ADAPTIVE SAMPLING IMPROVES ASSESSMENT OF MARINE RESERVES FOR FISHERIES

Kristen T. Honey, khoney@stanford.edu, Stanford University

INTRODUCTION:
Physical conditions like swell are expected to affect the distribution and abundance of fish. In addition, SCUBA dive surveys may tend to occur in calm water. Hence, sampling could become biased and under- or over-count fish if swell effects are ignored. Biophysical links between local flow, swell conditions, and fish assemblages have important implications for the monitoring of fish populations and marine reserves, as well as the assessment of California’s Marine Life Protection Act (MLPA).

PURPOSE AND HYPOTHESIS:
The project identified small-scale flow characteristics that can inform researchers about when to count fish to efficiently and accurately characterize populations and ecosystem conditions. The project’s primary objective was to determine if swell conditions can influence the distribution and abundance of fish in the study area.

QUESTION ADDRESSED: How does swell influence fish distribution and abundance?

UNDERLYING HYPOTHESIS: An adaptive sampling procedure to monitor fish assemblages, while considering biophysical processes and swell conditions, will outperform both, in experimental power and cost efficiency, a classical “fixed” sampling procedure that monitors fish at pre-determined times, irrespective of conditions.

RESULTS:
Approximately 150 fish transects were completed in August and September 2009. The total fish count exceeded 1,200 individuals and included 26 different species from 16 genera. Given the high degree of ecosystem variability (see Fig. 2), correlations between swell conditions and fish abundance require additional data for statistical significance (see On-Going Research). For both benthic and mid-water counts, species assemblages demonstrated associations with specific swell conditions:

- More fish were observed in low swell.
- Rockfish observations increased under medium swell.
- Surfperch observations increased under large swell.

MEDIUM-SWELL RESULTS:
MEDIUM SWELL = Daily swell conditions fall within the middle third of the study’s observed range (maximum of range’s lower third to minimum of the upper third, across the 2.5 month study period).

Divers observed fish, including rockfish, more frequently during medium swell than other conditions.

Conditions observed: 66/118 surveys = 55%
Most often observed at: Lover’s and 10-m sites
(see Fig. 1)

Fish counted:
792 individuals: average 12 fish per dive
26 species: 10 belkis spp.
16 genera

CONCLUSIONS:
This pilot study offers insights into how ocean swell conditions affect fish at a local scale. During periods of low and high swell, SCUBA divers observed fewer fish, thereby underestimating some known resident populations like nearshore rockfish. Recommendations for sampling are preliminary, but project results are informing us when to count fish.

The implication for PISCO and marine monitoring programs is that SCUBA divers conduct fish surveys in medium swell, when feasible, and appropriately calibrate other counts (see Fig. 3). Optimal survey designs must include adaptive techniques to account for and correct for potential biases from biophysical interactions between local hydrodynamics and fish assemblages.

ON-GOING RESEARCH:
During summer 2009, fieldwork will be expanded with multiple dive teams and sophisticated automated technology (e.g., cameras, wave gauges, thermistor chains, and ADCPs deployed with Stanford’s Environmental Fluid Mechanics Laboratory, Hopkins, and PISCO). Future research is possible through generous support from Stanford and the Packard Foundation (Hopkins Marine Life Laboratory grant).