ICES CM 2014/3064 G:04

Social indicators of community-level vulnerability for the West Coast

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Summary
In a research effort for the U.S. West Coast, we employ a methodology that incorporates a diverse range of secondary data and proxy measures of community attributes with the aim of considering multiple social and ecological dimensions simultaneously. We analyze demographic, geographic, meteorological, quality of life and fisheries-specific data for a set of 2,529 coastal communities in Washington, Oregon and California. A factor analysis applied to these data allows us to examine relative similarities among variables for a set of proposed indices of community vulnerability. Communities can then be compared, relative to one another, according to each vulnerability index provided by the analysis, offering policy-makers and ecologists a potential means of incorporating human communities into ecosystem-based research, models and management approaches.

Introduction
In fisheries and ecosystem social science, we see an emerging effort to test methods for examining and characterizing coastal communities, as well as the relationships between these human communities and their adjacent marine environments. Fisheries management decisions often require consideration of fishing and coastal community-level impacts. An objective of ecosystem-based management, more broadly, concerns the ways in which potential ecosystem shifts, in addition to policy and management shifts, might affect individuals and human communities as integrated components of marine ecosystems. The research presented here uses varied secondary data, extracted and analyzed at the community-level, to provide relative comparisons of risk and vulnerability for the coastal communities adjacent to the California Current Large Marine Ecosystem (CCLME). These analyses may then be incorporated into the CCLME's associated Integrated Ecosystem Assessment (IEA). Our research approach finds its origins in earlier fisheries social science efforts aimed at quantitatively linking evidence of fishing activity to a specific subset of coastal communities, such that marine managers interested in the potential social impacts of proposed policies could identify those communities in which fishing was most socioeconomically salient (Sepez, et al. 2007). The social indicators work presented here builds on this earlier research by considering linkages to the marine environment more broadly, and seeks to provide relative assessments of vulnerability for a range of socioeconomic and biophysical characteristics of coastal communities (Jacob, et al. 2012). Originating in East Coast fisheries social science, the indicators approach has now been adopted by social scientists in all U.S. fisheries management regions (Jepson and Colburn 2013).

Materials and Methods
This method relies on secondary community-level data drawn primarily from the U.S. Census and its annual updates within the American Community Survey (ACS) along with annual fisheries data, both confidential and publicly available fisheries data, maintained and organized by the Pacific Fishery Information Network (PacFIN). Additionally, we examine other publicly available sources for their capacities to provide data pertinent to potential categories of community vulnerability. These vulnerability categories of data include, for example, data that might allow for analyses of natural hazard risks (e.g. tsunamis and weather events), quality of life measures (e.g. crime and cost

of living information) and coastal gentrification processes (Colburn and Jepson 2012). Once these data sources are examined and the necessary data are extracted and organized for a given year, with the appropriate scaling of data for community-level analyses, a factor analysis approach allows for the grouping of some of these data according to single factor solutions. Through the factor analysis and its concomitant single factor solutions, we develop our indices of community vulnerability. We are then able to compare coastal communities relative to one another, for a given year, according to our set of indices.

Results and Discussion

In an initial analysis, we produced sociodemographic indices of vulnerability, as well as indices characterizing commercial fishing activities, for those communities in coastal counties in Washington, Oregon and California. A general factor analysis allowed us to evaluate the overall relationships between our included 2010 variables, and subsequent factor analyses of 4 or 5 similar variables allowed us to construct single factor solutions associated with vulnerability indices. For example, we produced sociodemographic indices of vulnerability that included a personal disruption index, a population composition index and an index of poverty for coastal communities. These index results are in keeping with the results from factor analyses conducted for the East Coast (Jepson and Colburn 2013).

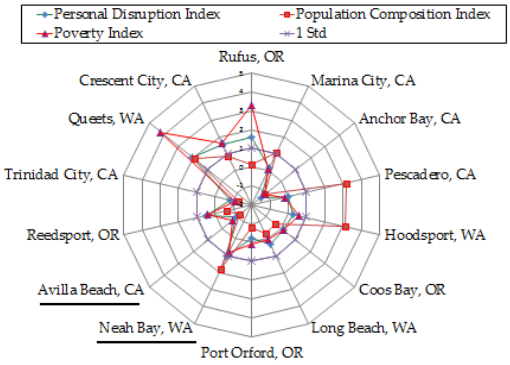

Figure 1. A subset of West Coast communities compared according to sociodemographic indices of vulnerability

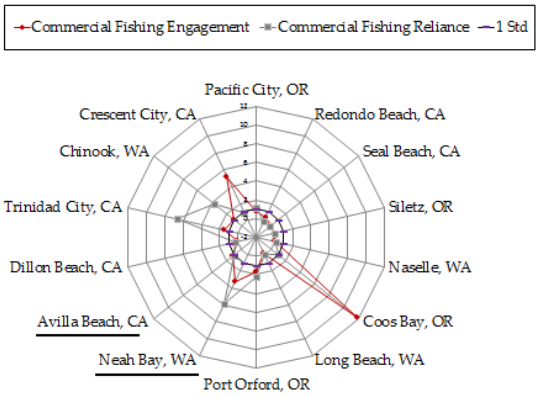

Figure 2. A subset of West Coast communities compared according to indices of fishing activity

In order to highlight the commensurability this method generates, the West Coast communities of Avilla Beach, CA and Neah Bay, WA are underlined in contrast to one another (Figure 1). While Avilla Beach measures well below the mean for all three indices of sociodemographic vulnerability, the community of Neah Bay appears to be relatively socially vulnerable. Similarly, Avilla Beach measures low on both indices of commercial fishing activity, whereas Neah Bay lies above the mean in terms of each index (Figure 2). Comparing West Coast communities across all five highlighted indices suggests that, as compared to Avilla Beach, Neah Bay would, for example, be a more likely community of interest in a California Current ecosystem assessment.

References

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