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ARTICLE

Understanding Social Resilience in the Maine Lobster Industry

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Abstract

The Maine lobster *Homarus americanus* fishery is considered one of the most successful fisheries in the world due in part to its unique comanagement system, the conservation ethic of the harvesters, and the ability of the industry to respond to crises and solve collective-action problems. However, recent threats raise the question whether the industry will be able to respond to future threats as successfully as it has to ones in the past or whether it is now less resilient and can no longer adequately respond to threats. Through ethnographic research and oral histories with fishermen, we examined the current level of social resilience in the lobster fishery. We concentrated on recent threats to the industry and the ways in which it has responded to them, focusing on three situations: a price drop beginning in 2008, a recovery in 2010–2011, and a second collapse of prices in 2012. In addition, we considered other environmental and regulatory concerns identified by fishermen. We found that the industry is not responding effectively to recent threats and identified factors that might explain the level of social resilience in the fishery.

The Maine lobster *Homarus americanus* fishery is heralded for its cultural status, the participatory nature of its regulatory scheme, the conservation ethic of its harvesters, and more recently, its seemingly infinite increase in landings and value (Acheson 2003; Acheson and Gardner 2010). Despite these characteristics, during the summer of 2012, this iconic fishery experienced the lowest prices in 30 years. The media reported examples of the way industry members described the 2012 season: “I don’t see any winners in this, this year.” (Seelye 2012); “It’s down to a point now where it’s not worth it to go out. It’s ridiculous.” (Wickenheiser 2012); and “There ain’t no money right now to be made” (Lobstermen tying up their boats 2012).

This may seem to be a familiar narrative, as the historical booms and busts of the lobster fishery have been well documented (Acheson and Steneck 1997; Acheson 2003; Acheson and Gardner 2010). However, over the past three

decades the lobster fishery has experienced much more boom than bust (Acheson 2003), as exemplified by a steady increase in landed weight and value since the mid-1990s (Figure 1). While this positive trend has been attributed to a combination of external factors, including the reduced abundance of predators and favorable environmental conditions (Acheson and Steneck 1997; Boudreau and Worm 2010; Steneck et al. 2011), the industry’s success is often also attributed to its unique comanagement system and its ability to respond to crises and solve collective-action problems (Acheson 2003; Acheson and Gardner 2010; Wilson et al. 2013).

The 2012 crisis raises the question whether the industry will be able to respond to future threats as successfully as it has to ones in the past or whether it is less resilient now and thus no longer able to adequately respond to threats. We examined social resilience in the Maine lobster fishery in terms of the

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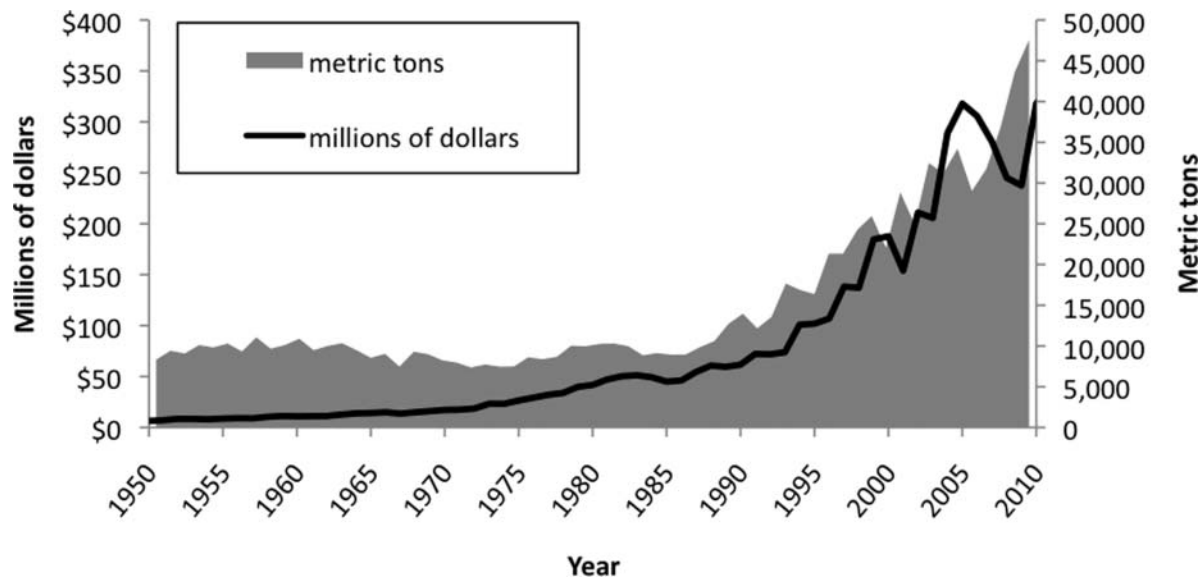


FIGURE 1. Maine lobster landings and value (Maine DMR 2012b).

specific threats facing fishermen and their ability to respond to these threats.

THEORETICAL PERSPECTIVE

Although the concept of resilience is pervasive in the ecological literature, we focus on social resilience or “the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change” (Adger 2000:347). It is difficult to discuss resilience without also addressing vulnerability, which we define 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 2006:281). Communities and individuals are more vulnerable if they are not able to adapt or if they are less resilient. Following a “people ecology” perspective, we sought to understand resilience by focusing on the differential threats faced by individuals and groups and their ability to respond to these threats (Vayda and McCay 1975; McCay 1978).

Threats can vary by frequency, intensity, and duration (Cutter 1996). Responses also vary in terms of the time that has to be invested and the magnitude of the adjustment necessary. We classify responses as *coping* (smaller, short-term reactions that can easily be reversed and modified as threats change) and *adaptations* (longer-term adjustments that require more investment and organization and are more difficult to alter in the future). The level of response is often determined by the condition of the threat. The theory of the “economics of flexibility” suggests that the likelihood and timing of these different response types relate to the depth of the threat (McCay 2002), i.e., that responses that require smaller investments (coping) will occur first, reserving some “flexibility” with which to respond to potential future threats or an intensification of the

current threat. In this way responders ration their capacity for resilience, reserving *adaptation* responses for threats that are of larger magnitude or for use after lower-level *coping* responses have failed (McCay 2002:357).

METHODS

This paper is one component of a larger study assessing vulnerability and resilience in Maine fishing communities. As part of this project we conducted 18 semistructured (Bernard 2002) and 26 oral history interviews (Ritchie 2003) with fishermen, other community members, and government officials in four fishery-dependent communities in Maine from October 2010 to December 2011. These interviews lasted from 1 to 2 h and focused on the threats that fishermen have faced and the ways in which they have responded to these threats. We began our study with key-informant interviews and then relied on snowball sampling to broaden the representation until theoretical saturation (Bernard 2002). We selected respondents to represent the diverse marine fishery-related occupations in each community. The fishermen interviewed ranged in age from 34 to 80, with an average age of 54. While not all respondents were lobster fishermen, the majority of those interviewed held lobster licenses, representing zones A and D from the Canadian border to the midcoast region of Maine. All interviews were recorded, and all of the oral histories and a majority of the semistructured interviews were transcribed. Detailed notes were taken from other semistructured interviews. Three focus groups were held in June 2012 to gather more insight from fishermen and community members ($n = 13$) and to ground-truth some of the findings from the interviews; these sessions were recorded and detailed notes were taken from the audio files. We used QSR NVivo 9 to analyze data following a modified grounded theory approach that involved multiple

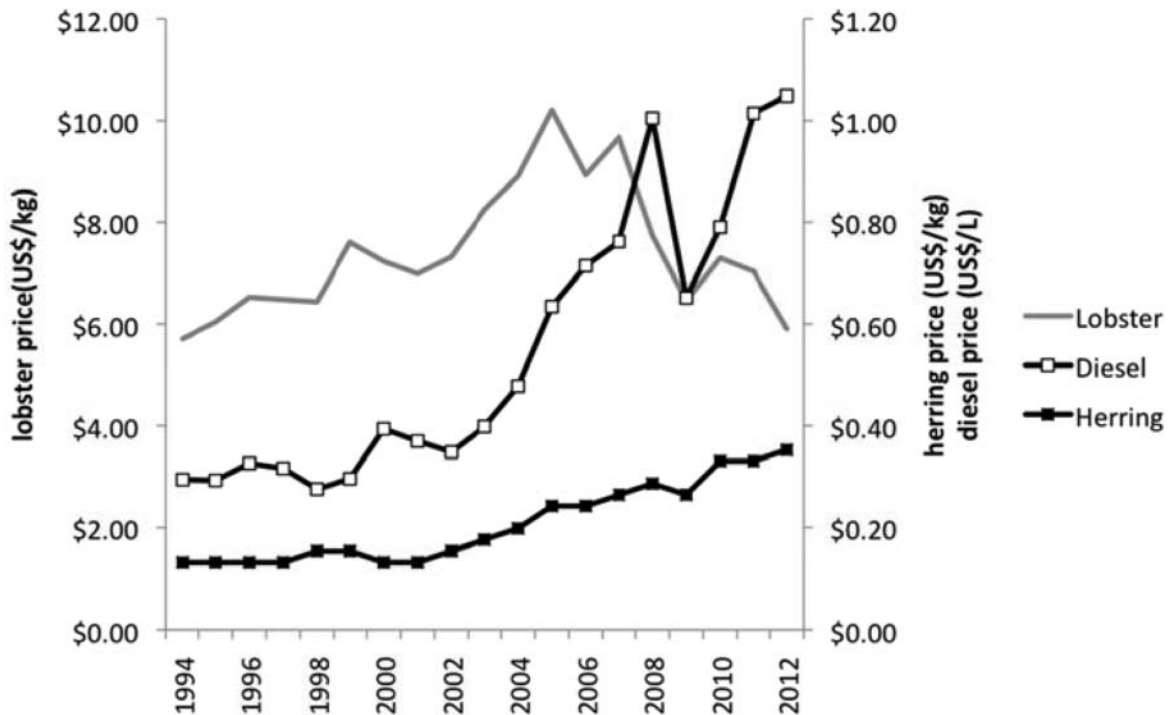


FIGURE 2. Lobster and herring prices are exvessel value (Maine DMR 2012b). While this accurately reflects the average price a lobster harvester receives at the boat, the price that he/she would pay for herring as bait would be much higher than the exvessel value and may increase at a more rapid rate. For example, it has been reported that a barrel of herring bait (approximately 91 kg) cost \$25 in 2000 and \$150 in 2010 (Acheson and Acheson 2010). The price of diesel fuel is taken from the U.S. Energy Information Administration and may not reflect the actual price paid by harvesters. Additionally, all of these prices may vary based on the quantity purchased or sold. However, the trend of increasing expenses and decreasing lobster prices is clear.

iterations of coding (Glaser and Strauss 1967; Strauss and Corbin 1998). In this paper we draw on themes that emerged from this analysis along with news articles and notes from public meetings that occurred after completion of the interviews.

In our analysis, we concentrated on recent threats to the industry and the ways in which it has responded to them, focusing on three situations: a drop in lobster prices beginning in 2008, a recovery of prices in 2010–2011, and a second collapse of prices in 2012. We also considered other environmental and regulatory concerns identified by fishermen. We discuss the current level of vulnerability in the lobster fishery and what we have learned about its resilience based on responses to recent threats. We also note factors that may explain the level of social resilience in this fishery and why it has not been able to respond effectively to recent threats.

MANAGEMENT OF THE MAINE LOBSTER FISHERY

Lobster management in Maine relies on a combination of informal and formal institutions (Acheson 2003). Historically, access to the lobster fishery has been restricted informally through “harbor gangs,” small groups of fishermen who “maintain a fishing territory for the use of its members” (Acheson 2003:24). Membership in a harbor gang is restricted, and territory is defended from incursion by adjacent gangs through

harassments ranging from verbal threats and abuse to the destruction of gear. Territoriality persists today, and reports of gear molestation from trap cutting to suspicious boat sinkings occur annually.

Formal management of lobster fishing has relied on effort controls (limited entry and trap limits). Enacted by the Maine state legislature in 1995, the Zone Management Law established a statewide trap limit, an apprenticeship program for new entrants, and a trap tag program that links traps to their owners. Additionally, the law created a formal comanagement system in the form of lobster management zones. Councils of fishermen elected by other license holders in the zone allow members to modify existing rules and propose new rules regarding trap limits and limited entry with a two-thirds majority vote. These proposals, if approved by the commissioner, are then transformed into state regulations by the Department of Marine Resources (DMR). As a result of this process, all zones have limits of 600–800 traps and six of the seven zones have restricted entry with varying entry-to-exit ratios.¹ This

¹To remove effort from the fishery, most zones have created entry-to-exit ratios; a system where the number of new licenses issued in a year is dependent upon the number of licenses (more specifically trap tags) retired in the previous year. Licenses in the zone without entry-to-exit ratios have only increased by 2% from 1997 to 2011, while across all zones licenses have decreased 12% (Dayton and Sun 2012).

has helped to slow entry into the fishery and continue the sense of resource stewardship and empowerment of license holders. Lobster management also includes minimum and maximum size restrictions and a prohibition on the harvest of reproductive females. These measures, known as the double-gauge law and V-notch program, evolved through state legislation as a result of lobbying from the industry and are an example of successful collective action by this industry. Although these regulations were enacted by the legislature, they have long been supported by the industry because they follow fishermen's conservation logic, namely, to preserve lobsters during their most vulnerable stages of life (Acheson 2003:218).

2008 GLOBAL ECONOMIC CRISIS

In 2008, lobster fishermen faced a crisis with many of the same characteristics as the predicament faced in the summer of 2012. While the threats were similar—low prices, lack of market, and excess product—the mechanisms behind them were very different. In 2008, the dismal global economic climate created a chain of events resulting in a loss of market for Maine lobsters, which carried into much of the 2009 season.

As much as 70% of the lobsters landed in Maine are shipped to Canada for processing, reshipment, or export back to the United States (Steneck et al. 2011). Many of these processing plants were funded by Icelandic banks until October 2008, when the Icelandic banking system collapsed, pulling funding from the processors and forcing a majority to cease operations. The resulting reduction in demand forced Maine lobster prices down to record lows; as one lobsterman described the situation, "I made more money when I was 15 years old fishing out of a skiff" (Richardson 2010). Another described it as "an economic disaster the size of Katrina" (Lobster solutions hard to come by 2008).

Exacerbating the effect of these market pressures and low prices on lobster harvesters was the fact that bait and fuel prices were increasing simultaneously (Figure 2). One fisherman whom we interviewed put these price changes into historical perspective as follows:

In 1994 . . . we got \$2.60 a pound [\$5.73/kg] for our product, fuel was 70 cents a gallon [\$0.18/L], and our bait was \$8 a bushel [\$0.12/kg]. Last year [2009] we got \$2.60 a pound [\$5.73/kg], the bait was \$21 a bushel [\$0.32/kg], and fuel was \$2.89 [\$0.76/L].²

The cumulative impact of these threats led the lobster industry to adjust their strategies in creative ways to keep their businesses afloat.

The most common responses by lobster harvesters were changes in fishing behavior to increase profits. Some increased fishing effort to increase their landings and compensate for the

low prices. Others limited the number of traps they hauled, hoping to reduce the glut in the market and drive the price up, or stopped hauling altogether because the prices they received were not enough to cover their expenses. These opposing strategies had little influence on overall landings and price, prompting some lobstermen to call for an industrywide tie-up to reduce production until prices recovered. However, due to a 1958 consent decree lobstermen are prohibited from refraining to harvest lobsters until a minimum price is reached and from compelling others to refrain from harvesting. Because Maine lobstermen are owner-operators, this type of organized tie-up violates U.S. antitrust laws related to collusion and price fixing. While an industry-led tie-up was prohibited, many fishermen hoped the state would intervene; however, the state has the authority to shut down the fishery only when it is required to protect the resource, not in response to economic conditions.

Unable to impact prices at the dock, many fishermen adopted strategies to reduce their expenses, such as dropping their sternmen and fishing alone. One fisherman describes his strategy to cut costs during 2008 as follows:

We still kept fishing, but . . . you probably didn't haul as often, you know, and you didn't run your boat so hard. You didn't burn as much fuel. You know, you just kept going. You just tried to ride it out and stay with it.

According to our interviews, such responses are customary among fishermen who are having a particularly bad year or experience unexpected circumstances that increase their costs (such as a large repair or maintenance issue or other unforeseen personal expenses). Many fishermen refer to "belt tightening," i.e., reducing their expenses and living off as little as possible as their strategy to get through tough times. In 2008, the belt tightening was industrywide.

Due to the widespread nature of the crisis in 2008, there were additional responses that were practiced industrywide or that required organization from multiple facets of the industry. The Maine Lobster Promotion Council worked with local grocery chains to run lobster promotions in order to increase demand as well as publicizing the crisis with an ad campaign geared toward local consumers intended to increase demand in the fall when the tourist season is over. The public sector also offered support. U.S. Senator Olympia Snowe organized meetings between industry members and federal agencies to develop processing plants in Maine. The U.S. Department of Agriculture Trade Adjustment Assistance program was created to provide training and financial assistance to farmers or fishermen who have been negatively impacted by foreign imports³ and is assisting over 4,000 fishermen in New England

²Unattributed quotes are from interviews or focus groups conducted for this project.

³While the specific threat to the lobster industry in 2008 was related to a lack of export markets, the TAA program was developed to increase domestic production of seafood overall, which suffers from a \$9 billion deficit (TAA 2010).

(Northeast lobstermen begin to realize benefits from the USDA's Trade Adjustment Assistance (TAA) program 2012). In October 2008, Maine Governor Jon Baldacci signed an executive order creating a Task Force on the Economic Sustainability of Maine's Lobster Industry to examine possible long-term solutions to buffer the lobster fishery from global economic conditions. The task force drafted a strategic plan that included recommendations to increase markets within Maine, improve product quality and adjust the timing of landings to maximize price, and create promotional opportunities for Maine lobster (Mosely Group 2009). While the report identified strategies to promote Maine lobster, implementation of the plan required \$7.50–8.25 million of funding per year, a majority of which would be provided by industry assessments. The Maine Lobstermen's Association voted against such assessments, and due to the lack of industry support no legislation was drafted to implement the recommendations of the strategic plan.

RECOVERY IN 2010–2011

Despite the “crisis of 2008,” interviews conducted in 2010 and 2011 indicate that most fishermen characterized the Maine lobster fishery as resilient. Market demand had increased, and while prices had not rebounded to their pre-2008 levels, they were rising (Figure 2). The opinion that the lobster fishery was financially viable was almost unanimous, as described by one interview respondent: “Last year [2010] them guys made a fortune off that lobster.” Fishermen without lobster licenses who were interviewed during this period commonly expressed regret that they had not gotten licenses when they were available or had let their licenses lapse in favor of participating in other fisheries. These attitudes signify the perceived health of the industry and the importance of lobster as part of a diversified, resilient harvesting strategy. As one fisherman put it, “the only thing I'm missing is my lobster license, which is a big one. I'd like to have that card in my deck.” Similarly, another fisherman stated, “it seems to me like in the last few years they've done pretty good. I mean they must be doing alright because they're all trading in their boats every year for bigger, newer boats.”

While the overall perception was that the resource was doing well, anxiety about the future status of the fishery remained. Concerns during this period focused on both potential stock declines and market volatility. One fisherman explained his concern as follows: “In my opinion, lobster fishing has never been better than it has been in the last 15–20 years. How long is it gonna last? That's the big question. Nobody knows the answer.” Even absent any reductions in stock abundance, the instability in prices gave rise to market concerns for the future:

The stocks have been pretty much increasing. There were a couple lull years, oh, I would say around 2008, 2009 were down years a

TABLE 1. Comments illustrating lobster harvesters' perceptions of market-related problems in the industry.

“Lobster price has rebound some, but if that goes to the shit again at \$2 a pound, which it can, you're screwed.”
 “We need to do a better job marketing our product.”
 “Our financial business plan is based on a \$4 boat price. If we get below \$4, it doesn't work.” (Lobstering in 2010, 2010)
 “. . . if they'll do that and start processing all the Maine lobsters, don't let Canada have our lobsters for nothing, keep the lobsters in the United States, the price would go up.”
 “. . . another thing that we should be doing is instead of lugging our lobsters to here and there, we should be buying them and processing them here. Take the meats. I mean we can now dissect our lobsters and take the meat and freeze it and can it, do this and that with it. It's something we could be doing in this community right here.”

little bit, but since then the stocks have been increasing again. The stocks look really, really good for the future . . . Now if the market doesn't adjust to it, it doesn't mean it's a good thing. I'd rather catch 1,000 lb [454 kg] at \$5.00 a pound [\$11/kg] than catch 3,000 lb [1,360 kg] at \$2.00 a pound [\$4.41/kg].

This uncertainty, combined with increased dependence on a single species, is frequently cited as a source of vulnerability for the industry's future (Steneck et al. 2011; Wahle et al. 2013).

There are approximately 7,000 license holders on the coast of Maine, many living in towns with limited alternative economic opportunities. One fisherman described the dependence on lobster in his town this way:

So your lobster stocks collapse . . . this town's screwed because we're not diverse enough to handle something like that and probably in the '90s when it was diverse, it was scallopers, draggers, lobstermen, all of the above, and everybody made a living doing a little bit of everything, but now it's basically all their eggs are in lobstering except for a scattering few.

It is generally established that diversity leads to increased resilience in social–ecological systems (Folke et al. 2002). This increase in resilience occurs both during disturbances (when diversity reduces the impact of threats by spreading the risk) and after disturbances (because a diverse system has a greater capacity to respond to change) (Folke et al. 2002; Turner et al. 2003). The strategy of diversification is also utilized specifically by fishermen. Much like maintaining a stock portfolio with high- and low-risk investments, fishermen who harvest multiple species can buffer the effects of a price collapse or reduced catch of a particular species by shifting to other fisheries. This strategy is particularly important in an environment with high uncertainty, such as fishing, as it is difficult to predict future hazards (Berkes 2007). However, given increasingly restrictive

regulatory environments, a diverse harvesting strategy is more difficult to employ, reducing resilience in many fisheries (Tuler et al. 2008; Murray et al. 2010). Historically, many fishermen in Maine utilized this strategy and targeted a diverse mix of species, harvesting what was abundant and in season. As many species such as groundfish began to decline and regulatory restrictions were strengthened, many fishermen transitioned to harvesting lobster or intensified their lobster harvesting efforts. This dependence on lobster has led some scholars to describe the Gulf of Maine as a lobster monoculture (Wilson et al. 2007; Steneck et al. 2011). Such a shift may have been a successful response to threats at the time, but the increased dependence on a single fishery has also reduced the current level of resilience in the fishing industry.

Despite the responses and adjustments made by the industry in 2008, many fishermen continued to refer to the vulnerabilities that had been identified that year and spoke to the need to increase the economic sustainability of the fishery (Table 1). Looking back, it appears that their concerns about market stability and lobster prices were extremely prescient, as these vulnerabilities were exposed again just 2 years later.

2012 ENVIRONMENTAL CRISIS

The summer lobster season of 2012 materialized in many ways as a *déjà vu* of 2008, with lobster prices falling dramatically. While the external price shock experienced by the fishermen was much the same, the mechanism creating the threat was very different, however. Unseasonably warm water temperatures caused a glut of soft-shell lobsters in the late spring and early summer—too early for the Maine tourist season and its associated markets and overlapping the period when Canadian processors are at full capacity processing domestic lobster. Because soft-shell lobsters do not package well, they cannot be shipped live, further reducing the available market. Additionally, soft-shell lobsters fetch lower prices, as they contain less meat than comparable hard-shell ones. These factors combined in the summer of 2012 to produce the lowest lobster prices in 30 years, down to an exvessel value of \$1.35 per pound (\$2.98/kg) in some ports (Seelye 2012).

Confronting threats similar to those faced in 2008, the industry unsurprisingly reacted with almost identical responses. Many lobstermen started to increase their fishing effort to make up for the lower prices. One fisherman stated, “I didn’t used to need to come in with a huge haul to make a living Now I do” (Seelye 2012). Other lobstermen took the opposite approach and began tying up their boats, hoping that a reduction in supply would increase prices. Again, there were calls for an organized tie-up but the commissioner of the DMR said that the state could not shut down the fishery for economic reasons and would not tolerate any type of peer pressure, including cutting traps to encourage other boats to tie up (Lobstermen tying up their boats 2012).

While the DMR did not have the authority to intervene, the state government reiterated its support for the industry, creating a committee of Lobster Advisory Council members, processors, dealers, exporters, and industry representatives to “consider whether there are changes that could be made in the lobster fishery to improve the quality of the product landed and the profitability of the industry” (Maine DMR 2012a). The governor also announced that the state would investigate ways to encourage additional processing capacity in Maine. One new Maine processing plant shipped its first load of lobsters in August 2012 and is anticipating processing 4.8 million pounds (2.2 kg) per year when running at full capacity (Hall 2012). Additional plants opened in 2013, increasing Maine’s overall processing capacity to 10–12 million pounds; approximately 60–70% of Maine lobster landings are still shipped to Canada for processing, however (Canfield 2013).

Although this new processing capacity will undoubtedly help reduce the dependence on Canadian processors, some say that it is putting the cart before the horse: “If you don’t focus on marketing, [having] more processors in Maine is just going to force the price down” (Trotter 2012). Echoing the sentiment expressed in 2008 as well as the conclusions of the governor’s task force of that year, many lobstermen feel that the focus needs to be on increased marketing and branding of Maine lobster as a product: “What we have that (Canadians) don’t have is a great brand We just need to be innovative. In the U.S., the Maine brand is strong, there are huge untapped markets right here in this country” (Trotter 2012). The recent increase in processing capacity in Maine may facilitate this branding, as more product will be available that can be labeled “Maine made” because it will not have traveled to Canada for processing. The federal government has supported this marketing strategy, and Maine congresswoman Chellie Pingree was able to negotiate with two major cruise lines to commit to purchasing 8,800 lb (3,991 kg) of Maine lobster to be served to passengers on ships that visit Maine (McCracken 2012). While this is an important step that will help increase domestic markets and create demand for the product, it may be no more than a symbolic effort, as the order accounts for less than one one-hundredth of a percent of total lobster landings in Maine.

OTHER THREATS FACING FISHERMEN

In addition to the drop in prices in 2008 and 2012, our research identified other factors that threaten the resilience of the lobster fishery in Maine. First, the limited-entry system has made it difficult for many young people to obtain lobster licenses. One fisherman explained the situation as follows: “You gotta jump through hoops and breathe fire to get in the fishery now . . . you have to apprentice and log days and hours to get on a waitlist and will be dead and gone before (you) ever gets into lobstering.” This has many fishermen concerned about the future of the lobster industry as current fishermen

begin to age and retire without a matching influx of young fishermen:

I think we'll see a drastic dip in the number of people in the fishing business, because we've limited entry drastically. You take a town like this one that has 60 or 80 fishermen in it, half of those guys probably won't be in the business 20 years from now, and I don't see 20 or 30 [new entrants into the fishery] coming along.

Members of the industry are not the only ones concerned about the rising age structure of harvesters and the restrictions of the current limited-entry system. During the 125th legislative session, the Maine legislature directed the DMR to commission an independent evaluation of the costs and benefits of the limited-entry licensing system. The resulting report suggested that one deficiency of the system is the long waiting period for receiving a new license and that the current average tenure on the waiting list is 6 years (Dayton and Sun 2012).⁴

Additionally, fishermen are concerned about future environmental conditions that may threaten the industry. The sea surface temperatures of the northeastern continental shelf were higher in the first 6 months of 2012 than they have been in the last 70 years, and preliminary data suggest that this has affected temperatures throughout the water column, including bottom temperatures (Dawicki 2012). This has many fishermen worried that the Gulf of Maine could experience stock declines similar to those seen in southern New England in the late 1990s. One fisherman explained his concern about future environmental conditions this way:

One of the things that I worry about more than anything else is environmental conditions because we've seen in Long Island Sound and places south of Cape Cod where the fishery can be wiped out almost overnight because of environmental factors—pollution, warm water . . . I think Maine has always been protected because of its cold water . . . I worry that if it warms up just a little bit, we're gonna have major problems.

The combination of warm water temperatures and an increased density of lobsters has led to concern that shell disease will be a threat in the future; although the prevalence of the disease has increased since 2010, it is still seen in less than 1% of the lobsters sampled in Maine.

DISCUSSION

The parallels between the 2008 and 2012 crises are difficult to ignore. Both were characterized by external threats that affected lobster prices and markets. While the drivers behind these threats differed—global economic and environmental conditions, respectively—the results were very much the

same. So what does all this mean in terms of the resilience of the Maine lobster fishery?

One would think that having experienced the crisis of 2008, the industry would have been better prepared to respond to the threats faced in 2012, but as Patrice McCarron, executive director of the Maine Lobsterman's Association stated, "Unfortunately, this summer's crisis revealed that little progress has been made since 2008" (MacPherson 2012). The fact that the industry was not more prepared to respond to a similar crisis 4 years later indicates that the lobster industry is not as resilient as we think.

We classify many of the responses to the crises of the past 4 years as *coping* strategies (short-term changes in behavior designed to withstand a perturbation) rather than *adaptation* (longer-term strategies that require larger investments and that are more difficult to reverse) (Tuler et al. 2008). In the past the lobster industry has been remarkably successful in responding to threats, enacting institutional changes from trap limits to V-notching, size gauges, and the zone council system (Acheson 2003). So why has it not adapted similarly to the new market pressures and historically low prices? We offer five possible explanations: (1) adaptation and institutional change take time, and because the current threats are relatively new the industry has not had adequate time to adapt to them; (2) the crisis is not perceived as extreme or imminent enough to require long-term adaptation; (3) the current management scheme is unable to adapt to these types of challenges; (4) the new economic threats are external and on a broader scale, requiring larger market-based responses that are outside the scope of the harvesting operation; and (5) the unpredictable timing and nature of these new threats has led to coping responses.

Adaptation Takes Time

The process followed by Maine lobster fishermen throughout the 20th century to devise the rules and institutions that currently regulate the Maine lobster fishery illustrates that institutional change and adaptation is a slow, complex process (North 1990). First, the lobstermen had to agree that changes were necessary and would have a positive impact on the fishery. Obtaining agreement in a fishery often characterized as fiercely individual can be an arduous task. One fisherman describes the difficulty in organizing lobster fishermen as follows: "You could have 3,000 guys agreeing on doing something and you have one guy saying, 'No, I'm not going. I'm gonna do it my way,' and the 3,000 will rapidly join him." Once consensus was achieved, the lobstermen had to convince the state legislature to enact legislation to create the institutions necessary to implement reform. This has not been a quick, easy process; it has required 70 years of evolving biological, social, and political conditions to create the current lobster management scheme (Acheson 2003).

The recent crisis in the lobster fishery has spanned just 5 years, and with the rebound in prices from 2010 to 2011 the

⁴While the report made numerous recommendations to remedy this, none have been implemented as of the publication of this article.

actual period in which the threats were experienced is even shorter. Therefore, it may be premature to expect the lobster industry to have devised new institutions that increase their resilience to these price shocks. Some fishermen are aware of the time required for this process. As one explained, “There is no quick fix to this. We do not need to overreact and act fast by putting in some regulation that just won’t work in the long run” (Lobster solutions hard to come by 2008). The historical ability of the industry to devise institutions to adapt to variability in stock abundance generates confidence in its capacity, given adequate time, to adapt to the new threats and to create new institutions that will address the issues.

Level of Crisis

The level of a threat can be determined by its intensity, frequency, and duration (Cutter 1996), which in turn affect the magnitude of the response to the threat (Kasperson et al. 1995; Dow 1999). While the crises of 2008 and 2012 created difficult economic times for many in the lobster industry, the effects have been relatively short-lived. We recognize that the crises were catastrophic for lobstermen who lost their boats or who were forced out of the industry, but for those who were able to continue fishing our interviews showed that during the years 2010 and 2011 many still perceived the fishery to be doing well. Just 2 years after experiencing the crisis of 2008, fishermen spoke of threats to the lobster industry in vague, futuristic terms.

The perception that threats to the lobster fishery are not imminent or of high enough degree to require substantial adaptation is supported by the widespread success of the lobster fishery for the past 30–40 years. With increases in landings and relatively stable markets since the mid-1980s, many in the industry have not experienced significant misfortune. As one fisherman explained,

The fishermen who are 40 and under have never known struggle. They really haven’t... All they’ve ever known for the last 20–25 years is ever-increasing catches, ever-increasing wallets, and they may think they have, okay, but they’ve never known struggle... To me, struggling is no matter what you have for bills you can’t catch enough lobsters to pay for ‘em. And they’ve never known that.

The recent success of the fishery has left younger members of the industry without the “social memory” of strategies that have been successful in responding to threats in the past. Social memory is a key aspect of resilience, as it provides a wealth of information regarding the diversity of responses available to different threats and their likely outcomes (Folke et al. 2005). This lack of social memory reduces the resilience of the lobster industry, as it cannot utilize the “head start” in responding to threats that social memory provides.

This lack of experience with previous threats may also lead the industry to underestimate the level of current threats. Due to the recent positive trend in landings, there is little

perception that there is any current threat to the abundance of Maine lobster stocks. One fisherman in 2011 described the status of the resource as follows:

The ocean is full of lobsters, it’s full of them. There’s nothing to get 50 lobsters in a pair of traps; it’s not keepers, you understand, but lobsters overall... I’ve never seen that in any of my lifetime, so things look good in the lobster industry for a while if they all live.

Because of this, many fishermen believe that they will be able to compensate for lower prices by fishing harder and are therefore less likely to make long-term adaptive changes. Some fishermen recognize the futility of this strategy, however:

Well, see, lobstermen have a bad business plan. When the price drops they go harder to try to make up for price difference, which you start to use more bait; so when you start to use more bait it increases the bait price and, as you go harder, you burn more fuel and then you start catching even more lobsters that even drives the price of lobsters even further down, so it’s not a really good business plan.

Intensifying pressure on the resource may not be a good business plan, but the fact that it is seen as a viable strategy when times get tough may be one factor impeding the institutional change necessary for long-term sustainability in the market.

Previous institutional changes in the lobster fishery have followed crises that were perceived as significant, imminent threats. The transition of the industry from one in which harvesters had a “pirate ethic” and violated laws for personal gain to one with a “conservation ethic” that promoted sustainable regulations and compliance has been attributed to the catastrophic stock collapse in the 1930s, which caused 30% of lobstermen to leave the industry (Acheson and Gardner 2010). After years of division, this crisis shocked the industry, catalyzing the transition to more sustainable regulations and industrywide understanding of the importance of complying with those regulations. Perhaps the price drops of 2008 and 2012 have not been catastrophic enough for the industry to realize institutional change.

Noneconomic threats are also perceived as future threats, but they do not appear urgent to a majority of the industry. Environmental changes, such as shell disease and consistent changes in water temperature have yet to substantially impact harvest levels and are therefore deemed to be less urgent. A shock to the system of the same magnitude as the stock collapse of the 1930s may be necessary before real institutional change will occur.

Adaptability of the Current Management Scheme

The level of vulnerability of the lobster industry after the shocks of the last 4 years remains to be seen. Some of this will hinge on future market and environmental conditions that are unknowable, but it will also be determined by the flexibility of

the institutions that regulate the industry. At a recent meeting at which lobstermen were asked to list elements of the current management system that are working, many fishermen found it difficult to think of a bright spot. One fisherman summarized it as “the whole thing’s broke.” The comanagement system of the lobster fishery relies heavily on harvester participation, which has declined in recent years. Fishermen who have attended meetings say that as a whole the industry is “apathetic until after the fact” and that opinions are not voiced until after policy decisions have been made. This may be due to fatigue, as lobstermen have attempted to change regulations in the past only to meet interference from the state. One fisherman described the process as “good intentions go in and garbage comes out.”

One of Elinor Ostrom’s⁵ design principles for long-enduring institutions is that “external authorities do not challenge the rights of appropriators to devise their own institutions” (Ostrom 1990:101). The state has ultimate authority over which industry proposals are adopted in the form of regulations, and while this provision lends organization and authority to the process, in its current form it may not prove responsive enough to industry needs. If the institutions stay rigid and change does not occur, the industry could be at a precipice, where threats that were previously absorbed become catastrophic (Holling 1986). However, if the system remains flexible, the lobster industry may increase its resilience and ability to adapt to recent and future threats.

Perhaps the zone council system is “not adaptive to industry,” as some fishermen have stated. This alone does not preclude the ability of the industry to respond to current threats. One aspect of resilient systems is that a disturbance or threat “has the potential to create opportunity for doing new things, for innovation, and for development” (Folke et al. 2005:253). The lobster industry could demonstrate its resilience by devising new ways of responding outside of the zone council or legislative system. This type of response may require additional leadership or political entrepreneurs to initiate reform. Political entrepreneurs are people who “do more than work for the public good; they also offer information, expertise, and public resources” and “are the means by which [the rules] are negotiated” (Acheson 2003:72, 79). They can be the catalyst required to generate new rules and institutions to respond to threats. As the fishing community ages, there seems to be less interest in spending the time required to make the connections and persuade the right people to make regulatory changes. This lack of leadership reduces social resilience and the ability to initiate new responses to change. Without a new generation of political entrepreneurs to take the reins, it may be difficult for any new system of management, or increased flexibility of current management schemes, to come to fruition.

⁵Nobel Prize winner and noted researcher of common pool resource institutions.

Broad-Scale Threats Require Response at a Matching Scale

The current threats facing the industry exhibited by the price drops of 2008 and 2012 are large-scale, external threats; therefore, any successful response must be at an appropriately broad scale. When the global economy falls into a recession that affects lobster prices or water temperature changes the temporal distribution of landings, there are few response options available to the individual harvester. As one lobsterman stated, “The only thing you can do is tighten your belt up and keep on fishing.” Individual or collective action from harvesters cannot respond adequately to an external threat of this scale.

Collective action in the lobster fishery is akin to a prisoner’s dilemma, and although the industry has collectively devised institutions to respond to threats in the past these threats were largely internal and related to taking collective action for conservation (Acheson and Gardner 2010). Threats of this nature are at a scale to which individual fishermen can respond, as their behavior has a direct effect on stock abundance, resulting in an effective, tight feedback loop that links their response to its effect on the threat. This feedback loop is a key factor in stimulating responses (Berkes 2002). As a threat broadens in scale, the feedback loop becomes less coupled, decreasing the motivation for response. Because the price threats in the lobster fishery are at a broad scale, this feedback loop is less tightly related to the harvesters’ responses; therefore, a larger-scale response is required, such as one by the state. However, while the state allows for collective action with respect to conservation (e.g., the double-gauge law and V-notching), it prohibits it with respect to economic objectives (i.e., coordinated tie-ups), further impeding the ability of lobster fishermen to respond to economic changes such as those experienced in 2008 and 2012.

Nested scales of management increase resilience in complex social–ecological systems (Ostrom and Janssen 2004). When multiple scales of management exist, there is a variety of responses available to address threats within the system. The current management institutions in the lobster fishery are appropriate to respond to threats to the resource, but in order to respond to broader, market-based threats new, larger-scale institutions are required. There is evidence that toward the end of the 2012 season the industry acknowledged the need for large-scale market-based responses. In the fall of 2012, the industry was exploring license surcharges of \$3 million annually that would fund promotional efforts aimed at expanding local, regional, and global markets (Schreiber 2012). This support for a larger-scale response is an encouraging sign for future resilience in the lobster industry.

Unpredictable Threats Lead to Coping Responses

One reason coping responses have been the main ones thus far is the unpredictable nature of these new threats. Collective

action and new institutions were successful in responding to past threats because those threats were predictable and consistent. It was much easier to foresee the threats of increased effort in the fishery and the harvesting of short lobsters than it is to anticipate when market prices will drop. The source, extent, and timing of the more recent threats to the lobster industry are unpredictable. Environmental changes may be easier to respond to if there are gradual changes such as consistent, incremental shifts in the species' distribution or a slow, linear increase in the prevalence of shell disease. But if these changes occur in an abrupt, unpredictable manner with no evidence of changing future conditions, the responses will be equally abrupt and unplanned.

There is a general recognition that the good times cannot last forever. This is exemplified by the ways in which lobstermen describe the future: "There's going to be a huge, huge catch of lobsters for a few years now. But that can be reversed real quick." "No one says lobsters have to stay alive; they could die just as quick as they come." "It's good right now, but it's not going to stay that way." While the uncertainty of the future is almost universally acknowledged, there is no general recognition of what the specific threats will be or when they will occur. Because the threats are unpredictable, reliance on coping responses may be the most logical strategy.

The current resilience in the lobster industry may be best described by (1) the attitude among harvesters that they need to be prepared for future threats, whatever they may be, and (2) the coping responses they are implementing to deal with a less predictable future. This attitude is reflected by a reduction in purchases of new boats. As one lobsterman described the situation, "There's not many boat builders making lobster boats right now because . . . people aren't buying." Another fisherman described the way he is changing his behavior due to this unpredictability as follows: "The way the fishing is now, I can't see myself doing the tricks I used to do, trade trucks every year, I mean. I think I'm gonna have to keep what I've got." While large-scale, institutional responses will help increase the resilience to future market threats, smaller coping strategies appear to be the best option now available to increase the resilience to other unpredictable, external threats in the future. It remains to be seen whether the resilience created by these coping responses will be adequate to withstand future threats.

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REFERENCES

- Acheson, J. M. 2003. Capturing the commons: devising institutions to manage the Maine lobster industry. University Press of New England, Lebanon, New Hampshire.
- Acheson, J. M., and A. W. Acheson. 2010. Factions, models, and resource regulation: prospects for lowering the Maine lobster trap limit. *Human Ecology* 38:587–598.
- Acheson, J. M., and R. Gardner. 2010. The evolution of conservation rules and norms in the Maine lobster industry. *Ocean and Coastal Management* 53:524–534.
- Acheson, J. M., and R. S. Steneck. 1997. Bust and then boom in the Maine lobster industry: perspectives of fishers and biologists. *North American Journal of Fisheries Management* 17:826–847.
- Adger, W. N. 2000. Social and ecological resilience: are they related? *Progress in Human Geography* 24:347–364.
- Adger, W. N. 2006. Vulnerability. *Global Environmental Change* 16:268–281.
- Berkes, F. 2002. Cross-scale institutional linkages: perspectives from the bottom up. Pages 293–321 in E. Ostrom, T. Dietz, N. Dolsak, P. C. Stern, S. Stonich, and E. U. Weber, editors. *Drama of the commons*. National Academies Press, Washington, D.C.
- Berkes, F. 2007. Understanding uncertainty and reducing vulnerability: lessons from resilience thinking. *Natural Hazards* 41:283–295.
- Bernard, H. R. 2002. *Research methods in anthropology: qualitative and quantitative approaches*, 3rd edition. Altamira Press, Walnut Creek, California.
- Boudreau, S. A., and B. Worm. 2010. Top-down control of lobster in the Gulf of Maine: insights from local ecological knowledge and research surveys. *Marine Ecology Progress Series* 403:181–191.
- Canfield, C. 2013. Maine moves to capture lobster-processing market. Associated Press (July 5). Available: <http://bigstory.ap.org/article/maine-moves-capture-lobster-processing-market>. (January 2014).
- Cutter, S. L. 1996. Vulnerability to environmental hazards. *Progress in Human Geography* 20:529–539.
- Dawicki, S. 2012. Sea surface temperatures reach record highs on northeast continental shelf. National Oceanic and Atmospheric Administration Ecosystem Advisory 2. (18 September 2012).
- Dayton, A., and J. Sun. 2012. An independent evaluation of the Maine limited-entry licensing system for lobster and crab. Report of Gulf of Maine Research Institute to Maine Department of Marine Resources, Boothbay Harbor.
- Dow, K. 1999. The extraordinary and the everyday in explanations of vulnerability to an oil spill. *Geographical Review* 89:74–93.
- Folke, C., J. Colding, and F. Berkes. 2002. Synthesis: building resilience and adaptive capacity in social–ecological systems. Pages 352–387 in F. Berkes, J. Colding, and C. Folke, editors. *Navigating social–ecological systems: building resilience for complexity and change*. Cambridge University Press, New York.

- Folke, C., T. Hahn, P. Olsson, and J. Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources* 30:441–473.
- Glaser, B., and A. Strauss. 1967. *The discovery of grounded theory: strategies for qualitative research*. Aldine, Chicago.
- Hall, J. 2012. Lobster processing: young Mainer to open seafood plant. *Portland Press Herald* (August 13). Available: http://www.pressherald.com/news/getting-lobsters-from-trap-to-table_2012-08-14.html. (August 2012).
- Holling, C. S. 1986. The resilience of terrestrial ecosystems: local surprise and global change. Pages 292–317 in W. Clark and R. Munn, editors. *Sustainable development of the biosphere*. Cambridge University Press, Cambridge, UK.
- Kasperson, R. E., J. X. Kasperson, B. L. I. Turner, K. Dow, and W. B. Meyer. 1995. Critical environmental regions: concepts, distinctions, and issues. Pages 1–41 in J. X. Kasperson, R. E. Kasperson, and B. L. Turner, editors. *Regions at risk: comparisons of threatened environments*. United Nations University Press, Tokyo.
- Lobster solutions hard to come by. 2008. *Commercial Fisheries News*. Available: http://www.fish-news.com/cfn/editorial/editorial_11_08/Lobster_crisis-Solutions_will_come_hard.html. (February 2015).
- Lobstering in 2010. 2010. *Free Press* (January 7). Available: http://freepressonline.com/main.asp?Section_ID=52&SubSectionID=78&ArticleID=4574. (February 2015).
- Lobstermen tying up their boats. 2012. *WMTW-TV*, Portland, Maine (July 12). Available: <http://www.wmtw.com/news/money/Lobstermen-tying-up-their-boats/-/8791814/15499618/-/oskfp7z/-/index.html?absolute=true>. (August 2012).
- MacPherson, I. 2012. A road map for the future. *Landings: News and Views from Maine's Lobstering Community* (October 15). Available: <http://mainelandings.org/tag/lobster-council-of-canada/>. (October 2012).
- Maine DMR (Maine Department of Marine Resources). 2012a. Lobster Advisory Council's profitability and lobster quality committee meeting. *Maine DMR*, Augusta.
- Maine DMR (Maine Department of Marine Resources). 2012b. Historical Maine landings data. Available: <http://www.maine.gov/dmr/commercialfishing/historicaldata.htm>. (August 2012).
- McCay, B. J. 1978. Systems ecology, people ecology, and the anthropology of fishing communities. *Human Ecology* 6:397–422.
- McCay, B. J. 2002. Emergence of institutions for the commons: contexts, situations, and events. Pages 361–401 in E. Ostrom, T. Dietz, N. Dolsak, P. C. Stern, S. Stonich, and E. U. Weber, editors. *Drama of the commons*. National Academies Press, Washington, D.C.
- McCracken, C. 2012. Cruise ship buys local lobsters on waterfront: congresswoman Pingree thanked for new business opportunity. *Bangor Daily News* (September 12). Available: <http://bangordailynews.com/community/cruise-ship-buys-local-lobsters-on-waterfront-congresswoman-pingree-thanked-for-new-business-opportunity/>. (October 2012.)
- Mosely Group. 2009. Maine lobster industry strategic plan. Report for Governor's Task Force on the Economic Sustainability of Maine's Lobster Industry, Augusta.
- Murray, G., T. Johnson, B. J. McCay, M. Danko, K. St. Martin, and S. Takahashi. 2010. Creeping enclosure, cumulative effects, and the marine commons of New Jersey. *International Journal of the Commons* 4:367–389.
- North, D. C. 1990. *Institutions, institutional change, and economic performance*. Cambridge University Press, New York.
- Northeast lobstermen begin to realize benefits from the USDA's Trade Adjustment Assistance (TAA) program. 2012. *Fishermen's Voice* 17:11–12.
- Ostrom, E. 1990. *Governing the commons*. Cambridge University Press, New York.
- Ostrom, E., and M. A. Janssen. 2004. Multilevel governance and resilience of social-ecological systems. Pages 239–259 in M. Spoor, editor. *Globalisation, poverty, and conflict*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Richardson, J. 2010. Mainers gobbling lobster to keep industry afloat. *Portland Press Herald* (March 13). Available: http://www.pressherald.com/archive/mainers-gobbling-lobster-to-keep-industry-afloat_2008-10-28.html. (October 2012).
- Ritchie, D. A. 2003. *Doing oral history: a practical guide*. Oxford University Press, New York.
- Schreiber, L. 2012. Lobster industry aims bigger on marketing. *Working Waterfront* (November 14). Available: <http://www.workingwaterfront.com/articles/Lobster-Industry-Aims-Bigger-on-Marketing/15081>. (December 2012).
- Seelye, K. Q. 2012. In Maine, more lobsters than they know what to do with. *New York Times* (July 28). Available: http://www.nytimes.com/2012/07/29/us/in-maine-fishermen-struggle-with-glut-of-lobsters.html?_r=1&hp. (October 2012).
- Steneck, R. S., T. P. Hughes, J. E. Cinner, W. N. Adger, S. N. Arnold, F. Berkes, S. A. Boudreau, K. Brown, C. Folke, L. Gunderson, P. Olsson, M. Scheffer, E. Stephenson, B. Walker, J. Wilson, and B. Worm. 2011. Creation of a gilded trap by the high economic value of the Maine lobster fishery. *Conservation Biology* 25:904–912.
- Strauss, A., and J. Corbin. 1998. *Basics of qualitative research: techniques and procedures for developing grounded theory*. Sage, Thousand Oaks, California.
- TAA (Trade Adjustment Assistance for Farmers). 2010. U.S. lobster exports & the U.S.–Canada relationship. Available: <http://taatraining.cffm.umn.edu/LobsterMrktOV/Default.aspx?SectionID=194>. (October 2012).
- Trotter, B. 2012. Maine ponders industry strategy as lobster protests continue in Canada. *Bangor Daily News* (August 8). Available: <http://bangordailynews.com/2012/08/08/business/maine-ponders-industry-strategy-as-lobster-protests-continue-in-canada/>. (February 2015).
- Tuler, S., J. Agyeman, P. P. da Silva, K. R. LoRusso, and R. Kay. 2008. Assessing vulnerabilities: integrating information about driving forces that affect risks and resilience. *Human Ecology Review* 15:171–184.
- Turner, B. L., R. E. Kasperson, P. A. Matson, J. J. McCarthy, R. W. Corell, L. Christensen, N. Eckley, J. X. Kasperson, A. Luers, M. L. Martello, C. Polsky, A. Pulsipher, and A. Schiller. 2003. A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the USA* 100:8074–8079.
- Vayda, A. P., and B. J. McCay. 1975. New directions in ecology and ecological anthropology. *Annual Review of Anthropology* 4:293–306.
- Wahle, R. A., A. Battison, L. Bernatchez, S. Boudreau, K. Castro, J. H. Grabowski, S. J. Greenwood, C. Guenther, R. Rochette, and J. Wilson. 2013. The American lobster in a changing ecosystem: a U.S.–Canada science symposium, 27–30 November 2012, Portland, Maine. *Canadian Journal of Fisheries and Aquatic Resources* 70:1571–1575.
- Wickenheiser, M. 2012. Maine lobstermen reeling from low prices, seeking cooperation from dealers. *Bangor Daily News* (July 5). Available: <http://bangordailynews.com/2012/07/05/business/maine-lobstermen-reeling-from-low-prices-seeking-cooperation-from-dealers/>. (December 2012).
- Wilson, J. A., J. M. Acheson, and T. R. Johnson. 2013. The cost of useful knowledge and collective action in three fisheries. *Ecological Economics* 96:165–172.
- Wilson, J., L. M. Yan, and C. Wilson. 2007. The precursors of governance in the Maine lobster fishery. *Proceedings of the National Academy of Sciences of the USA* 104:15212–15217.