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### **For Immediate Release**

Note to reporters/editors: Sidebar, photos and graphics are available.

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### **Common Synthetic Fragrances Harmful to Marine Life**

Artificial fragrances in perfumes, soaps, shampoos, cosmetics, air fresheners and scores of other personal health care products are widely regarded as nontoxic. Non-toxic, 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 toxic 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. The results were published recently in *Environmental Health Perspectives*, a journal of the National Institute of Environmental Health Sciences.

In their research, Stanford University postdoctoral 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. Due to 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 ingested easily.

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 do this, mussels collected near the

Hopkins Marine Station in Pacific Grove, Calif., were exposed to six commercial synthetic musks. Gills were carefully sliced from living mussels and placed in water containing very low concentrations of synthetic musks – 300 parts per billion or less. After two hours of exposure, gills were removed, washed and placed in musk-free water with a special red fluorescent dye.

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 multixenobiotic resistance (mxr).

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



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