COLLABORATION AMONGST THE KELP:

PROVIDING CRITICAL DATA AND MECHANISTIC UNDERSTANDING FOR MARINE MANAGEMENT

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PROJECT OVERVIEW

In summer 2009, a team of Stanford University researchers began a collaboration between ecologists, biomechanists 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 will provide long-term data on the health and functioning of nearshore marine ecosystems.

GOALS

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

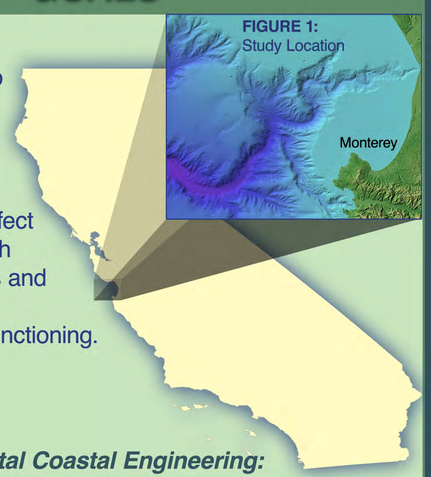


FIGURE 1: Study Location

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.

PILOT BUOY 2009

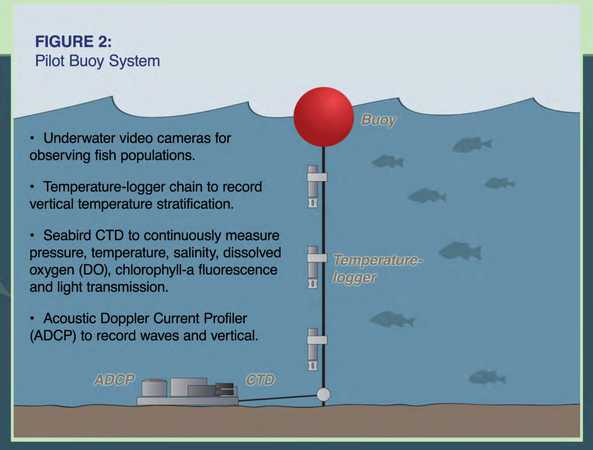
Automated Surveys of Physical Conditions:

In October 2009, the EVP team deployed two pilot buoy systems, one at 10-meters depth and the other at 20-meters depth. Each buoy system contains the following sub-surface equipment (see **Fig. 2**).

Instruments log autonomously for approximately one month, before SCUBA divers must recover, download data, and redeploy instruments. Recorded measurements add to wave data already being collected by a Datawell wave rider buoy, installed off Hopkins in late 2008. Real-time data for the Datawell buoy are displayed on a new webpage at **http://mlo.stanford.edu/buoy.htm**.

Within a kelp forest environment, we tested the use of different instruments, technological combinations, and equipment configurations with the 2009 buoy systems. Lessons learned from 2009 are informing the buoy design for the Marine Life Observatory, expected to permanently launch in spring 2010.

FIGURE 2: Pilot Buoy System



SCUBA Surveys of Ecological Conditions:

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. URSKIs located at 5-, 10-, 15-, and 20-meter depths generated an *in situ* index of relative swell intensity.

With URSKIs 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.

EXPECTED RESULTS

FIGURE. 3: Adaptive Sampling Design

Image sources: PISCO, Monterey Bay Aquarium

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.

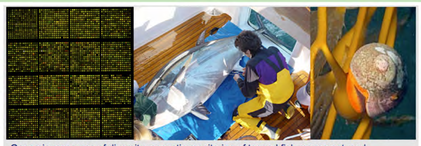
MARINE LIFE OBSERVATORY

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.

FIGURE 4: Hopkins Marine Life Observatory

http://mlo.stanford.edu



Genomic measures of diversity, acoustic monitoring of tagged fish movement, and automatic monitoring of kelp grazing can speed collection of basic ecosystem data for use in basic science and management.

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