

# SEA GRANT NEWS

“Science Serving California’s Coast”

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**Photo credits:**

**Cover photo: Dennis Darnell—In bigger surf, drifters were sometimes recovered with the help of a jet ski. Shown driving is marine technician Bill Boyd with Marissa Yates, a physical oceanography graduate student holding the recovered drifter.**



**Left: graduate students, postdoctoral fellows and one of the technicians who helped with the drifter experiments. Below: a volunteer floats passively beside a drifter he released. Photos: Dennis Darnell**



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# Common Synthetic Fragrances Harmful to Marine Life

## WHAT CAN YOU DO?

- Buy unscented or “eco-friendly” personal care products, or cut back on those you are currently using.

## FACTS

- In 2000, about 4,000 tons of polycyclic musks—a common group of synthetic musks—were used in products worldwide.
- The findings from this Sea Grant research project extend recommendations in a National Research Council report, commissioned by the EPA and published in July 2002. The report states: “For odorants commonly present in biosolids, the EPA should move aggressively to develop acute toxicity values for use in assessing the risks posed by these chemicals and should support research on the interaction between these chemicals and pathogens in causing human disease.”

California mussels (*Mytilus* sp.).  
Photo: Sherry Ballard©California Academy of Sciences

Artificial fragrances in perfumes, soaps, shampoos, cosmetics, air fresheners and scores of other personal health care products are widely regarded as nontoxic. Nontoxic, however, does not mean safe for the marine environment, as a new California Sea Grant study shows. In a series of experiments with California mussels, scientists have discovered that synthetic musks, while not directly harmful to an organism, increase its sensitivity to toxic agents in the environment. The finding raises concerns that these very common household compounds may pose unanticipated environmental as well as human health risks.

In their research, published recently in *Environmental Health Perspectives*, the journal of the National Institute of Environmental Health Sciences, Stanford University postdoctorate fellow Till Luckenbach and professor David Epel showed that synthetic musks compromise a cellular defense mechanism that normally prevents toxins from entering cells. Synthetic musks intensify the toxicity of other pollutants by interfering with efflux transporter proteins embedded in cell membranes. These proteins pump many kinds of toxins out of cells. When these proteins are “overwhelmed” by foreign compounds, toxins that would normally be excluded can accumulate, causing cellular damage.

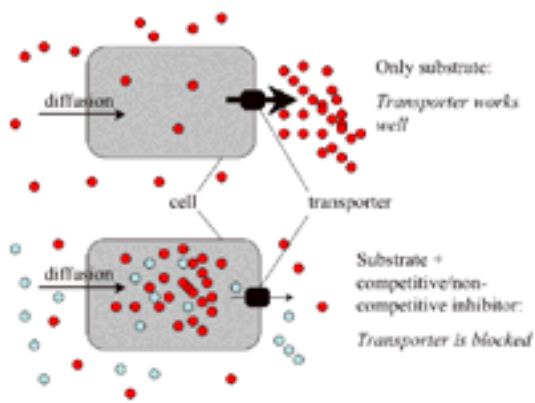
Because synthetic musks are not degraded by sewage treatment and because they are common in personal health care products, they continuously enter waterways via sewage discharges and runoff. The compounds also accumulate in the tissues of fish and invertebrates as well as in human adipose tissue, blood plasma and breast milk. Despite their pervasiveness and ability to bioaccumulate, their toxicity and environmental risk generally have been considered low, Epel said. Musk xylene is an exception to this. As a result of human health concerns, its use was discontinued in Japan and Germany. Although still used in the United States, it is no longer added to lipsticks and other products that can be easily ingested.

Luckenbach and Epel’s goal was to examine whether synthetic musks might also pose a health risk by compromising an animal’s “xenobiotic defense system”—the



process by which efflux proteins remove toxins from cells. To test this, mussels collected near the Hopkins Marine Station in Pacific Grove, California, were exposed to six commercial synthetic musks. Gills were carefully sliced from living mussels and placed in water containing low concentrations of synthetic musks—300 parts per billion or less. After two hours of expo-

sure, gills were removed, washed and placed in musk-free water with a special red fluorescent dye.



When efflux transporter proteins function normally, they remove toxins (red dots) from a cell. When the transporter does not function normally, toxins accumulate. Synthetic musk compounds have been shown to impair transporter proteins in mussels, increasing the animals' exposure to otherwise excluded toxins in the environment. Photo: Epel laboratory, Stanford University

Under normal conditions, efflux transporters in the gill tissue would recognize the dye as a foreign compound and remove it. If the transport mechanism were impaired, however, dye would be expected to accumulate in cells. This is exactly what was observed.

Gills exposed to synthetic musks accumulated dye at much higher concentrations than control groups. Normal cell functioning continued to be impaired 24 to 48 hours after exposure ended. The scientists called this finding “troubling” since it implies that brief events such as sewage or chemical spills could have lasting environmental effects.

Because humans and mammals also have xenobiotic defense systems, the findings potentially have implications for human health. Human cells use the same efflux transporter mechanism as mussels, Epel explained. Understanding this mechanism is a topic of cancer research. In cancers unresponsive to chemotherapy, for example, it is thought that efflux proteins may be responsible for preventing chemicals from entering—and then killing—cells. These cellular pumps recognize a large number of chemically unrelated compounds, which is why broad resistance to treatment is called multi-drug resistance or multidrug resistance (MDR).

The experiments with mussels, Epel said, raises the possibility that people exposed to musks and other xenobiotics might have impaired xenobiotic defense systems and hence might be increasing their exposure to normally excluded toxins.

“One of the assumptions about these chemicals is that they are regarded as environmentally low risk compared to pesticides and oil products,” Epel said. “This is the first study to show that some personal care products in

water do have an effect, even in low concentrations. Our results indicate that the effects on the first line of defense might be irreversible or continue long after the event. It’s a warning sign. It’s a smoking gun. Are there other chemicals out there that have similar long-term effects? Could these be harming these defense systems in aquatic organisms? And could they be having similar effects in humans?”

In addition to receiving California Sea Grant funding, this research was conducted with support from the German Academic Exchange Service and the California State Resources Agency. ■ ■ ■



Biologist David Epel tested the effects of synthetic musk compounds on defense systems of mussels.



Till Luckenbach, a postdoctoral fellow in the Epel laboratory, was the lead author of the study. Photos: Chris Patton, Stanford University

# Drifter Experiment to Study Dispersion in Surf Zone

In early November, a group of physical oceanographers, technicians and graduate student volunteers released and recaptured a set of drifters just north of the famed Black's Beach surfing area in La Jolla. The fieldwork was part of an ongoing effort to understand the complex process of dispersion in the surf zone.

In simple terms, dispersion is a measure of dilution and mixing, akin to pouring cream in a mug of black coffee and stirring. The blob of cream stretches, folds and twists, slowly losing any recognizable form. Eventually, all semblance of the blob disappears, as the black coffee turns uniformly lighter in color.

If scientists understood dispersion in the mug, and knew how vigorously the coffee was stirred, they could model the spread of cream through the cup. In a sense, this is what Sea Grant researchers Falk Feddersen and Bob Guza of Scripps Institution of Oceanography are trying to do, but for the surf zone. They are seeking to understand how blobs of water, sewage, runoff pollution, plank-

tonic larvae or fish eggs, for example, are dispersed in the surf.

To gather the data that will make this possible, they released pairs of drifters at set locations in the surf zone. The degree to which these pairs separated as they floated along is a measure of dispersion. Drifters that moved together indicate areas where dispersion was weak. In areas where the pairs took markedly different paths, dispersion was strong.

Currently, Feddersen and colleagues are checking the quality of the raw data they gathered during the two-day field experiment. As the data are cleaned up, the researchers will produce maps showing the drifters' paths through the surf. They will then compare these maps to



Surf-zone drifters deployed for the experiment. Sea Grant funding helped in their design and testing. The drifters' long antennas receive signals from GPS satellites and a computer inside logs raw GPS data. Each drifter also broadcasts its position to a radio receiver located on the Scripps Institution of Oceanography pier.



Kent Smith, a marine technician, carries a drifter from the surf. The drifter was released on a day when waves were often over head-high. A prevailing strong alongshore current swept this drifter southward. Photos this page: Christina S. Johnson

ones generated by numerical models of surf-zone dynamics. As the science progresses, it is hoped that simulations of surf-zone dynamics can be integrated into larger-scale, coastal ocean circulation models. This would enable coastal managers, fisheries biologists and others involved in marine science to begin to see linkages between the California Current system and the surf zone. ■ ■ ■

# “Don’t Release” Campaign Aims to Stem Tide of Aquatic Invasions

**A**lthough most invasive species enter as hitchhikers on ships, aquarium owners and the pet trade unknowingly complicate the challenges of dealing with aquatic species invasions by releasing aquatic plants and animals into local waterways and storm drains.

A new public education campaign “Habitattitude”—unveiled this fall at Super Zoo, a large pet industry trade show in Las Vegas—teaches aquarists, backyard pond owners and water-garden hobbyists about the dangers of releasing and promotes simple actions for people to take when faced with an unwanted plant or fish.

Look for the “Habitattitude” logo on fish bags, new aquariums and brochures at pet stores and nurseries near you.



The U.S. Fish and Wildlife Service, the Great Lakes Sea Grant Network and the Pet Industry Joint Advisory Council are partners on the “Don’t Release” Habitattitude campaign. ■ ■ ■



Hydrilla shown growing in aquarium. The pernicious qualities of this fast-spreading aquatic plant have affected both natural and man-made ecosystems. Photo: California Department of Food and Agriculture

## Seafood Quality Workshops Held

**M**ore than 80 percent of the seafood that Americans eat is imported from about 160 countries. Keeping that food supply safe was the topic of recent workshops that taught attendees how to assess the quality of three popular seafoods – tuna, mahi and shrimp.

Approximately 20 people were trained November 3–4, 2004, at two workshops designed for U.S. seafood importers, processors, overseas exporters and third-party seafood inspectors. The workshops were sponsored by the National Fisheries Institute in partnership with California Sea Grant, the



After workshop attendees tried their hand at scoring fish samples, James Barnett, the U.S. Food and Drug Administration’s national sensory expert, discussed how he would have scored each sample. Photos this story: Christina S. Johnson

U.S. Food and Drug Administration and the U.S. Department of Commerce’s Seafood Inspection Program.

For more information about these November workshops, visit the web at [www.csgc.ucsd.edu](http://www.csgc.ucsd.edu). For information on future workshops, visit California Sea Grant’s Seafood Technology web site at <http://seafood.ucdavis.edu> or call Pamela Tom, Program Manager, at 530-752-3837. ■ ■ ■



Kenneth Cusak, a lab manager at Certified Laboratories, Inc., a third-party seafood-inspection company, smelling a tuna steak for any slightly sour or cheesy odors indicative of spoilage.

# California State Fellows Update

California Sea Grant is currently sponsoring two State Fellows in marine policy.

Leah Akins, a recent master's graduate in marine ecology at UC Davis, is working at the California Resources Agency's Ocean Resources Management Program in Sacramento. Becky Stamski, a recent master's graduate in earth science from UC Santa Cruz, is spending her nine-month fellowship at the Monterey Bay National Marine Sanctuary.

Akins is working with Brian Baird, assistant secretary for ocean and coastal policy, to implement the state's new ocean action plan, which was crafted in response to—and in support of—the recent report by the U.S. Commission on Ocean Policy. California Governor Arnold Schwarzenegger's plan, unveiled in October, established the Ocean Protection Council and set aside \$31 million to improve ocean protection and ocean monitoring, and related issues.

Becky Stamski is working with Andrew DeVogelaere, the research coordinator at the Monterey Bay National Marine Sanctuary, on developing a better understanding of coastal erosion and the effects of coastal structures such as seawalls in the sanctuary. The sanctuary is aiming to take a region-wide, proactive approach to coastal erosion and armoring, Stamski said. Her work will help the sanctuary develop these policies. ■ ■ ■



As a graduate student in marine ecology at UC Davis, Leah Atkins studied how the supply of larvae to shore affects intertidal crab populations around Point Reyes. As a California Sea Grant State Fellow, she is learning how to use marine science to improve ocean policy and management. Photo: Megan Donahue



California Sea Grant State Fellow Becky Stamski on the R/V *Shearwater*. The research vessel is towing a video camera mounted to an underwater sled. Live video images of the sea floor are used to map geologic features in the Monterey Bay National Marine Sanctuary. Photo: Bob MacKnight

# New Online Publications

California Sea Grant Communications publishes short summaries of new, ongoing, and recently completed research, education and outreach projects.

These summaries are written for a non-technical audience and list references to relevant peer-reviewed research articles for more in-depth discussions of issues. Online versions of these handy one-page Project Profiles can be downloaded at: <http://www.csgc.ucsd.edu/RESEARCH/ProjProfIndx.html>.



