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# Seismic Testing of Old Navy Pier Shows What Could Happen During ‘Big One’

If recent seismic tests at the Port of Long Beach are any indication, old working piers in California may be less prone to collapse during moderate earthquakes than previously thought.

This was a conclusion from a series of field experiments funded by the National Sea Grant College Program and led by engineering professor Scott Ashford of UCSD’s Jacobs School of Engineering and graduate student Sean Walsh. In May, they vibrated, shook and pushed on a former Navy pier to gauge how the 50-year-old, 1000-foot structure would respond to ground shaking—and to validate new seismic design criteria for marine oil terminals in California.

The most dramatic experiments were so-called “lateral load tests” in which a series of hydraulic pistons were configured so that they would push against one side of the pier. Under extreme loads, sustained over long periods of time, sections of the upper part of the pier were eventually displaced four feet relative to the base of the pier’s piles, about 40 feet beneath the waterline. The resulting structure resembled some kind of odd rendition of the leaning tower of Pisa, with modern touches of cracked concrete and bent metal reinforcement. Significantly, however, the tilted pier never collapsed. “We were all surprised by how ductile it was,” Ashford said. “More ductile means more earthquake resistant. It just kept on going. We kept pushing it, and it did not fail. We expected the pier to perform poorly.”

The San Andreas fault, along with its complex network of sister faults, makes California one of the most seismically active regions in the country. Because of the region’s high seismic risk, building codes for homes, hospitals and schools in California are among the strictest in the nation. The State Lands Commission is now implementing new



Instruments called accelerometers record how the pier moves in response to an applied force. By placing three of these instruments at right angles to each other, all accelerations in the horizontal and vertical directions are recorded.



The metal pole is an “actuator,” a giant hydraulic piston. With great force, it pushes against the side of the pier. Photos: UC San Diego, Department of Structural Engineering

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A 5,000-pound rotating shaker vibrates sections of the pier at different frequencies to identify the structure's natural harmonics from which structural characteristics such as stiffness are inferred. More vigorous shaking simulates ground motions that might be felt during an earthquake.

#### Seismic Testing (continued)

design criteria that will extend this level of protection to marine oil terminals—huge piers where supertankers pipe oil into holding tanks on land. The goal is to reduce the chances that moderate earthquakes will cause disastrous oil spills. There are about 60 marine oil terminals in ports such as Long Beach, Oakland and Los Angeles that may need retrofitting to meet new standards.

Ashford and Walsh's experiments were designed to gather information on how to retrofit these piers, with a broader goal being to revitalize the nation's port infrastructure. As they continue to analyze data gathered during the tests, what is learned will be shared with port authorities, oil companies and other interested parties in a series of educational workshops to be held at all major ports in the state.

An ultimate goal is to develop computer models that engineers and port designers can use to simulate how a structure might respond during an earthquake. The data gathered from this project is making it possible for Ashford and Walsh to

truth-check these still primitive models. "These tests will give us some confidence that when we use our computer models, they are predicting what will happen in reality," Ashford said.

It is rare that engineers have an opportunity to conduct full-blown, destructive tests on real marine structures. Usually, seismic tests are performed on model structures

put on shake tables. The opportunity to conduct field tests on Pier 3 arose only because the Port of Long Beach planned to demolish the pier as part of its \$500 million upgrade of port infrastructure.

The Long Beach/Los Angeles port complex has become America's gateway to Asia. Together, they handle more containers than any other port complex in the nation. The State Lands Commission, the Port of Long Beach, the Port of Los Angeles, and the construction companies Manson Construction-Connolly Pacific JV, Han-Padron Associates, and Penhall Company provided support for Ashford's research. ■ ■ ■



A hydraulic piston bolted to two sections of the pier slowly expands, subjecting the pier to lateral loads that might be experienced during an earthquake. Photos: UC San Diego, Department of Structural Engineering

# Growth Hormone Promotes Fish Growth



In a discovery that could have broad ramifications for finfish aquaculture operations around the world, a Sea Grant scientist has shown that recombinant bovine growth hormone accelerates growth rates in tilapia.



Tilapia aquaculture facility. Photo: LaDon Swann, Mississippi-Alabama Sea Grant Consortium

The hormone, known by its acronym rBGH or BST and sold under the trade name Posilac by Monsanto Company, is widely used by the dairy industry to increase milk production. The hormone is a synthetic version of naturally occurring bovine somatotropin produced in a cow's pituitary gland.

In experiments led by Hawaii Sea Grant Director Gordon Grau, in collaboration with California Sea Grant and Monsanto, tilapia (*Oreochromis mossambicus*) injected with Posilac, after four weeks, had grown to be almost twice the size of control animals, a significant increase given that cows produce only about 10 percent more milk on the hormone. In a parallel study led by Ernest Chang of UC Davis, the hormone was shown to

have no effect on growth rates in shrimp.

Tilapia are a group of fish native to Africa. They are high in protein, mild tasting and hearty to the stresses of intensive aquaculture.

Because they are so easy to raise and good tasting, tilapia are now the third most valuable farmed seafood product in California, trailing catfish and hybrid striped bass. They are also a major seafood import. About 82 million pounds, worth about \$100 million, were imported into the United States in

2001. Virtually all of this was farmed product, and almost half was from China.

Though Grau's experiments show that it is theoretically possible to boost growth rates with the hormone, thereby decreasing feed

costs and increasing production, Posilac is not yet ready for commercial aquaculture use. To obtain his results, Grau injected each tilapia individually. This kind of tedious, time-consuming work is infeasible at large farms where thousands of fish are harvested daily.

"This growth hormone is not something that is going to be practical overnight," Grau said. "We were interested in seeing whether it would work in fish. It does. This motivates further studies." Industry needs to look at how to administer the hormone, perhaps by immersing fish in hormone baths, he said. Putting the hormone in feed is not effective because the fish's gastric juices digest the hormone, breaking it into its constituent amino acids.

Grau became director of Hawaii Sea Grant in 2000 and maintains an academic position at the Hawaii Institute of Marine Biology on Oahu. While a postdoctoral student at UC Berkeley, he studied growth in salmon with California Sea Grant support. ■ ■ ■



Tilapia are very popular food fishes in Africa and Asia, and are becoming increasingly appreciated in the United States, particularly on the East Coast. Photo: Andre P. Seale

# Sea Grant a Gatekeeper for New FAO Website

The Food and Agriculture Organization (FAO) of the United Nations has selected program manager Pamela Tom of the California Sea Grant Seafood Technology Program to be one of its “gatekeepers” for FishPort, a new website on fish and seafood safety.

FishPort ([www.fishport.org](http://www.fishport.org)) is the cornerstone of the FAO’s Aquatic Food Product Initiative, unveiled in Rome last spring and supported jointly by the Canadian Food Inspection Agency. The goal of the initiative is to make cutting-edge information on fisheries and seafood science equally accessible to both developed and developing countries so that all nations have opportunities to improve the quality and safety of their seafood products.

As gatekeepers, Tom and other experts within the international scientific community will review submissions to FishPort to ensure all posted information is scientifically valid and relevant. The group will also be charged with steering the operational framework and implementation of the site.



FAO has asked Pamela Tom, manager of the Seafood Technology Program, to be a “gatekeeper” for its new website on seafood safety and quality.

Grimur Valdimarsson, director of the FAO’s Fishery Industries Division, says he envisions FishPort as becoming a leading source of up-to-date fish and seafood science information.

California Sea Grant is proud to be part of this important global initiative. ■ ■ ■

# Where Are They Now? Former Sea Grant Fellow Lands Faculty Position at U. Mass

Former NOAA Fisheries/National Sea Grant Fellow Sylvia Brandt has landed a coveted tenure-track position in the Department of Resource Economics at the University of Massachusetts, Amherst.

An economist with a doctorate from UC Berkeley, Brandt studies one of the hottest topics in fisheries management: ITQs, or individual transferable quotas, a system of management in which fishermen are allocated shares in a fishery and may buy and sell their shares, through a free-market system similar to how stocks on Wall Street are traded.

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Sylvia Brandt was awarded a NOAA Fisheries/Sea Grant Fellowship in resource economics in 2000. In 2002, she became a faculty member at the University of Massachusetts, Amherst.



Seafood is an important source of protein for people around the world. Shown here, workers in India harvest carp raised in an inland aquaculture pond. Photo: I. de Borhegyi for FAO

# Isaacs Scholarship Awarded...Glow from Brittlestars Tells Story of Toxicity

**M**arwa Kaisey, a recent graduate of La Jolla High School, has won this year's prestigious John D. Isaacs Memorial Scholarship for her research on the toxicity of heavy metal contamination in San Diego Bay.

California Sea Grant announced her award at the 52nd annual California State Science Fair in spring 2003. Her project, "Brittlestar Bioluminescence: An Indicator of the Toxicity of San Diego Bay," also won First Place in the environmental sciences division of the Greater San Diego Science and Engineering Fair.

John D. Isaacs was a world-renowned oceanographer and an ardent supporter of California Sea Grant. The Isaacs Scholarship, established in 1981, the year after his death, is awarded to promising young scientists in the hopes of continuing his legacy of scientific achievement, innovation and thoughtful regard for marine life.

In the project that earned her an Isaacs Scholarship, Kaisey examined the biologically available component of metal contamination in San Diego Bay, using the "glow" from bioluminescent brittlestars as an indicator of toxicity. Brittlestars, starfish-like creatures, emit a dimmer-than-usual glow when exposed to heavy metals. The dimmer the glow, the more toxic the environment.

Kaisey was able to show that sediments from murkier inner reaches of the harbor were less toxic than those from the Bay's mouth.

This surprising find, she theorized, is due to suspended particulate matter. Particulates give metals something on which to adhere. Once bound to particulates, metals are unavailable for absorption. Although the inner bay is highly polluted, suspended particulate matter attenuates its toxicity. At the



Marwa Kaisey, a first-year student at UCLA, and winner of the 2003 Isaacs Scholarship. Photo: Lee Salem

mouth, where water clarity is good, metals roam freely, and thus have greater opportunity to poison brittlestars.

Kaisey is using her \$12,000 Isaacs scholarship to attend UCLA, where she plans to major in either biology or marine biology.

"I definitely want to pursue science," Kaisey said. "Through the Isaacs Scholarship and the Ocean Bowl, I've taken an interest in marine science. It's fun and it's definitely something I want to pursue." Kaisey was captain of her school's Ocean Science Bowl team and was recently awarded one of only four National Ocean Scholar Program awards from the Consortium for Oceanographic Research and Education for her participation in the competition.



San Diego Bay ranks as one of the most polluted bays in the nation. The main source of heavy metal contamination is copper leached from antifouling hull paints. Photo: Fred Greaves

Fellow Lands Faculty Position (continued)

Brandt's current research is an offshoot of what she studied while a resource economics fellow with NOAA Fisheries and Sea Grant. Much of her research, then and now, focuses on understanding the socioeconomics of the \$48-million-a-year surf clam fishery, one of only two commercial fisheries in America managed under an ITQ management system, the other being the longline sablefish and halibut fishery on the West Coast.

"The fellowship made a huge difference for me," Brandt said. "If one thing in all my graduate school made my thesis doable and of high quality, it was the NOAA/Sea Grant fellowship. It was not just the money but becoming part of a network of people. I appreciate it quite a bit."



It may be fisheries managers, however, that end up thanking Brandt for her early interest in incorporating sociology and economics into analyses of fisheries policies. The Bush administration has voiced its support of market-based incentives for fisheries management, and a moratorium on establishing new ITQs ended in 2002. "I am now studying how fishermen behave when they anticipate a policy change and how to incorporate this behavior into policies," Brandt said. ■ ■ ■

Sablefish longliners unfurl lines a mile in length with hooks every 15 to 20 feet. Photo: John Bortniak, NOAA Corps.