In summer 2009, a team of Stanford University researchers began an collaboration between ecologists, biomathematicians and engineers at the Hopkins Marine Station (see Fig. 1). This is one of Stanford's Environmental Venture Projects (EVP), funded by the Woods Institute for the Environment. It is under a larger initiative to establish a Marine Life Observatory, which is to provide long-term data on the health and functioning of nearshore marine ecosystems.

Our goal is to reveal how small-scale physical and biological processes affect nearshore fish assemblages and kelp forest ecosystem functioning.

Environmental Coastal Engineering:
To develop a kelp forest observatory to identify key physical processes affecting fish populations in a marine protected area (MPA).

Ecology:
To quantify the effect of nearshore hydrodynamics and environmental conditions on rocky-reef fish behavior, abundance, recruitment and juvenile survivorship and to identify the mechanisms that link physical, environmental and biological processes.

Marine Management and Conservation:
To optimize monitoring of juvenile and adult fish assemblages in nearshore habitats and assessments of the efficacy of MPAs by accounting for influences of local hydrodynamic and environmental regimes.

Simultaneously, inexpensive underwater moorings were placed in the kelp forests off Hopkins Marine Station. Moorings monitored local swell with an Underwater Relative Swell Kinetics Instrument (URSKI), a new technology developed by Jared Figurski and PISCO. UR SkiS were located at 5-, 10-, 15-, and 20-meter depths generated an in situ index of relative swell intensity.

With UR SKIs properly calibrated and logging swell data (local scale, 10-1000s m), SCUBA divers surveyed local habitat and juvenile- and adult-fish assemblage structure. Each of the four depths had three replicate transects, forming a survey design of 12 permanent transects between 5 and 20 meters in the kelp forest. PISCO-style fish surveys were conducted under a variety of swell conditions in mid-water and benthic transects. For all juvenile and adult fish, divers recorded species composition, location, density, and size structure (to the nearest cm). Divers completed an average of two dives (-12 transects) each day, 2 days a week, for 5 weeks.

1. Basic information about connections between physical and environmental variability and fish distribution, which will inform the rational design of surveys and management of nearshore environments and MPAs (see Fig. 3).
2. A new model for monitoring and understanding the dynamics of nearshore marine ecosystems, emphasizing fine-scale physical-biological coupling.
3. Improved understanding of flows in a complex nearshore kelp forest environment.
4. A prototype of a real-time monitoring system and automated survey technologies in nearshore environments, which can be replicated in California and other coastal regions.

The long-term goal of the Hopkins Marine Life Observatory is to provide time-series data on the health and functioning of marine ecosystems of the central California coast. It will serve as an autonomous observation platform, offering new mechanisms for collecting, synthesizing and disseminating marine ecosystem data (see Fig. 4).

The Marine Life Observatory is fundamental to Stanford's solution-oriented goals and the Center for Ocean Solutions, which aims to mesh the basic science function of marine scientists with policy decision-making. Its mission is to answer questions about the impact of management or environmental changes on marine life.

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