Johns Hopkins University, Department of Mechanical Engineering
2020 Fall Virtual Seminar Series: Class 530.803

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"Navigating in a turbulent environment"

Presented by Professor Mimi Koehl
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When organisms locomote and interact in nature, they must navigate through complex habitats that vary on many spatial scales, and they are buffeted by turbulent wind or water currents and waves that also vary on a range of spatial and temporal scales. We have been using the microscopic larvae of bottom-dwelling marine animals to study how the interaction between the swimming or crawling by an organism and the turbulent water flow around them determines how they move through the environment. Many bottom-dwelling marine animals produce microscopic larvae that are dispersed to new sites by ambient water currents, and then must land and stay put on surfaces in suitable habitats. Field and laboratory measurements enabled us to quantify the fine-scale, rapidly-changing patterns of water velocity vectors and of chemical cue concentrations near coral reefs and along fouling communities (organisms growing on docks and ships). We also measured the swimming behavior of larvae of reef-dwelling and fouling community animals, and their responses to chemical and mechanical cues. We used these data to design agent-based models of larval behavior. By putting model larvae into our real-world flow and chemical data, which varied on spatial and temporal scales experienced by microscopic larvae, we could explore how different responses by larvae affected their transport and their recruitment into reefs or fouling communities. The most effective strategy for recruitment depends on habitat.

Mimi Koehl, a Professor of the Graduate School in the Department of Integrative Biology at the University of California, Berkeley, earned her Ph.D. in Zoology at Duke University. She studies the physics of how organisms interact with their environments, focusing on how microscopic creatures swim and capture food in turbulent water flow, how organisms glide in turbulent wind, how wave-battered marine organisms avoid being washed away, and how olfactory antennae catch odors from water or air moving around them. Professor Koehl is a member of the National Academy of Sciences and the American Academy of Arts and Sciences, and is a Fellow of the American Physical Society. Her awards include a MacArthur "genius grant", a Presidential Young Investigator Award, a Guggenheim Fellowship, the John Martin Award (Association for the Sciences of Limnology and Oceanography, for "for research that created a paradigm shift in an area of aquatic sciences"), the Borelli Award (American Society of Biomechanics, for "outstanding career accomplishment"), the Rachel Carson Award (American Geophysical Union, for "cutting-edge ocean science"), and the Muybridge Award (International Society of Biomechanics "highest honor").