Understanding how to balance human well-being and ecological integrity is one of the fundamental challenges in conservation and natural resource management. As our human-footprint on ecosystems expands and deepens, we are increasingly realizing that human well-being is crucial to understanding the dynamics of social-ecological systems and managing them sustainably. Despite the growing focus on valuing, and therefore measuring, human well-being alongside ecological quality indicators (i.e. biodiversity, ecosystem function), we still lack clear ways to operationalize these goals (Mace 2014). Developing methods for measuring how human wellbeing is affected by biophysical dynamics and in turn drives people to change their pattern of natural resource use is a major part of advancing sustainability science (Hicks et al. 2016).

+ conceptual advance in recognizing the twin importance of ecosystem dynamics and human wellbeing, but challenge remains in operationalizing these policy goals.

Fisheries

+ EBFM has had considerable effort paid developing methods and analyses to quantify species interactions. But no matching work on social side. This is

Implications of our findings

This work is relevant beyond the US case study in which it was applied

+ international cooperation is required everywhere for ocean policy to be successful. It’s much easier to achieve cooperation if people’s needs are properly accounted for.

+ As such, this method applied to places like the Baltic, \_\_\_ where diversity of fishermen has already been while characterized, could provide management new insights into how people depend on fisheries and provide a tool to examine impacts of policy, market or ecological changes.

+ CAS thinking is also broadly more useful

Building these networks provides a quantitative way to characterize the ways people depend on multiple fisheries for commercial fishery livelihoods and a scale of analysis complementary to that of food webs making this an important extension in the goal of achieving ecosystem based fishery management.

While we depend on income, an economic measure, this work provides a quantitative, not exclusively economic way to analyze importance of fisheries to human well being from place to place. Because work on ecosystem based management has been dominated by ecology, there’s been pressure for work capturing the social dynamics to fit into the paradigm of these food-web models. As a result, much work on ecosystem based management has been economic, an easy disciplinary match where instead of flows of energy, flows of capital can be modeled and studied.

This work underscores the fact that there is often nothing natural about political boundaries, as fishermen on the US west coast participate across state and federal jurisdictions.

Understanding the economics of these systems is important for capturing how people depend on and use natural resources, but only capture part of the picture. For example the importance of fisheries is often characterized by how much money, in aggregate, landings are responsible for. By that measure on the US west coast, for example, pacific hake, dungness crab, and market squid are some of the most economically important fisheries. However when we examine participation networks, we see that crab is central in most regions, highlighting that most fishermen depend on it for at least part of their livelihoods. Hake and market squid, however, are often more marginal for west coast-based fishermen. And in southern California, we miss spiny lobster completely. An extremely high-value but limited in number of ports present. Thus if something where to happen to these fisheries, the Dungeness crab fishery change would affect the most people by far. Something particularly relevant considering that the dungness crab fishery closed this winter.

Forecasting and preparing for social impacts is not the only thing this method can help. By identifying common combinations of fisheries, these networks make abundantly clear the possibility of management cascades: indirect effects of management change mediated by shifting effort of fishermen. More work needs to be done, but the impact of fishery closures on how people redistribute effort across existing fisheries is crucial to predicting social and ecological effects of policy change.

Also see differences between southern CA and rest of coast networks. These have many more types of fisheries than further north.

These networks suggest that different fisheries may have different importance for management. Dungeness crab, for example, is extremely central in all participation networks in which it’s found. The possibility of a ‘management cascade’, where changes in policy in one fishery result in changes in participation in another, could be possible and captured here.

This approach also provides a way to characterize the heterogeneity in social structure from place to place, which may account for differences in policy efficacy of a single management change. Dungeness crab for example, while central in Washington and Oregon, is increasingly replaced by spiny lobster in California. This regional variation in composition but similarity in topology underscores the importance of fishermen