Cumulative effects, creeping enclosure, 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 commons and suggest that enclosure can be a process and function of multiple events and processes and need not be the result of a single regulatory moment. We provide a short review of the 'expected' effects of enclosure, based on classic studies as well as more recent fisheries work. Some of this work has focused on Individual Transferable Quotas (ITQs), and has suggested a loss of flexibility, erosion of community, proletarianization of fishermen, and corporatization of the fishery are among the effects of enclosure. Here we present some findings of our research to discuss if and how the signs of enclosure may be visible in fisheries that do not feature ITQs through the rich detail that emerges from attention to the lived experiences of fish harvesters and to the cumulative effects of regulations. Relying on an oral history approach, we examine the multiple micro-political moments and enactments that result appear to have resulted in 'creeping' enclosure, and provide a case study of the incremental and cumulative processes by which neo-liberal formations can be implemented. We cast these processes as 'flows' of governance and discuss how this creeping process of enclosure has affected the flows of information between fish harvesters, managers and scientists by affecting both participation in fisheries and the accumulation of knowledge itself.

Key Words: *New Jersey; enclosure; fisheries management; social-ecological systems; coupled human and natural systems; learning*

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. The region encompassing state waters (extending to three nautical miles) and the adjacent federal waters (from three to 200 nautical miles) was once virtually open-access, but over the last 20 years, as limits have been reached and conservation priorities have come to the fore, the marine commons has become intensively managed by state, interstate, and federal agencies.

In 1976, the U.S. 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 U.S. Exclusive Economic Zone (EEZ) and gave the U.S. the authority need to take control of its fisheries. Establishment of the EEZ or "200 mile limit" 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 1950's. The Magnuson-Stevens Act also established eight Regional Fishery Management Councils that are charged with preparing Fishery Management Plans for species targeted by commercial and recreational fishing industry. The direction of single-species management has resulted in the development of 45 Fishery Management Plans (FMPs) for domestic species. There are 7 FMPS related to NJ fisheries, five of which are managed by the Mid-Atlantic Fisheries Management Council, and two which are jointly managed by the Mid-Atlantic and New England Fisheries Management Councils. Many of these FMPs have also undergone additional amendments involving significant changes. 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 the Atlantic States Marine Fisheries Commission. The FMPs alone represent a tremendous amount of regulations that the industry must deal with. 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).

In the state of New Jersey the capture of all major species and most minor ones is now heavily regulated and fishers must deal with 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. Cumulatively, these regulations are extremely complex and difficult to summarize beyond the very general way we have done here.

These initiatives have met with some success, including improvements in Mid-Atlantic fish stocks such as black sea bass and bluefish and the continued viability of Atlantic mackerel, surfclam, and ocean quahog populations (NMFS, 2003; see also Mid-Atlantic Fishery Management Council 2003). Such longer term results of management,

however, have required short-term costs borne largely by those who depend on the fisheries in question. Moreover, these costs are cumulative. Indeed, 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." At the same time, of course, fishers have faced dramatic changes in markets, technologies, the marine environment, and the coastal communities in which they are embedded—ranging from changing prices of inputs like diesel fuel, to the effects of climate change on resources to coastal gentrification. While the causes of such cumulative effects are multiple, management policies play a key role in determining the economic and social potential of fishing communities; and they repeatedly reconfigure the human environment[1] within which such communities are embedded.

Our research has explored the cumulative effects of these processes of increased management of the commons on the people, businesses, and communities most directly dependent on the commons through fishing. In this paper we depict these processes as ones of "creeping enclosure" where enclosure is seen as a process and function of multiple events and processes that need not be the result of a single regulatory moment. Here we present some findings of our research to discuss how the signs of enclosure may be visible in fisheries that do not necessarily feature ITQs through the rich detail that emerges from attention to the lived experiences of fish harvesters and to the cumulative effects of regulations. Relying on an oral history approach we outline a case study of the incremental and cumulative processes by which neo-liberal formations can be implemented. Finally, by drawing on an emerging literature that describes coupled human and natural systems (CHANs) we further cast these processes as 'flows' of governance and discuss how this creeping process of enclosure has affected the flows of information between fish harvesters, managers and scientists by affecting both participation in fisheries and the accumulation of knowledge itself.

Signs of Enclosure

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 programs assigning more exclusive and tradeable property rights, particularly Individual Transferable Quotas (ITQs), which in the United States are now discussed as among a class of "Limited Access Privileges" (LAPs). 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). 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

[1] By human environment, we are referring broadly to elements of the natural and physical environment and the relationship between people and those elements, following the 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; "cumulative effects" is another key phrase.

rights; and increased corporatization of fisheries that had been primarily family- and community-based (McCay 1995, 2004; National Research Council 1999). Some of these consequences are planned, mainly the economic efficiency ones, and others are unintended but no less real. The entire process and most of its consequences can be construed as contributing to the neo-liberal political economy of fisheries (Mansfield 2004).

We posit 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," whereby the cumulative effects of numerous regulations make it harder for people to keep fishing.

Methods:

Informants were selected through a peer referral process targeting those 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). 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. Secondly, 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, human communities, and fishing practice.

We conducted a total of 40 oral history 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 11 interviews were conducted with 'recreational' fish harvesters who ran for-hire charter or 'party' boat operations and who are therefore commercial fishers in a different sense. Interviews ranged from approximately 1 hour to over 3 hours and the majority took place at respondent's homes or on board their vessels and sometimes used nautical charts to help organize discussion around particular places. Transcripts were coded using QSR N7 qualitative software. The coding process involved an inductive approach, with themes and categories emerging from analysis of the interview transcripts.

In addition, we collected documentation about the changes in regulations over time in order to develop a timeline and an historical framework to help orient these interviews. 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 that regulate New Jersey fisheries[2]. However, an analysis of these

[2] 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, access the permit holder letters available at (http://www.nero.noaa.gov/nero/nr/index.html), retrieve, and summarize 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

complex, cumulative changes is beyond the scope of this paper. Instead, we have chosen instead to focus here on the effects of those changes in a cumulative and general sense and on the relationship between those effects and 'knowledge' as a linking variable.

Preliminary Results:

The coding was inductive and generated a large set of discrete "effects" of regulatory change in New Jersey's commercial and for-hire fisheries. Table 1 shows how the New Jersey fishermen interviewed experienced what we are calling "creeping enclosure."

Table 1: Cumulative effects sorted by analytical themes

Reduced flexibility and barriers to entry	Increased burdens and costs	Other/Personal.	Adaptive maneuvers and resistance
Quitting a fishery Inability to compete in new fisheries Harder to make a living Increased difficulty in entering fishery Reduced flexibility/ versatility Increasing processor control of fishery. Reduced emphasis on a particular fishery Changing fleet dynamics (communication and competition)	Burden of carrying extra gear Paperwork burden Wasting fish Harder to make a living Difficulty in obeying all regulations (being penalized by mistake) Increased time spent obeying regulations Quitting fishing Increased difficulty of work License costs/speculation Destruction of pre-existing markets Effects on 'retirement fund' Changes in seasonal rounds/work day Changing fishing locations	Feeling of persecution Decreased safety at sea Changing time away from home Declining encouragement for children entering fishery	Fishers getting more organized Shifting to other fisheries License costs/speculation Fishing other species just to qualify Innovation of new gear types/techniques

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 from an interview with a Barnegat Light gill-netter (transcript #14), in which the interviewee is talking about then new seasonal

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timeline between 1996 and present. Describing changes prior to 1996, involves accessing each Fisheries Management, 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.

restrictions on fishing for bluefish (*Pomatomus saltatrix*),expresses the general process of "Creeping enclosure":

> "Well we have to go do something else…[In the past, before regulations on dogfish (*Squalus acanthias*)] 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 [monkfish: *Lophius americanus*] 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)

Similarly, a scalloper and multiple boat owner from Barnegat Light expressed it this way:

> "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).

The second column from the left in Table 2 has more detailed issues of increased regulatory burdens and costs, which play into increased difficulties in making a living and entering fisheries. This identifies a major mechanism of cumulative impact: as costs and other burdens multiply, new regulations or other challenges take even greater effect. As important to some people can be the responses in our third column "Other/Personal," such as increased feelings of persecution from governments and the media (including the rise of warnings about eating seafood that is not "sustainably" harvested); having to spend more time away from home; having 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). Another inshore gillnetter from Barnegat Light reflected on what happened when his 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 keep in the business (i.e. by gear innovation) and by becoming more organized, in order to have a stronger voice in the regulatory process. As we return to below, this also affects the relationships between fisheries managers, scientists and harvesters.

> RES: And over time, have people gotten more organized?
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> I: Oh no doubt, tremendously so.
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> RES: Why?
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> I: Well, it's for survival I think. The government's really stepped up on regs, so…for one thing, the Magnusson Stevenson 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).

Challenges in Interpretation:

In considering these preliminary results, there are a number of analytical 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, and it is 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 market shifts, international market shifts, and changes in resource abundance and/or location (which is itself a reflection of several factors – natural variability, climate change, fishing pressure, water quality, etc.). 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 seem 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 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 both helped compensate for the cumulative decline in fishing opportunities experienced by the inshore gillnet fleet of Barnegat Light, which once was very diversified and opportunistic. It still is opportunistic, but the opportunities are far fewer.

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 existing 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.

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.

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.

Table 2: Complaints about management regulations

Problems with History	Open-access (some fisheries seen as still open-access)
Attachment of license to boat (not individual)	Sense of disparity of regulatory impacts
Incentives of governments not followed through	Data gathered not utilized
Not enough regulations	Managers don't 'really know what is going on'
Quotas too small to make a living	Difficult to attend meetings
Regulations taking on a life of their own	Lack of sympathy for commercial fishers
Lack of voice for commercial fishers	'Draconian' regulations (severity of regulation does not match need)
Inter-management council disparities	Not enough political support for commercial fishers
Difficult to manage regulations	Inadequate understanding of socio-economic impacts
Lack of scientific reliability/lack of scientific information	'Agenda' of managers to reduce size of the fishery
Regulators/Managers being subject to pressure from environmental groups	'all take and no give' – regulations seen as being a one-way street
Corruption/subject to political pressure	'Building up' not rewarded
'Right idea/wrong in operation'	
Observers	
'Un-American'	

In a sense, of course, complaints can be seen as an effect: a complaint implies dissatisfaction, which is an effect. Indeed, as we elaborate below, this 'dissatisfaction' should be seen as a key cumulative effect. Other than that dissatisfaction, however, the themes recorded here were not immediately associated with an economic or socio-cultural impact.

How does creeping enclosure affect learning?

One of the implications of our focus on creeping enclosure is that it seems to represent a key process of change in the nature of coupled human and natural systems, which are now honored with an acronym, CHANS (Liu et al. 2007, see also Dolan et al. 2005; Ommer 2007; Gunderson and Holling 2002). 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. Responses include formal changes in regulations (i.e., governance) and informal adaptations (e.g., changes in fishing practices, technology, culture, etc.).

The production of knowledge 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. Learning further requires that we also capture feedback about the results of our actions on the environment, and adapt accordingly, and it occurs through a complex feedback loop. One form that captured feedback takes is traditional ecological knowledge (TEK) or experience-based knowledge (EBK), 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 the experience-based and research-based knowledge, such as through cooperative fisheries research (Johnson 2007).

Interpretation of accumulated information, signals, and observations (feedback) is difficult due to the complex, non-linear, and multi-scale nature of social-ecological system dynamics (Wilson 2006). Therefore, decisions 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 the one hand, enclosure can help in the production of knowledge. For example, enclosure can engender collaboration because individuals in a smaller pool of participants may have greater incentives and resources to learn. One of the most successful examples of industry-science cooperative research in the Northeast U.S. 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 the 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 transactions 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).

On the other hand, creeping enclosure also results in a reduction in the number of fishery participants and/or diversity of interactions between and among harvesters, managers and scientists, and between harvesters and the natural environment. Generally, less flow in terms of observations and experience from the environment generates greater uncertainty. 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) meaning that the production of knowledge is impacted at both the individual and collective level. Put another way, learning is linked closely to our ability to capture, interpret, and respond to changes in the system (i.e., feedback) (Folke et al. 2005; Walker et al. 2002; Wilson 2006) and creeping enclosure can reduce the flow of information from the environment to society (feedback), and consequently the production of knowledge.[3]

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 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). 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 somethin' else. You went yellowtailing, you went fluking, or winter flounder, or cod fishin'. 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?

[3] Of course creeping enclosure can also affect the social side of things: with fewer people involved in fishing, opportunities to learn from others may be truncated. This is addressed below, in relation to reduced social capital.

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 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)

Moreover, 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 that? As participants leave fisheries due to creeping enclosure, they take with them their social capital and memory that are necessary for effective responses. 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 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 enclosure 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 (i.e., regulations) are most appropriate is not based on all of the information that otherwise might be available.

Conclusion

Relying on an oral history approach, we examined the multiple micro-political moments and enactments that result appear to have resulted in ‘creeping’ enclosure, and provide a case of the incremental and cumulative processes by which neo-liberal formations can be implemented. These processes may be seen as ‘flows’ of governance which not only affect participation in the fisheries but also the adaptive capacity of the entire socio-ecological systems involved. We suggest that enclosure processes can modify flows of information among fish harvesters, managers and scientists by affecting both participation in fisheries and the accumulation of knowledge itself.

REFERENCES CITED

Berkes, F., Hughes, T. P., Steneck, R. S., Wilson, J. A., Bellwood, D. R., Crona, B., Folke, C., Gunderson, L. H., Leslie, H. M., Norberg, J., Nyström, M., Olsson, P., Österblom, H., Scheffer, M., and Worm, B. (2006). Globalization, Roving Bandits, and Marine Resources. *Science* 311 (5767):1557 - 1558.

Bochenek, E.A., Wallace, D., Powell, E.N., and Weinberg, J. (2005). Surfclam management advice generated through partnering of academia, government, and industry. Poster Presented at the American Fisheries Society Symposium: Partnerships for a Common Purpose: Cooperative Fisheries Research and Management. Anchorage, Alaska. September 2005.

Casey, K. E., Dewees, C.M. et al. (1995). The Effects of Individual Vessel Quotas in the British Columbia Halibut Fishery. *Marine Resource Economics* 10(3): 211-230.

Dolan, A. H., Taylor, S. M., Neis, B., Eyles, J., Ommer, R.E., Schneider, D.C., and Montevecchi, W.A. (2005). Restructuring and Health in Canadian Coastal Communities: A Social-Ecological Framework of Restructuring and Health. *Ecohealth* 2(3): 195-208

Folke, Carl, Thomas Hahn, Per Olsson, and Jon Norberg. 2005. Adaptive governance of social-ecological systems. *Annual Review of Environmental Resources*. 30: 441-473

Gunderson, L.H., and Holling, C.S. (2002) Panarchy: Understanding transformations in human and natural systems. Island Press, Washington, D.C.

Johnson, T. (2007). Integrating Fishermen and Their Knowledge in the Science Policy Process: Case Studies of Cooperative Research in the Northeastern U.S. Unpublished doctoral dissertation, Rutgers the State University of New Jersey.

Liu, J., Dietz, T., Carpenter, S.R., Alberti, M., Folke, C., Moran, E., Pell, A.N., Deadman, P., Kratz, T., Lubchenco, J., Ostrom, E., Ouyang, Z., Provencher, W., Redman, C.L., Schneider, S.H., Taylor, W.W. (2007). Complexity of Coupled Human and Natural Systems. *Science* 317 (5844): 1513 – 1516.

Mansfield, B. (2004). Neoliberalism in the oceans: "rationalization," property rights, and the commons question. *Geoforum* 35(3): 313-326.

McCay, B. (1995). Social and Ecological Implications of ITQs: An Overview. *Ocean and Coastal Management* 28 (1-3): 3-22.

McCay, B. (2004). ITQs and Community: An Essay on Environmental Governance. *Review of Agricultural and Resource Economics* 33(2): 162-170.

McCay, B., St. Martin, K., Lamarque, J., Jones, B., Oles, B., and Stoffle, B. (2006). Mid-Atlantic Fishing Community Profiles: A Report to NOAA Fisheries, Northeast Fisheries Science Center. New Brunswick, N.J.: Department of Human Ecology, Rutgers the State University.

Mid-Atlantic Fishery Management Council. (2003). Mid-Atlantic Council Continues Year of Successful Management. Press release issued May 14, 2003. Accessed at http://www.mafmc.org/mid-atlantic/press/2003/pr03-11.htm

National Marine Fisheries Service/National Oceanic and Atmospheric Administration (2003). Report to Congress: Status of Fisheries of the United States – 2002. Washington, D.C..

National Research Council (1999). Sharing the Fish: Toward a National Policy on Individual Fishing Quotas. Washington, DC, National Academy Press.

Ommer, R.E. with the Coasts Under Stress Research Team (2007). Coasts Under Stress: Restructuring and Social-Ecological Health. McGill-Queen's University Press: Montreal and Kingston.

Squires, D., Kirkley, J., and Tisdell, C.. (1995). Individual Transferable Quotas as a Fisheries Management Tool. *Reviews in Fisheries Science* 3(2): 141-169.

Turner, Nancy J., and Berkes, F. (2006). Coming to Understanding: Developing Conservation through Incremental Learning in the Pacific Northwest. *Human Ecology* 34 (4).

Walker, B. H., Carpenter, S.R., Anderies, J.M., Abel, N., Cumming, G.S., Janssen, M.A., Lebel, L., Norberg, J., Peterson, G.D., and Pritchard, R. (2002). Resilience Management in Social-ecological Systems: a Working Hypothesis for a Participatory Approach. *Ecology and Society* 6 (1):14.

Wilson, J. A. (2006). Matching Social and Ecological Systems in Complex Ocean Fisheries. *Ecology and Society* 11 (1):9.