

*The Donaldson Lecture Series**Interdisciplinary Topics in Chemistry, Chemical Engineering and Materials Science,
and Mechanical Engineering sponsored by the Donaldson Company**Mimi Koehl**Robert and Virginia Gill Professor in Natural History
Department of Integrative Biology
University of California, Berkeley***TUESDAY, NOVEMBER 28, 2006****4:00 P.M. • 100 SMITH HALL***Settling down: How do larvae of bottom-dwelling marine organisms land in the right place?***A RECEPTION WILL FOLLOW THIS SEMINAR IN THE
DALE SHEPARD ROOM OF COFFMAN UNION**

Abstract: Many bottom-dwelling marine animals produce microscopic larvae that are dispersed to new sites by ambient water currents. How do these larvae manage to land in suitable habitats? We addressed this question using larvae of the sea slug, *Phostilla sibogae*, which must land on reefs where their prey, the coral *Porites compressa*, are abundant. We conducted field and wave-flume studies of how water, dissolved chemical cues released by *Porites*, and larval-mimic particles move above and within Hawaiian coral reefs subjected to turbulent wave-driven water flow. We found that chemicals leaching from corals are strained and dispersed as fine filaments swirling in the waves above a reef. Therefore, microscopic organisms like larvae swimming in turbulent flow encounter odors as rapid on-off pulses. On the microscopic scale, we assessed how the ciliary swimming by the larvae and their ability to adhere to surfaces in moving water were affected by realistic patterns of encounters with chemical cues from *Porites*. By combining these data about larval behavior with data about spatially and temporally varying patterns of water velocities and cue concentrations above a reef, we calculated that rates of transport of larvae to a reef are enhanced by their responses to cues released from the reef.

WEDNESDAY, NOVEMBER 29, 2006**4:00 P.M. • 2-470 PHILLIPS-WANGENSTEEN***Sniffing by hairy noses: Odor capture by crustacean antennules in turbulent environment*

Abstract: Odors are dispersed in the environment by turbulent wind or water currents. The first step in smelling is capture of odor molecules from the surrounding fluid. Many animals capture scents using olfactory antennae bearing arrays of chemosensory hairs. We studied the fluid mechanics of odor capture by the hairy olfactory antennules of a variety of marine animals (lobsters, crabs, mantis shrimp). Experiments with dynamically-scaled physical models of antennules showed that these animals “sniff” (i.e. take discrete samples of the water) by flicking their antennules; water only penetrates the chemosensory hair array during the flick downstroke. In a laboratory flume, we used planar-laser-induced fluorescence to reveal how flicking antennules of different designs interact with the spatial and temporal patterns of concentration of odors as they are dispersed by turbulent ambient water flow above the substratum. On the scale of an antennule, an odor plume is not a diffuse cloud, but rather is a series of fine filaments of scent swirling in odor-free water. The spatial pattern of these filaments depends on distance from the odor source. When water penetrates the chemosensory hair array during a flick, it carries these fine-scale patterns of concentration into the receptor area, where they are retained until the next flick. Thus, the physical act of sniffing captures snapshots of the fine-scale structure of an odor plume.

Mimi Koehl [<http://ib.berkeley.edu/labs/koehl>] is Robert and Virginia Gill Professor in the Department of Integrative Biology at the University of California, Berkeley. She studies the physics of how organisms interact with their environments, focusing on issues such as how microscopic creatures swim and capture their food, how wave-battered marine plants and animals avoid being washed away, how olfactory antennae catch odors from the air or water around them, how flight evolved, and the “skeletal” design of squishy animals like worms and sea anemones. She earned her Ph.D. in Zoology from Duke University, and after postdoctoral work at Friday Harbor Laboratories (University of Washington) and in England (University of York) she was on the faculty at Brown University before moving to Berkeley. Mimi’s awards include a Presidential Young Investigator Award, a Guggenheim Fellowship, a MacArthur “genius grant,” the Borelli Award (American Society of Biomechanics, for outstanding career accomplishment), and the Rachel Carson Award (American Geophysical Union). She is a member of the National Academy of Sciences and the American Academy of Arts and Sciences. She is also the heroine of a children’s book (*Nature’s Machines*) that is part of the National Academy of Sciences’ series “Women’s Adventures in Science.”