Project Title:
Bottom-Up and Top-Down Indicators of Ecosystem Variability: An Integrated Ecosystem Assessment for the California Current System

Principal Investigator(s):
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Goals:
Development of leading ecological indicators for evaluation of the California Current System ecosystem.

Approach:
Using advanced statistical techniques we quantified the relationships between the coastal environment (e.g., wind indices, advection and retention of coastal waters, sea surface temperature, coastal sea level, and the temporal aspects of these factors) and population and community production of sentinel species. We focus on a single trophic chain (i.e., zooplankton, rockfish, seabirds) that correlates to dynamics across the more complex food web along the Central California coast. Once the relationships between environment and biology are quantified, environmental observations can be used to predict biological responses. Hence, an environmentally-based indicator of ecosystem state can be produced.

Work Completed:
A primary goal of FATE is to develop indicators of ecosystem health (state). We have accomplished this goal with the current project. We have used path analysis and partial least squares regression to visualize and quantify links between biological and physical components in the California Current ecosystem and to predict reproductive success at three trophic levels. We examined the applicability of this approach using a hierarchical pattern of environmental indices and relationships previously described in the literature, and quantitative measures of zooplankton, fish, and seabird productivity. We showed each trophic level and community production can be modeled using environmental and biological data in a manner that provides a comprehensive evaluation of physical and biological connectivity and mechanisms. Importantly, our approach to modeling an ecosystem represents a practical middle ground between simple correlative methods typically employed and a complete mechanistic understanding of all physical and biological mechanisms regulating variability in reproductive success.

Applications:
Successful ecosystem-based conservation of marine resources will benefit from quantitative indicators of ecosystem productivity, particularly if such indicators quantify and incorporate the relationships between physical and biological components of the ecosystem simultaneously. Despite previous explorations of relationships between physical processes and resulting biological responses, explicit understanding of mechanistic connections has been elusive. We provide an indicator of ecosystem state based on mechanistic and statistically robust models.

Publications/Presentations/Webpages:

Wells, B.K., J. Field, J. Thayer, C. Grimes, S. Bograd, W. Sydeman, F. Schwing, and R. Hewitt. In review. Untangling the relationships between climate, prey, and top predators in an ocean ecosystem. *Ecology*.

Wells, B.K., J. Field, J. Thayer, C. Grimes, S. Bograd, W. Sydeman, F. Schwing, and R. Hewitt. 2007. Untangling the relationships between climate, prey, and top predators in an ocean ecosystem. *American Fisheries Society Annual Meeting*.

Wells, B.K., J. Field, J. Thayer, C. Grimes, S. Bograd, W. Sydeman, F. Schwing, and R. Hewitt. 2006. Bottom-up modeling to fit central California seabird production to environmental and biological variables. CalCOFI.