Applied Geography xxx (2014) 1–10

Contents lists available at ScienceDirect

Applied Geography

journal homepage: www.elsevier.com/locate/apgeog

The importance of place: Unraveling the vulnerability of fisherman livelihoods to the impact of marine protected areas

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ARTICLE INFO

Article history:
Available online xxx

Keywords:
Vulnerability
Fishermen
Marine protected areas
Fishing
Socioeconomic
Sea urchin

ABSTRACT

Marine protected areas (MPAs) hold great promise as an effective conservation tool, but the potential negative socioeconomic impacts of MPAs remain poorly understood. Indeed, little work has been done to advance the frameworks and methods needed to assess, measure, and communicate the potential negative socioeconomic impact of MPAs and incorporate this information in MPA planning and management efforts. To address this gap, we test a vulnerability assessment termed the Livelihood Vulnerability Index (LVI) that is designed to measure the relative potential impact a proposed MPA network may have upon fisherman livelihoods. To test the LVI, specifically we ask, how does the vulnerability of fishermen to the impact of MPAs differ across place? We explore this question through two core areas of inquiry surrounding the study of vulnerability assessments: 1) Ranking and comparing vulnerability and 2) Explaining attributes of vulnerability. Through this study we demonstrate how the historical and current conditions fishermen experience in a given place shape vulnerability levels in various ways. Variability in the attributes of a particular place such as weather conditions, the size of fishing areas, availability of alternative fisheries, and changes in kelp cover contribute inherently as measures of vulnerability but they also shape fishermen perceptions of what are important measures of vulnerability. Secondly, counter to existing notions, the use of weights in vulnerability assessments may not significantly impact vulnerability scores and ranking. Together these findings emphasize the need to test vulnerability assessments against actual experienced impact or harm across geographies and groups of fishermen towards an informed refinement of vulnerability assessments. We emphasize that the particularities of place are critical to understand, to appropriately assess and thus to effectively mitigate vulnerability in order to promote the future well being of fisherman livelihoods.

Introduction

Globally, fishermen[1] are experiencing a broad array of complex environmental, social, economic, and political pressures and changes. These can range from shifts in global economic markets, changes in climate patterns, environmental degradation, and increases in fishing competition and regulatory constraints. In California, these changes and mounting pressures have serious implications on the state's 6,828 registered commercial fishermen (CDFW, 2012)—many of whom earn the majority of their livelihood from fishing. Fishermen are a particularly vulnerable population group as they rely upon fish populations—a common pool natural resource—as their income source. Harvesting fish is rife with uncertainty such as the incertitude in maintaining access to fishing grounds or fish stocks and uncertainty in environmental patterns or events that affect the abundance and quality of fish in local waters. As scientists, policy makers, and managers work to address the changing environmental and socioeconomic landscape within which fishermen must operate, there is great need to understand the particular vulnerabilities of fishermen. This is important to not only understand the socioecological system of fishing but also to effectively target and promote socially and economically responsible management and conservation interventions.

This case study is situated within the California Marine Protected Area (MPA) network planning process which was completed in 2012 and mandated by the Marine Life Protection Act (MLPA). Specifically, we utilize a vulnerability assessment termed the Livelihood Vulnerability Index (Chen, López-Carr, & Walker, 2014) to measure

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[1] The term 'fishermen' is used to denote people who fish. In the California commercial fishing community this is the preferred term regardless of gender.

http://dx.doi.org/10.1016/j.apgeog.2014.10.015
0143-6228/

the relative potential impact the proposed MPA network may have upon fisherman livelihoods. As marine spatial plans are developed worldwide in response to conservation and climate change mitigation initiatives, there is an urgent demand to develop and refine approaches and methods to assess how MPAs and other spatial management measures may impact fisherman livelihoods (Blount & Pitchon, 2007; Freudenburg, 1986; Hall-Arber, Pomeroy, & Flaxen, 2009; McShane et al. 2011; Voyer, Gladstone, & Goodall, 2012).

Vulnerability assessments have been gaining popularity particularly in management and planning applications as methodologies have advanced to provide vulnerability maps, indices, and rankings that aid in quantitative and spatial trade-off and prioritization analyses (Brooks, Neil Adger, & Mick Kelly, 2005; Cutter, Boruff, & Shirley, 2003; Engle, 2011; Hahn, Riederer, & Foster, 2009; Kelly & Adger, 2000; O'Brien et al. 2004; Schroter et al. 2005; Tuler, Webler, & Polsky, 2013). In particular vulnerability assessments are actor-centric and focus on characterizing and measuring the level of exposure, sensitivity, and adaptive capacity the actor or set of actors have to a particular stress (Adger, 2006; Nelson, Adger, & Brown, 2007). However, despite the growing research surrounding vulnerability assessments, the field remains relatively nascent and disaggregated in the sense that vulnerability assessments are often designed specific to the particular stress and actors under study.

Nevertheless, it has been argued that a diversity of approaches and methods are required to study the full complexity of vulnerability in socioecological systems. Eakin and Luers (2006) highlight that what may seem to be disjointed vulnerability studies are indeed complementary in that each advances knowledge on a particular aspect of vulnerability assessments. In their review, the authors organize the existing empirical literature into bodies of literature and present common core components to vulnerability assessments. The purpose of this study is to implement a previously developed vulnerability assessment (the Livelihood Vulnerability Index) and explore this assessment's contribution in two core components of vulnerability assessments identified by Eakin and Luers (2006): 1) Ranking and comparing vulnerability and 2) Explaining attributes of vulnerability.

Conceptual framework

The Livelihood Vulnerability Index

The vulnerability assessment instrument we utilized in this study is named the Livelihood Vulnerability Index (LVI) (Chen et al. 2014) developed for the California commercial sea urchin fishery. This framework defines vulnerability as “the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt” (Adger, 2006) and evaluates vulnerability as a function of three factors—exposure, sensitivity, and adaptive capacity (Adger, 2006; Marshall, 2010; Turner et al., 2003; Tuler, Webler, & Polsky, 2009). The LVI estimates the relative ability of California commercial sea urchin fishermen to cope with the change associated with proposed marine protected areas (MPAs).

The purpose of the LVI is to measure the relative vulnerability of fishermen to the potential impacts that result from the loss of fishing grounds associated with the establishment of marine protected areas. In brief, exposure refers to the extent in which the actor or set of actors are exposed to the stress (Marshall, 2010). In this study we utilize the weighted percent loss of fishing grounds to MPAs as a measure of exposure. Sensitivity is defined as the degree of change or harm caused by exposure to the stressor (Adger, 2006; Marshall, 2010). In this study we conceptualize sensitivity as the factors that constrain a fisherman's ability to adapt to change. Together exposure and sensitivity determine the impact of a stressor. Conversely, adaptive capacity comprises the factors that promote one's ability to adapt to change or cope with the stressor. Indeed, the concepts of sensitivity and adaptive capacity are closely tied as diminished adaptive capacity may lead to increased sensitivity and vice versa. For more details on how the LVI was developed, see Chen et al. (2014). (Figs 1 & 2)

Ranking and comparing vulnerability

As mentioned above, the development of vulnerability assessments has gained popularity over the past decade as a way to inform mitigation efforts. Specifically, the development of vulnerability indices and scores to compare levels of vulnerability to a certain stressor such as climate change have been used by governmental bodies, agencies, and organizations to prioritize the allocation of resources to implement targeted and place-appropriate vulnerability reduction solutions.

To compare and rank vulnerability across population groups, comparable vulnerability indices must be developed. This activity is rife with challenges such as the availability of data, selection and weighting of vulnerability measures/metrics, and comparable scales of analysis. Despite this, a literature base has grown and converged in utilizing similar frameworks to develop vulnerability assessments of fishing populations (Allison & Ellis, 2001; Cinner et al. 2012; Mills et al. 2011; Tuler et al. 2013). Together these studies are beginning to facilitate comparison of vulnerability across population groups as they consistently utilize a standard definition of vulnerability (Adger, 2006) that parse out vulnerability into three core dimensions: exposure, sensitivity, and adaptive capacity and then further into measurable vulnerability variables.

The general challenges mentioned above still exist across these studies yet as vulnerability assessments of fishing populations advance, we may begin to build a more common framework to facilitate the comparison and ranking of vulnerability. However, to do so, there is great need to examine vulnerability beyond climate change. The vast majority of vulnerability assessments of fishing populations are centered on climate change and yet there are other (and perhaps more immediate and direct) types of change fishermen may experience such as the establishment of MPAs or other management measures. Developing vulnerability assessments under a wide array of scenarios may be key to developing robust vulnerability assessments that consider the multitude of stressors fishermen face. In this study we implemented a vulnerability assessment centered around the establishment of a proposed MPA network and compared vulnerability levels across varying scales to rank and compare vulnerability across varying fisherman population groups.

Explaining attributes of vulnerability

A central utility of vulnerability assessments is to identify specific attributes or variables and investigate their contribution to increasing or decreasing vulnerability levels to inform effective vulnerability mitigation efforts (Brooks et al. 2005; Engle & Lemos, 2010; Kelly & Adger, 2000; Nelson et al. 2007). To the extent vulnerability attributes or variables contribute unequally to vulnerability levels, assigning weights may be necessary to faithfully model vulnerability outcomes. Yet the use of weights in vulnerability assessments remains largely understudied, can be controversial, and methods vary significantly across studies. Some vulnerability assessments do not utilize weights (Hahn et al. 2009), some studies utilize weights created from the researcher's knowledge (Eakin & Bojorquez-Tapia, 2008), and some studies utilize participatory methods to develop weights (Chen et al., 2014). Confounding the difficulty in using weights is that the proper weights of vulnerability variables can vary significantly from place to place.

Please cite this article in press as: Chen, C., & Lopez-Carr, D., The importance of place: Unraveling the vulnerability of fisherman livelihoods to the impact of marine protected areas, *Applied Geography* (2014), http://dx.doi.org/10.1016/j.apgeog.2014.10.015