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Expanding the 'geography' of resilience in fisheries by bringing focus to seafood distribution systems

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ABSTRACT

Seafood distribution systems are often viewed as exogenous from fisheries and marine resource management. However, these systems are closely coupled. The transportation and transformation of fish out of water (i.e., distribution and processing) is affected by and affects the resource and those that exploit and manage it. Despite this linkage, the feedback between harvesting and post-harvesting activities has been largely unstudied, reinforcing an artificial disconnect. This paper brings focus to this gap by examining the interplay between seafood distribution and social-ecological resilience - arguably an important objective of fisheries management. Drawing on the notion of "portfolio" fishing, this paper seeks to extend the concept beyond the material boundaries of the resource itself and the individual strategies of those who harvest marine resources, using the Atlantic herring and Spiny dogfish in New England as case studies. The broader interpretation of portfolio fishing allows us to understand seafood distribution as a new axis of diversification that has direct implications for the social-ecological resilience of fisheries. Expanding the geography of resilience in fisheries inland, beyond the existing regulatory 'wrack line,' brings to focus the interrelatedness of fisheries and distribution, and raises challenging questions about how to deal with social-ecological systems that extend beyond the borders of regulatory control.

1. Introduction

Social-ecological systems are complex assemblages of interconnected human and natural components (Anderies et al., 2004). Tinkering with the pieces of these coupled systems can have unexpected consequences (Ames, 2004; Frank et al., 2011). Of particular interest and concern to many are the points at which systems become brittle and fail to return to their previous form and function (Scheffer et al., 2001; Steneck et al., 2002). Indeed, preventing unintended and unwanted transformations is often a central objective for natural resource managers and policymakers as they deal with the unenviable task of balancing exploitative activities with conservation limits (Folke et al., 2005; Ma et al., 2013).

The thresholds at which these transformations occur depend on both the magnitude and duration of stress that is exerted on a system and the resilience of the system, defined by Folke et al. (2005: 443) as "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks." These changes can be both ecological and socioeconomic. Systems that can withstand incremental and abrupt impacts are less prone to unwanted transformations, and thus less susceptible to major social, economic, and ecological disruptions (Folke, 2006).

Resilience in fisheries and other social-ecological systems can be cultivated by way of both ecological and social reinforcement (Adger et al., 2001). The ecological scaffolding of fisheries can be bolstered in multiple ways, including habitat restoration and conservation strategies that protect the life histories of fish stocks and maintain the integrity and connections between functional groups (Beck et al., 2001; Hughes et al., 2005). These strategies can target both the biophysical components of systems (Worm et al., 2006), as well as the ecological components (e.g., by maintaining foodweb integrity, non-target species, and forage fish stocks) (Pikitch et al., 2004). Social and economic safeguards also help to reinforce systems and cultivate resilience (Folke, 2006). Social learning, for

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example, through forms of co-management and tight feedback loops, can result in improved knowledge about social-ecological dynamics that facilitate adaptability and increase resilience (Berkes, 2009). Also important are robust institutions (Low et al., 2003), individual and collective agency (Brown and Westaway, 2011; Coulthard, 2012), and institutional alignment across scales (Young, 2002).

These ideas all contribute to the broader notion that a diverse, multidimensional system is vital to maintaining resilience (Chapin et al., 1999). Recognizing the need for diversity in fisheries management, many have argued that a 'portfolio approach' to management should be adopted such that ecological (Baldursson and Magnusson, 2014; Edwards et al., 2004; Figge, 2004) and economic (Kasperski and Holland, 2013; Sethi et al., 2014) diversification is maintained (or enhanced). Calls for a portfolio approach to managing risk are particularly evident in fisheries economics that builds off the literature on investment optimization (Markowitz, 1971). Such scholarship has repeatedly demonstrated that individual fishermen that participate in a diverse array of uncorrelated or asynchronous fisheries face less financial risk over time than those that specialize in a single fishery or multiple fisheries that are closely coupled. The logic is simple: fishermen that have access to more than one fishery can move on if a fishery begins to decline or becomes unprofitable. In doing so, these portfolios make fishermen less prone to the regulatory closures, stock declines, and market failures of particular fisheries and thus more resilient to disruptions.

Although this strategy has theoretical promise, it is becoming increasingly difficult for fishermen in the US to create and maintain diverse portfolios. Rather, individual fishermen are increasingly constrained as a result of management strategies that restrict geographic mobility and the ability to switch between fisheries and gears (Lowe and Carothers, 2008). In Maine, for example, in 2013 only 26% of the 7,490 commercial fishermen held licenses to fish for more than one species (ME DMR, 2015a). Even in this marine resource dependent state, fishers cannot easily purchase new licenses to diversify their incomes and reduce their risk of disturbance. The majority of the state's seven lobster zones have long and stagnant waitlists that have made it nearly impossible for new fishermen to gain entrance as a result of restrictions established in 1995 (Title 12, Part 9, Chapter 619, Section 6421). To enter the lucrative elver fishery, fishermen need to enter a lottery system (Title 12, Part 9, Chapter 621, Section 6505-A) that has dismal odds. Simultaneously, there is a moratorium on new licenses in the state's Atlantic scallop fishery (Title 12, Part 9, Chapter 607, Section 6706) and the Northern shrimp fishery is closed because the stock biomass is low. These shortcomings have prompted recent attempts by the legislature to improve the licensing system by way of proposed actions such as "An Act to Promote Sustainability in the Scallop Fishery" (127 LD 908, HP 627) and "An Act to Improve Lobster Licensing" (127 LD 896, HP 615). Though these examples are specific to Maine, the general pattern of reduced mobility and restricted access is widespread across the US and elsewhere internationally (Criddle and Strong, 2013; Pinkerton, 2013). In many places, fishermen are essentially locked into fisheries with limited capacity to expand their portfolios, a dynamic that will only be amplified as new limited entry programs are established to restrict access further, particularly for small-boat operators and fishermen with limited resources (Olson, 2011).

This limited access to diverse marine resources represents an impediment to resilience in fisheries, but to focus exclusively on individual fishing portfolios as a strategy for building resilience represents a problematic blind spot for understanding risk avoidance in fisheries more broadly. On the one hand, such a focus fails to fully appreciate that individual resilience stems not only from what fishermen can catch, but also what they can do with it, a point we will discuss further in our examples of distribution systems. Further, a narrow focus on individual portfolios fails to situate the sources and implications of risk for fishing communities more broadly, leaving unanswered the questions of resilience "of what" and "for whom" (Cote and Nightingale, 2012), a point we return to when we discuss newly emerging initiatives in the Northeast that represent more diverse economies and community relations (Gibson-Graham, 2008).

The intent of this paper is to begin to create an expanded view of the 'geography' of resilience in fisheries beyond its current domain by illustrating the linkages between fisheries and seafood distribution systems. We use the term 'seafood' in this paper as shorthand for all uses of wild captured marine resources, including fish for direct human consumption and other uses such as fertilizers and pharmaceuticals. Here, we also use the word 'geography' as opposed to 'focus' or 'domain' with intentionality, as a double entendre intended to capture our interest in broadening both the physical and conceptual notion of resilience in fisheries.

Seafood distribution systems are often viewed as exogenous to fisheries and marine resource management because they fall outside the statutory purview of fisheries management institutions. As such, fisheries science has largely concentrated on understanding fish in the water and extractive activities in service to the management process. However, seafood harvest and distribution systems are closely coupled. The transportation and transformation of fish out of water (i.e., distribution and processing) affects and is affected by the resource and those that exploit and manage it by influencing demand. However, despite this linkage, the feedback between harvesting and post-harvesting activities has been largely unstudied, reinforcing an artificial disconnect. Our goal is to bring focus to this gap by examining the interplay between seafood distribution and resilience in fisheries by highlighting linkages to the socioeconomic components of resilience. We aim to extend the notion of portfolio fishing beyond the material boundaries of the resource itself and the individual strategies of those who harvest marine resources. Adopting a broader interpretation allows us to understand seafood distribution as a new axis of diversification. Here, we put forward the observation that resilience in fisheries depends not only on the portfolio of fisheries that an actor can access, or on maintaining the ecological diversity of a system (both of which are important), but also on the portfolio of markets and distribution channels that exist within the seafood distribution system more broadly.

In tracing the distribution of fisheries beyond the docks, it becomes evident that the resilience of fisheries is not simply dependent on where, when, and how species are caught or on the status of stocks, but also on what happens to these marine resources after they have been landed. The ability of a fishery (including its stakeholders) to withstand unanticipated economic and ecological changes without suffering serious socioeconomic disruption or relying on major reactive measures such as disaster relief or government interference is partly dependent on the structure and composition of the seafood distribution system. For example, how reliant are fishers or dealers on a single market? How exposed might the fishery be to shocks and changes in available markets? What options exist when markets abruptly atrophy? To make our point, we describe seafood distribution in the Northeast United States, through cases studies of Atlantic herring (*Clupea harengus*) and spiny dogfish (*Squalus acanthias*) fisheries. We begin with a brief description of seafood distribution in the Northeast and then discuss the specifics of the herring and dogfish fisheries in more depth. These descriptions are based on exploratory research of management and policy documents, social and economic impact assessments, and public information on the web, supplemented by