



Perceived adaptive capacity and natural disasters: A fisheries case study



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ABSTRACT

Fishermen may be increasingly impacted by natural disasters, given sea level rise and the likely increased frequency and severity of storms associated with climate change. Planning for resiliency in the face of these disasters requires understanding the factors that influence fishermen's capacity to adapt. The paper examines perceptions of adaptive capacity of New York and New Jersey commercial and for-hire fishermen one year after Hurricane Sandy. Subjective adaptive capacity to changes in the fishery in general and those caused by natural disasters was assessed. A comparison between commercial and for-hire fishermen revealed important differences and similarities with regard to attributes influencing their perceived adaptive capacity. While both groups show high levels of coping capacity in general, for-hire fishermen presented more confidence in their ability to obtain work and income outside the fishery while commercial fishermen were more confident in their ability to remain in fishing. For both groups, those that suffered more intense impacts from the storm had more negative levels of perceived adaptive capacity. Understanding the perceived adaptive capacity of commercial and for-hire fishermen can help researchers and policy makers better understand and address each sector's response to impacts of future natural disasters and human driven changes.

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1. Introduction

In preparing for and recovering from the aftermath of a disaster, measuring and understanding levels of adaptive capacity (ability to adapt to change) can help to target planning and recovery efforts. Adaptive capacity and related concepts of resilience and vulnerability have become an important area of study in general, and in fisheries specifically. Much debate exists in the literature concerning conceptual definitions of resilience, vulnerability, and adaptive capacity and how these concepts correlate with each other in the context of complex social-ecological systems (see Gallopín, 2006; Cutter et al., 2008; Rajib et al., 2014). In this study, we adopt conceptual definitions from Jepson and Colburn (2013), where vulnerability is considered a pre-existing state that can show either high or low vulnerability to stressors and impacts, resilience is an assessment of long-term trends in relative vulnerability, and adaptive capacity is the ability of individuals

or groups to respond to or bounce back from specific stressors and impacts. Based on these definitions, enhancing adaptive capacity through adequate planning efforts is a fundamental step in promoting resilience (re. Wagner et al., 2014). However, different individuals or groups have different characteristics of adaptive capacity, so it becomes important to understand what variables lead people to react in specific ways. Some of these variables are related to membership in specific groups (Cutter et al., 2003; Brooks et al., 2005). In this paper, the focus is on work-related groups (re. Smith and Clay, 2010), specifically, commercial and for-hire fishermen.

Commercial fishing is characterized by the landing of fish and other seafood for sale to market. That is the commercial fisherman's business, though it is also often a way of life. For-hire fishing, on the other hand, is based on renting recreational fishing time on a vessel to a group (charter fishing) or a set of individuals (party boat fishing). Thus, the owner of a for-hire vessel earns a living by charging recreational fishermen to go out on his/her vessel. For-hire fishermen may or may not also consider fishing to be a way of life. Though both commercial and for-hire fishermen depend upon similar natural resources, we predict that differences inherent to these two sectors lead to different levels or types of adaptive capacity. While it is expected that commercial fishermen's

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perceptions are influenced by a strong attachment to the occupation of fishing as supported by a large body of literature (Apostle et al., 1985; Pollnac and Poggie, 1988, 2006; Pollnac and Poggie, 2006; Binkley, 1995; Marshall et al., 2007; Glazier, 2007; Pollnac et al., 2015), aspects affecting for-hire fishermen's views on their adaptive capacity are largely unknown. Understanding differences between commercial and for-hire fishermen in characteristics of adaptive capacity in general and to natural disasters is important for both fisheries policy and coastal community disaster planning. Here, we focus specifically on levels of *perceived* adaptive capacity, since, in the face of stressors, people often act upon their subjective perceptions rather than objective measures, as subjective perceptions and objective measures can be very different from each other (Grothmann and Patt, 2005; Smith and Clay, 2010).

The objective ability or capacity of human individuals or societies to adapt to change is linked to availability of resources (e.g., financial, institutional) and an individual's or group's *access* to those resources. Many of these can be measured via secondary data regularly collected by government agencies at multiple geographic scales and by specific industry sub-groups (e.g., the US Census). In contrast, subjective aspects of adaptation are associated with their *perception of the adequacy* of available resources (e.g., financial, social) in allowing and aiding them to cope and adapt, and the extent to which people feel they are prepared to endure such changes or impacts and undertake steps to cope with them. Secondary data are often available only at the national level (e.g., World Values Survey, 2014), and not necessarily tied to sub-groups such as fishermen. Thus, sub-group level analyses often require primary data collection.

In the context of fishing communities, understanding fishermen's perceived levels of adaptive capacity can help develop rules and regulations that promote resilience and maintain livelihoods while safeguarding the sustainability of resources. Implementing policies that take into account the resilience and adaptability of resource users is also believed to maximize compliance and, therefore, be more effective in meeting policy goals (Marshall and Marshall, 2007; Kalikoski et al., 2010). In fact, certain approaches to natural resource management that are more participatory and flexible (e.g., adaptive management, co-management) are regarded as efficient methods for establishing and increasing adaptive capacity in social-ecological systems (Folke et al., 2002; McClenachan et al., 2015). Knowing the differences in adaptive capacity of fishing communities, as based on their relative dependence on commercial or for-hire fishing can help to further target these policies.

Many studies have been conducted to investigate socio-economic impacts of natural and man-made transformations on commercial fisheries, including aspects of adaptation to natural disasters (Acheson, 1981; Clay, 1996; Flint and Luloff, 2005; Olson, 2006; Pomeroy et al., 2006; Jepson and Jacob, 2007; Pollnac et al., 2008; Ebbin, 2009; Forster et al., 2014; Deason et al., 2014). Fewer efforts have focused on similar aspects in the recreational fishing industry, which includes the for-hire sector (Murray et al., 2010). For decades, commercial fisheries in the US have been the subject of frequent and sometimes substantial changes in policy, implemented to conserve fish stocks. More recently, a shift to stricter regulations on recreational fishing activities has been discussed in the literature in light of increased resource exploitation by this sector (Sutinen and Johnston, 2003; Cooke and Cowx, 2006; Abbott and Wilen, 2009; Abbott et al., 2009; Murray et al., 2010; Ihde et al., 2011; MacKenzie and Cox, 2013). Changes associated with the adoption of strict regulations to conserve declining fish stocks can have very significant consequences for commercial and for-hire fishermen alike, thus stressing the importance of understanding specific factors influencing fishermen's perceptions of their adaptive capacity and how they differ between sectors within the industry.

Multiple recent studies address the difficult state of affairs for many fishermen and fishing communities throughout the U.S. as a result of fish stock decline and strict regulations (Clay et al., 2014; Jacob et al., 2013; Olson, 2011; Carothers et al., 2010; Allen and Gough, 2006). Many of these issues are becoming increasingly critical under climate change and prospects of drastic environmental transformation, as well as more frequent and intense natural disasters (Howard et al., 2013). Coastal communities such as those involved in fishing are among the social-ecological systems most vulnerable to natural disasters (Mamauag et al., 2013; Becker et al., 2014). Extreme climate events such as floods, storms, and hurricanes can have important effects on fisheries production in marine systems (Brander, 2007; Chang et al., 2013) that, coupled with other direct and indirect effects of natural disasters (e.g., destruction of homes and businesses, and impacts on tourism), can result in major socio-economic impacts to entire coastal communities. These extreme natural events compound the ongoing impacts of fishing and environmental changes (including climate change) on fish stocks, along with fisheries regulatory changes designed to maintain or rebuild those stocks to sustainable levels. These changes that significantly affect coastal environments have led to increased concern in recent decades with aspects of vulnerability and resilience in U.S. fishing communities (Jepson and Colburn, 2013; Jacob et al., 2013; Forster et al., 2014; Wagner et al., 2014; Deason et al., 2014). However, studies have often focused on fishermen in general, or only on commercial fishermen, not making the comparison between fishery sectors conducted in the present study. Since fishing communities differ in their relative dependence on commercial fishing, for-hire fishing, or a combination of both (Jepson and Colburn, 2013), it is important to compare aspects of vulnerability and resilience of different sectors within the industry.

In the case of natural disasters, degrees of vulnerability are highly determined by factors such as geographic location and intensity of the disaster; a successful recovery from impact can depend heavily on a system's capacity for adaptation (Cutter et al., 2008). In the U.S., fishery law requires that fisheries regulations provide for the sustained participation of fishing communities and the minimization of adverse economic impacts (MSFCMA, 2007). Thus, one geographic unit that should be assessed for resilience and vulnerability is the *community*. Fishery management practices that also promote adaptive capacity, and ultimately resilience, in fishing communities can help to increase the chance for those communities to successfully recover from a natural disaster. Fishermen's perceived adaptive capacity to impacts, which is the focus of this research, can be used as an indicator of overall adaptability and coping capacity of communities that are highly dependent on fishing resources. These aspects should be considered in conjunction with objective measures and other aspects of the larger community not examined in this study (e.g., perceptions of other community members). To the extent that large numbers of fishermen may have different types of adaptive capacity, successful recovery may vary in degree or character.

This study focuses on commercial and for-hire fishermen of New York and New Jersey one year after Hurricane Sandy and quantitatively analyzes their perceived adaptive capacity. Hurricane Sandy provided an ideal case study for the investigation of variables related to perceived adaptive capacity in fishing, both in general and in response to natural disasters. Sandy made landfall on October 29, 2012 at Brigantine, NJ and, though the impacts stretched along the U.S. east coast and even inland, New Jersey and New York were the hardest hit states in terms of both property damage and number of deaths (NWS (US National Weather Service), 2013; CDC (US Centers for Disease Control and Prevention), 2013). Marine fishing was highly disrupted for coastal fishing communities, resulting in the U.S. Secretary of Commerce issuing

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