**Project Title:** The Dynamics of Adaptation to Climate-Driven Variability in California Current Fisheries And Fishing Communities

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The livelihoods of fishermen who work in large marine ecosystems (LMEs) are heavily influenced by the variability inherent in biological and oceanic systems, as well as by the intrinsic uncertainty of economic and management structures. However, as fishermen attempt to adapt to these changes by moving across fisheries, their actions may strongly impact them and their communities, as well as actively influence local ecosystem dynamics. To date, the linkages between environmental variability and ecological, economic, and social outcomes in LMEs are poorly understood. Efforts to determine how humans influence ecological variability in LMEs, even as they are subject to it, have been limited. Developing this knowledge is important so that regulators may adopt fisheries management approaches that allow fishermen to adapt to environmental variability while at the same time enhancing the social and economic value of fisheries and mitigating risks to both ecosystems and livelihoods. This project addresses these research needs in the context of the fisheries of the California Current LME on the U.S. West Coast. Together, ecologists, economists and social scientists will integrate primary survey and interview research, modeling, and outreach to: 1) understand how environmental variability affects linked social and ecological processes; 2) investigate how more integrated fisheries management can enhance social and ecological resilience; and 3) engage state and federal fisheries managers and fishing communities in the development and application of modeling approaches to better achieve ecological and social goals.

To better operationalize ecosystem-based fisheries management, the researchers will use time series distributions, and to identify ‘portfolios’ of species whose productivity varies synchronously or asynchronously. To better understand fishermen’s patterns of participation across multiple fisheries, this research will combine data from ethnographic interviews and structured surveys of fishermen, with data on fishing participation, revenues and costs, to develop an empirical model of fishing supply behavior that integrates economic motivations (e.g., profits, financial risks, and outside employment opportunities) with non-monetary considerations (e.g., psychological satisfaction from fishing or strong social ties to the fishing community).

Finally, the researchers will integrate the model of fishing supply with models of the population dynamics of key fish stocks under environmental variability to create a coupled ecological-economic simulation model of West Coast fisheries. This model will be used by the researchers, in conjunction with fishery managers and stakeholders, to consider how alternative management approaches may enhance or hamper the resilience of the fishery by affecting fishermen’s adaptive behavior. The model will also enable the researchers to understand how non-monetary social considerations influence the resilience of fishing communities in the face of environmental variability.
Research Plan

**Outcome:** Fishery managers and participants can anticipate, prepare for, and mitigate direct and indirect impacts of climate variation on fisheries and fishing communities.

**Year 1:**
(a) hold a workshop with fishery managers and industry to seek input on research design
(b) conduct a survey and interviews of West Coast fishermen to determine motivations for and benefits from fishery participation;
(c) construct time series of biomass and recruitment for several fisheries of interest along with time series of data on climate and ocean conditions.

**Year 2 & 3:**
(a) construct models of salmon, Dungeness crab, groundfish, albacore and pink shrimp fisheries linked by participation model
(b) interview a sample of West Coast fishermen to examine the social importance of fishing for identity, social networks, and quality of life;

**Year 4:**
(a) use the model to explore scenarios in which climate events impact one or more fisheries directly and others indirectly through participation decisions;
(b) use the model to explore what types of fishing portfolios, for individuals or ports, result in lower variation in income and higher quality of life;
(c) hold a second workshop with fishery managers and industry stakeholders to consider the results of model simulation scenarios.