diadromous fish.

“Freshwater fish have continued to decline since the late 1970s, with the primary causes being habitat loss, dwindling range, and introduction of nonnative species,” said USGS director **Mark Myers**. “In addition, climate change may further affect these fish.”

The groups of fish most at risk are the highly valuable salmon and trout of the

Pacific Coast and western mountain regions; minnows, suckers, and catfishes throughout the continent; darters in the Southeastern United States; and pupfish, livebearers, and goodeids, a large, native fish family in Mexico and the Southwestern United States.

Nearly half of the carp and minnow family and the Percidae (family of darters, perches, and their relatives) are in jeopardy. Fish families important for sport or commercial fisheries also had many populations at risk. More than 60 percent of the salmon and trout had at least one population or subspecies in trouble, while 22 percent of sun-

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fishes—which includes such well-known species as black bass, bluegill, and rock bass—were listed. Even one of the most popular game species in the United States, striped bass, has populations on the list.

Regions with especially notable numbers of troubled fish include the Southeastern United States, the mid-Pacific coast, the lower Rio Grande, and basins in Mexico that do not drain to the sea.

Hotspots of regional biodiversity and greatest levels of endangerment are the Tennessee (58 fishes), Mobile (57), and southeastern Atlantic Slope river systems (34). The Pacific central valley, western Great Basin, Rio Grande, and rivers of central Mexico also have high diversity and numbers of fish in peril, according to the report. Many of the troubled fish are restricted to only a single drainage. “Human populations have greatly expanded in many of these watersheds, compounding negative impacts on aquatic ecosystems,” noted **Howard Jelks**, USGS researcher and senior author of the paper.

Of fish on the 1989 imperiled list, 89 percent either are still listed with the same conservation status or have become even more at risk. Only 11 percent improved in status or were delisted. The authors emphasized that improved public awareness and proactive management strategies are needed to protect and recover these aquatic treasures.

“Fish are not the only aquatic organisms undergoing precipitous declines,” said USGS researcher **Noel Burkhead**, a coauthor of the report and chair of the American Fisheries Society (AFS) Endangered Species Committee. “Freshwater crayfishes, snails, and mussels are exhibiting similar or even greater levels of decline and extinction.”



An endangered holiday darter from the Amicalola Creek population, Georgia. Darters are among the most threatened Southeastern fish; they have been likened to aquatic canaries. Photograph by **Noel Burkhead**, USGS.



A threatened Waccamaw killifish from the Atlantic Slope region of the Southeastern United States. Photograph courtesy of **Fritz Rhode**, North Carolina Department of Environment and Natural Resources.



A threatened sicklefin redbreast from the Tennessee River. Photograph courtesy of **Steve Fraley**, North Carolina Wildlife Resources Commission.



An endangered Alabama sturgeon from the Mobile River. Photograph courtesy of **Patrick O'Neil**, Geological Survey of Alabama.

The authors noted that the list was based on the best biological information available. “We believe this report will provide national and international resource managers, scientists, and the conservation community with reliable information to establish conservation, management, and recovery priorities,” said **Stephen Walsh**, another coauthor of the report and USGS researcher.

This is the third compilation of imperiled freshwater and diadromous fishes of North America prepared by the American Fisheries Society’s Endangered Species Committee. Additional information

is available at URL <http://fisc.er.usgs.gov/afs/>.

The complete reference for the recent paper is: Jelks, H.L., Walsh, S.J., Burkhead, N.M., Contreras-Balderas, S., Díaz-Pardo, E., Hendrickson, D.A., Lyons, J., Mandrak, N.E., McCormick, F., Nelson, J.S., Platania, S.P., Porter, B.A., Renaud, C.B., Schmitter-Soto, J.J., Taylor, E.B., and Warren, M.L., Jr., 2008, Conservation status of imperiled North American freshwater and diadromous fishes: Fisheries Magazine, v. 33, no. 8, p. 372-407 [URL http://www.fisheries.org/afs/docs/fisheries/fisheries_3308.pdf].

Outreach

USGS Celebrates 10th Annual Open House in St. Petersburg, Florida

By Ann Tihansky

The Mayor of St. Petersburg, other community leaders, scientific partners, the general public, and U.S. Geological Survey (USGS) staff from the Florida Integrated Science Center (FISC) office in St. Peters-

burg celebrated the center’s 10th annual Open House on Wednesday, November 5, 2008. A short ceremony commemorated the event, which drew more than 400 visitors. **Jack Kindinger**, Associate Center

Director, welcomed everyone and recognized distinguished guests, including St. Petersburg Mayor **Rick Baker** and City Council Chairman **James Bennett**; **Shahra**

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Anderson, representing Senator **Bill Nelson's** office; **Michelle Todd** with Florida Governor **Charlie Crist's** office; City of Clearwater Councilman **George Cretekos**; St. Petersburg Downtown Partnership President **Peter Betzer**; USGS FISC Director **Barry Rosen**; and **Chris D'Elia**, Professor of Environmental Science and Policy at the University of South Florida (USF) St. Petersburg, among other guests.

Kindinger introduced **Lisa Robbins**, who began the Open House tradition 10 years ago when she was the Center Director. **Robbins** shared memories about the modest open-house beginnings and reflected on how the event has grown over the years. Students who visited open-house events as fourth graders during years past are now returning as student interns and scientists. "Through activities like this one, we are really making an impact," **Robbins** said. She also acknowledged the importance of the vision and the community support from such partners as the USF College of Marine Science and the Downtown Partnership. **Robbins** introduced **Peter Betzer**, "an important figure who worked to make the vision a reality. **Peter** was a key individual who helped bring the USGS to St. Petersburg 20 years ago."

"A lot has happened in the past 20 years," said **Betzer**, former Dean of the College of Marine Science, who has been a key participant in making the community vision come to life. He added to **Robbins'** reflections on changes that have taken place in the past 20 years since the USGS was established here. **Betzer** noted that the USGS provided a critical piece of



Jack Kindinger (at podium) welcomes everyone as he kicks off a short ceremony celebrating the 10th annual USGS Open House at the center in St. Petersburg, Florida. In background (left to right): **Lisa Robbins**, City Council Chairman **James Bennett**, **Peter Betzer**, Mayor **Rick Baker**, and USGS staff **Susan Wadyka** and **Erik Lahti**.

the puzzle as downtown leaders worked toward creating a first-class marine-science center in St. Petersburg. "We are now more successful in luring other related science and technology to the area because of the strong presence of the C.W. Bill Young Marine Science Complex and all of the partners it includes [see *Sound Waves* article at URL <http://soundwaves.usgs.gov/2008/06/staff5.html>]. It takes good city leadership to follow through and make all of these things happen."

Betzer introduced Mayor **Baker**, pointing out that he was recently recognized by *Governing* magazine as "2008's Mayor of the Year" (see URL <http://www.governing.com/poy/2008/baker.htm>) One of Mayor **Baker's** hallmarks is his support of education. The USGS participates in many of his initiatives, such as being a corporate partner for Bay Point Elementary Magnet School (see *Sound Waves* article at URL <http://soundwaves.usgs.gov/2005/10/outreach2.html>). Mayor **Baker** recognized that he depends on many others to make things

happen and introduced City Council Chairman **James Bennett**. The two shared praise for the USGS as a community partner and recognized the importance of the scientific work conducted here, which benefits the entire region. **Bennett** remarked that he brings his daughter to the Open House every year.

After the ceremony, cupcakes were served, and everyone took the opportunity to visit more than 40 displays highlighting scientific work by the USGS and many of its partners (see related article, this issue). ❁



(Left to right) **Michelle Todd**, **James Bennett**, **Lisa Robbins**, and **Peter Betzer** share a sweet moment.

Florida Integrated Science Center's 10th Annual Open House— Scientists Out and About Sharing Science

By **Ann Tihansky** and **Theresa Burress**

Sharing science with the community was a big activity for the U.S. Geological Survey (USGS)'s Florida Integrated Science Center (FISC) during the month of November. The USGS FISC office in St. Petersburg hosted the center's 10th annual Open House and 10th annual Earth Science Day for fourth graders on

November 5 and 6, respectively. During the Open House on November 5, the center held a short ceremony recognizing the milestone of 10 years of sharing science with the community (see related article, this issue), and scientists and staff talked to more than 400 Tampa Bay residents and community leaders about

projects ranging from wetlands and climate to mapping and fish ecology. The next day's event was dedicated to nearly 1,000 fourth-grade students, emphasizing the American Geological Institute's 2008 Earth Science Week theme, "No Child Left Inside."

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Outreach, continued

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Students from 14 schools attended Earth Science Day, with 8 schools taking advantage of charter-bus transportation provided through a grant from the Southwest Florida Water Management District. The buses made trip logistics easier for everyone and allowed some schools to attend that had been unable to previously. National Honor Students from Seminole High School and Lakewood High School helped with exhibits and as tour guides. After their experiences, several

of the volunteer students asked about the possibility of internships and earning community-service hours at the St. Petersburg facility.

Many organizations that partner with the USGS also participated in the Open House and Earth Science Day: the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, the Friends of the Tampa Bay National Wildlife Refuges, the Southwest Florida Water Management District, the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute, Mote Marine Laboratory, the Clearwater Marine Aquarium, Nature's Classroom, the Pier Aquarium, Suncoast Seabird Sanctuary, Tampa Bay Watch, and Gatorama (which provided a live alligator).



"Fish Going In-Seine" exhibit. Above left: **Justin Krebs** (left) and **Adam Brame** give tips to youngsters learning to use a seine to catch fish. Above right: **Adam Brame** shows how to use the key to identify fish caught in the seine.



In keeping with the theme "No Child Left Inside," FISC Director **Barry Rosen**, St. Petersburg Associate Center Director **Jack Kindinger**, and Southeast Region Program Officer **Sonya Jones** visited all of the USGS exhibits and selected the three that best represented the idea of getting outdoors and learning more about the world around you. Along with a commemorative plaque custom-made by **Dave Wegener**, prizes of \$1,000 for travel expenses to attend a scientific meeting of their choice were given to the winning teams. The "Get Outdoors" award went to **Nancy Dewitt** and **BJ Reynolds** for their hands-on mapping exhibit called "Cool Contours." The "Spirit of Exploring" award recognized **Adam Brame**, **Justin Krebs**, and **Mark Squitieri** for their exhibit called "Fish Going In-Seine,"

a hands-on fish collection and identification exercise that put young students into the scientist's seat. The "How Does It Do That?" award went to **Hilary Stockdon**, **Dave Thompson**, and **Katy Serafin** for their explanation of how waves work, called "Surf's Up, WAY UP!"

The two days—Open House and Earth Science Day—were quite successful and prepared many scientists with ideas for other ways to share their science. The Great American Teach-In was formally held nationwide on November 19, 2008, and FISC scientists and staff spent much of the month sharing science in a wide variety of venues throughout the community.

As a result of visiting the Open House, a member of the Pinellas Geological Society invited **Ann Tihansky** to talk at the Soci-

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Dave Thompson (far end of rope) and **Hilary Stockdon** (near end) use a rope and a lot of human energy to show how waves work.



The Normile Conference room was transformed into a hub of activity, with such exhibits as *Catch Climate Fever*, *Tsunami!*, *Geowall*, *Map Your World*, and *CSI—Tracks in the Sand*.

Outreach, continued

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ety's monthly meeting on November 25. She spoke about Florida geology and how it influences the modern landscape and many environmental issues facing Florida.

Tom Smith, a USGS ecologist who studies mangroves and coastal ecosystems, discussed "Mangroves of the World—Why Are They Important?" as part of a lecture on mangroves and eco-art held at Florida Botanical Gardens in Largo on November 18. **Smith** is working with artist **Xavier Cortada** and students from Shorecrest Preparatory School in St. Petersburg on an eco-art project to reforest Tampa Bay. In September, **Smith** led the students in collecting mangrove propagules (seedlings of red mangroves) from the Weedon Island Preserve. The propagules were installed at the Florida Botanical Gardens in a mangrove eco-art display—an aesthetic array of propagules as they germinate in individual cups. Next year, students will plant the seedlings in areas of Tampa Bay where **Smith** is recording the success of the seedling harvest and reforestation efforts. The students will then collect a new batch of seedlings to refresh the display. (See URL http://www.xaviercortada.com/?RP_learn.)

Barbara Poore, a USGS geographer whose current work focuses on social vulnerability to natural hazards, participated in a panel discussion titled "Feel the Heat: Climate Change, Vulnerability, and Environmental Justice," held at Studio@620 in St. Petersburg on November 20. The discussion, moderated by **David Hastings**, associate professor of marine science and chemistry at Eckerd College, focused on how people may be affected by changing climate, rising sea level, and extreme



Students learn how scientists investigate climate change by studying pollen and foraminifera.



FISC scientist **Ann Marie Ascough** is ready to help visiting students select from various images and pose as a scientist in different field settings. **Janice Subino** and **Megan Frayer** took pictures and printed souvenirs that visitors could take home.

storms like Hurricane Katrina and how society will respond to those who are most vulnerable to future climate catastrophes. The Studio@620 Round Table on Social Justice is a forum for Tampa Bay community leaders to discuss social-justice issues affecting the community. **Monique Hardin**, co-director and attorney with Advocates for Environmental Human Rights in New Orleans, brought up some important issues that sparked excellent discussion. **Poore** remarked that participating in a discussion that put science in a social context was very exciting. This discussion series is cosponsored by Eckerd College, Stetson University College of Law, and the University of South Florida, St. Petersburg (see URL http://www.studio620.org/620/e_sjrt.php).

On November 19, several other FISC scientists and staff participated in the actual Great American Teach-In—a 1-day nationwide event that provides scientists and other professionals an opportunity to visit elementary, middle, and high schools and share science with the younger generation.

Representing FISC's Coastal Change Hazards group, **Charlene Sullivan** and **Katy Serafin** visited seven classes of 20 third and fourth-graders at Mildred Helms Elementary School in Largo, where they discussed some of the technical tools, such as lidar (light detection and ranging), used to understand and predict the impacts of hurricanes. **Sullivan** commented that the students were struck most by oblique aerial photographs showing the differences

in coastal landscapes before and after hurricanes. **Kara Doran** also spoke about coastal-change hazards, during visits with students at Northwest Elementary School in St. Petersburg.

Don Hickey discussed sharks with students at Our Savior Lutheran School in St. Petersburg on November 19. **Hickey's** talk culminated in a virtual field trip to the beach in Venice, Florida, where the kids had a chance to dig for their own shells and shark teeth. The students were thrilled to learn that they could each keep a shark tooth as a souvenir. **Hickey** said, "We discussed sharks, jellyfish, coral reefs, pollution, and recycling. But the thing they'll remember most is the opportunity to dig in the sand and find their very own treasure."

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Two volunteer National Honor Society Students who assisted **Kathryn Smith** with her exhibit, which showed how scientists use a geographic information system (GIS) to measure coastal change.

Outreach, continued

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At Bay Point Elementary in St. Petersburg, **Theresa Burress** and **Jordan Sanford** used a large volcano model to illustrate the importance of monitoring natural hazards. Students in first through third grades participated in an activity in which they played scientists, emergency managers, news reporters, and the public. The student scientists observed the volcano and provided data to the emergency managers, who had to decide whether to close the surrounding park area and notify the student reporters. The student reporters then broadcast the volcano-park closings to the public and defended the emergency managers' decisions. Some of the youngest scientists closed the volcano park at the first hint of volcanic activity, whereas others were content to leave the area open to the public until the volcano model began making ominous rumbling sounds and spewing clouds of smoke.

Kathryn Smith visited students at Campbell Park Elementary School in St. Petersburg, where she discussed geographic information systems (GIS) and mapping. Other elementary-school speakers included **Kristine DeLong**, who spoke at Kenly Elementary School in Tampa, and **Chris Reich**, who spoke at Starkey Elementary School in Largo. **John Lisle** spoke to students at Ridgcrest Elementary School in Largo, as well as to older



The USGS Florida Integrated Science Center held its 10th annual Open House and Earth Science Day on November 5 and 6, 2008.

students at Palm Harbor Middle School in Palm Harbor. Several FISC scientists spoke with middle and high school students. **Terrie Lee** and **Robert Bradley** talked about hydrology and water-related field activities at Pinellas Park Middle School. **Rob D'Anjou** discussed ecology and wetlands with students at New Port Richey High School in New Port Richey.

At East Lake High School in northern Pinellas County, **Chris Moses** presented some refresher points about plate tectonics to five classes. **Moses** also talked about SCUBAnauts International (URL <http://www.scubanautsintl.org/>), a Tampa Bay area nonprofit organization that aims to engage students ages 12-18 in science education through underwater exploration. ❁

Meetings

“Water Wars” Focus of Annual Northeast Florida Environmental Law Summit

By **Stephen J. Walsh**

On November 6, 2008, **Stephen Walsh**, biologist at the U.S. Geological Survey (USGS) office in Gainesville, Florida, served as a panelist at the annual Northeast Florida Environmental Law Summit on “Water Wars: Use, Conflict, and the Future,” jointly hosted by the Florida Coastal School of Law and Jacksonville University. **Walsh** presented a talk titled “Relationship of Flow to the Aquatic Faunas of Florida Rivers, Springs, and Estuaries.”

The conference, now in its second year, is intended to bring together scientists, legal professionals and students, and natural-

resource managers to discuss current and emerging environmental issues of regional interest. Ten other panelists included representatives from the University of Florida, the University of South Florida, the South Florida Water Management District, the University of Utah's S.J. Quinney College of Law, the Environmental Law Institute of Washington, D.C., and independent legal experts. Discussions at the conference examined the myriad issues related to allocation, consumption, and

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Generalized map of Southeastern United States, showing locations of some of the rivers discussed at the 2008 Northeast Florida Environmental Law Summit.

Meetings, continued

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redistribution of water resources in and around Florida, with emphasis on:

- a tri-State water conflict over resources in Florida, Georgia, and Alabama (particularly the Apalachicola, Flint, and Chattahoochee Rivers),
- intra-State surface waters (Kissimmee River, the Everglades, coastal rivers), and
- ground-water resources.

Cynthia Barnett, senior writer for *Florida Trend* magazine and author of the award-winning book *Mirage: Florida and the Vanishing Water of the Eastern U.S.*, gave a keynote address to the approximately 100 attendees. The general consensus among panelists and members of the audience was that the water resources in Florida are extremely stressed and that innovative solutions and well-organized cooperative efforts are required to protect both the quantity and quality of these resources. ❁



Despite its numerous waterways, Florida is still susceptible to drought, and some parts of the State are currently undergoing drought conditions (see URL <http://www.dep.state.fl.us/Drought/>). This pair of photographs shows low-water conditions during a previous drought (top, taken November 16, 2001) and high-water conditions during the normal spring flood cycle (bottom, taken February 12, 2002) at Piney Reach on the Apalachicola River, Florida. Declining flows in the river caused by droughts and upstream water consumption have increased the severity and duration of disconnected backwater habitats during low-flow periods of the year, typically early summer through mid-fall. Photographs by **Stephen Walsh**.

Awards

USGS Geologist Amy Draut Wins SEPM 2009 James Lee Wilson Award

By David Rubin and Helen Gibbons

Geologist **Amy Draut** will receive the 2009 James Lee Wilson Award for “Excellence in Sedimentary Geology by a Young Scientist” from the Society for Sedimentary Geology (SEPM) at their annual meeting in Denver this June. **Draut** earned a B.S. in geological sciences and environmental studies from Tufts University in 1997, and a Ph.D. in marine geology and geophysics from the Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in March 2003. After a summer of fieldwork in the Talkeetna Mountains of Alaska, studying volcanoclastic sedimentary rocks of a Jurassic island-arc complex, **Draut** came to the USGS in fall 2003 to do postdoctoral research with **Dave Rubin** of the Western Coastal and Marine Geology Team. She investigated eolian sediment transport in the Grand Canyon and the role of eolian sedimentation in the preservation of archeological sites. Her postdoctoral research expanded to include modeling of sedimentation processes in watersheds and coastal regions. In

February 2006, she joined the team as a Research Geologist.

Draut has worked on a wide variety of geologic problems, including studies of modern dune, river, coast, shelf, and trench sediment deposits as well as ancient sedimentary and volcanic rocks. She has published papers on sedimentation, stratigraphy, and geomorphic evolution of the Gulf Coast; sedimentary processes in modern and ancient oceanic island-arc settings; the stratigraphic and geochemical evolution of arc volcanism; the genesis of continental crust in Ireland and Alaska; millennial-scale climate variations recorded in isotopic data from North Atlantic foraminifera; and the role of fluvial and eolian processes in the preservation of archeological sites in the Grand Canyon.

The James Lee Wilson Award is presented to young geoscientists “who have achieved a significant record of research accomplishments in sedimentary geology,



Amy Draut at the USGS Pacific Science Center, Santa Cruz, California (inset), and doing fieldwork on the Elwha River in northern Washington.

including all aspects of modern and ancient sedimentology, stratigraphy, and paleontology, fundamental and applied.” Established in 1996, it was named in honor of **James Lee Wilson**, an “internationally recognized expert on geology of carbonate sedimentary rocks and paleontologist.” (A short biography is posted at URL <http://www.sepm.org/members/wilson.htm>.)

Congratulations, **Amy**, on an honor well deserved! ❁

Africanized Honeybees in the Florida Everglades

By Tom Smith

A Bee Alert about Africanized honeybees (a.k.a. “killer bees”) has been published by the Animal Control Division of the Public Works Administration of Pompano Beach, Florida. The 4-page article by Animal Control Officer **David Aycock** can be downloaded from Pompano Beach’s Web site at URL <http://www.mypompanobeach.org/directory/publicworks/animal/> or from *Sound Waves*’ Web site at URL <http://soundwaves.usgs.gov/2009/01/staff.html>.

Why am I directing you to this article?

In November 2008, while conducting fieldwork in a sawgrass marsh near the Harney River in Everglades National Park, my team got attacked by a swarm of bees that had several characteristics suggesting that they are Africanized. The bees were highly aggressive and followed us for some 80 m or so away from the initial point of contact. We subsequently discovered that the hive was very exposed, also characteristic of these bees. The hive was attached to the underside of a plankway—just like the plankways many of us use to access our study sites and hydro platforms (stations that house hydrologic-sampling equipment).

The attack resulted in a visit to the emergency room, where the team member who had been stung the most got treatment. So bee careful out there!

A final note: On December 5, Everglades National Park ranger and amateur beekeeper **Dave Fowler** successfully removed the hive. Samples have been sent to the U.S. Department of Agriculture’s laboratory in Gainesville, Florida, for DNA testing, which will determine the degree of Africanization in the bees. Thank you, **Dave!** 🐝



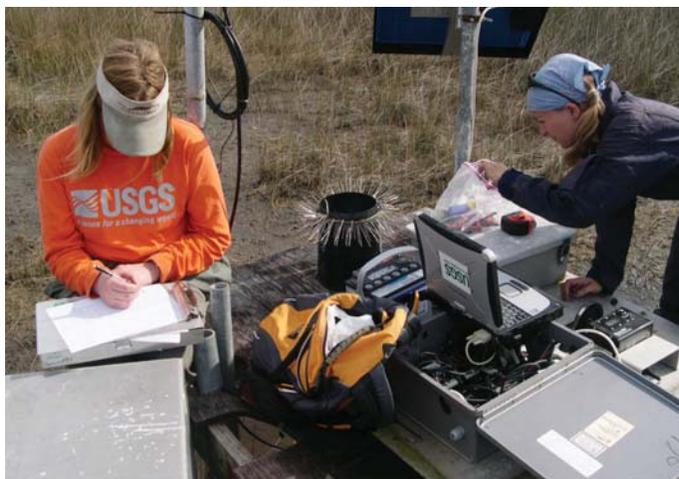
Aggressive bees nesting on underside of plank in a sawgrass marsh near the Harney River in Everglades National Park, Florida.



The hive underneath the plank.



*Hydrologic technician **Gordon Anderson**, a member of **Smith’s** team, repairs a rain gage at the USGS hydrologic-sampling station (a.k.a. “hydro platform”) near the Harney River. Note planks laid over sawgrass marsh to facilitate access to platform.*



***Ginger Tiling** (left) and **Karen Balentine**, members of **Smith’s** team, conduct routine maintenance on platform instruments.*

Reversing Coral Reef Decline in Hawai'i—A New Look at a Critical Problem

New discoveries about how even small amounts of sediment can severely affect fragile coral ecosystems and suggestions about solutions are presented in a new book written by a team of U.S. Geological Survey (USGS) scientists and their colleagues. Coral reefs are in decline worldwide, and a leading cause of their decline is the runoff of sediment and pollutants from nearby land surfaces.

After a multiyear study of the long fringing coral reef off south Moloka'i, the scientists' findings have been published as *The Coral Reef of South Moloka'i, Hawai'i—Portrait of a Sediment-Threatened Fringing Reef*. Using vivid photographs and color illustrations, the book was written, edited, and designed to appeal to a broad audience while maintaining its strong scientific basis. The book begins by explaining the geologic evolution and natural processes that shape the reef and impacts to the reef resulting from human activity on the land. The book concludes by exploring alternative scenarios for the future.



Front cover of *The Coral Reef of South Moloka'i, Hawai'i—Portrait of a Sediment-Threatened Fringing Reef*.

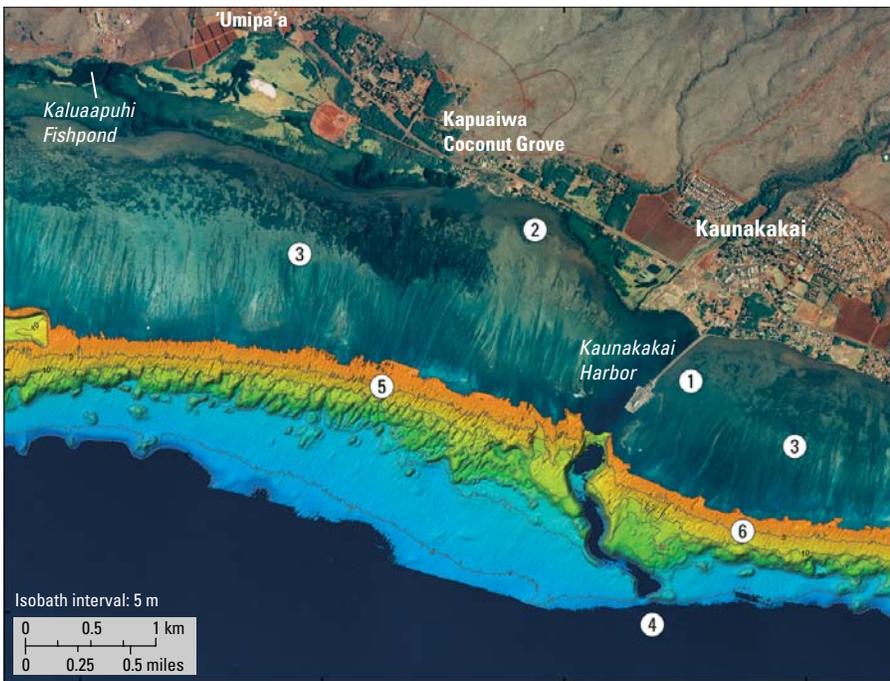
The reef off south Moloka'i is the longest fringing coral reef in the Hawaiian chain and one of the best preserved. However, it is also severely threatened by large loads of sediment that wash off land heavily

altered by farming, ranching, grazing by wild goats, and other activities. The book sheds new light on the causes and results of the distinct band of muddy water that was first reported by marine explorer **Jacques Cousteau** decades earlier—a phenomenon that now obscures the reef nearly every day.

USGS scientists and their colleagues placed instruments on the sea bottom that recorded data on such factors as water temperature, wave height, and suspended-sediment concentration for months at a time. The scientists also mapped coral locations and collected numerous samples of sediment and coral. These data gave scientists an opportunity to monitor in detail how the reef functions. The team studied the process of resuspension of mud on the reef: daily winds and high tides combine to stir the mud particles repeatedly. The effect of this process is that even very small amounts of sediment washed onto the reef from land become suspended nearly every afternoon, blocking light, interfering with photosynthesis of beneficial algae living in the coral, and disrupting many other critical processes that sustain the reef.

Thomas J. Goreau, president of the Global Coral Reef Alliance, wrote the foreword, in which he notes the book's "remarkably integrated approach to the

(Coral Reef Decline continued on page 12)



Town of Kaunakakai, Moloka'i, and surroundings, showing three-dimensional sea-floor bathymetry overlaid on an aerial photograph. 1, Kaunakakai Wharf; 2, muddy reef flat off Kapuawai Coconut Grove; 3, reef flat covered with algae and limited coral; 4, old stream channel; 5, coral reef with pronounced spur-and-groove morphology; 6, coral reef with stunted growth.

Publications, continued

(*Coral Reef Decline* continued from page 11)

reefs of Moloka'i, combining geology, oceanography, and biology to provide an in-depth understanding of the processes that have made these reefs grow and that now limit them."

Although the book's emphasis is on the Moloka'i reef, the authors believe that their findings provide important information for others entrusted with protecting and managing coral reefs elsewhere in the tropical Pacific and Caribbean. Land-based pollution continues to be a major threat to reefs, along with unsustainable fishing practices and climate change. USGS scientist and lead editor **Michael Field** observed: "It is now recognized that impacts to coral reefs from climate change may be severe, and so it is all the more important to eliminate, wherever possible, other major stressors to reefs. One of these is very clearly runoff of sediment and pollutants."

The new book was featured in an article in the December 11, 2008, issue of the *Moloka'i Dispatch*, which called it a "landmark report." Posted at URL <http://www.themolokaidispatch.com/node/2809>, the article includes an interview with **Field** and a local perspective on the importance of the new publication.

The volume—published as *The Coral Reef of South Moloka'i, Hawai'i—Portrait of a Sediment-Threatened Fringing Reef*, U.S. Geological Survey Scientific Investigations Report 2007-5101, edited by **Michael Field**, **Susan Cochran**, **Josh Logan**, and **Curt Storlazzi**—can be viewed online at URL <http://pubs.usgs.gov/sir/2007/5101/>.



Aerial photograph of the reef flat off Kamalo, Moloka'i, showing numerous channels and blue holes (roughly circular, steep-walled depressions) in the reef flat.

Softcover copies of the book can be purchased for \$39.00 at the USGS Store; visit URL <http://store.usgs.gov/>, or call 1-888-ASK-USGS. A limited number of individual softcover copies are available at no charge by e-mailing **Susan Cochran** at scochran@usgs.gov.

For more information about USGS coral reef studies, visit the USGS Pacific Coral Reefs Web site at URL <http://coralreefs.wr.usgs.gov/>. ☼



Lobe coral and finger coral off the south coast of Moloka'i.



Adult 'alo'ilo'i (Hawaiian domino damselfish) cluster around a head of finger coral on the south coast of Moloka'i.



Wide expanse of finger coral off the south coast of Moloka'i.

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