

Fieldwork

USGS Researchers Collaborate with National Park Service Scientists to Understand the Impact of Watershed Erosion on Coral Reefs in War-in-the-Pacific National Historical Park, Guam

By Curt Storlazzi

Guam, the largest of the Mariana Islands and an American territory since the end of the Spanish-American War in 1898, had quickly and easily fallen into Japanese hands in the early morning of December 10, 1941, putting approximately 20,000 Chamorros (natives of Guam) and U.S. citizens under the flag of the Rising Sun. Two and a half years later, on the morning of July 21, 1944, first elements of the U.S. 3rd Marine Division landed at Asan, Guam, and lead assault troops of the U.S. 1st Provisional Marine Brigade landed at Agat, about 10 km to the south, on the other side of Apra Harbor. These 30,000 Marines faced 18,500 Japanese defenders entrenched in caves, pillboxes, and bunkers on the island. The battle for Guam lasted a month and cost more than 12,000 American and Japanese lives. In commemoration of the United States and Guam's involvement in World War II, the National Park Service (NPS) established War-in-the-Pacific National Historical Park in 1978. The park, which honors the bravery and sacrifice of those participating in the campaigns of the Pacific Theater of World War II, seeks to conserve and interpret outstanding natural, scenic, and historic values and objects on the Island of Guam (see URL <http://www.nps.gov/wapa/>). The two beaches where the U.S. Marines landed at Asan and Agat were incorporated as the two largest (of six total) units in the park; the other four units are old Japanese defensive positions in the hills overlooking west-central Guam.

War-in-the-Pacific National Historical Park comprises 926 acres of land and 1,002 acres of marine waters. The marine



View of the Asan Unit of War-in-the-Pacific National Historical Park, which extends from this viewpoint approximately 2 km offshore. Sediment exposed by the landslides visible in the photograph is transported down to the fringing coral reef by the Asan River, which runs through Asan village in the center of the photograph. Photograph by Curt Storlazzi.

waters are home to more than 3,500 marine species and 200 species of coral, giving the park one of the highest levels of species diversification within the National Park system. Corals generally need clear, oligotrophic waters (low in nutrients and suspended sediment). Human activity has significantly increased the rate of sedimentation along many areas of Guam's coastline, including within the park. These human activities are related primarily to land-management practices, including

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Guam, showing the six units of War-in-the-Pacific National Historical Park (red). An interactive map of the park is posted at URL <http://www.nps.gov/wapa/planyourvisit/placestogo.htm>.

Sound Waves

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Submission Guidelines

Deadline: The deadline for news items and publication lists for the December issue of *Sound Waves* is Friday, October 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

Fieldwork, continued

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urban development, unregulated use of off-road vehicles, and illegal wildfires. The wildfires, which are intentionally set by hunters to clear lines-of-sight and draw in new game, remove the grasses and small trees that stabilize the soil. Typhoons strike Guam frequently, commonly dropping more than 30 cm of rain in 24 hours and flushing the unstabilized soil down to the coast and into the park's waters. Studies by the park's Natural Resource Division staff have shown that

- soil loss from burned areas is nearly sixfold higher than from vegetated areas,
- sediment-collection rates in tube traps on the park's fringing reef are very high,
- the trapped material is composed dominantly of fine terrestrial sediment, and
- trap-collection rates vary widely.

Their work further shows that the input of terrestrial sediment to the park's near-shore waters is greater during the wet season (July-December), which coincides with peak coral spawning and larval settlement.

In 2006, War-in-the-Pacific National Historical Park asked the U.S. Geological Survey (USGS) to develop studies that would provide quantitative information about the deposition, residence time, and movement of fine terrestrial sediment through the park's fringing coral-reef system, so that the NPS can better manage the park's marine resources. The USGS Coral Reef Project established a plan with NPS, and in July 2007, **Curt Storlazzi**, **Josh Logan**, and **Kathy Presto** (USGS, Santa Cruz, California), along with **Greg Piniak** (National Oceanic and Atmospheric Administration [NOAA], formerly a USGS Mendenhall Postdoctoral Research Fellow in Santa Cruz), traveled to Guam to conduct a cooperative study with NPS for increasing our understanding of geologic and oceanographic processes on Guam's coral reefs. **Storlazzi**, **Logan**, **Presto**, and **Piniak** worked with the park's Natural Resource Division scientists **Allison Palmer** and **Holley Voegtle** to scout out sites for USGS and NPS oceanographic and terrestrial instrument packages. Over the next 2 weeks,

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Josh Logan deploying a wave/tide gauge and temperature/salinity sensor. Because of the complex bathymetry and delicate nature of coral-reef environments, the scientists must deploy instruments using scuba gear and lift bags (yellow) to avoid damaging the corals or the instruments. Water depth is approximately 10 m (33 ft). Photograph by **Curt Storlazzi**.

Fieldwork, continued

(Guam continued from page 2)

the USGS team installed seven benthic instrument packages, three moorings, a terrestrial digital-camera system, a weather station, and a stream gauge in the park. These instruments will provide quantitative time-series measurements (measurements collected at regular time intervals) of oceanographic processes (currents, surface waves, internal waves), meteorologic forcing (winds, rainfall, barometric pressure), and water-column properties (temperature, salinity, turbidity, photosynthetically available radiation). This study will last 7 months, and the results will be

used to identify flow and transport patterns under various forcing conditions.

USGS staff will return to Guam in late October to recover the instruments, download data, and refurbish and redeploy the instruments until the end of the typhoon season in January. This work will be another chapter in ongoing USGS research to investigate the impact of land-based pollution on coral reefs in the United States and U.S. Trust Territories (see URL <http://coralreefs.wr.usgs.gov/sediment.html>), and will build on continuing USGS-NPS multidisciplinary cooperative coral-reef research efforts (see

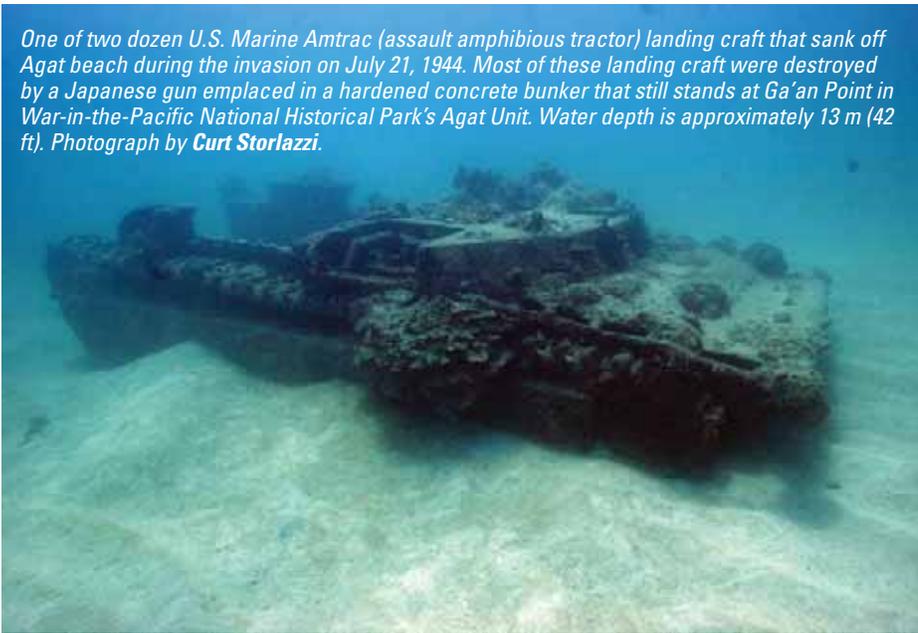
NPS Web page on coral at URL <http://www.nature.nps.gov/water/coral.cfm>).

This experiment will also provide NPS with quantitative baseline data to compare with possible future measurements during the planned large-scale expansion of U.S. military installations at Apra Harbor, less than 2 km from the park. Furthermore, this work will address shared objectives with the U.S. Coral Reef Task Force (USCRTF)'s Guam Local Action Strategy (LAS; scroll down to factsheet link at URL <http://www.coralreef.gov/las/>), which designated the Asan watershed as one of its five priority watersheds for study. USGS researchers, along with the NPS staff, hope to continue this cooperative-science program on behalf of the coral reefs and reef ecosystems in one of our Nation's historic battlegrounds.

During the USGS scientists' time on Guam, they experienced several interesting events. Just before the group arrived, Super Typhoon Man-Yi passed Guam with 140- to 160-mph winds and 35-ft waves that caused several ships (including a 530-ft container ship) to sink in the Philippine Sea to the west of Guam; during their first days on the island, the USGS researchers frequently saw U.S. Coast Guard aircraft performing search-and-rescue operations. During instrument deployment inside the park on July 18, the USGS group discovered an unmapped field of unexploded ordnance, consisting of artillery shells left over from World War II. On July 20, a magnitude 5.0 earthquake struck the Mariana Trench just 20 mi east of where the USGS scientists were staying. The following day, July 21, was the 62nd anniversary of the landing of U.S. Marines, celebrated in west-central Guam with an annual Liberation Day parade. This year's parade included numerous floats, two local mayors riding a carabao (a Guamanian water buffalo), and a flyover at low altitude by U.S. bombers, fighters, and helicopters out of Andersen Air Force Base and Naval Base Guam. ☼

◀ Two World War II artillery shells, outlined in yellow, in a previously unmapped field of unexploded ordnance near one of the USGS instrument sites in War-in-the-Pacific National Historical Park. Water depth is approximately 20 m (66 ft). Photograph by Curt Storlazzi.

One of two dozen U.S. Marine Amtrac (assault amphibious tractor) landing craft that sank off Agat beach during the invasion on July 21, 1944. Most of these landing craft were destroyed by a Japanese gun emplaced in a hardened concrete bunker that still stands at Ga'an Point in War-in-the-Pacific National Historical Park's Agat Unit. Water depth is approximately 13 m (42 ft). Photograph by Curt Storlazzi.



Mercury Contamination in Waterbirds Breeding in San Francisco Bay

By Josh Ackerman and Collin Eagles-Smith

References to the neurological effects of mercury exposure date back several centuries. In the 1800s, when mercury was a common ingredient used in the production of felt hats, the term “mad as a hatter” entered the vernacular as a reference to the slurred speech, irritability, tremors, and other odd behavior that mercury exposure could cause. These neurological and behavioral effects were made famous by the delirious Mad Hatter character in **Lewis Carroll’s** 1865 masterpiece *Alice in Wonderland*.

However, environmental concerns regarding mercury contamination were not widespread until the tragedy in Minamata Bay, Japan, in the late 1950s, when an estimated 27 tons of mercury-containing compounds were released into the bay from a plastics factory. The mercury accumulated up the food chain into fish, which comprised a major portion of the fishing town’s diet. The outcome was drastic—the fishery collapsed, several hundred people died, and more than 3,000 others had contracted “Minamata disease,” which caused devastating neurological impacts from methyl mercury exposure. Since this and other tragic mercury-related events, extensive research has been undertaken to understand the distribution, cycling, and accumulation of mercury in the environment. These past studies have indicated that mercury is a potent neurotoxin and a common contaminant in aquatic ecosystems throughout the world, and is a significant health threat to both humans and wildlife.

San Francisco Bay has a legacy of mercury contamination from historical mercury mining in the Coast Ranges and gold extraction in the Sierra Nevada. An estimated 220 million pounds of mercury were mined in the coastal mountains from the mid-1800s to the mid-1900s. Additionally, over 26 million pounds of mercury were used for gold recovery in the Sierras. During these mining activities, roughly 10 percent to 30 percent of all the mercury



A radio-marked avocet is readied for release. Subsequently, it will be tracked to determine movements and habitat use. Photograph by Scott Demers, USGS.

used was lost to the surrounding watersheds and has since been making its way, attached to sediment particles, into the San Francisco Bay-Delta. This pollution has resulted in San Francisco Bay being listed as an impaired water body under the Clean Water Act, and a bay-wide fish-consumption advisory has been enacted by the State of California’s Office of Environmental Health Hazard Assessment (for more information visit URL <http://www.oehha.ca.gov/fish/general/sfbaydelta.html>).

The most sensitive endpoint of mercury toxicity in wildlife is reproductive impairment; thus mercury contamination in San Francisco Bay may reduce the reproductive success of waterbirds breeding within the estuary. Although these effects have been little studied in the estuary, the risk is a concern because San Francisco Bay is a site of hemispheric importance to shorebirds, annually supporting over half a million wintering and migrating shorebirds and more than a quarter million ducks. Current restoration plans to enhance exist-

ing wetlands and to convert salt-evaporation ponds into tidal marsh could result in accelerated microbial conversion of legacy inorganic mercury to methyl mercury, the form of mercury which is highly toxic and most bioavailable to wildlife and humans.

In a large collaborative project funded by the CalFed Ecosystem Restoration Program, biologists of the U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), San Francisco Bay Bird Observatory, and PRBO Conservation Science are investigating the risks of mercury to waterbirds breeding within the estuary. This unprecedented project seeks to assess mercury burden and dietary exposure in waterbirds and, ultimately, the effects that mercury has on avian reproduction within the estuary.

This study is examining several aspects of the biology of five waterbird species that are common residents of San Francisco Bay and associated wetlands. The species being studied include two shorebirds (American avocet and black-necked stilt), two terns (Forster’s tern and Caspian tern), and one diving duck (surf scoter). This is a multifaceted project that includes capturing and radio-marking birds to track their movements and habitat use, sampling bird blood and feathers for mercury concentrations and chemical signatures of diet, monitoring nesting success, and examining chick movements and survival. Although the study was initiated only recently, in 2005, it has already produced several interesting results. For example, it has been determined that mercury concentrations are generally higher in fish-eating birds (terns) than in birds that eat mainly aquatic invertebrates (shorebirds). This is likely due to the fact that methyl mercury bioaccumulates within the environment, such that fish that are eaten by birds already will have accumulated high levels of mercury from consuming large amounts of invertebrate prey.

(Mercury Contamination continued on page 5)

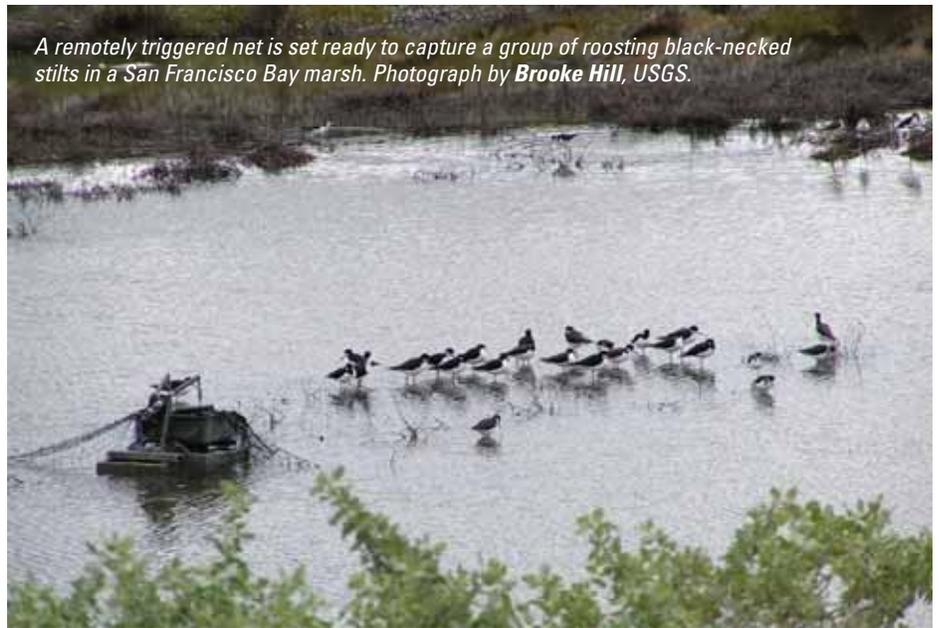
(Reprinted, with permission, from the Summer 2007 issue of *Tideline* [v. 27, no. 2], the newsletter of the San Francisco Bay National Wildlife Refuge Complex; see URLs <http://www.sfbws.org/tideline.htm> and <http://www.fws.gov/sfbayrefuges/>.)

Research, continued

(Mercury Contamination continued from page 4)

Furthermore, mercury concentrations are high enough to be a cause for concern, especially in the most southern and northern portions of the bay. For example, 5 percent of stilts, 6 percent of avocets, 10 percent of Caspian terns, and 58 percent of Forster's terns breeding in South Bay sites south of the Dumbarton Bridge (Alviso salt-pond complex) were at or above the high-risk category for mercury contamination. The higher mercury levels in the South Bay are likely a consequence of highly contaminated sediments that have been transported through Alviso Slough, the discharge point for the Guadalupe River. This watershed drains from the historic New Almaden quicksilver mine—one of the largest mercury mines in the western United States—and residual mercury remains within the environment. High levels of mercury in the North Bay are likely from the Sacramento-San Joaquin Delta, and ultimately from upstream historic gold-mining activities in the Sierras. Although it is difficult to detect how mercury toxicity might actually manifest itself in wild birds, mercury usually has its greatest effect on reproduction. These effects can include reduced breeding effort; altered breeding behavior; impaired vision, hearing, and motor skills; embryo death and deformities; reduced egg hatchability; and reduced chick survival.

Although mercury will continue to be a problem in San Francisco Bay for the

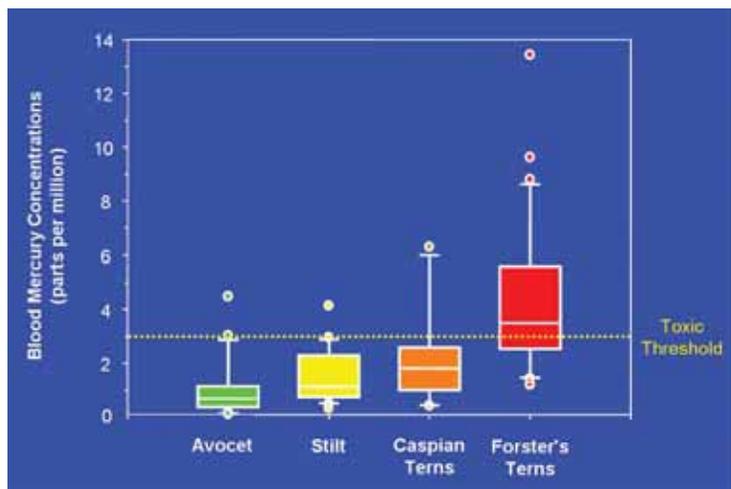


A remotely triggered net is set ready to capture a group of roosting black-necked stilts in a San Francisco Bay marsh. Photograph by Brooke Hill, USGS.

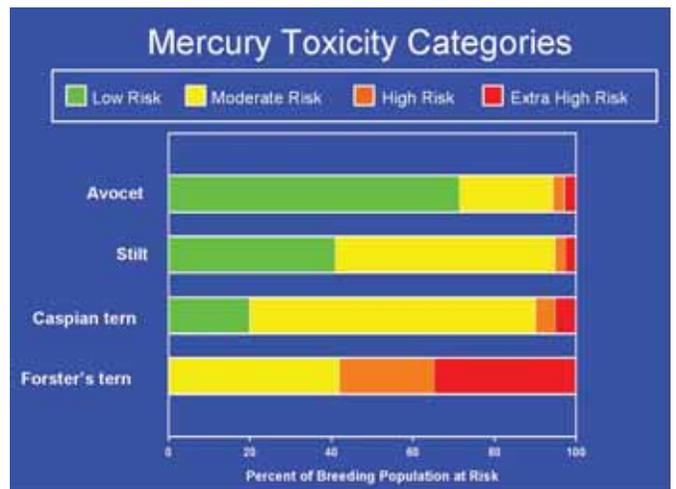
foreseeable future, the benefits of wetland creation for wildlife will likely outweigh many concerns about the potential for increased methyl mercury production. Scientists will continue to conduct research within the San Francisco Bay National Wildlife Refuge Complex to understand mercury's availability to wildlife and its effects on breeding waterbirds.

About the authors: *Josh Ackerman*, a Research Wildlife Biologist at the USGS Davis Field Station, studies waterbird ecology and the ecotoxicological effects

of mercury on avian reproduction. *Collin Eagles-Smith*, formerly a biologist with the U.S. Fish and Wildlife Service, Environmental Contaminants Division, and now a Research Wildlife Biologist at the USGS Davis Field Station, studies aquatic food-webs and the bioaccumulation and ecological effects of mercury contamination. Each of the authors received a Department of the Interior Superior Service Award in 2006 for their research on the effects of mercury on bird reproduction in the San Francisco Bay and Delta (see URL <http://soundwaves.usgs.gov/2007/01/awards.html>). ❁



Mercury concentrations in the blood of breeding waterbirds approached and surpassed toxic threshold levels in the South San Francisco Bay, especially for fish-eating terns. Bird samples were analyzed for mercury at the USGS Davis Field Station Mercury Lab.



The percentage of the breeding populations of several waterbird species that are at risk of reduced reproductive success and declining populations due to mercury contamination in the South San Francisco Bay. USGS and USFWS graphic.

Art and Science Combine to Create Awareness of Louisiana's Coastal Wetlands

By Susan Horton

The U.S. Geological Survey (USGS)'s National Wetlands Research Center (NWRC) in Lafayette, Louisiana, is always looking for new ways to expand its education and outreach efforts in the community. So, when art-gallery director **Roger Laurent** called USGS outreach contractor **Susan Horton** (IAP World Services, Inc.) to ask NWRC to be part of an exhibit of paintings and photographs of Louisiana's barrier islands and coastal wetlands, the answer was "yes." Connecting the science and mapping to the art was easy.

The exhibit, shown at Gallery 912 from late July through August, was titled "Hell and High Water" and featured 45 pieces of artwork from Southeastern Louisiana University's chairman of visual arts, **Dennis Sipiorski**, and professor of graphic design **Karin Eberhardt**. A Wisconsin native, **Sipiorski** showed acrylic paintings inspired by his trips to the barrier islands in the 27 years that he's lived in Louisiana. Since 2004, **Eberhardt** has been visiting and photographing the barrier islands and using a computer to digitally manipulate her images and present them as collages.

While the artists were documenting and recording their impressions of these fragile habitats along the Gulf Coast, USGS scientists and geographers were interpreting and mapping changes in Louisiana wetland habitats—including barrier islands, such as the Chandeleur Islands, Isles Dernieres, and Timbalier Islands—using aerial photography and satellite imagery.

USGS maps displayed at Gallery 912 to complement the art exhibit included a map of Racoon Island (in the Isles Dernieres chain) and another map showing 50 years of changes in Louisiana's coastal zone, including changes in the land/water ratio caused by Hurricanes Katrina and Rita.

Even more striking changes were visible on a historical map of the Louisiana coast, surveyed by **George Gauld** in 1778. This map, "A Plan of the Coast of Part of West



Greg Smith (right), USGS National Wetlands Research Center director, and **Roger Laurent**, Gallery 912 director, visit during the opening reception of "Hell and High Water," July 27, in Lafayette, Louisiana. Three paintings by featured artist **Dennis Sipiorski** are visible behind **Smith**.



Susan Horton (right) talks with Gallery 912 guests about Louisiana's coastal land loss. The map, "Land Area Change in Coastal Louisiana After the 2005 Hurricanes: A Historical Perspective," was created by USGS geographer **John Barras**. To the right of **Susan** is one of **Dennis Sipiorski's** paintings, "Bird in House."

Florida & Louisiana," which was found on the Web site of the Geography and Map Division of the Library of Congress (URL <http://www.loc.gov/rr/geogmap/>), was contributed by NWRC photo interpreter **Jason Dugas** (IAP World Services contractor).

The exhibit opened July 27 with an artists' reception attended by **Horton** and **Joy Merino**, a coastal ecologist with the National Oceanic and Atmospheric Administration's National Marine Fisheries Service, who shared

information about efforts to restore some of the barrier islands through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA; URL <http://www.lacoast.gov/cwppra/>).

Several hundred visitors to the "Hell and High Water" exhibit now have a new perspective on the importance of Louisiana's coastal wetlands and what's happening to them as seen through the eyes of an artist, a photographer, and those scientists and geographers at NWRC who study and map these disappearing habitats. ❁

USGS Helps Provide Teacher Research Experience in Long Island Sound

By Larry Poppe and Dann Blackwood

During August 2007, **Larry Poppe** and **Dann Blackwood** from the U.S. Geological Survey (USGS)'s Woods Hole Science Center participated in a Teacher Research Experience (TRE) program. Along with the USGS, cosponsors of this year's Connecticut program were the National Undersea Research Center (NURC) at the University of Connecticut, the National Marine Fisheries Service (NMFS) Milford Laboratory, the Connecticut Department of Environmental Protection's Long Island Sound Resource Center (LISRC), and Connecticut Sea Grant.

Under the 2007 TRE theme of "Exploring the Habitats of Long Island Sound," five middle- and high-school science teachers and two students were invited aboard the NMFS research vessel *Loosanoff* for 3 days of collecting samples, video, and still images of the ocean floor for analysis. Classroom orientation and time on the *Loosanoff* provided teachers and students with insights into the Long Island Sound ecosystem and an opportunity to conduct all facets of a research cruise, including planning, deck operations, data collection, and logging.

Larry Poppe was principal investigator of the primary research project, which involved mapping the distribution, extent,



Larry Poppe (standing at rear) provides guidance as TRE participants examine a sediment sample on the deck of the research vessel *Loosanoff*.

and characteristics of shell beds around cape-associated shoals off the north shore of Long Island. These shell beds are ecologically and sedimentologically important. Ecologically, shell beds form a critical habitat that shelters juvenile fish and benthic infauna from mobile predators, they provide a hard substrate for sessile fauna and flora, and they supply food for boring species. These characteristics have been shown to produce a benthic complexity that benefits numerous species. Sedimentologically, shell beds form a transitional environment between conditions favoring coarse bedload transport

and those favoring sorting and reworking.

Other research projects included appraising bottom variation at control sites for fish studies around Charles Island (principal investigator, **Ron Goldberg**, NMFS) and examining soft-coral habitats on isolated deep-water bathymetric highs (principal investigators, **Ivar Babb** and **Peter Auster**, NURC).

Results of the cruise will eventually be woven into teaching materials and posted on Web sites of the USGS' Woods Hole Science Center (URL <http://woodshole.er.usgs.gov/>) and the Long Island Sound Resource Center (URL <http://www.lisrc.uconn.edu/>). Teachers will generate maps, videotapes, and other teaching materials from the research that will become part of an Education link on a new Web site, developed by the National Undersea Research Center and the Connecticut Department of Environmental Protection, called "An Underwater Tour of the Long Island Sound" (URL http://www.lisrc.uconn.edu/lis_uwtour/index.asp).✻

USGS Scientist Shows Evidence for 300-Year-Old Tsunami to Participants in International Tsunami Training Institute



A fleet of canoes followed U.S. Geological Survey (USGS) geologist **Brian Atwater** from mudbank to mudbank along the Niawiakum River on Washington State's south coast, where he showed

Brian Atwater (left) points out a sand layer deposited by an ancient tsunami to NBC reporter **Anne Thompson**. Partly obscured by **Atwater** is his research collaborator **Andy Moore**, assistant professor of geology at Earlham College. Courtesy of the *Today Show*, NBC News.

the paddlers evidence for the most recent Pacific Northwest earthquake of magnitude 9 and the associated Pacific Ocean tsunami. Most of the paddlers were visitors from the Indian Ocean region, hoping to gain knowledge that would help make their home countries safer from the threat of tsunamis. The field trip, held July 26, 2007, was part of a new Certificate Program in Tsunami Science and

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Outreach, continued

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Preparedness offered by the University of Washington (UW) in cooperation with the National Oceanic and Atmospheric Administration (NOAA). This program is the first offering of the International Tsunami Training Institute, established by NOAA and the U.S. Agency for International Development (USAID) in response to the tsunami that claimed 300,000 lives around the Indian Ocean in December 2004.

Thirty-one participants from Indonesia, Sri Lanka, Thailand, India, and the Maldives—the countries most severely affected by the December 2004 tsunami—took part in the inaugural 2-week intensive program at UW, all expenses paid by USAID. They included specialists in fields related to tsunami warning, preparedness, and mitigation and disaster management.

“Analysis of the 2004 Sumatra tsunami showed that the biggest gap in tsunami preparedness in the region was one of training, not technology,” said **John Stephens**, director of Academic Programs for UW Educational Outreach. The new certificate program, instigated by UW Educational Outreach and NOAA’s Pacific Environmental Laboratory, is intended to help close that gap.

Washington State, showing locations of the Niihau and Copalis Rivers, where USGS geologist **Brian Atwater** led field trips to evidence for the 1700 Cascadia earthquake and tsunami.

The program is a core component of a broader U.S. Government effort to support the development of a tsunami-warning system in the region under the U.S. Indian Ocean Tsunami Warning System Program, funded by USAID. Through this 2-year, \$16.6 million effort, scientists and experts from the United States are sharing their technical expertise, providing guidance, and helping to build multihazard-warning-system capacity within the Indian Ocean region (to learn more, visit URL <http://www.iotws.org/>). The goal is to reduce losses from future tsunamis by helping governments and



communities identify tsunami hazards and prepare for them decades before disaster strikes, and to issue warnings that reach coastal residents just minutes after the detection of earthquakes and tsunamis.

Because tsunami preparedness and mitigation require coordination among emergency managers, policymakers, community planners, scientists, engineers, and other professionals, the Certificate Program in Tsunami Science and Preparedness organizes participants in cross-disciplinary teams, each of which completes a tsunami-preparedness plan for a specific community at risk in their country. Taught by leading tsunami experts from the University of Washington, NOAA, the USGS, and other institutions, this is the first program in the world offering all the major components of tsunami preparedness in a centralized location.

“Seattle is a national nexus for tsunami research because of the subduction earthquake hazard in this area,” said **Catherine Petroff**, program developer and affiliate assistant professor in civil and environmental engineering at UW. The Pacific Northwest is threatened by earthquakes

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Brian Atwater (center) points out evidence of the 1700 Cascadia earthquake and tsunami to field-trip participants during a canoe trip along the Niihau River.

Outreach, continued

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and tsunamis from the Cascadia subduction zone, a largely offshore fault that runs 700 mi from Vancouver Island, British Columbia, to Cape Mendocino, California. “The Cascadia subduction zone off our Northwest Coast bears a striking similarity to the Sumatra subduction zone that generated the devastating 2004 Indian Ocean tsunami,” said **Frank I. González**, a retired research scientist for the NOAA Center for Tsunami Research in Seattle and affiliate professor in Earth and space sciences at UW.

USGS geologist **Atwater**, who also is an affiliate professor in Earth and space sciences at UW, studies the geologic records of earthquakes and tsunamis from past centuries to help engineers, public officials, and coastal residents prepare for future earthquakes and tsunamis. On the July 26 canoe trip with the visitors from South and Southeast Asia, he pointed out traces of the 1700 Cascadia earthquake, which occurred a century before the Lewis

and Clark expedition. The associated tsunami, in addition to inundating the Pacific Northwest coast, ran across the Pacific Ocean and went ashore in Japan. Japanese written records of the resulting damage, combined with North American geology and tree-ring studies, enabled scientists to determine that the tsunami had been triggered by a Pacific Northwest earthquake, of approximate magnitude 9, on the evening of January 26, 1700.

One of the canoes on the trip contained a television crew from NBC Universal’s *Today* show. The crew had spent the previous day with **Atwater** and Earlham College geologist **Andrew Moore**, investigating earthquake and tsunami geology along the Copalis River. NBC made highlights from both days into “Earthquake Hunter: Protecting the Future,” a 5-minute segment that aired around the country on Sunday, August 26, and featured **Atwater**, Washington’s earthquake and tsunami evidence, and the new tsunami

training program. Additional coverage was provided by a crew from CBS affiliate KING-TV (Channel 5, Seattle), whose story aired on July 27.

The International Tsunami Training Institute’s first training program in Asia will be held at the Asian Institute of Technology in Bangkok, Thailand, in February 2008. UW Extension expects to offer its second Certificate Program in Tsunami Science and Preparedness in summer 2008 (for more information, visit URL http://www.outreach.washington.edu/ext/certificates/tsp/tsp_gen.asp).

To learn more about the 1700 Cascadia earthquake and tsunami, read “The Orphan Tsunami of 1700—Japanese Clues to a Parent Earthquake in North America” (URL <http://pubs.usgs.gov/pp/pp1707/>). To learn what you can do to survive a tsunami, read “Surviving a Tsunami—Lessons from Chile, Hawaii, and Japan” (URL <http://pubs.usgs.gov/circ/c1187/>).✿

Meetings

USGS Participates in Groundwater-Seawater Interactions Symposium at IUGG Assembly in Italy

By Peter Swarzenski and John Bratton

For almost 2 weeks last summer (July 2-13, 2007), participants from around the world, including a delegation of 22 U.S. Geological Survey (USGS) scientists, gathered for the 24th International Union of Geodesy and Geophysics (IUGG) General Assembly in the historic town of Perugia, Italy. IUGG general assemblies are held every 4 years; the previous one was in Japan in 2003, and the 2011 site has yet to be determined. The IUGG meeting, attended by approximately 4,400 scientists, included a broad range of geoscience topics (for a full scientific program, visit URL <http://www.iugg2007perugia.it/>). One session that included substantial USGS participation was a symposium titled “A New Focus on Groundwater-Seawater Interactions,” which was expertly convened by **Ward Sanford** (USGS, Reston, Virginia), and

co-convened by **Christian Langevin** (USGS, Fort Lauderdale, Florida), **Maurizio Polemio** (National Research Council, Italy), and **Pavel Povinec** (Comenius University, Bratislava, Slovakia).

USGS scientists **Peter Swarzenski** (Santa Cruz, California) and **John Bratton** (Woods Hole, Massachusetts) contributed presentations on topics related to submarine groundwater discharge during the 2-day symposium. The session was well attended by oceanographers and hydrologists, an indication that this burgeoning interdisciplinary field is benefiting from both marine and

(IUGG continued on page 10)



Italy, showing location of Perugia.

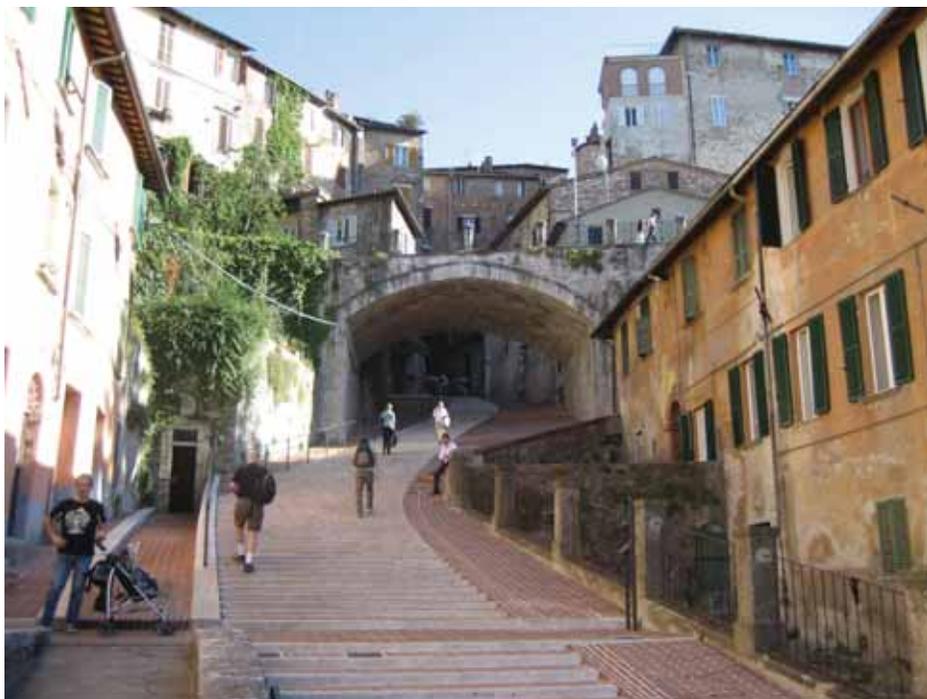
Meetings, continued

(IUGG continued from page 9)

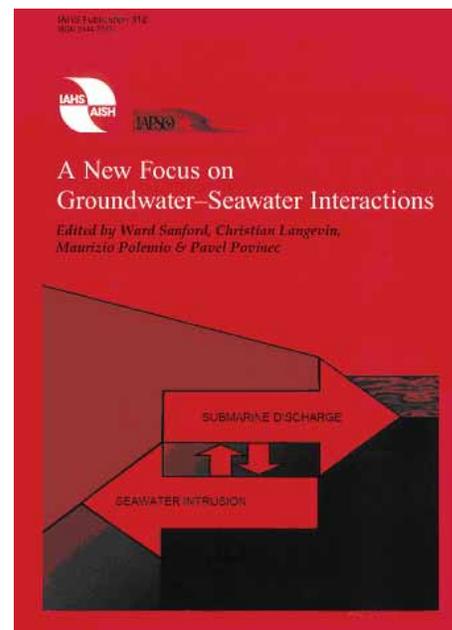
terrestrial perspectives. The 27 presentations and additional posters provided clear evidence for the importance of incorporating realistic geologic information into sophisticated variable-density flow models, and for the strength of new geochemical and geophysical tools that can locate and quantify submarine ground-water discharge. The International Association of

Hydrological Sciences (IAHS) published a proceedings volume consisting of 38 presented papers (IAHS Publication 312, URL <http://www.cig.ensmp.fr/~iahs/redbooks/312.htm>). The symposium succeeded at the challenging task of bridging many of the gaps in understanding and methodology that exist among the various subdisciplines of oceanography, hydroge-

ology, geophysics, geochemistry, numerical modeling, and resource management as applied to the topic of water and chemical fluxes across the sea floor. ❁



Via Appia winds uphill toward the historic center of the old city of Perugia. Photograph courtesy of J.F. Bratton.



The conveners of our session also edited a proceedings volume that contained 38 papers and was published by IAHS. The complete reference for the volume is: Sanford, Ward, Langevin, Christian, Polemio, Maurizio, and Povinec, Pavel, eds., 2007, A new focus on groundwater-seawater interactions: IAHS Publication 312, 344 p. [URL <http://www.cig.ensmp.fr/~iahs/redbooks/312.htm>].

Staff and Center News

Western Coastal and Marine Geology Team Welcomes Three New Hires

By Jane Reid

The U.S. Geological Survey (USGS)'s Western Coastal and Marine Geology team is pleased to announce that three new employees have recently joined us at the Pacific Science Center in Santa Cruz, California. **Jennifer Ludwick** is our new contract administrative assistant and office manager, replacing **Kathleen Donahue**, who left the USGS to pursue a graduate degree in education. **Jennifer** comes to us from Mission College in Santa Clara, Cali-

fornia, where she was an Executive Assistant to the Vice President of Instruction. She holds an Associate in Applied Science Degree, Office Administration/Administrative Assisting, from ESS College of Business in Dallas, Texas. While pursuing this degree, she served as President of the Student Advisory Committee and was a member of the Dallas Central Chapter of Professional Secretaries International. **Jennifer** is a well-traveled individual,

coming from a military-background family, and currently lives in the long-time family home in Watsonville with her two dachshunds. **Jennifer** co-owns a dance studio and event-production company in Soquel and is a professional belly dancer.

Steve Watt has been hired as a contract employee to work with **Bruce Jaffe** on studies of tsunami deposits. **Steve** earned a Master's degree with **Gary**

(New Hires continued on page 11)

(New Hires continued from page 10)



Jennifer Ludwick outside the USGS Pacific Science Center, Santa Cruz, California.

Greene at Moss Landing Marine Laboratories (MLML) in 2003 and then spent 3 years working for Sea Engineering in Santa Cruz. During his time at MLML and Sea Engineering, **Steve** became familiar to several of the staff at the Pacific Science Center when he monitored dredging at the Santa Cruz Harbor. That work, which he discussed at length with members of the Western Coastal and Marine Geology team, included mapping areas of the sea floor and looking for changes in offshore sediment texture and benthic habitat. In his new position with the USGS, **Steve** will be mapping boulder distribution on Bonaire (an island in the Netherlands Antilles) as part of an effort to distinguish storm-wave deposits from tsunami deposits, and looking at shoreline change caused by the December 2004 earthquake and tsunami in Sumatra. Yes, as a long-time Santa Cruzan, he surfs and mountain-bikes.

Mark Buckley has joined the USGS as a term employee to work with **Bruce Jaffe** on tsunami deposits, sediment transport, and tsunami-inundation modeling. **Mark** received a Bachelor's degree in physical oceanography from the University of San Diego in 2006. Since then, he has been working toward a Master's degree in ocean engineering from the University of Rhode Island (URI) and working as a graduate assistant for URI's Graduate School of Oceanography. Last summer, **Mark** accompanied Western Coastal and Marine Geology team scientists **Jaffe** and **Bruce Richmond** to St. Croix, U.S. Virgin Islands, to look for evidence of historical tsunamis. At the Pacific Science Center, he will apply his strong quantitative background to many aspects of tsunami studies, including inundation modeling and the identification and interpretation of tsunami deposits, particularly those formed by the 2004 Indian Ocean tsunami. **Mark's** hobbies include surfing, snowboarding, and camping.

Please welcome **Jennifer**, **Steve**, and **Mark** when you're visiting the Pacific Science Center! 🌊



Mark Buckley outside the USGS Pacific Science Center, Santa Cruz, California.



Steve Watt and his wife **Janet** on a recent trip to New Zealand. **Janet** works in the Geophysical Unit of Menlo Park (GUMP) at the USGS office in Menlo Park, California.

Another Good Showing by USGS Paddlers in Outrigger-Canoe Races

By Amy Draut

Four scientists from the U.S. Geological Survey (USGS)'s Pacific Science Center formed a team to paddle in the 15th Annual Aloha Outrigger Canoe Races held on Sunday, August 19, in Santa Cruz, California. The outrigger races, featuring 32 teams, were part of a Polynesian cultural festival held annually on the Santa

Cruz Municipal Wharf. This year's USGS team, **Bruce Jaffe**, **Kurt Rosenberger**, **Doug George**, and **Amy Draut**, had more than enough motivation and enthusiasm to make up for a lack of experience in paddling together. The team, named Pohaku Mana (Hawaiian for "Magic Rocks"), made it to the third (semifinal) round of

competition, where they lost to the eventual second-place finisher, Team Seafood. After being eliminated, the USGS team (along with coworkers, family, and friends in their cheering squad) stayed to watch the final, where the top two teams finished only 0.4 seconds apart.

(Outrigger Races continued on page 12)

Staff and Center News, continued

(Outrigger Races continued from page 11)

This is the second year that USGS personnel have participated on their own time in the annual outrigger races. (Read about last year's race in *Sound Waves*, September 2006, URL <http://soundwaves.usgs.gov/2006/09/staff.html>.) For more information about this year's race, see two articles in the *Santa Cruz Sentinel* at URLs <http://www.santacruzsentinel.com/archive/2007/August/17/style/stories/13style.htm> and <http://www.santacruzsentinel.com/archive/2007/August/20/sport/stories/02sport.htm>.

The USGS group plans to enter the race again next year, and invites any other would-be paddlers to come along. 🌟

Team Pohaku Mana (left to right): Bruce Jaffe, Kurt Rosenberger, Amy Draut, and Doug George (with Doug's nephew Daniel, the team mascot).

Team Pohaku Mana heading to the starting line to compete in the semifinals.



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