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Sound Waves

Coastal Science and Research News from Across the USGS

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Fieldwork

Satellites Help Scientists Track Migratory Birds: GPS Latest Tool in Fight Against Avian Influenza

By Catherine Puckett and John Takekawa

As a research wildlife biologist at the U.S. Geological Survey (USGS), **John Takekawa** conducts most of his work on coastal and estuarine birds of North America's west coast, but this past summer found him in Asia on the grassland steppe of northeastern Mongolia. There, he and colleagues attached global-positioning-system (GPS) satellite transmitters to wild whooper swans in a study that will shed light on the whooper swans' migratory patterns and help reveal how wild birds may be involved in the spread of avian influenza.

Many of the populations **Takekawa** studies migrate from the coast to breeding grounds in remote inland areas (see "Finding the Needle in a Big Haystack—Locating Surf Scoter Nests in the Northern Boreal Forest" in *Sound Waves*, August 2005, at URL **http://soundwaves.usgs.gov/2005/08/**). Whooper swans breed on shallow lakes and slow-flowing rivers in northern Eurasia and winter on agricultural land near coasts. Their breeding areas are distributed from Iceland to northeastern Siberia, and their wintering areas from Europe to coastal China and Japan. The whooper swans depart from breeding areas in September and reach wintering areas by November, leaving in mid-March for a May return. As much as 60 percent of the global population of more than 100,000 are found in the western Palearctic (Europe, Asia, and northern Africa) during the winter. They feed on aquatic plants and grasses in the breeding season, with added food from crop fields in the winter.

*Release of a whooper swan marked with a GPS transmitter. Photograph by **B. Chun**, National Museum of Korea.*

*Location of site in northeastern Mongolia where 10 whooper swans were captured and outfitted with GPS transmitters in August 2006. Visit URL **http://www.werc.usgs.gov/sattrack/whooperswan/overall.html** for their updated locations.*

In August 2006, a team of international scientists from the USGS and the United Nations Food and Agriculture Organization (FAO) joined the Wildlife Conservation Society (WCS) and the Mongolian Academy of Sciences (MAS) in a whooper-swan surveillance project that is part of the Wild Bird Global Avian Influenza Network for Surveillance (GAINS) program funded by the U.S. Agency for International Development (USAID). The team attached lightweight, solar-powered GPS transmitters to

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Sound Waves

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Deadline: The deadline for news items and publication lists for the March issue of *Sound Waves* is Thursday, January 11.
Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
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Fieldwork, continued

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wild whooper swans in an effort to track the birds to their wintering grounds.

Such research is providing information on migration routes and informs governments about potential threats from such diseases as highly pathogenic avian influenza (HPAI). The HPAI strain known as H5N1 is extremely lethal for various bird species, especially poultry and some waterfowl species. When transmitted to people through close contact with infected birds, the virus can be deadly. Leaders across the world are concerned about a potential pandemic threat should the virus become transmissible among humans.

"We are working to understand the role wild birds may play in the spread of H5N1," said **Scott Newman**, a WCS field veterinarian working as International Wildlife Coordinator for Avian Influenza for the FAO, based in Rome, Italy. "Although poultry and bird trade are probably the primary routes of movement, migratory birds are likely involved in some areas." Recommendations from the FAO-OIE International Scientific Conference on Avian Influenza and Wild Birds in Rome (URL **http://www.fao.org/ag/againfo/subjects/en/health/diseases-cards/conference/index_en.html**) include improving our understanding of wild-bird behavior, precise migratory strategies, sites of aggregation and convergence, and interactions between wildlife and domestic species.

*Marking whooper swans with GPS transmitters. Photograph by **N. Batbayar**, Mongolia Wildlife Science and Conservation Center.*

The whooper swans drew increased attention after large numbers perished in

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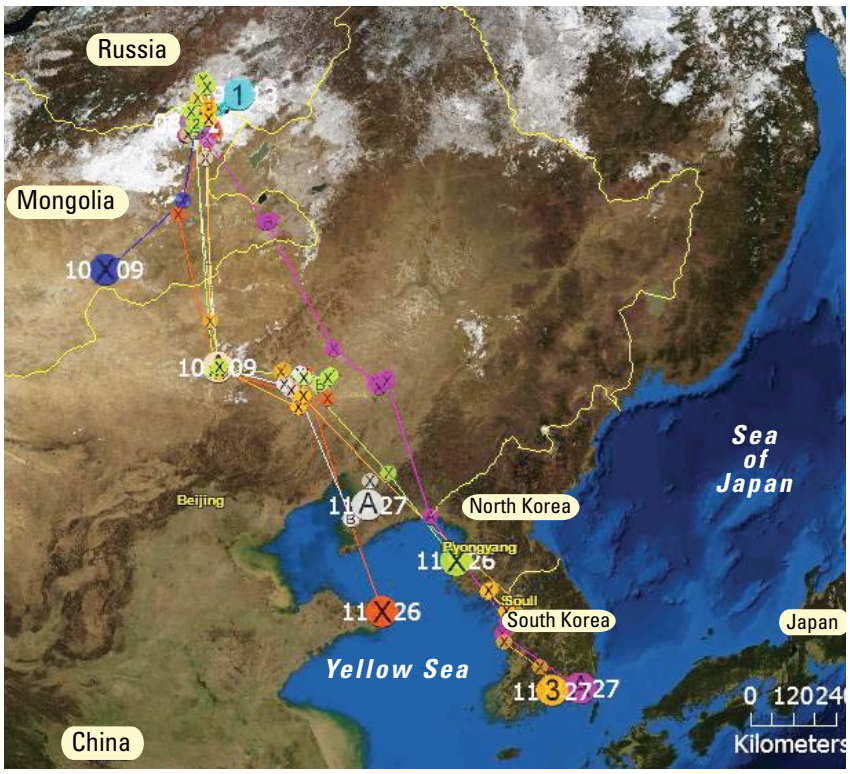

*Satellite image showing movement of marked whooper swans from breeding area in northeastern Mongolia to wintering areas along coast, as of November 29, 2006. Visit URL **http://www.werc.usgs.gov/sattrack/whooperswan/overall.html** for updated locations.*

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Mongolia in 2005 and in western China in 2005 and 2006 in areas where few poultry are present. Subsequent sampling of the dead swans by WCS scientists verified that some of the swans were infected with HPAI. This discovery suggested that HPAI may be moving through the region and may spread from it, prompting the study to identify where these migratory-bird populations fly in the winter.

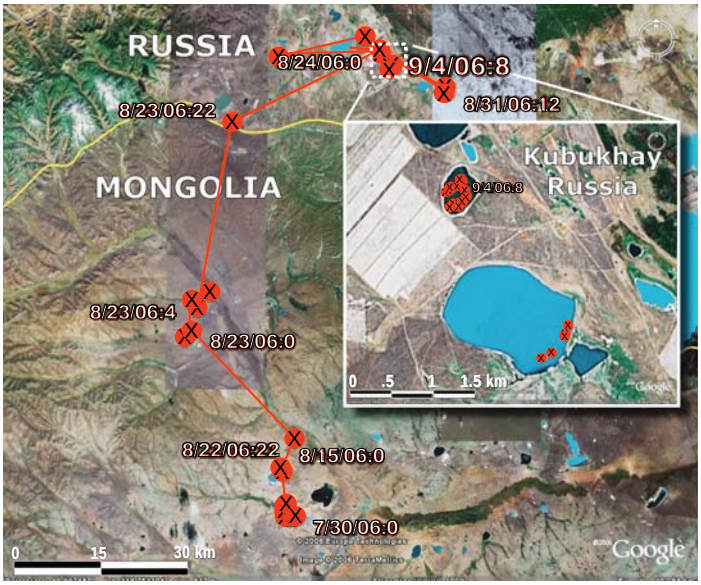
"Although we are sampling wild birds for avian influenza in the field, we will not be able to fully understand their role in this disease unless we better understand their movements," said **William Karesh**, WCS's director of the Field Veterinary Program in New York and coordinator of the GAINS system. "WCS samples birds in East Asia under the GAINS program, but when we find infected birds, we need to know where they are going."

Many migratory-bird species nest thousands of miles from where they spend the winter, and it is difficult to determine which groups come from which areas, said **Takekawa**, whose work as a member of the USGS Western Ecological Research Center in California has included extensive use of radio telemetry to track migratory birds.

*Field camp on a lake in eastern Mongolia, August 2006. Photograph by **N. Batbayar**, Mongolia Wildlife Science and Conservation Center.*

"We are marking swans with very small GPS transmitters that are similar to navigation systems on cars, but that transmit their locations back to us through weather satellites so we can track their movements."

Whooper swans were captured by the international team in early August on the grassland steppe of far eastern Mongolia, near the borders with Russia and China. Each year, swans molt their feathers after the breeding season; during that flightless period, the birds were captured by biologists in boats and on foot. Small, 70-g (2.3 oz, or the weight of a dozen quarters) solar-powered transmitters were affixed on 10 of the 8-kg (18 lb) large swans with backpack harnesses. The harnesses are made of Teflon ribbon that deteriorates and falls off the birds within a few years.



*Satellite-tracking movement path of one whooper swan leaving its breeding area in northeastern Mongolia on August 23 and crossing into southern Russia, where it subsequently occupied several lakes near the small town of Kubukhay (inset). At the Mongolian-Russian border, data indicate that the swan was in flight, traveling about 35 m (115 ft) above the ground at 55 km/hr (34 mi/hr). Image from **D. Douglas**, USGS.*

Takekawa noted that satellite-tracking data will provide information that will not only help scientists better understand and document links between wild birds and the spread of avian influenza but also help enhance conservation efforts through determining the nonbreeding ranges of birds and the mechanisms involved in long-distance migration.

The GPS transmitters are made by a wildlife specialty company (Microwave Telemetry, Inc., of Columbia, Md.); only in the past 5 years have they been reduced to a size suitable for migratory birds. The transmitters' locations, with an accuracy better than 30 ft, provide a wealth of information on migrating birds and use of their habitats that was unavailable before. The locations are recorded every 2 hours and stored in the transmitter's memory before being sent to the research team by e-mail every 2 days through weather satellites.

Whooper-swan locations are being updated twice weekly on a project Web page (URL **http://www.werc.usgs.gov/sattrack/**), which also includes access to the data in Google Earth format. A comprehensive database of information on international wild-bird avian-influenza surveillance and migratory-bird activity is posted on the WCS Web site (URL **http://www.gains.org/**). Biologists **David Douglas** (USGS Alaska Science Center, URL **http://alaska.usgs.gov/science/biology/**) and **Diann Prosser** (USGS Patuxent Wildlife Research Center, URL **http://www.pwrc.usgs.gov/**) are coinvestigators in the study and are providing assistance with analyses and fieldwork.

Effects of Urbanization on Nearshore Ecosystems in Puget Sound: Liberty Bay Pilot Study

By Renee Takesue, Jessie Lacy, Rick Dinicola, Ray Watts, Vivian Queija, Elisa Graffy, Dennis Rondorf, Theresa Liedtke, and Paul Hershberger

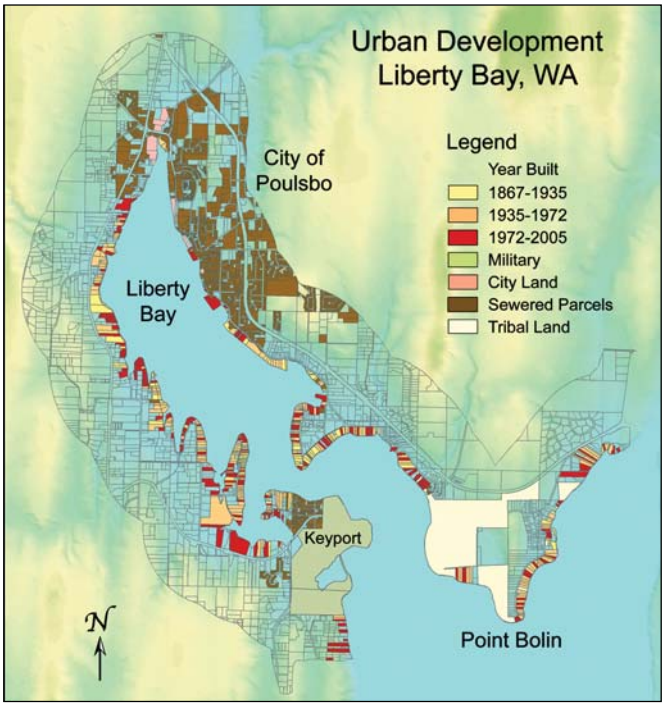
Puget Sound's rich ecosystem, which includes orcas, bald eagles, salmon, and hundreds of other species, directly or indirectly depends on the nearshore region for food, shelter, or reproduction. The processes that sustain the sound's nearshore ecosystem, however, are vulnerable to human activities, such as shoreline development, nutrient and contaminant inputs, boat traffic, and freshwater diversion or impoundment. As a result of urbanization, 33 percent of Puget Sound's shoreline has been altered, and more than 40 species of concern have significantly declined. Urbanization has many effects, such as altering the rate at which precipitation flows from the land into the sound, either as surface or ground water; it also affects water quality. Impervious surfaces, such as roads, roofs, and parking lots; septic systems; lawn fertilizers; and pesticides all contribute to these changes. Further changes are expected because the human population of the Puget Sound region is projected to increase by about 2 million within the next 15 years.

To better understand how urban land use and development affect the nearshore environment, an interdisciplinary team of scientists from the U.S. Geological Survey's (USGS) Multi-Disciplinary Coastal Habitats in Puget Sound Project began exploring the effects of urbanization on the sound's nearshore processes and ecosystems. In 2006, they chose Liberty Bay, a semi-urbanized embayment adjacent to the city of Poulsbo, for a small-scale pilot study. This site was chosen because:

- its nearshore environment is affected by wastewater contamination and shoreline armoring,
- a gradient in urban development extends from Poulsbo (highly developed) to Point Bolin (relatively undeveloped; see map), and
- the bay's nearshore environment is used for spawning by forage fish (small fish that serve as food for sport and commercial fish).

A preliminary look at the data from our 2006 study shows some results that raise further questions and suggest promising and exciting avenues for future research.

Using public records, geographers **Vivian Queija**, **Ray Watts**, and **Elisa Graffy** compiled databases documenting spatial variation in urban attributes that alter natural watershed flows—for example, dwellings, septic systems, and impervious surfaces. They are developing methods to quantify additional attributes from images and other raw data. Early analysis shows that the density of land-ownership parcels along the shoreline correlates negatively with herring spawning; if there is a causal relationship, the specific mechanism is unknown.



Land parcels (gray lines) around the shore of Liberty Bay are narrow and closely spaced, typical of urban development. Three-fourths of the land parcels within 1 km of the shore use septic systems. Distance from Poulsbo to Point Bolin is 6.5 km.

***Jessie Lacy**, **Rick Dinicola**, and **Greg Justin** service a mooring in the center of Liberty Bay. Moored sensors measured temperature, salinity, fluorescence of chlorophyll a, and optical backscatter continuously from mid-April through May 2006.*

Untreated wastewater from leaking septic systems and sewers is an ongoing problem in Liberty Bay, resulting in elevated levels of coliform bacteria and shellfish-harvesting bans. In addition to coliform bacteria, wastewater typically carries excess nutrients, such as nitrogen and phosphorus, that can overstimulate the growth of algae, which, in turn, harms the natural ecosystem in various ways. Because of local wastewater inputs, we expected higher nutrient levels in Liberty Bay than at less developed Point Bolin, our reference site. In fact, water-column nutrient concentrations (measured weekly during April and May in discrete water samples collected 1 m below the surface and 1 m above the bottom) were generally higher at Point Bolin than in Liberty Bay.

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This pattern could reflect greater nutrient uptake in Liberty Bay, since warmer water temperatures measured within the bay may have increased the growth of phytoplankton and their consumption of nutrients, particularly nitrate and silica. To compare how primary productivity varied over time in Liberty Bay and at Point Bolin, the fluorescence of chlorophyll *a* (chl *a*)—a proxy for phytoplankton concentrations—was measured at both sites every 10 minutes 1 m below the surface during April and May. Measurements at both sites showed that three phytoplankton blooms occurred during these 2 months.

Hydrologist **Rick Dinicola** collected water samples for nitrate isotopic analysis to help distinguish wastewater nitrogen from nitrogen derived from other sources. He also collected sediment samples for analysis of such wastewater indicators as pharmaceuticals and personal-care products (PPCPs, a broad array of substances, from prescription medicines to cosmetics and sunscreen). Future work will be done to determine where and how nutrients and PPCPs are delivered by shallow ground water discharging into Liberty Bay.

To track the potential extent of wastewater influence on Liberty Bay's nearshore ecosystem, biologists **Dennis Rondorf** and **Theresa Liedtke** measured stable-nitrogen-isotopic ratios ($\delta^{15}N$ values) in sediment and in organisms throughout the food web. These ratios provide information about the source of the nitrogen—for example, precipitation, fertilizers, and animal waste—and about trophic structures—the who-eats-whom relationships that define the food web. Wastewater input may lead to a stressed or shortened food web; $\delta^{15}N$ values should indicate whether the trophic structures in Liberty Bay, where wastewater input is likely, differ from those at less developed Point Bolin. They might also show whether the marine plants in Liberty Bay use wastewater nitrogen. Mean $\delta^{15}N$ values of two types of macroalgae were significantly higher in Liberty Bay than at Point Bolin, pointing to a possible wastewater influence. In spring 2007, sampling will target age- and size-specific organisms, and additional isotopic tracers will be explored to provide a clearer understanding of the trophic dynamics in Liberty Bay.

***Lisa Gee** (left) and **Ryan Tomka** collect bivalves for stable-nitrogen-isotopic analyses.*

***Mike Hannam** (left) and **Renee Takesue** survey plant and sediment characteristics in a healthy eelgrass bed (*Zostera marina*) at low tide on the east side of Point Bolin.*

To determine whether urban development has led to elevated metal concentrations, geochemist **Renee Takesue** measured total-metal concentrations in bottom sediment. Sedimentary metal concentrations were below the levels of concern set by the State of Washington; however, **Takesue** observed distinct spatial patterns, two of which are clearly associated with human activities. Chromium and nickel contents were elevated ubiquitously throughout Liberty Bay and at Point Bolin, probably as a result of historical inputs associated with activities at the Naval Undersea Warfare Engineering Station at Keyport. Lead and tin contents were elevated near a wrecked automobile abandoned on the beach. If urban runoff has contributed such metals as copper or zinc to Liberty Bay, the levels are low.

To explore whether urban development affects benthic substrate and thus benthic communities, **Takesue** measured sediment-grain-size distributions in the study area. The grain-size data show bottom sediment to be significantly sandier and more consolidated adjacent to the city of Poulsbo than along undeveloped sections of shore. Development along the city's shoreline includes three municipal and private marinas, several docks, a waterfront street, and shoreline armoring; activities associated with building and maintaining these structures may affect the nearby bay floor. Geographers observed that shoreline armoring appears to have no correlation with the probability of herring spawning, possibly because herring spawn on subtidal vegetation or structures farther from shore. Armoring may have its greatest impact on the upper beach. Future work will explore the relationships between shoreline armoring, beach characteristics, and the success of beach-spawning forage fish, such as surf smelt and sand lance.

The Liberty Bay pilot study is off to an excellent start: Team scientists have designed and implemented a fully interdisciplinary research and field plan, despite logistical obstacles. USGS scientists have established collaborative relationships with Washington Department of Fish and Wildlife biologist **Dan Penttila**, with Suquamish Tribe biologist **Paul Dorn**, and with local volunteers of the Liberty Bay Foundation (**Luis Barrantes**, coordinator).

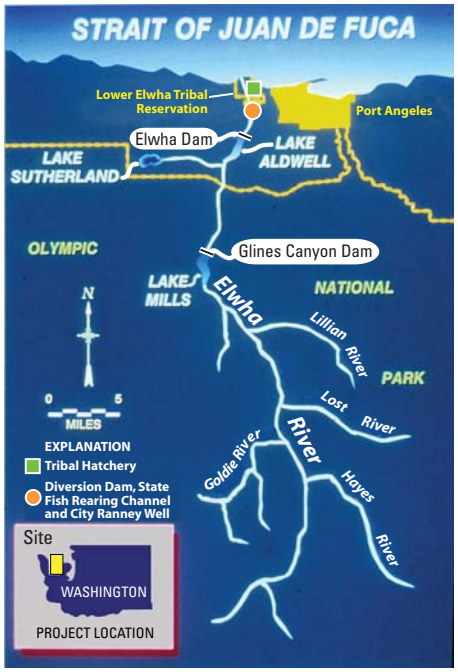
In 2007, team scientists will investigate further some of the intriguing results of the 2006 work and will commence the second phase of the pilot study, focusing on beach and nearshore processes, habitats, and ecosystem impacts associated with armored shorelines.

Studying the Elwha River, Washington, in Preparation for Dam Removal

By Amy Draut

In a few years, the Federal Government will begin the biggest dam removal in U.S. history, restoring a major coastal watershed and its prized salmon river on the Olympic Peninsula, Wash. U.S. Geological Survey (USGS) scientists are already working on the Elwha River Restoration Project, which has been in the works for many years, being planned by organizations that include the National Park Service (NPS), the Bureau of Reclamation, and the Lower Elwha Klallam Tribe. The project will involve removing two large dams on the Elwha River to help restore this stream and the associated coastal zone to a more natural state and to improve ecosystem health (see related article in *Sound Waves*, February 2005, at URL **http://soundwaves.usgs.gov/2005/02/research.html**).

Elwha and Glines Canyon Dams were completed on the Elwha River in 1913 and 1927 at heights of 32 and 64 m, respectively, to provide hydropower for local timber companies. The dams blocked the natural supply of sediment to the lower river and coast, causing changes on the flood plain and erosion of beaches downdrift (east) of the river mouth. Because the dams were built without fish passage, their presence has greatly limited the available spawning run for salmon and steelhead, fish that spend most of their lives in the ocean but return to the stream where they hatched in order to reproduce. These native fish populations have declined severely in the Elwha watershed and around the Pacific Northwest, owing partly to the dam-related loss of their river spawning habitat. At present, salmon and steelhead have only 7.8 km of the river to use as spawning habitat (the distance from the river mouth to Elwha Dam). After dam removal, more than 70 km of the river should eventually become usable habitat for these fish.



*Schematic map of northwestern Washington, showing locations of Elwha and Glines Canyon Dams on the Elwha River. (Modified from map by Bureau of Reclamation, posted at URL **http://www.nps.gov/archive/olym/elwha/diagrams/colormap.htm**.)*

Elwha Dam, the lower of two dams on the Elwha River in northwestern Washington scheduled for removal. Spillway on right side of photograph has eroded substantially, and rounded pieces of concrete from dam are a common component of sediment in recent study's first survey reach downstream of dam.

In 2000, the Federal Government purchased Elwha and Glines Canyon Dams from the timber companies that formerly owned them. It was agreed that because both dams were aging and needed costly repairs, a better alternative to repairing them would be to remove them and thereby restore the river habitat. Dam removal will take place in stages over 2 years and is scheduled to begin in 2009. This will be the first watershed-restoration project in which dams this large will be removed, and so it presents a unique opportunity to study how a river and coastal system respond to the changes that will follow dam removal, especially the reintroduction of sediment as the river erodes much of the sediment now trapped in the two reservoirs. More than 80 percent of the Elwha watershed lies within the boundary of Olympic National Park and has never been developed. It is hoped that dam removal will improve not only the native fish populations but also the general condition of the ecosystem in this largely pristine area.

Scientists from the USGS Western Coastal and Marine Geology (WCMG) team are part of a large, interdisciplinary group of researchers studying the Elwha watershed as agencies gear up for dam removal. In September 2006, **Amy Draut**, **Tom Reiss**, and **Josh Logan** conducted the first of numerous planned USGS surveys of the river channel. They documented channel topography and sediment grain size in three study areas between Elwha Dam and the river mouth. They also surveyed part of the river channel upstream of both dams, at a site in Olympic National Park, to use as a "control" area to monitor changes in channel form and sediment unrelated to the dams or dam removal. These four sites will be revisited twice a year, in spring and fall, to document the magni-

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tude of changes that occur seasonally in the dammed system. After dam removal begins, the scientists will continue to monitor these areas to evaluate how the river and intertidal zone change when the reservoir sediment begins to move downstream.

In addition to the research in the river channel and intertidal zone, WCMG scientists **Guy Gelfenbaum**, **Guy Cochrane**, **Jon Warrick**, and **Dave Rubin** are leading mapping and oceanographic profiling in the nearshore zone and farther offshore along the coast. USGS specialists in biology, hydrology, and geography are also conducting studies related to dam removal. USGS scientists are working closely with the Lower Elwha Klallam Tribe, the National Oceanic and Atmospheric Administration (NOAA), and the NPS to learn as much as they can from this first-of-its-kind comprehensive watershed-restoration experiment.

For more information, visit URLs **http://www.nps.gov/archive/olym/elwha/home.htm** and **http://www.elwha.org/River%20Restoration.htm** or contact **Amy Draut** at **adraut@usgs.gov** or 831-427-4733.

◄ ***Josh Logan*** *surveying part of Elwha River channel, in the intertidal zone.*

Tom Reiss *surveying a section of the lower Elwha River and coastal zone.* ►

Massachusetts Sea-Floor Mapping Project Expands to South Shore and Cape Cod Bay

By Walter Barnhardt and Seth Ackerman

Since its beginning in 2003, the cooperative sea-floor-mapping project in Massachusetts has mapped the geology of 897 km^2 (346 mi^2) of the coastal ocean, mostly inside the 3-mi limit of State waters. The project, jointly undertaken by the U.S. Geological Survey (USGS) and the Massachusetts Office of Coastal Zone Management, has expanded to cover new areas this year and brought in several new partners. We recently welcomed **Kathryn Ford** of the Massachusetts Division of Marine Fisheries to the USGS Woods Hole Science Center, where she now spends part of every week integrating geologic-framework information from this project into her studies of marine habitat. In addition, **Duncan FitzGerald** and **Christopher Hein** of Boston University are contributing their expertise toward understanding and modeling the processes that control the mapped distribution of sediment on the inner shelf.

The initial phase of mapping (2003-05) was focused on areas extending northward from Boston Harbor to the New Hampshire-Massachusetts State line (see article in *Sound Waves*, December 2005-January 2006, at URL **http://soundwaves.usgs.gov/2006/01/fieldwork5.html**). Water depths were mostly in the 5- to 40-m range but locally included areas as much as 90 m deep. Various geophysical techniques were used to map the inner shelf, including interferometric and multibeam sonars (to map bathymetry), sidescan sonar (to map substrate type), and compressed-high-intensity-radar-pulse (CHIRP) seismic-reflection profiling (to map sediment thickness and structure). Data from multibeam and sidescan sonars were also provided by the National Oceanic and Atmospheric Administration (NOAA) to augment USGS efforts in Boston Harbor. Sediment sampling and bottom photography were used to

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validate or "ground truth" the remotely sensed geophysical data. Results of the first phases of this project are available in two USGS Open-File Reports:

- *High-Resolution Geologic Mapping of the Inner Continental Shelf: Nahant to Gloucester, Massachusetts* (USGS Open-File Report 2005-1293), at URL **http://woodshole.er.usgs.gov/pubs/of2005-1293/**
- *High-Resolution Geologic Mapping of the Inner Continental Shelf: Boston Harbor and Approaches, Massachusetts* (USGS Open-File Report OFR 2006-1008), at URL **http://woodshole.er.usgs.gov/pubs/of2006-1008/**

The latest phase of mapping began in August 2006 with a 3-week research cruise aboard the *Megan T. Miller*. The 100-ft vessel was outfitted with geophysical systems and two mobile laboratories that allowed for data acquisition and onboard processing in near-real time. The survey focused on shallow-water (less than 50 m deep), nearshore areas along the South Shore coast from Hull to Duxbury, where we collected more than 2,300 km of trackline geophysical data covering an area of 270 km^2. The scientific crew included **Bill Danforth**, **Emile Bergeron**, **Walter Barnhardt**, **Wayne Baldwin**, **Maianna Hanshaw**, and **Elizabeth Pendleton** on the first leg (Aug. 1-13) and **Dave Foster**, **Chuck Worley**, **Tom O'Brien**, **Seth Ackerman**, **Emily Himmelstoss**, and **Sandy Baldwin** on the second leg (Aug. 13-23). The weather was kind to us, but once again, the success of the cruise depended on the "A-team" of technicians from the USGS Marine Operations Facility. From the first day until the last, they overcame a seemingly endless series of failed air conditioners, global-positioning-system (GPS) navigation shutdowns, unplanned losses of power, broken sonar side-mounts, and an ocean full of gear-snagging lobster pots. Next year, three cruises are planned

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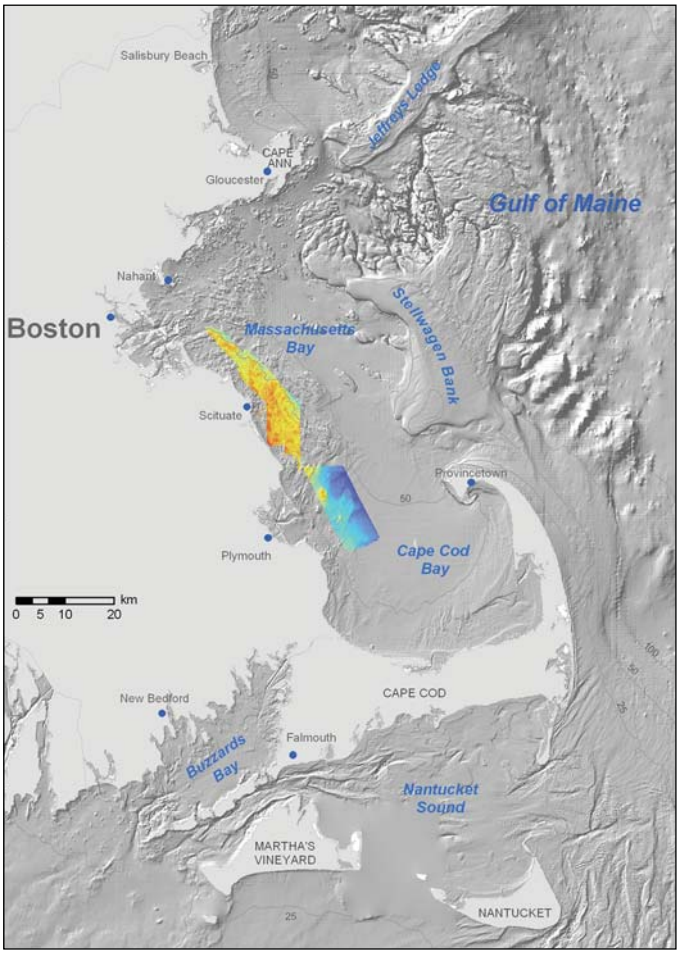
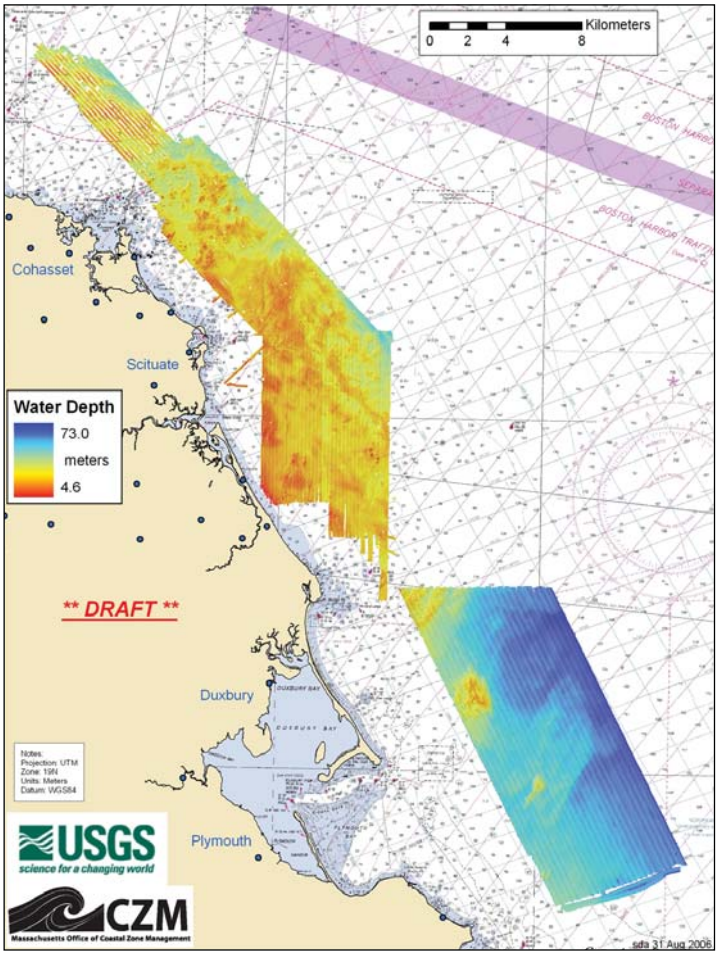


Eastern Massachusetts, showing area mapped in 2006 (colored polygons near shore between Boston and Cape Cod Bay). Flat-gray areas, land; sea floor in survey area is color coded for depth, ranging from red (shallow) to dark blue (deep).



Shaded-relief bathymetric map of Massachusetts coast, showing extent of August 2006 offshore survey. Additional surveys in 2007 will complete mapping of shallow-water areas along the coast and farther south in Cape Cod Bay.

(Massachusetts Mapping continued from page 8)

as the project expands southward into Cape Cod Bay to complete the geophysical mapping and acquire bottom samples and cores. Ultimately, the maps and data layers generated by this project will provide a physical framework for marine scientific research and resource management in the Massachusetts coastal zone.

Published reports, preliminary maps, and project updates are posted on the Woods Hole Science Center project Web site at URL **http://woodshole.er.usgs.gov/project-pages/coastal_mass/**.

*USGS crew members **Tom O'Brien** (left), **Dave Foster**, and **Emily Himmelstoss** launch a CHIRP subbottom profiler with pontoon floats from the* Megan T. Miller. *Photograph by **Sandy Baldwin**.*

USGS Welcomes Students for Earth Science Week Celebration in Menlo Park, California

By Helen Gibbons

Where could students get a bumpy ride in an "earthquake chair," crack open a geode, compare the eruptions of Mount St. Helens and Kilauea, look at anaerobic microbes living inside termite guts, get their own pieces of basalt dredged from the deep-sea floor, learn how to read a map, and much more? At the U.S. Geological Survey (USGS) center in Menlo Park, Calif., on Friday, October 13, 2006, in a 1-day celebration of Earth Science Week.

***Mary McGann** shows students a small grab sampler (behind core sample) used to collect sediment from the sea floor. Photograph by **Florence Wong**.*

Approximately 1,350 students from more than 20 local schools swarmed over the campus from 9:30 a.m. to 2:30 p.m., enjoying interactive, hands-on exhibits and activities designed to stimulate interest in Earth science. The mild day was ideal for outdoor as well as indoor exhibits, which were set up at approximately 25 stations around campus. The visiting students ranged from 1st through 8th graders, and there was something to please kids at every level. Offerings by Western Coastal and Marine Geology (WCMG) team members included:

- "Mid-ocean Ridge Explorations," in which **Carol Reiss** and **Ginger Barth** gave a quick lesson in plate tectonics and showed the students samples of weird animals (tube worms) and mineral chimneys collected at hot springs on mid-ocean ridges.
- "San Francisco Bay Floor," in which **Florence Wong**, **John Chin**, and **Don Woodrow** took students on virtual "flights" over sea-floor terrain inside and outside the Golden Gate and invited them to examine mud and silt cored from beneath the bay floor.
- "Our Micro-World," in which **Mary McGann** described tiny animals that live in sediment on the sea floor, let students handle a small grab sampler

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(used to collect sea-floor sediment) and sieves (used to separate sediment grains of different sizes), and helped them look at tiny marine creatures through microscopes.

- "Submarine Landslides Can Cause Destructive Tsunamis," in which **Lori Hibbeler** let students trigger "tsunamis" by sliding a brick into a tub of water—one of the many popular exhibits reprised from last spring's campuswide Open House (see URL **http://soundwaves.usgs.gov/2006/07/outreach.html**).
- "Rock Giveaway," at which **Peter Triezenberg** and **Ray Sliter** gave away pieces of basalt dredged from 2,000-m water depth on the Juan de Fuca Ridge off Washington and Oregon. **Carol Reiss** organized this activity, with the help of **Alex Ma** and **Peter**, who helped break the rocks into giveaway-size pieces, and **Carolyn Degnan**, who provided photographs and posters for a backdrop.

WCMG team members also helped behind the scenes to make the event run smoothly: **Carol Reiss** served on the planning committee; **Carolyn Degnan** and **Helen Gibbons** helped direct traffic; and **Helen**, **Florence Wong**, and **Greg Gabel** put up numerous signs to guide visitors to displays.

Earth Science Week is an annual event, celebrated this year from October 8 to 14, 2006, with the theme "Be a Citizen Scientist!" As noted on the event's Web site (URL **http://www.earthsciweek.org/**), citizen scientists are "real people collecting data, observing, and testing…. A citizen scientist is YOU involved in real science and research!" The numerous hands-on activities at the USGS Menlo Park celebration encouraged just such involvement.

Teachers and parent chaperones expressed delight with the day's offer-

(Earth Science Week continued on page 11)

***Ray Sliter** is ready to give away samples of basalt from the Juan de Fuca sea-floor spreading ridge (below) and soon finds himself surrounded by eager students (left). Photographs by **Florence Wong**.*

***Andrea Foster** shows a student colonies of microorganisms living in San Francisco Bay mud, most of them in layers that lack oxygen. These animals—and bacteria living in termite guts, also on display at this popular exhibit—opened students' minds to microbes living in harsh environments, such as hypersaline lakes, underground oil deposits, deep-sea hydrothermal vents—maybe even other planets. Photograph by **Lewis Mendez**.*

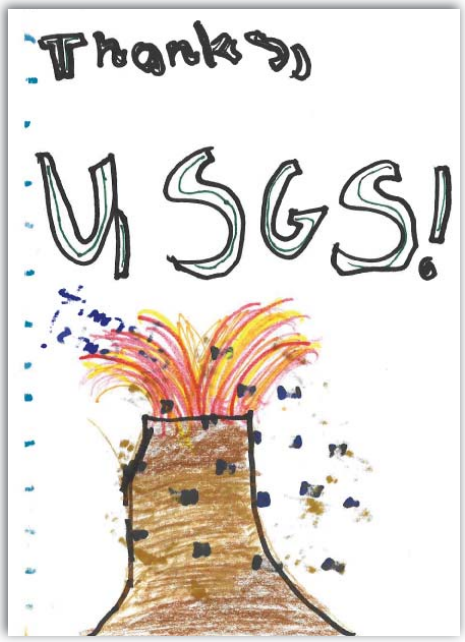
***Don Woodrow** explains what scientists can learn from mud and silt cored from beneath the floor of San Francisco Bay. Photograph by **Florence Wong**.*

(Earth Science Week continued from page 10)

ings, and the children's enjoyment was obvious. In thank-you letters received by event organizer **Christy Ryan**, one teacher wrote: "I thought the exhibits were extremely well done, the presenters obviously excited about their work, and terrific with the children…." Another wrote: "Our students commented that this was the best field trip they had ever gone on. We are a school with a huge English as a Second Language population, and these kids just don't have the background knowledge or experience of most kids. Earth Science Day brought education to a higher level for them." A satisfied student wrote: "I loved going to USGS! It was an amazing experience.… Maybe someday I'll work at USGS."

The USGS in Menlo Park was only one venue in the nationwide celebration of Earth Science Week. Earth scientists at universities, government agencies, and businesses nationwide opened their doors to visitors, visited classrooms, and hosted field trips. Earth Science Week was established in 1998 by the American Geological Institute (AGI) to give students and citizens new opportunities to discover the Earth sciences and to encourage stewardship of the Earth. It highlights the important contributions that Earth and environmental sciences make to society, and invites the public to become engaged in current scientific exploration. More information about USGS Earth Science Week activities, including links to suggestions for how the public can learn about and get involved in science, is posted at URL **http://www.usgs.gov/earthscience/**.

***Carol Reiss** (above) briefs students on sea-floor spreading and plate tectonics. Photograph by **Florence Wong**.*



Thank-you note from a satisfied customer.

*Students are eager to answer a question posed by **Lori Hibbeler** at her display on how "Submarine Landslides Can Cause Destructive Tsunamis." Photograph by **Lewis Mendez**.*

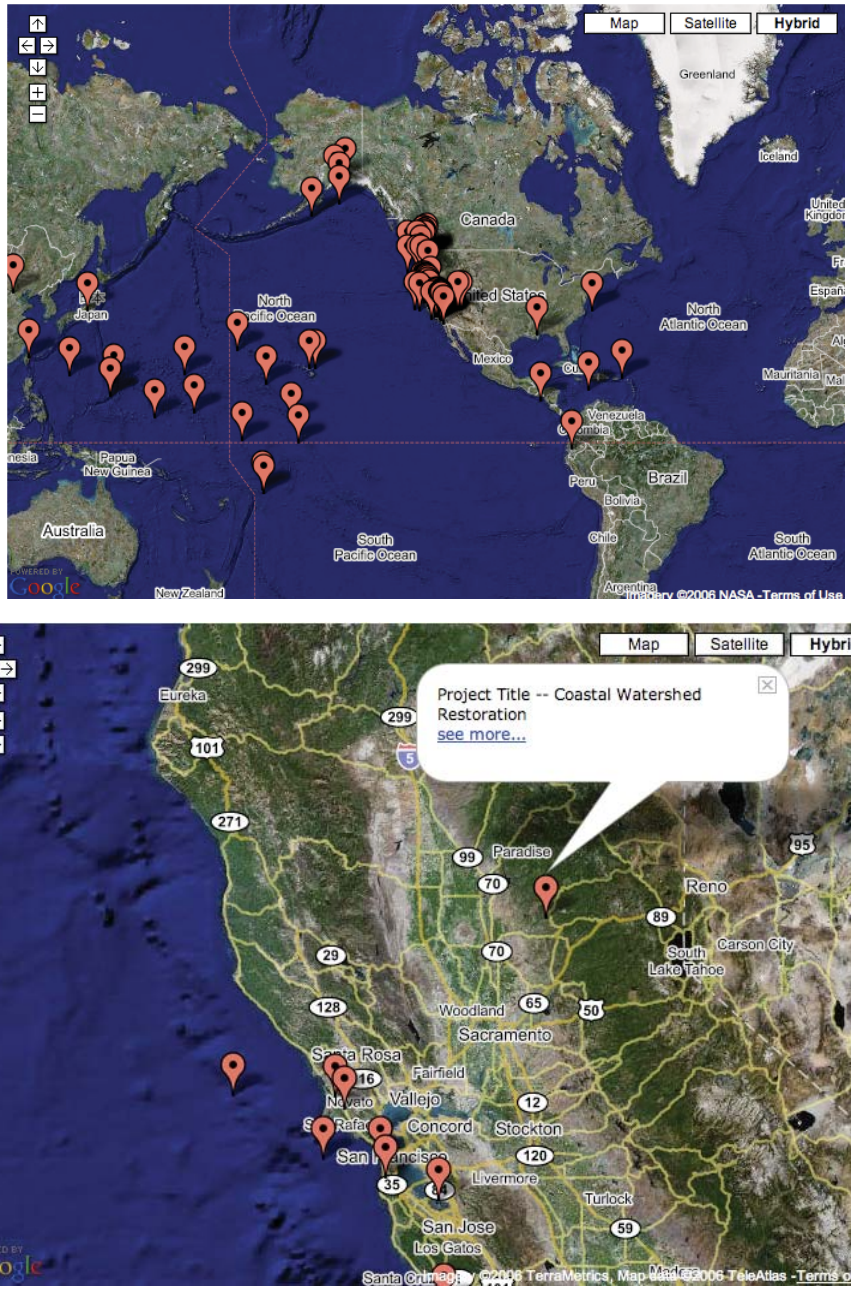
Google Maps View of Western Coastal and Marine Geology Projects

By Laura Zink Torresan

The U.S. Geological Survey (USGS)'s Western Coastal and Marine Geology (WCMG) team announces a new portal to its current projects, using a Google Maps interface. WCMG contractor **Alex Ma** programmed the initial Google Maps layout and interface with a few examples. WCMG Webmistress **Laura Zink Torresan** added all the locations across the globe.

Now visitors to the WCMG Web site can browse the globe to find just where the WCMG team is currently conducting research. All the standard Google Maps features are available, such as panning and zooming, and turning different map views on and off.

Please visit the WCMG Google Maps Project Interface at URL **http://walrus.wr.usgs.gov/research/projects/**.



Balloons on these Google Maps (world, above right, and closeup of northern California, right) show where Western Coastal and Marine Geology team members are conducting studies, and serve as links to Web pages about those studies.

USGS Florida Integrated Science Center in St. Petersburg Hosts Public for Community Forum on Red Tide

By Kate Bradshaw

The past several years have seen persistent outbreaks of harmful algal blooms along Florida's west coast. Related fish kills and respiratory ailments affect tourism along the beaches, creating public concern regarding the cause of these events. The Red Tide Forum, a scientific workshop held July 17-July 20, 2006, was designed to bring together scientists from across a wide array of disciplines to discuss the future research needs surrounding blooms of the dinoflagellate species *Karenia brevis* in the Gulf of Mexico. The workshop—sponsored by the National

(Red Tide Forum continued on page 13)

(Red Tide Forum continued from page 12)

Oceanic and Atmospheric Administration (NOAA), Mote Marine Laboratory, and the Florida Fish and Wildlife Commission's Fish and Wildlife Research Institute (FWRI)—convened nearly 70 scientists hailing from many different organizations, including NOAA, FWRI, the University of South Florida, the Woods Hole Oceanographic Institution (WHOI), the University of North Carolina, Wilmington (UNCW), and Mote Marine Laboratory.

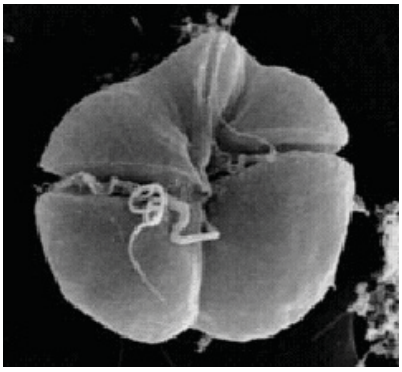
Because of intense public interest, a public forum was held on the evening of July 20, 2006, immediately after the Red Tide Forum. Scientists from the workshop spoke with the public and addressed questions from audience members. Mote Marine Laboratory in Sarasota, Fla., hosted the public forum, setting up links with two satellite locations so that citizens throughout west-central Florida could participate and interact with the panel of researchers. The first satellite location was at the U.S. Geological Survey (USGS)'s Florida Integrated Science Center office in St. Petersburg, an important Federal partner in a vibrant community of marine-science research institutions concentrated in the city's downtown; and the second was at Florida Gulf Coast University in Fort Myers.

"The goal was to get as many involved as we could," said **Nadine Slimak**, public information officer at Mote. "The public has a lot of questions," she added. The algae that cause red tide, *Karenia brevis*, are responsible for widespread fish kills, respiratory distress in humans, and neurotoxic shellfish poisoning, which can harm those who consume shellfish. In 2005 alone, 89 manatee deaths were attributed to red tide. "This [forum] is an opportunity for researchers to identify where the research questions lie," **Slimak** said.

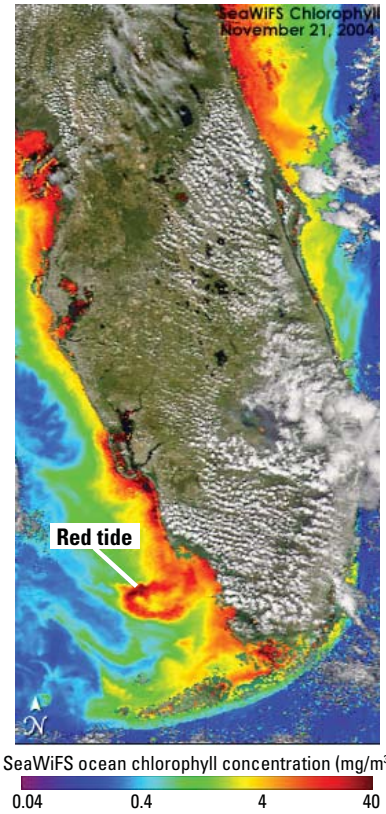
Technology at Mote Marine Laboratory and the two satellite locations enabled all those in attendance to see PowerPoint presentations and to be seen and heard by the panelist researchers. **Don Anderson** of WHOI opened the public forum with an overview of key facts about red tide and its impacts and a summary of results from the scientific workshop. He pointed out that although scientists know a great deal about red tide—they have a clear picture of what red tide is, research and technology have allowed mapping and prediction of red-tide blooms, and detailed data have been compiled regarding how red tide can adversely affect marine and terrestrial life—scientists have yet to pinpoint the direct cause of red tide or develop a sound means of mitigation. "We don't have the critical knowledge at this point to understand how red tide blooms," said panelist and Smithsonian Environmental Research Center researcher **Mario Sengco**.

The USGS office in St. Petersburg hosted 21 audience members—citizens of all ages seeking answers about red tide. "We're very concerned," said **Andrea Antaya**, who moved to the west coast of Florida from Cape Cod, Mass. She regards seafood and sailing as essential parts of life that are threatened by harmful red-tide blooms. **Antaya** recalled her first experience with a red-tide bloom in Florida; she was on the beach and had a "terribly allergic reaction," but the "doctors didn't have an answer." **Antaya** wanted to know if red-tide blooms are triggered by human activity. Forum participants asked questions that ranged in subject matter from protecting manatees to the downside of certain mitigation techniques currently being studied, such as clay flocculation (in which tiny particles of clay are sprayed onto the water: the clay sticks to the algal cells, and the resulting clumps sink to the bottom; see URL **http://www.serc.si.edu/labs/protistan_ecology/flocculation.jsp**). Many who asked questions were residents of beach communities seeking a definitive answer as to whether or not pollution is the direct cause of a perceived increase in red-tide blooms, and what can be done about it.

For more information about the Red Tide Forum, please visit URL **http://www.mote.org/index.php?src=gendocs&refno=509&category=Main&search=red%20tide%20workshop**. (This link can also be found by entering the keywords "red tide forum, mote" into an Internet search engine.)❁



A scanning electron microscope view of Karenia brevis*, the alga that causes red tide. Image from NOAA (URL* ***http://www.oceanservice.noaa.gov/topics/coasts/hab/welcome.htm****).*



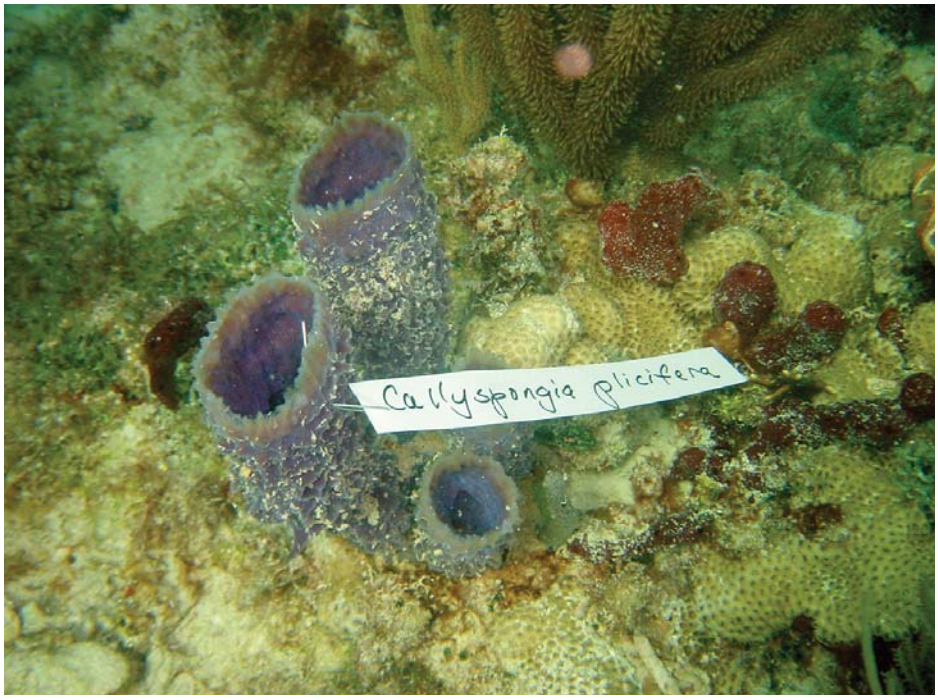
Satellite image of the Gulf of Mexico off southwestern Florida on November 21, 2004, reveals a red tide: the oval-shaped red area to the west of the shore. Highest chlorophyll concentrations (indicating highest concentrations of algae and other ocean plants) are red; lower chlorophyll concentrations are green and blue. Image from the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) flying on the OrbView-2 satellite; courtesy of NASA Earth Observatory (URL ***http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=16754****).*

USGS Researcher Participates in First Benthic Sponge Taxonomy Course at Mote Marine Laboratory

By Christina Kellogg

I went to this course knowing one thing about marine sponges: they are bacterial apartment buildings. As a U.S. Geological Survey (USGS) microbiologist who studies bacteria associated with corals, I have seen plenty of shallow-water and deep-sea sponges and have considered researching sponges' microbial biodiversity. Before beginning such a study, however, I thought it would be helpful to be able to identify and describe the sponge of interest: "the red squishy one" doesn't exactly pass muster in a journal article!

The course "Benthic Workshop: Marine Sponges" took place August 12-20, 2006, at Mote Marine Laboratory's Tropical Research Laboratory in the Florida Keys (URL **http://isurus.mote.org/Keys/**). Taking this course was a lot like experiencing immersion in a foreign language. At first, the sponges all looked alike, and their names were Greek to me (well, OK, Latin). But by the end of the week, I was able to identify more than 30 common Florida and Caribbean sponges by name just by looking at them. I also learned enough to key out an unfamiliar sponge to at least the family, if not genus, level.



*An underwater classroom: sponges were temporarily tagged to help students learn their scientific names. Photograph by **Chantal Collier**, Florida Department of Environmental Protection.*

***Chris Kellogg** (USGS) and instructor **Shirley Pomponi** (Harbor Branch Oceanographic Institution) examine a deep-sea sponge at Mote Marine Laboratory's Tropical Research Laboratory. Photograph by **Amanda Weinkauf**, Delta-Seven, Inc.*

The well-organized and practical field and laboratory exercises made a steep learning curve possible to surmount.

The course was taught by **Shirley Pomponi**, president and chief executive officer (CEO) of Harbor Branch Oceanographic Institution (URL **http://www.hboi.edu/**) and an internationally recognized sponge expert. Participants included representatives from Federal and Florida State government organizations, private consulting companies, and academic institutions.

The course included lectures on sponge ecology and chemical ecology (why sponges make interesting chemicals) from Colombian scientist **Andia Chaves-Fonnegra**. Field studies included looking at sponges in three different habitats: reef, mangrove roots, and seagrass flats/hard bottom. The key element was that **Shirley** and **Andia** temporarily labeled the sponges with waterproof tags listing their scientific names. The labels were a huge help, both for creating photographic records and for training our eyes to recognize common species. Back on land, the instructors let us examine some representative samples of deep-sea sponges that had been collected by submersible.

In addition to the field studies, there was also a laboratory component to the course. Because sponges can occur in many different shapes, it is often necessary to look at their skeletal and cellular makeup under the microscope in order to identify them correctly. In the laboratory, we learned how to prepare samples in order to see spicules (distinctive calcite or silica structures that make up sponge skeletons) or fibers that can be diagnostic of particular sponge taxa. We also practiced preparing thin sections of sponge tissue to look at the arrangement of fibers and spicules together. Other experiments included isolating bacteria from sponges and testing for bioactive compounds (antibiotic effect on *Escherichia coli*) in sponge extracts.

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(Sponge Course continued from page 14)

The culmination of the course was setting up a Microsoft Access database of common Florida and Caribbean sponge species, with entries based on both macroscopic features (such as shape and color) and microscopic features (such as large and small types of spicules). Because we entered information about the sponges as searchable records, we can use the database as a future resource—if we observe, say, a red branching sponge, we can enter that information and see what the choices are for that color and morphology, and then narrow our identification by looking at the spicules under the microscope. The database is a work in progress that will be added to by this and future classes of the course on benthic sponge taxonomy.

*Participants in Mote Marine Laboratory's first course on benthic sponge taxonomy. Instructors **Shirley Pomponi** and **Andia Chaves-Fonnegra** are in front row, 5th and 6th from left, respectively; author **Chris Kellogg** is between them in back row. Photograph by **Dennis Lavrov**, Iowa State University.*

Students learned to look closely at details of sponge architecture—for example, these chimney-like openings through which the orange sponge Tedania ignis *expels water. Photograph by **Amanda Weinkauf**, Delta-Seven, Inc.*

USGS Team Receives Service to America Medal

By Gaye Farris

A team of U.S. Geological Survey (USGS) scientists has received a 2006 Service to America Medal for their search-and-rescue work in the aftermath of Hurricane Katrina.

The scientists, led by **Thomas Casadevall**, USGS regional director in Denver, Colo., are from the USGS National Wetlands Research Center in Lafayette, La., and the USGS Louisiana Water Science Center in Baton Rouge, La.

Casadevall and representatives of the team received the medal in Washington, D.C., on September 27, in recognition of both their humanitarian and their scientific work immediately after Hurricane Katrina hit the Louisiana coast on Aug. 29, 2005.

Among team representatives at the awards ceremony were **Gregory J. Smith**, director of the National Wetlands Research Center; **Charles Demas**, director of the Louisiana Water Science Center; **James B. Johnston**, Spatial Analysis Branch Chief at the National Wetlands Research Center; and **Wayne Norling**, safety officer at the National Wetlands Research Center.

Also attending as a guest at the event was USGS employee **Debbie Norling**, who spearheaded the National Wetlands Research Center's donations of food, water, clothing, and blood and coordinated evacuee-shelter volunteers in Lafayette. (See related article, "Debbie Norling Honored with Excellence Award," in *Sound Waves*, Oct. 2006, at URL **http://soundwaves.usgs.gov/2006/10/awards.html**.)

The team is one of eight recipients of Service to America Medals, sponsored by the Atlantic Media Co. and the nonprofit, nonpartisan Partnership for Public Service to recognize the accomplishments of

(Service to America continued on page 16)

(Service to America continued from page 15)

America's public servants. Medals are given for significant contributions by Federal employees, based on their commitment and innovation as well as the impact of their work on addressing the needs of the Nation. Though not trained in search and rescue, 25 USGS employees put to use their knowledge of boats and flood waters acquired during research when they answered a call for help from the State of Louisiana. They joined a multiagency State and Federal team in navigating the flooded streets of New Orleans and rescuing stranded citizens from rooftops and porches. The group directly rescued approximately 600 people and provided food, water, and other assistance to about 2,000 more, from August 31 to September 5.

The group had the immediate support of **Casadevall**, who was the first U.S. Department of the Interior senior executive to reach Louisiana after the storm. He was aware of the importance of senior-leadership support during a crisis because he himself began his career in 1980 with another natural disaster, the eruption of Mount St. Helens volcano.

Not only did USGS scientists perform boat rescues, but they also used their spatial-technology skills to help locate more than 8,000 callers to 911 from August 30 to September 27, when flooded streets and responders unfamiliar with the New Orleans area made locating some victims impossible by normal means. The USGS team was able to convert street addresses to latitude and longitude and produce maps for boat and helicopter rescuers with Global Positioning System (GPS) equipment. For those without GPS access, scientists provided maps with geographic coordinates overlaid on street grids. More than 600 maps and other information products were produced daily.

In addition to the immediate "geo-addressing" of 911 calls, the USGS produced maps and data for the Federal Emergency Management Agency (FEMA)'s Urban Search and Rescue Incident Support Team. To do this, the USGS team worked in shifts 24 hours a day, from 3 days after the storm hit until the end of October. They produced detailed street maps for ground searches that included such information as search intensities, open roads, boat-access points, and 911 call data.

The USGS team also supplied the U.S. Army Corps of Engineers with maps of the city's levee system and pumping stations. At the Corps' request, the USGS team installed temporary real-time water-level gauges in Orleans, Plaquemines, and St. Bernard Parishes, as well as Lake Pontchartrain, to measure dewatering of the metropolitan New Orleans area.

The spatial-analysis team helped 15 other government teams in mapping work, including the Louisiana Governor's Office of Emergency Preparedness, the U.S. Fish and Wildlife Service, the Louisiana Department of Wildlife and Fisheries, the Louisiana Geological Survey, the Louisiana State Police, and the U.S. Department of Agriculture.

The USGS team has previously received recognition for its efforts from the Department of the Interior, the Louisiana House of Representatives, FEMA, and ESRI (formerly known as the Environmental Systems Research Institute).

Another USGS employee, **Emily H. Majcher**, a hydrologist at the Maryland-Delaware- D.C. Water Science Center, was a finalist for the Service to America Medal for her work in developing new technology to treat contaminated wetlands without disturbing the surrounding ecosystem.

Department of the Interior senior advisor **Robert J. Lamb** was a finalist for his work in pioneering new conservation strategies built on cooperation among government citizens, environmental groups, and the private sector. Finalists were honored in June in Washington, D.C.

To learn more about the Service to America medals, visit URL **http://www2.govexec.com/SAM/**.

Representing the USGS at the Service to America Medal award ceremony on September 27, 2006, in Washington, D.C., were: front row, from left, ***Charles R. Demas, P. Patrick Leahy, Thomas J. Casadevall, James B. Johnston, George J. Arcement, Garron B. Ross,*** *and* ***Benton D. McGee;*** *back row, from left,* ***Gaye S. Farris, Craig Conzelmann, Gregory J. Smith, Deborah A. Norling, Wayne Norling, William R. Jones,*** *and* ***Robert E. Doyle****.*

In Memoriam: Terry Bruns, 1946-2006

By Mike Fisher

U.S. Geological Survey (USGS) marine scientist **Terry R. Bruns** died unexpectedly on September 24, 2006. **Terry's** research and management efforts on behalf of the Western Coastal and Marine Geology team span more than 30 years. He is perhaps best remembered for his affable smile and embracing, upbeat personality. He was ever eager to assist others, and he brought these traits to bear during some of the team's most trying periods. Characteristically, his duties were conducted with a steady hand at the helm.

Terry Bruns partook of the golden years of marine-geologic research in the USGS—the 1970s and 1980s—when the farthest flung corners of the Pacific Ocean were within our purview and science was all that we were about. What a wild ride it was back then, he often mused. **Terry** was brought aboard in response to the energy crunch of the 1970s, and he began his research career by evaluating the geology and petroleum potential of the Gulf of Alaska. Through repeated marine surveys, he found that, indeed, the seas there are dismayingly high and rough, but the oil potential is low. **Terry** also made early contributions to our understanding of the geology and petroleum potential of the Arctic National Wildlife Refuge, now a focus in the heated national controversy over energy production versus wilderness preservation. Aboard the Ocean Drilling Program's research vessel *Resolution*, **Terry** helped drill into the Fiji Basin and the Tonga island arc. These are a few highlights of a long research career that also included studies in California and the Pacific Northwest.

***Terry Bruns**, 1946-2006*

Terry served the team for 9 years (1996-2005) as Associate Team Chief Scientist, deftly handling such tasks as guiding the team's numerous office moves, crafting long-term space plans for the Santa Cruz office, and coordinating marine operations with the needs of scientists. As noted in one of his many award citations, **Terry** was "our rock" during his tenure, "providing continuity, wise guidance, occasional scolding, a willing ear, a noble spirit of camaraderie and selflessness, and behind-the-scenes...mastery to hold us together."

On October 3, 2006, at Zott's, a local beer garden, about 80 of **Terry's** friends and colleagues gathered in fond eulogy. Seemingly just for this occasion, a weeklong spell of somber, dismal weather moderated to dappled sunlight. More than a dozen speakers remembered **Terry's** impact on their lives. Most spoke warmly of his humanity and concern for others. A few noted his occasional fits of temper at obdurate bureaucracy. Some noted his love of book collecting and printing and his passion for the outdoors. His sudden, untimely death defies understanding, but his many friends will remember him with great fondness.

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*Excerpts from tributes to **Terry** (which will be posted, with additional memories and photographs, at URL **http://walrus.wr.usgs.gov/staff/tbruns/**):*

"My teacher-mother used to explain to particularly disruptive kids that they could start right now being people who others are glad to see enter a room, or glad to see exit the room. In this life we can strive to be great geologists or whatever, but overall, are people generally glad to see us or not? We were always delighted to see **Terry** come in. We loved his e-mails, we loved his e-mailed corrections. We enjoyed wide-ranging conversations with him...from exercise to elderly parent care to Alaskan geology to coaching kids to collecting old books. We loved his sense of humor, and now feel the loss of a good and kind man from this world…."

—Chris Gutmacher & Andy Stevenson

"**Terry's** demise leaves a big hole in [the Western Coastal and Marine Geology Team], right in the heart. I will remember him as our Team mom. Always available, always caring—ready to provide perspective and the silver lining for any dark cloud. I truly believe he cared more about his colleagues and their personal welfare than anyone else I've known in the USGS. It is hard to say good-bye to such a friend—just don't feel like letting go."

—Sam Johnson

"I worked in the library for many years and whenever **Terry** came into the library he was always friendly and kind to everyone. I know that he was also very giving of his time. He participated in outreach in the schools and at the USGS open house. Terry's passing is a great loss for the USGS, as well as for his friends and family."

—Page Mosier

"At the completion of USGS Leadership classes, students are given a Leadership Coin and asked to pass it on to someone else at the USGS who demonstrates outstanding leadership. I realized that Terry embodied all the best qualities of leadership and had seen our team through many transitions and difficult periods. These coins are fairly rare; I'd never seen or heard of them outside the class. However, when I presented Terry with the coin, he opened a drawer and added it to his growing collection of Leadership Coins! I was just one of many who appreciated what a treasure he was.... I'll miss his sense of humor, his open door, and his generous heart."

—Stephanie Ross

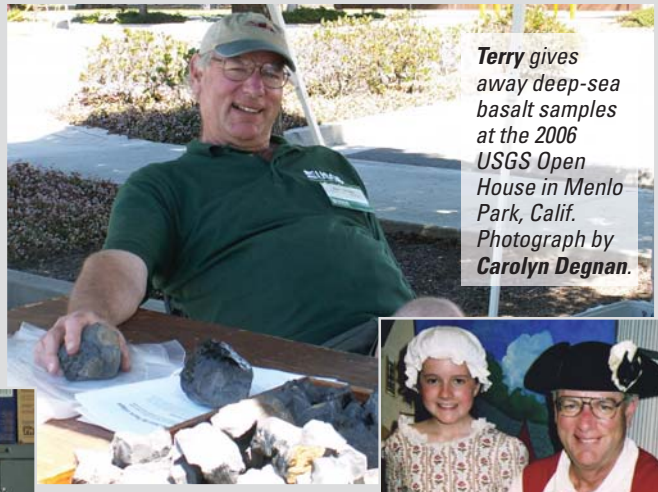
"A society grows great when old men plant trees in whose shade they know they shall never sit."

—Greek proverb, quoted by Terry at the bottom of each of his e-mail messages.

(Terry Bruns continued on page 18)

(Terry Bruns continued from page 17)

► ***Terry*** *(left) and* ***Gretchen Luepke (Bynum)*** *in the opening number of the 1976 USGS Pick and Hammer Show. Photograph courtesy of* ***Gretchen****.*

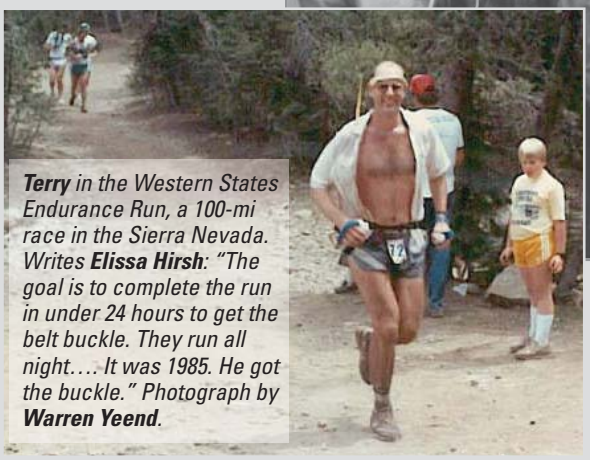


Terry *gives away deep-sea basalt samples at the 2006 USGS Open House in Menlo Park, Calif. Photograph by* ***Carolyn Degnan****.*

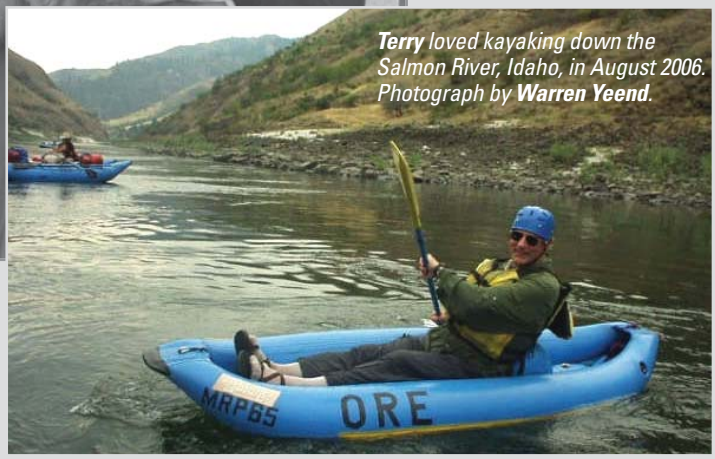
► ***Brian Edwards*** *(left) and* ***Terry*** *clown around at the team holiday party, 2002. Photograph by* ***Florence Wong****.*

► ***Terry*** *and* ***Jenna Stanley*** *at "Landelsburg," an annual reenactment of a colonial village where* ***Terry****, a hobby printer, supervised a print shop (see related article in* Sound Waves*, May 2004, at URL* ***http://soundwaves.usgs.gov/2004/05/staff.html****). Photograph by* ***Helen Gibbons****, 2005.*

► *Participants enjoy the aftermath of the Christmas Relays at Lake Merced in San Francisco, Calif., 1978. Each member of a four-runner team completes a 4.5-mi lap around the lake.* ***Les Magoon*** *(far right) ran for the first time with* ***Terry*** *(second from left), who had invited him to round out a team. Photograph courtesy of* ***Les****, who ran many more races with* ***Terry*** *over the next 2 decades.*



Terry *in the Western States Endurance Run, a 100-mi race in the Sierra Nevada. Writes* ***Elissa Hirsh****: "The goal is to complete the run in under 24 hours to get the belt buckle. They run all night.... It was 1985. He got the buckle." Photograph by* ***Warren Yeend****.*



Terry *loved kayaking down the Salmon River, Idaho, in August 2006. Photograph by* ***Warren Yeend****.*

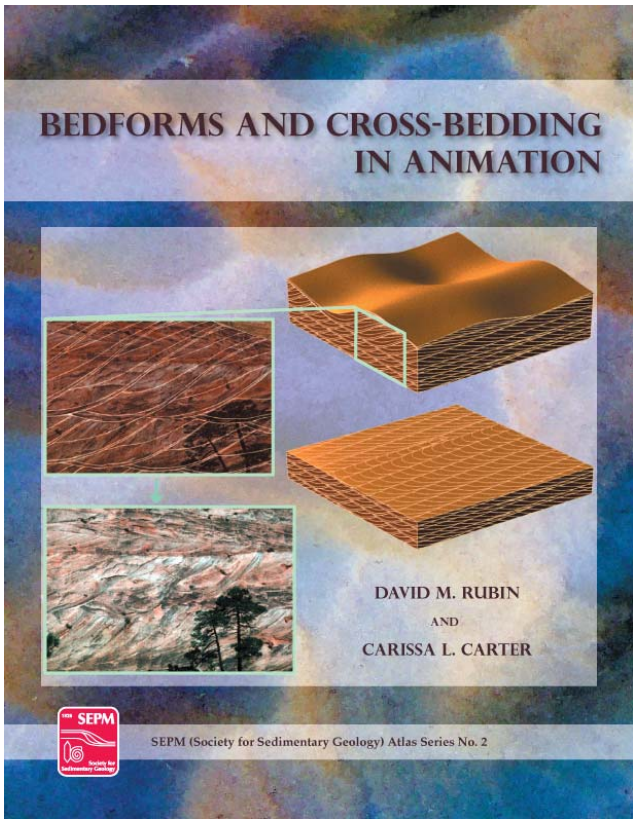
Release of DVD "Bedforms and Cross-Bedding in Animation"

By David Rubin

The Society for Sedimentary Geology (SEPM) recently released "Bedforms and Cross-Bedding in Animation," a publication on DVD by U.S. Geological Survey (USGS) scientists **David Rubin** and **Carissa Carter**. The DVD—which made its debut at the Geological Society of America's annual meeting in Philadelphia, Pa., in October 2006—includes approximately 100 movies of bedforms and cross-bedding, an interactive user interface for selecting and viewing movies, a printable 195-page Portable Document Format (PDF) file of the second edition of **Rubin's** "Cross-Bedding, Bedforms, and Paloeocurrents" (the first edition was published by SEPM in 1987), and documentation for Matlab® programming code for modeling bedforms and cross-bedding. A scaled-down version of some of these materials has been posted on the USGS Western Coastal and Marine Geology Team Web site at URL **http://walrus.wr.usgs.gov/seds/bedforms/animation.html**, with the help of team Webmistress **Laura Torresan**.

The full reference for the new publication is:

Rubin, David M., and Carter, Carissa L., 2006, Bedforms and cross-bedding in animation: Society for Sedimentary Geology (SEPM) Atlas Series, no. 2, DVD.



Cover of pamphlet advertising the new DVD.

Recently Published Articles

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