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Creeping enclosure, cumulative effects and the marine commons of New Jersey

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Abstract: In response to declining fish stocks and increased societal concern, the marine 'commons' of New Jersey is no longer freely available to commercial and recreational fisheries. We discuss the concept of 'creeping' enclosure in relation to New Jersey's marine fisheries and suggest that reduced access can be a cumulative process and function of multiple events and processes and need not be the result of a single regulatory moment. Our findings suggest that some of the

'expected' effects of enclosure, including loss of flexibility, erosion of community, proletarianization of fishermen, and corporatization of the fishery are visible in fisheries that do not feature explicitly privatized property or access rights. We rely on an oral history approach and the rich detail that emerges from attention to the lived experiences of fish harvesters to provide a framework for understanding the range of cumulative effects that have resulted from this process of creeping enclosure. We conclude with a discussion of how the gradual process of enclosure has affected the flows of information between the bio-physical environment and fish harvesters, managers and scientists by reducing both participation in fisheries and the accumulation of knowledge itself.

Keywords: Coupled human and natural systems, enclosure, fisheries management, learning, New Jersey, social-ecological systems

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1. Introduction

In response to declining fish stocks and increased societal concern, the marine "commons" of New Jersey is no longer freely available to commercial and recreational fisheries.[1] By law and custom, the region encompassing state waters (extending to three nautical miles) and the adjacent federal waters (from 3 to 200

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nautical miles) is treated as public domain. It was once virtually open-access, but over the last 20–30 years, as fish and shellfish populations have declined and conservation priorities have come to the fore, the marine commons has become intensively managed by state, interstate, and federal agencies. These regulations did not happen all at once or originate from a single place but both individually and cumulatively they have had impacts/effects on coastal communities. In this paper we adopt the notion of "cumulative effects" to describe the outcomes of multiple events and processes (regulatory changes) that are not the result of a single regulatory moment. We also present the notion of "creeping enclosure" to describe one of those outcomes, wherein fishing actors have seen a "creeping" (not the outcome of a single regulatory moment) process of enclosure that has led, among other things, to reduced flexibility, increased burdens and costs, a range of adaptive responses, and a number of 'personal' impacts. In introducing these concepts, we detail the methods we used to document and describe cumulative effects, along with some of the important methodological challenges we encountered. In our results and discussion we begin describing how this process of creeping enclosure plays a key role in determining the economic and social potential of fishing communities; and in reconfiguring the human environment within which such communities are embedded. While these effects are multiple and diverse and will be the subject of future research, in this paper we draw on an emerging literature that describes coupled human and natural systems to explore one way that this creeping process of enclosure may affect prospects for improved fisheries management, namely through its effects on flows of information between the bio-physical environment and fish harvesters, managers and scientists.

In 1976, the US Congress passed the Fishery Conservation and Management Act, which is now known as the Magnuson-Stevens Act. The Magnuson-Stevens Act provided for the conservation and management of fishery resources within the US Exclusive Economic Zone (EEZ) and gave the US the authority needed to take control of fisheries in waters off its shores. Establishment of the EEZ or "200 mile limit" eventually prohibited foreign fishing vessels from operating within this area and eliminated pressure from a foreign fleet of factory trawlers that had been building since the 1950s. The Magnuson-Stevens Act also established eight Regional Fishery Management Councils that are charged with preparing management plans for commercial and recreational fisheries. Management is focused on single species or small sets of species and has resulted in the development of 45 Fishery Management Plans (FMPs) for domestic species. Many of the FMPs related to New Jersey fisheries are managed by the Mid-Atlantic Fisheries Management Council (MAFMC). These include bluefish, surfclam/ocean quahog, mackerel/squid/butterfish, and tilefish. Two are jointly managed by the Mid-Atlantic and New England Fisheries Management Councils (NEFMC): spiny dogfish and monkfish. Finally, the NEFMC manages several other species of current or past importance in New Jersey waters, including

groundfish, scallops and herring.[2] Many of these FMPs have also undergone additional amendments involving significant changes. The FMPs alone generate a tremendous number of regulations that commercial industries and sports anglers must deal with. There are also numerous regulations for the fisheries within state waters (3 nautical miles) that have been imposed by the state's Fish and Wildlife agency (within the Department of Environmental Protection), most of which are coordinated with regulations in other states through an interstate body, the Atlantic States Marine Fisheries Commission. These state-level organizations manage (or co-manage) such important New Jersey fisheries as shad (*Alosa sapidissima*), striped bass (*Morone saxatilis*) and summer flounder/scup/black sea bass (the latter is co-managed with the MAFMC). Finally, there are countless other laws that regulate vessels, crew and the facilities where vessels are docked as well as rules and regulations that apply to businesses in general (i.e., labor laws, workmen's compensation, occupational health and safety, and so on).

Like other coastal states, New Jersey has long exercised jurisdiction over inshore waters, which extend from a coastal baseline to three nautical miles, including shellfish closures for public health reasons, some licensing requirements, and some limits on finfish seasons, sizes, and so forth. Nonetheless, until recent years, access remained essentially open even if licenses were required. State regulations have greatly increased and access is becoming more restricted just as in federal waters, and partly because of requirements for coordination with federal management and the interstate management regime.

Consequently, both commercial and recreational fishers who use ports in the state of New Jersey to fish in state and federal waters are facing more complex and thorough regulations. The capture of all major species and most minor ones is now heavily regulated, and fishers must deal with a complex mix of quotas, trip limits, bag limits, minimum size limits, gear specifications, seasons, closed areas, crew size requirements, health and safety training and equipment requirements, insurance, catch processing and storage requirements and other related requirements that help ensure safe working conditions, a marketable product, and sustainable fisheries. Many of the important fisheries – notably groundfish, scallops, surfclams, and ocean quahogs – also have limited access licensing for commercial uses. In addition, seasonal closures severely restrict the for-hire (charter and 'head' or 'party' boats) industry. Cumulatively, the regulations are extremely complex and difficult to summarize beyond the very general way we have done here.

It is important to note that these management initiatives have met with some success, including improvements in all fish stocks managed by the Mid-Atlantic

[2] Bluefish: *Pomatomus saltatrix*; surfclam: *Spisula solidissim*; ocean quahog: *Arctica islandica*; mackerel: *Scomber scombrus*; Squid: *Loligo* and *Illex* spp.; butterfish: *Peprilus triacanthus*; tilefish: *Lopholatilus chamaeleonticeps*; summer flounder: *Paralichthys dentatus*; scup: *Stenotomus chrysops*; black sea bass: *Centropristis striata*; spiny dogfish: *Squalus acanthias*; monkfish: *Lophius americanus*; scallop: *Placopecten megallanicus*; herring: *Clupea harengus*.

Fishery Management Council (ASMFC 2003; Mid-Atlantic Fishery Management Council 2003; NMFS 2003; Furlong 2009). It is common to observe that such longer term results of management require short-term costs borne largely by fishers and others who depend on the fisheries in question. In the longer-term, those costs should be compensated for by opportunities created as stocks recover. However, these costs are often cumulative, at least in the "mid-term" of the period of this study (approximately three decades), and the pattern thus far has been one of continuation and further tightening of regulations even as stocks have recovered. In interviews done for a baseline study of the fishing communities of the Mid-Atlantic (McCay et al. 2006), we found that people often complain about the many different regulatory (and other) pressures they face: "it's not any one thing, it's all of it together."

Documenting the cumulative effects of regulations is a necessary part of the impacts required under the National Environmental Policy Act (NEPA, 42 U.S.C s 4321 et seq.) and proper NEPA analysis should investigate direct, indirect, and *cumulative* effects on resources, ecosystems, *and* human communities. Cumulative effects are defined in NEPA as "…the impact[s] on the environment which result[s] from the incremental impact of the action [of concern when doing an environmental impact analysis] when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR s 1508.7). The importance of understanding the nature of cumulative impacts has also been noted from the wider conversation on sustainable development. "Without incorporating cumulative effects into environmental planning and management, it will be impossible to move towards sustainable development, i.e., development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (CEQ 1997:3; see also President's Council on Sustainable Development 1996).

In practice the notion of cumulative effects has been used almost exclusively in the sense of the effects of human activities on natural environments, as in a recent effort concerning the marine environment (Halpern et al. 2008). The issue of cumulative effects for the "human environment"[3] has had little attention or understanding. Our research addresses this lack of understanding by exploring the cumulative effects of fisheries management on the people, businesses, and communities most directly dependent on the marine commons through fishing in New Jersey, under the general hypothesis that one important aspect of cumulative effects has been features of creeping enclosure. Relying on an oral history approach to interviews with commercial and for-hire recreational fishers, we present qualitative information on the perceived cumulative effects of changes

[3] By "human environment," we refer broadly to elements of the natural and physical environment and the relationship between people and those elements, following the US Council on Environmental Quality (40 C.F.R. 1508.14). This phrase is used in the National Environmental Protection Act (NEPA) as an essential part of Environmental Impact Statements.

in state and federal fisheries management. Given that this is a somewhat new research area, we spend considerable time discussing methodological issues involved in discerning cumulative effects with this approach. Finally, we explore some of the larger implications of these findings, and consider how the process of creeping enclosure has affected the nature of the coupled human and natural system in the area by changing the nature of relevant feedback and learning systems.

2. Methods

The research began with the documentation of the changes in regulations over time in order to develop a timeline and an historical framework to help orient the interviews.[4] This proved to be an enormously complex task as there is no single source that describes the incremental regulatory changes for any one species, let alone across the various FMPs and other tools that regulate New Jersey fisheries. An analysis of the complex, cumulative changes in marine fisheries management in the state is beyond the scope of this paper, but this background research was critical for informing the interview process and subsequent analysis.

Informants were selected through a peer referral process (Bernard 2005) that targeted people with a deep historical connection to the fishery as well as current participants. The sample was purposively selected from four fishing ports in the state of New Jersey, USA (Belford, Barnegat Light, Point Pleasant and Cape May/Wildwood). We also tried to include multiple representatives of each major gear sector/fishery. However, it quickly became apparent that nearly all of the fishers we contacted had been historically involved in a range of fisheries, reinforcing what people say about the Mid-Atlantic fisheries as historically diversified and flexible. Interviews were conducted using a semi-structured interview instrument in which informants were asked to explore shifts in their fishing behavior, fishing effort, and fishing grounds and to account for these shifts in terms of, but not limited to, regulatory change. In so doing, they were asked to relate these changes to other events such as resource fluctuation, and socio-economic factors such as changing markets or personal/family decisions such that a picture of the cumulative effects and the networks of causation emerged, linking resources, management measures,

[4] Our approach to archival research on federal fisheries management regulations was based on expert advice from personnel at NMFS, NERO, NEFSC, MAFMC, and the ASMFC. The first step was, for each species, to access the permit holder letters available at (http://www.nero.noaa.gov/nero/nr/index.html), and retrieve and summarize them into a final timeline. The next step was, for each species, to access the online Federal Register Advanced Search page (http://www.gpoaccess.gov/fr/advanced.html) and conduct searches for each year. These steps helped to establish a timeline between 1996 and present. Describing changes prior to 1996 involves accessing each Fisheries Management Plan, including executive summaries coupled with the approval letters from NMFS, that specify approved measures, the purpose and 'need for action' sections, and the history of FMP Development sections. Other useful resources include monitoring committee memos and examining Social Impact Assessments and Environmental Impact Statements for the alternatives in each FMP. Mike Danko of the New Jersey Sea Grant Program conducted a parallel review of marine recreational fishing regulations.

human communities, and fishing practice. The focus was always on the particular histories of those interviewed, their oral histories, although they also may have commented on the experiences of others and the larger communities in which they lived and worked.

We conducted a total of 44 interviews between December 2004 and December 2006. All but one were recorded and later transcribed. This included 29 interviews with commercial fish harvesters (of which 28 were recorded) including gill netters, long-liners, scallopers, and otter-trawlers, pursuing a range of species. An additional 15 interviews were conducted with 'recreational' fish harvesters who ran for-hire charter, 'head' or 'party' boat operations. While we acknowledge that recreational and commercial fishers are often separated in impact analyses and can be subject to different regulations, party/head boat operators and charter captains are often full-time fishers in a livelihood sense, have also experienced profound regulatory changes, and are important elements in many coastal communities in New Jersey.

We acknowledge some sampling bias. By selecting active fishers, we interviewed individuals that have more or less successfully navigated regulatory change (as well as the other aforementioned changes). We are missing those who did not successfully navigate these changes (i.e., that exited the fishery), who may be the people that have been most affected by regulatory change. We are also missing crew members, except as described to us by the skippers or captains we were talking to. We are also missing some younger entrants. On the one hand, we wanted individuals with a long track record in the fishery as they can best reflect on long-term changes in the fishery. Newer entrants may be subject to a sort of 'shifting baseline syndrome' and accept the current regulatory regime as the status quo. They are less able to reflect, in other words, on the 'cumulative effects' of change over time. On the other hand, newer entrants might be best situated to talk about the challenges (economic and regulatory) of entering the fishery at this time – which is an effect that came up in the interviews fairly regularly. In terms of the recreational sector, we are missing the customers who fish from the charter and party boat vessels.

Interviews ranged from approximately one hour to over three hours and the large majority took place at respondent's homes or on board their vessels though several took place in restaurants. We sometimes used nautical charts to help organize discussion around particular places. Transcripts were coded using QSR NVivo © qualitative software and the coding process involved an inductive approach, with themes and categories emerging from analysis of the interview transcripts by the researchers engaged in the interviews.

3. Results

Inductive analysis of themes and categories from the interviews resulted in a large set of discrete "cumulative effects" of regulatory change in New Jersey's commercial and for-hire fisheries that reflect the process of creeping enclosure. Table 1 shows how the New Jersey fishermen interviewed experienced creeping

Table 1: Cumulative Effects of Regulations in New Jersey Fisheries.

Reduced flexibility, uncertainty, and barriers to entry	Increased burdens and costs	Other/Personal	Adaptive maneuvers and resistance
• Quitting a fishery (C,R) • Inability to compete in new fisheries (C) • Harder to make a living (C) • Increased difficulty in entering fishery (C) • Reduced flexibility/ versatility (C,R) • Increasing processor control of fishery (C) • Reduced emphasis on a particular fishery (C,R) • Changing fleet dynamics (communication and competition) (C) • Reduced certainty about future regulations (C,R)	• Burden of carrying extra gear (C) • Paperwork burden (C,R) • Wasting fish (C,R) • Harder to make a living (C,R) • Difficulty in obeying all regulations (being penalized by mistake) (C,R) • Increased time spent obeying regulations (C,R) • Quitting fishing (C) • Increased difficulty of work (C) • Increased license costs (C) • Destruction/loss of pre-existing markets (C,R) • Effects on 'retirement fund' (C,R) • Changes in seasonal rounds/work day (C) • Changing fishing locations (C,R)	• Feeling of persecution (C,R) • Decreased safety at sea (C) • Social differentiation (due to inequities in regulatory impact) (C) • Changing time away from home (C) • Declining encouragement for children (of respondents) to enter fishery (C,R) • Conflict between inspected and uninspected vessels (R)	• Fishers getting more organized (C,R) • Shifting to other fisheries (C,R) • Fishing other species just to qualify (license speculation) (C,R) • Innovation of new gear types/ techniques (C) • Changing fishing locations (C,R) • Changes in seasonal rounds/work day (C) • Changing fleet dynamics (communication and competition) (C) • Seek new clientele (R) • Smaller boats (R)

C = reported by commercial fishers.
R = reported by recreational fishers (party boat and charters).

enclosure (one prominent facet of cumulative effects) through reduced flexibility, increased uncertainty and barriers to entry, increased costs and burdens in the recent history of New Jersey fisheries, various adaptive maneuvers and forms of resistance to change, as well as more idiosyncratic and personal events and consequences. In the table, each of the bulleted points is a distinct category of effect, and effects are sorted by column into analytical themes which we identified. In some cases, an effect is listed under more than one analytical theme. Those categories that were reported by commercial fish harvesters are indicated with a 'C' while those that were reported by recreational vessel operators are indicated with an 'R'. In interpreting this table, it is important to note that because of the semi-structured nature of these interviews, it was not appropriate to quantify how many fishers described each category of effect. Not every fish harvester reported each of these effects but the ones that are listed in the table above were those that emerged from several fishers. That said, there was significant agreement

and overlap among interviews. Finally, it is important to note that the categories were created by us during the inductive coding process. They strongly reflect the words of the harvesters themselves, but they are not verbatim. Direct quotes are provided to further illustrate some of the points.

The first column concerns the loss of flexibility or even opportunities for a livelihood from fishing due to increased barriers to entry and to full participation in highly regulated fisheries. The following excerpt is from an interview with a Barnegat Light gill-netter (interview #14), in which the interviewee is talking about then new seasonal restrictions on fishing for bluefish. He gives voice to the general process of "creeping enclosure" in explaining that in the past, when there was a new restriction, one could turn to something else, but that that is increasingly difficult:

> "Well we have to go do something else…[In the past, before regulations on dogfish] we'd dogfish or something like that. And then they knocked the dogfish out, you know, so I mean you have to jump from one thing to another…And they keep knocking things off of you. If they ever shut down monk fishing then we'd really be kind of messed up. Then the only thing you'd have to do is try to catch a mackerel, fighting the dogs [dogfish are notorious predators, and under management protection their populations have greatly increased, making this a commentary on ecosystem dynamics as well]." (interview #14)

The following is an excerpt from an interview with an Atlantic Highlands party boat owner discussing reduced flexibility due to a decline in number of types of fish species he is able to target:

> "Striped bass fishing, when I started striped bass fishing five years ago, [it] was 20% of my business, last time we did it on the computer, was 78% of my business. Imagine that. If that goes, I'm dead and that's after 50 years of the family business." (interview #107)

A scalloper and multiple boat owner from Barnegat Light added reflections on the need now to purchase limited access permits (which many of our respondents noted have become extremely, if not prohibitively, expensive):

> "With the fisheries, there isn't many more fisheries you've got to go into. Everything is regulated, and if you don't qualify, you can't get a permit, and you have to buy a permit from somebody else to get a permit..." (interview #7).

A charter boat captain expressed difficulty booking charters up to six months in advance (the preferred practice) when the season, size and bag limits are unknown and/or subject to change by managers.

> "The bluefin tuna [bluefin: *Thunnus thynnus*] season, even for this year, we don't know when the season is going to be. The regulators haven't come up and told us how many, what size, what ever yet. The thing is you go to trade

> shows in January, February, and March and people say I want to do a tuna trip in June. It's like, well we can commit to a trip, but we don't know if you can keep one fish, two fish or four fish and what size it will have to be." (interview #51)

This highlights a climate of reduced certainty about future regulatory conditions which, in the recreational sector, limits the ability and flexibility of operators to plan ahead.

The second column from the left in Table 1 has more detailed issues of increased regulatory burdens and costs, which play into increased difficulties in making a living from fishing. This identifies a major mechanism of cumulative impact: as costs and other burdens multiply, new regulations or other challenges take even greater effect. For example, one fisher, when asked if it was difficult to navigate the paperwork, replied:

> "Yeah, it is. There's reams and reams of it, and you've got to read it all and stay with it, you know. It used to be you never used to have it….[ ]…you know, if you're not a literate person or well read, you can get in trouble you know. Or if something gets lost in the mail, god forbid, or something like that, you know. They're getting better too; with a lot of stuff, they'll broadcast on the radio and stuff, so that help you – VHF and stuff. But yeah, you've got to be careful, 'cause a lot of times people will get in trouble. Just, they didn't have the proper information or they, you know, the letter came in and they weren't home – stuff like that. You've got to be careful." (interview #13).

Both recreational and commercial harvesters talked about the issue of 'wasting fish', where bycatch regulations, trip limits, or some combination of these and other regulations caused fishers to be unable to land fish that would otherwise be salable or, in the case of the party and head boats, utilized for personal consumption. This implies both economic and environmental costs. One commercial harvester, for example, talked about the problem about sometimes taking more than the trip limit when porgies (also known as scup) are encountered during squid fishing operations:

> "But when they run into porgies, you can get some big tremendous drags and big porgies too, and then you take a hundred boxes [100 boxes was at one time the trip limit] and you dump the rest. Isn't that a waste?" (interview #1)

As important to some people can be the issues listed in the third column of Table 1, "Other/Personal," such as increased feelings of persecution from governments, environmental groups and the media (including the rise of warnings about eating seafood that is not "sustainably" harvested); having to spend more time away from home; feeling the need to discourage one's children from entering the

fishing profession; and being forced into taking greater risks at sea (for example, fishing alone rather than with a crew member in order to cut back on expenses). Another inshore gillnetter from Barnegat Light reflected on the risks he and his brother took, going farther out to sea, when his inshore fishery for sturgeon was closed:

> "A lot of guys were still stuck at like the three mile line, and me and my brother started going like 10 miles, and that was far off…..we were really braving the elements, because we lost sight of land, and it was wintertime…." (interview #10).

The fourth column from the left in Table 1, "adaptive maneuvers and resistance," captures the fact that many fishermen have responded to increased regulatory pressures in ways that have allowed them to stay in the business, including gear innovations, changing the locations where they fish, and adjusting their activities throughout the year (their 'seasonal round'). Fishers also reported getting more organized, in order to have a stronger voice in the regulatory process, and some have learned the importance of querying the science involved as well as hiring scientists, as indicated in an interview with a Barnegat Light fisherman:

> RES: And over time, have people gotten more organized?
>
> I: Oh no doubt, tremendously so.
>
> RES: Why?
>
> I: Well, it's for survival I think. The government's really stepped up on regs, so…for one thing, the Magnuson Stevenson [sic] Act, which governs the management of the fisheries of the US, says the management councils/ the NMFS will make rules and govern the fisheries with the best available science. And sometimes the best available science was their science; it was the only science, so fishermen have become more adept at hiring their own scientists and learning the protocols and the procedures for what is acceptable science to them because a lot of times they say it's X and we say it's Y, and you can't just go up to a meeting and say you're full of shit, you know, this isn't true. You have to back it up with numbers, and they've tried to trip us up on it and stuff like that, but you have to be politically savvy. Well maybe it is politics too, but you have to know the way the system works if you want to influence the system or get your point across. It's not that anybody's lying or anything; it's just sometimes mistakes are made, you know what I mean. It's not a perfect science and, you know, there's certain ways to do things, so yes. And these days, as they reduce effort and they allow you to fish less and less, people have become very politically active. … Now the intelligent fishermen is realizing that his way of life is going to go away unless he gets

> together and stands up for it…I think a lot of guys are starting to realize that, cause there's a lot more associations and groups, you know, with a common interest that bond together. (Interview #13).

In assessing information like the above interview segments and the list of issues taken from oral history interviews, we identified a number of analytical/methodological challenges that should be considered. For example, respondents often focused on a specific regulation that they were unhappy about at the time of the interview in discussing effects, making it challenging to differentiate between cumulative effects and the effects of individual regulations. Furthermore, in many cases individuals have described the interactive effects of one, two or three regulations. These are interactive/cumulative in one sense, but this is not the same as the cumulative effects of *all* regulations. *Cumulative effects of which regulations* thus becomes an operative question – a particular regulation, some subset of regulations that have particular interactive/additive effects, or the 'universe' of all regulations. Depending on individual circumstance, there is a different constellation of regulations that have effects.

Moreover, it is difficult to disentangle the effects of regulatory change from all the other changes that have been occurring in fisheries and fishing communities over the lives and careers of fish harvesters. These other changes include changes in technology, waterfront development, local and global markets for seafood, and changes in resource abundance and/or location (which may itself reflect several factors – natural variability, climate change, fishing pressure, water quality, etc.). For the recreational sector additional changes include shifts in competing recreational activities such as theme parks and gambling, declining numbers of recreational anglers (those that populate charters and party boats), and an increase in the affordability of private boats, During the interviews we asked respondents to reflect on the relationships among these causes, but respondents themselves were often unable to disentangle them. For example, a 60-year-old gillnetter from Barnegat Light (interview #14) reflected on his experiences of everything from fishery closures (sturgeon, striped bass, shad) and limited entry, among other classically "management" restrictions, to the economics of supply and demand, and problems caused by pollution, climate change, and gentrification of his port town.

While the intent of the interview process was not to qualitatively describe effects as positive or negative, it also quickly became apparent that *regulatory effects* as a whole can not easily be described as 'good' or 'bad'. Indeed, few respondents seemed to suggest that all regulations are bad. On the contrary, many respondents have suggested that they think that certain regulations are good/necessary while other regulations are bad/unnecessary. "Cumulative effects" might therefore be seen as resulting from multiple forces pushing in different directions. For example, the same 60-year-old gillnetter (interview #14) remarked that the creation of a market for monkfish (once considered a "trash fish" and hence negligible by-catch) and the more recent boom in sea scallop prices

opened up new opportunities for the relatively small-scale fishers of this area. The scallop case is doubly complicated: the fishery, for sea scallops, has been "enclosed" through very restrictive limited permitting and limited days-at-sea, but a loophole, allowing a 400-lb. a day by-catch for "general category" boats, has been a boon to fishers closed out of other fisheries. By 2006 this daily "by-catch" fishery helped compensate for the cumulative decline in fishing opportunities experienced by many fisheries, including the inshore gillnet fleet of Barnegat Light, which once was very diversified and opportunistic. It still is opportunistic, but the opportunities are far fewer. However, in 2009 that fishery too was in the process of being severely regulated, forcing those who entered it more recently to cast about for alternatives, most of which by then required major outlays of capital for limited access permits.

The case of the scallop fishery highlights the fact that there are temporal and 'sectoral' elements to regulatory effects. For example, many of the "full-time" (licensed) scallopers we talked to who enjoyed a limited access license appeared to be doing fairly well, given the prevailing good prices and high abundance. However, many noted that this could all change relatively quickly and pointed to past years when the scallop fishery was quite marginal. Moreover, the perspective from outside this fishery was often somewhat very different, as were perspectives between full-time licensed scallopers and those operating under the "general category" licenses. In this sense, each individual is likely to have experienced a unique constellation of the types of effects described in Table 1. The distribution and relative severity of these cumulative effects across the population in New Jersey (or elsewhere) could be the subject of future research.

It is also important to note that particular regulations can have direct and indirect effects. For example, the creation of a closed area has the direct effect of causing fishers to fish elsewhere. The indirect effects might, however, include higher fuel costs, increased time spent away from home, increased time spent 'learning' new fishing areas and so on. By extension, an analysis of cumulative effects should include the combined direct and indirect effects of multiple events. Fuel costs are particularly interesting to consider in terms of direct/indirect effects, as well as the way in which the effects of regulations can interact with other large-scale processes such as shifts in the global market for fuel oil. Many of our respondents commented during our interviews that rising fuel (and insurance costs) had been particularly difficult to deal with. Indeed, in 2008 when we spoke again to some of these individuals, many noted that fuel costs had pushed them closer to the brink of insolvency and some had even left their boats tied up at the dock. Of course, higher fuel costs are not direct effects of regulations per se, but they can be an indirect effect when certain regulations (such as spatial closures) force fishers to fish farther away from their home ports. Likewise, some of the recreational fishers we spoke to reported that their relative overhead costs (including fuel) had increased due to mandated decreases in the number of days they can fish and the number of passengers they carry. Moreover, higher fuel costs

can exacerbate economic situations made precarious by the burdens of increasing regulations.

Perhaps the most challenging aspect of this research was distinguishing what might be termed 'complaints' from what would more appropriately be called 'effects'. Interviewees cited a wide range of complaints, which were also inductively coded, producing the list summarized in Table 2. A general methodological problem in the study was that while we intended to ask people about their own personal experiences in a neutral way, given the subject matter the conversations often became framed by those interviewed as critiques of or complaints about the regulatory system. We chose oral histories in an effort to avoid the politicization of responses, but that turned out to be unavoidable, given how much people's livelihoods have been affected by fishery regulations.

In a sense, of course, these complaints can be seen as an effect: a complaint implies dissatisfaction, which is an effect. The rationale for including two tables arose during the coding process, when it became clear that sometimes individuals were describing frustrations with the way decisions were made while in other cases they were describing the perceived effects of those decisions – by which we mean some perceived change in economic or socio-cultural condition. However, there are clear overlaps between the two tables, and the line between them is blurry. For example – some fishers described a situation where they felt that there sector was being inequitably 'picked on' (pelagic longliners come to mind here).

Table 2: Complaints about management regulations.

- Problems with "History" or the recorded catches of a boat used to determine management category
- Attachment of license to boat (not individual)
- Incentives of governments not followed through
- Not enough regulations
- Regulations taking on a life of their own (bureaucracies making rules just to make rules)
- Lack of voice for commercial fishers
- Inter-management council disparities
- Lack of scientific reliability/lack of scientific information
- Regulators/Managers being subject to pressure from environmental groups
- Corruption/subject to political pressure
- 'Right idea/wrong in operation'
- Observers
- 'Un-American' (impinging on freedom, opportunity, etc.)
- Timing for announcing regulations can be erratic or disadvantageous
- Open-access (some fisheries seen as still open-access)
- Sense of disparity/inequity of regulatory impacts
- Data gathered by fishers not utilized
- Managers don't 'really know what is going on'
- Difficult to attend meetings
- 'Draconian' regulations (severity of regulation does not match need)
- Not enough political support/sympathy for commercial fishers
- Inadequate understanding by managers of socio-economic impacts
- 'Agenda' of managers to reduce size of the fishery
- 'All take and no give' – regulations seen as being a one-way street towards restrictions
- 'Building up' (improving stocks) not rewarded
- Lack of voice for recreational fishers
- Recreational anglers punished for commercial overfishing

This is a complaint in the sense that it is a complaint about process. On the other hand, many respondents noted that regulatory changes have created inequities within fishing communities – the have/have not phenomenon. In this case we listed this idea in both tables, but note that it has slightly different meanings in each.

4. Enclosure, learning, and responses

The effects described in Table 1 are multiple and widespread and are the subject of continuing research (e.g. Murray in press). In closing this article we focus on the management implications of creeping enclosure in relation to 'coupling points' within the coupled human and natural system (see also Gunderson and Holling 2002; Dolan et al. 2005; Liu et al. 2007; Ommer 2007) that constitutes the marine commons. We raise the question of whether this kind of enclosure plays a role in both creating and reducing opportunities for learning and knowledge-led feedback response in coupled systems.

We observe that learning takes place in the "coupling" space – where knowledge is produced as information flows between the environment and society and is then responded to by human actors. The production of knowledge first involves the capturing of feedback, or signals, from the environment, as well as its interpretation. Capturing feedback from the environment occurs through the repeated interactions, experience, and observations of individuals. One form that captured feedback takes is traditional ecological knowledge or experience-based knowledge, which is often spread through stories, ceremonies, and other forms of discourse (Turner and Berkes 2006). Feedback is also captured through scientific research such as surveys, assessments, and experiments, which takes the form of research-based knowledge (RBK). Feedback can also come from a combination of experience-based and research-based knowledge, such as through cooperative fisheries research projects (Johnson 2007; Johnson and van Densen 2007; Johnson in press; Murray et al. 2008a,b).

Learning occurs through a complex feedback loop and further requires that we adapt to feedback about the results of our actions on the environment. Responses include formal changes in regulations (or governance more generally) as well as informal adaptations (e.g. changes in fishing practices, technology, culture, etc.). Interpretation of accumulated information, signals, and observations (feedback), however, is difficult due to the complex, non-linear, and multi-scale nature of social-ecological system dynamics (Wilson 2006). Therefore, decisions (adaptations) about appropriate responses are almost always made under conditions of uncertainty. We suggest – and hope to eventually further document – that creeping enclosure plays a role in both creating and reducing opportunities for learning and knowledge-led response.

On one hand, we posit that less flow in terms of observations and experience from the environment results in greater uncertainty. One of the principal effects of creeping enclosure is a reduction in the number of fishery participants and/or

the diversity of interactions between and among harvesters, managers and scientists, and between harvesters and the natural environment. Generally, creeping enclosure can reduce the flow of feedback (interactions, observations, signals, etc.) from the environment to society, and reduce the flow or exchange among members of society (i.e., sharing of information and opportunities to learn from others) meaning that the production of knowledge and opportunities for learning are impacted at both the individual and collective level (Walker et al. 2002; Folke et al. 2005; Wilson 2006).

We also suggest that the effects of creeping enclosure can reduce adaptive capacity (Walker et al. 2002) by limiting the ability of harvesters to respond to environmental change. Many advocates of fisheries management regulations push for measures that restrict participation and activities (resulting in creeping enclosure) with the argument that this is necessary for sustainability of fish populations and the resilience of the larger ecosystem. We suggest, however, that human actors must be able to respond appropriately to change. Organizational or institutional flexibility, social capital, and social memory are some factors that influence responses (Folke et al. 2005) and creeping enclosure reduces the flexibility of participants by limiting the options available for response. For example, in the past fishermen have been able to more easily switch between different fisheries in response to changes in resource availability, but now they have fewer options and feel dependent on a limited number of resources. One harvester's thoughts on this loss of flexibility (and the implications for stewardship) are illustrated in the following exchange with a clam fisherman from Pt. Pleasant:

> I: I mean, it's natural for a guy to want to make money, and as competitive as it is…you know, to compete with the other guy, but none of the fishermen are in business to put themselves out of business. You know, it's just like a farmer. A farmer isn't gonna ruin the land. He's a good steward of the land, because that's where his living is. He's gonna take care of that, you know. If he's gonna ruin the land, then he's outta business, and it's the same with the fishermen. You overfish 'em,…
>
> RES: They're gone.
>
> I: You're gone. Years ago, if things got bad in one fishery, I mean, if it slowed down, you went and done something' else. You went yellowtailing, you went fluking, or winter flounder, or cod fishing'. You could change. Today you can't change. You're in a directed fishery, and that's where you stay.
>
> RES: Do you think that's better or worse for the fishery?
>
> I: I'd say it's worse for the fishery because years ago, when you got down to where you were…say you were getting 2,000 pound of codfish at 10 cents a pound. Well, I ain't makin' out on that. I'm gonna go whiting fishing. Well, if you weren't allowed to go whiting fishing, you had to stay on that codfish, well…

RES: You're gonna keep hammering it.

I: You're gonna keep hammering and hammering, just to try to hang on, and the codfish is gonna take a beating and you're gonna go out of business anyway. You know, eventually you're gonna go under. And that's what I think of a directed fishery. Farming's the same thing. You grow tomatoes year after year and you have a bad year, you grow something else. If they tell you, "Well, you have to grow tomatoes, and that's it. You're a tomato farmer". What's gonna happen, you know? You gotta be able to change."

This same harvester (interview #17) went on to suggest that the formalized learning processes of science-based management can serve to delay decision-making, further eroding flexibility and the suite of 'response options' available to fishers:

I: I think the biggest problem is that they put a regulation into effect to make the fish come back; well the fish come back and by the time they get it in their science or whatever that the fish has made a come back well they're like years behind.

RES: You think there's not enough give back?

I: Yea, it's not done quick enough. You hear of stories about fisheries that they've made a come back – well, we don't see that in our science yet. By the time they get to it, it's been years or whatever. Like they don't have enough money to put the effort in to getting the science quick enough. (Interview #17)

As noted, a reduction in participants affects the social capital, including networks and leadership, that is often necessary to take action or adapt to change. Learning and response is, in part, influenced by the social memory of a community – have they experienced this before, and if so, what did they do and what was the outcome of those actions? As participants leave fisheries (due to creeping enclosure or for other reasons) they take with them the social capital and memory that are part of what is needed for effective responses. For example, only some of the older respondents we spoke to recalled the dynamics of the now vanished cod-fishery in New Jersey waters. While this is largely a function of time (not regulations) the memory of the role that the fishery once had and the potential that it represented is now largely lost among active fishers. More recently the shad and sturgeon fisheries have been closed by regulation and it is unclear if and when active fishers will be able to return to this fishery – and what will happen to their knowledge of the social-ecological dynamics of these fisheries.

Wilson (2006) illustrates that mismatches between environment and social scales in ocean fisheries leads to an unintended erosion of ecosystem structure and function. In this case, large-scale, single-species management does not capture local level feedback regarding changes in localized stocks and creates destructive

incentives. In other words, learning is insufficient. The "roving bandit" syndrome, where mobile fishers deplete localized areas of abundance and then move to more abundant and profitable areas, rather than develop stewardship of the resources is one outcome (Berkes et al. 2006; Wilson 2006). In this case, the "scale mismatch" results between local harvesters and global markets, and is related to incentives to develop highly efficient fishing technology, often for individual species. One result of this is what can be referred to as ecological overfishing, or an erosion of resilience (Wilson 2006). We suggest that creeping enclosure can lead to the same results: a lack of feedback resulting from the reduction in observations of multiple components of the system (less feedback) combined with a reduction in flexibility (limited possible responses) limits learning and can generate incentives to invest in highly efficient technology targeted at a limited (by regulation) number of species – resulting in the depletion of local resources (i.e., the "roving bandit" syndrome).

Enclosure can also inhibit learning by generating distrust between fishery participants, managers, and scientists and reduce the information flow between them. For example, fishermen often become concerned that sharing information or knowledge with regulators or scientists will result in greater restrictions and so are often reluctant to participate in knowledge production. Managers and scientists also limit flow in that they may not accept information from fishermen because they feel that regulations create disincentives for truthful reporting of information. The result is that our understanding of the impact of our actions and subsequent decisions about what kinds of responses (e.g. regulations) are most appropriate is not based on all of the information that otherwise might be available.

On the other hand, enclosure can help motivate the production of knowledge. In certain cases enclosure can engender collaboration because individuals in a smaller pool of participants may have greater incentives and resources to learn. For example, one of the most successful examples of industry-science cooperative research in the Northeast US occurs in the surfclam and ocean quahog fishery. Enclosure in that fishery (through ITQs) resulted in a group that is very involved in the production of knowledge about the fishery through government stock assessment surveys. Unlike other fisheries that are overcapitalized, this fishery has a lot of capacity now (including financial resources) and fewer participants mean fewer transaction costs which, in theory, facilitates collaboration. Since 1997, the industry has participated in many collaborative research efforts aimed at producing knowledge about the fishery for management, including the purchase of a state-of-the-art sensor package costing about $30,000 necessary for the research. More recently, the 2002 surfclam survey revealed a reduction in surfclam abundance that resulted in a 2004 survey funded by the surfclam industry in partnership with academia and government (Bochenek et al. 2005).

Threat of more regulations and possible future enclosure can also generate collaboration in research, with the aim of producing information needed to halt the enclosure process. Despite an increasing spawning stock biomass of summer flounder, recreational anglers were faced with reduced landing quotas in 2008

and possible closure for recreational anglers in 2009. Summer flounder is the single most sought after species by recreational anglers during May through September; an alternative fishery does not exist. A closure would have a devastating effect on all businesses that provide products and services to recreational anglers. In response to the possibility of a closure in 2009, the for-hire industry and associated support businesses formed a group focused on preventing a closure of the summer flounder fishery through improvements in the science used to determine the biomass. With donations from anglers, party and charter boat owners, marina owners, bait and tackle shop owners, bait and tackle wholesalers and others they were able to fund research to improve the stock assessment. The results were presented to scientists participating in the 2008 summer flounder stock assessment and were used to refine the estimate of the summer flounder spawning stock biomass. They were able to avoid severe reductions to the quota in 2008 and avoided a closure in 2009. However, the industry still faces the restrictions that come with a 2013 rebuilding deadline, but the group plans to continue working with scientists and managers to establish an equitable and scientifically accurate management strategy for summer flounder.

5. Conclusion

Our research project utilized an interview approach to document the cumulative effects of regulatory change on the people, businesses and communities most directly dependent on New Jersey's fisheries. Relying on an oral history approach helped to illuminate the general processes and outcomes involved through attention to the rich detail that emerges from a focus on the idiosyncratic experiences of the individuals involved. We believe that the categories and analytical themes that we identified through the inductive coding process will provide one building block for further elaboration of approaches and techniques for characterizing and documenting the *cumulative effects* of regulatory change. Overall, the cumulative effects of numerous regulations make it harder for people to keep fishing, change the composition and behavior of the fishing industry and the nature of fishing communities, and affect the ability to retain and pass on to others and other generations the traditions and knowledge of fishing.

In this article we have cast these regulatory changes as, among other things, contributing to a *process of creeping enclosure* which results from incremental and cumulative events rather than a single regulatory moment. One of the major findings of this research is that the signs of enclosure are visible in fisheries that do not necessarily feature explicitly privatized rules such as individual transferable quotas or ITQs. In marine fisheries research, "enclosure of the commons" has been studied most explicitly in response to the advent of limited entry programs. Enclosure is particularly evident in management regimes assigning more exclusive and tradeable property rights to individuals or firms, particularly ITQs, which in the US are now discussed as among a class of "Limited Access Privileges" or "Catch Share" programs. Analyses of the effects of these programs

have shown their achievements in the area of economic efficiency and business flexibility (Casey et al. 1995; Squires et al. 1995) and perhaps in helping avert fisheries collapse (Costello et al. 2008). However, reported social consequences include loss of flexibility for fishers who depended on moving among fisheries; erosion of community with rising differences between "haves" and "have-nots," loss of human and fiscal capital and/or intrusion of external sources of capital; changes in the relationships between crew and owners of capital and fishing rights; and increased corporatization of fisheries that had been primarily family- and community-based (McCay 1995, 2004; National Research Council 1999a; Lowe and Carothers 2008). Some of these consequences are planned, mainly the economic efficiency ones, while others are unintended but no less real. The entire process and most of its consequences have been construed as contributing to the neo-liberal political economy of fisheries (Mansfield 2004). Our interviews with fishers have shown that some of these consequences, as well as others, are also coming about through less dramatic actions and responses, or what we call "creeping enclosure."

From a policy perspective, these findings call for a more explicit review of fisheries management policies, particularly given recognition of the nation's public trust responsibilities for coastal waters, which arguably extend into the domain of extended jurisdiction as well as the customary territorial sea (Turnipseed et al. 2009). Another implication of this finding is how this process of creeping enclosure may affect fisheries management through its effects on the way information moves between the bio-physical environment and fish harvesters, managers and scientists. This includes changes in the flow of feedback from the environment to society, in certain cases the inhibition of adaptive responses, and both the discouragement and encouragement of social learning. Given recent emphasis on the importance of learning and the co-generation of knowledge in terms of social-ecological system health and resilience, we suggest that future research should seek to further describe these changes, and clarify under what specific conditions they may occur.

We have also noted a number of methodological and conceptual challenges that should be considered in conducting this kind of research. These challenges include the difficulty in distinguishing 'cumulative' effects from the effects of individual regulations, the complexities involving both direct and indirect effects, the notion that effects can be both 'good' and 'bad', challenges in disentangling the effects of regulations from all the other changes that coastal communities are facing, and the extent to which complaints, or politicization, can color interview results. We suggest that the methods and categories developed here should be understood as components of the necessary toolkit for examining cumulative effects on resources, human communities, and ecosystems (see CEQ 1997, 55–57). Additional methods will be appropriate in different settings and under different conditions.

As fisheries science and management begins to shift focus from single species to ecosystems, understanding the history of single species management and

its contribution to cumulative effects upon resources, ecosystems, and human communities takes on added significance. This project proposes to further our understanding of the cumulative effects of single species management in concert with other regulatory actions and socioeconomic processes on marine fisheries in New Jersey. The findings will not only provide guidance for future decision-making, but will yield an historical archive of the experiences related to cumulative effects and the voices of participants in the management and use of marine resources.

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