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Can Cross-Scale Linkages Increase the Resilience of Social-Ecological Systems?

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Introduction

There is a need for tools to help commons researchers study how institutions respond to environmental feedbacks and change. The concept of *resilience* provides a window for the study of change, emphasizing learning, self-organization and adaptive capacity (Gunderson and Holling 2002; Folke et al. 2002). How do societies and institutions deal with environmental change and, in turn, shape change? The objective of the paper is to explore the idea that cross-scale linkages help deal with change by enhancing adaptive learning.

Resilience has three defining characteristics. It is a measure of (1) the amount of change the system can undergo and still retain the same controls on function and structure; (2) the degree to which the system is capable of self-organization; (3) and the ability to build and increase the capacity for learning and adaptation (www.resalliance.org). The idea of resilience has been applied mostly to ecosystem dynamics to study renewal cycles, equilibrium shifts and adaptive processes, and more recently, it has been applied to social systems. A number of studies have been exploring the question of what makes a resilient social-ecological system (Berkes et al. 2003).

A key factor is the presence of effective and tight feedback mechanisms or a coupling of stimulus and response in space and time (Holling 1978; Lee 1993). For example, it is relatively easy to get a neighborhood association to act on a problem. But as problems become broader in scale (e.g., the global carbon economy), the feedback loops become looser and the motivation to act becomes less. Incentives can be created by tightening cost/benefit feedback loops, for example, by assigning property rights (Ostrom 1990; Ostrom et al. 1999). In some cases where the market can work properly and social costs are taken into account, privatization may be considered. In other cases, the transfer of communal property rights to local groups can be effective.

Resilience thinking helps commons researchers to look beyond institutional forms, and ask instead questions regarding the adaptive capacity of social groups and their institutions to deal with stresses as a result of social, political and environmental change. One way to approach this question is to look for informative case studies of change in social-ecological systems and to investigate how societies deal with change. From these cases, one can gain insights and construct principles regarding capacity building to adapt to change and, in turn, to shape change.

A number of examples exist to indicate that cross-scale linkages, both horizontal (across space) and vertical (across levels of organization), speed up learning and communication, thereby improving the ability of a society to buffer change, speed up self-organization, and increase the capacity for learning and adaptation (Lee 1993; Young 1999). This paper will deal with two cases, one involving aboriginal co-management in the Canadian North, and the other, cross-scale management of ocean fisheries.

Aboriginal Co-Management in the Canadian North

In the Canadian western Arctic, cross-scale co-management institutions evolving since the signing of the 1984 Inuvialuit Final Agreement, provide linkages for feedback across levels of organization. These linkages facilitate the transmission of community concerns, such as those about marine contaminants and climate change, to the regional, national and international levels (Berkes et al. 2001).

Resource co-management, or the sharing of power and responsibility between the government and local resource users, emerged in northern Canada through the settlement of land claims. Under the *Inuvialuit Final Agreement* (IFA) of 1984, a series of co-management boards were created, including the FJMC (Fast *et al*, 2001). This co-management board consists of two Inuvialuit representatives, two Government appointed representatives and a rotating chair. The FJMC is a consensus-based organization. Quarterly meetings and teleconference calls help to ensure that information is exchanged between members of the Board, engaging the FJMC in joint problem-solving and adaptive learning.

The FJMC can address different concerns, from local fishing issues to regional oil and gas development policy. This is because the FJMC dialogues with the Hunter and Trapper Committees (HTCs) in each of the seven IFA communities and directly advises the Minister of the Department of Fisheries and Oceans (DFO) on matters pertaining to fisheries and marine mammals in the Inuvialuit Settlement Region (ISR). An annual ‘community tour’ and meetings with the Minister of DFO help the FJMC to facilitate sharing information and concerns among the various levels of governance. By dealing with a broad range of issues (e.g., monitoring and harvest information for fish and marine mammals; cross-boundary issues; combining scientific and traditional knowledge), the FJMC is able to garner an in-depth perspective regarding fisheries management issues.

Incorporating local perspectives is an essential component of co-management, enabling local systems to be recognized and legitimized. Decisions requiring local input include data gathering, harvesting and allocation decisions, local knowledge, longer term planning and more inclusive decision-making (e.g., Pinkerton 1989). Participatory approaches with local stakeholders can ensure that multiple perspectives on management issues are considered. For example, the FJMC has been conducting traditional knowledge studies to feed into fisheries management plans that would incorporate both traditional and scientific information. In such situations, not only *what* information is included, but also *how* local perspectives are incorporated into the co-management process become important. Communities need to have the capacity to set their objectives and know what work they want done at the local level.

Co-management needs to be experimental and flexible so that both local-level and government-level institutions can learn from their mistakes and gradually build capacity to deal with new circumstances and change in general. The Beaufort Sea Beluga Management Plan under the IFA illustrates how the adaptive management perspective of Holling (1978) may be combined with the idea of co-management, in what might be called an adaptive co-management approach. The FJMC, in cooperation with local HTC's and DFO, developed the Beaufort Sea Beluga Management Plan that is widely supported throughout the ISR, in spite of only being voluntary in compliance (FJMC 2001).

With the recent increase in oil and gas exploration in the Beaufort Sea region, the FJMC is looking for finding a 'legislative fit' to help with formal policy recognition for this plan. For example, under the 1997 *Oceans Act* there is the provision for taking a flexible planning approach in creating marine protected areas (MPAs) (Fast *et al.* 2001). Creating an MPA in the Beaufort Sea beluga areas is being considered as one way to guarantee protection for the beluga as oil and gas interest builds up in the North. This is an example of how management can be adaptive: the FJMC started with an informal management plan that is working and, in response to development pressures, moved to the use of new and existing legislation for beluga protection.

Co-management is meant to establish a dialectic process, functioning not only from the top-down but also from the bottom-up (McCay and Jentoft 1996). Co-management arrangements may take many forms, depending upon the issues and context. The work of the FJMC demonstrates how an adaptive co-management approach enables changes in the locus, scale and the scope of decision-making to be appropriately made, depending on the issue being addressed. The inclusion of local perspectives, which are often not heard, is an integral component of any co-management system. Questions of scale are important because there is a multiplicity of levels and no one "correct" and all-encompassing perspective on a system (Berkes 2002).

Cross-Scale Management of Ocean Fisheries

The evolving theory of the commons fairly reliably establishes the conditions under which community-based conservation may or may not work; the theory of the

commons is sufficiently developed to enable prediction (Ostrom et al. 1999; Burger et al. 2001). However, many of the case studies on which the theory is based focus on single resources that are small in spatial scale and used by relatively few groups. They tend to involve only a small number of homogeneous resource users. However, as the spatial scale of the resource increases, the heterogeneity of resources and resource users also increases. As the scale of common resources and their users increases, commons governance arrangements become more complicated.

Is the theory robust across scale? There are debates in the literature regarding whether the findings of small scale and community-based commons studies can be scaled up to generalize about regional and global commons. Even though some of the principles from community-based studies no doubt do apply across the scale, there is growing consensus that new and different principles also come into play at different scales (Young 1999; Burger et al. 2001; Berkes 2002).

In the case of migratory marine resources, the problem of scale is crucial. A given stock may be used by coastal and offshore fisheries, by small and large-scale harvesters, and possibly by more than one national jurisdiction. The additional problem is that the movement of the stocks makes it very difficult to deal with problems of exclusion and subtractability. The management of migratory marine resources creates different kinds of problems than the management of stationary resources and stay-home resource users who tend to develop shared values and mutually agreeable rules, and who can monitor one another's behaviour and impose sanctions.

Regional resources pose cross-boundary issues. For commercial fisheries, it may be necessary to have quotas enforced by government authorities, as community-based solutions would not be effective. In the case of global common resources, the situation is often more complicated than regional commons. Global resources pose cooperation and enforcement problems that cannot be solved at the local or regional levels. At the global level, there is no superordinate authority that can enforce rules and sanction violators. Efforts to protect global common resources, such as migratory marine fish and marine mammals, have commonly depended on bilateral or multilateral international agreements. In effect, they depend largely on voluntary cooperation among national governments.

Consider the example of Atlantic bluefin tuna resources. The International Commission for the Conservation of Atlantic Tuna (ICCAT) regulates the fishery. Until recently, ICCAT recognized two stocks or two management units, one in the west and one in the east Atlantic. Larval surveys indicate two major breeding grounds, the Gulf of Mexico and the Mediterranean Sea. There has been a sharp decline in the abundance of the western Atlantic bluefin since the 1970s. In 1982, ICCAT began setting an annual catch limit to try to conserve the stock. It took nearly another decade before the tuna biomass stabilized at about 20 percent of the level during the 1970s (Magnusson et al. 2001). But the story does not end there. Much effort has gone into understanding the biology of the tuna, so that effective controls can be put into place for these two discrete populations or stocks of Atlantic tuna. Recent studies showed, however, that western-tagged bluefin tuna make transatlantic migrations. There is a mixing of tuna in western and eastern feeding grounds, and there may be mixing in the spawning grounds as well (Block et al. 2001).

The tuna example illustrates some of the complexities in the management of an international common resource. ICCAT, as a multilateral agency, can set quotas and protect the resource -- but only with the full agreement of the participating nations. Uncertainties in migration and other biological characteristics of the tuna create further management problems, pitting nation against nation in the global fishery. Because it is an offshore resource, monitoring is very difficult. Economic stakes are high: bluefin tuna is a very high-priced commodity and has a globalized market.

The tuna case is significant in that it also illustrates some of the management directions that have been used for migratory marine resources. Once an international management agency is set up, it relies on progressively more sophisticated technical research such as new ways of investigating migration patterns. Quotas are set and adjusted, according to the status of the resource and the scientific information available. But these measures may not be sufficient for conservation. Instead of providing biological clarity, new research may suggest additional complexity and raise scientific uncertainties.

Alternative Approaches and Emerging Perspectives

Common property theory does not have much to say directly about international conventions and ethical principles. But it does have contributions to make with respect to institutional mechanisms to connect the various levels of decision-making, from the community level to the international level. One set of institutional mechanisms pertain to bringing together groups of resource users and government agencies, through *co-management and multistakeholder* bodies. A second set concentrates on combining science and social values and objectives through *civic science* and policy communities such as *epistemic communities*. A third approach looks at *polycentric* organization with multiple and overlapping spheres of authority. A fourth approach, *institutional interplay*, concentrates on the various ways in which institutions at different levels interact. I deal with each in turn.

Co-management is a partnership in the sharing of management power and responsibility between a group of resource users and the government. Canada's National Round Table on the Environment and the Economy defines co-management as "a system that enables a sharing of decision-making power, responsibility, and risk between governments and stakeholders, including but not limited to resource users, environmental interests, experts and wealth generators" (NRTEE 1998: 14). In the case of migratory marine resources, the partnership is not likely to involve merely two parties (resource users and the government) but rather multiple parties. This is because there are likely to be several communities or regions of resource users and several levels or branches of the government, depending on the nature of the migratory resource.

Hence, migratory marine resources are likely to require multi-level co-management, as an extension of partnerships in simple co-management. However, there is little experience with multi-level co-management, most of the literature deals only with simple partnerships involving local-level management with government-level management (NRTEE 1998; Berkes 2002). As many marine resource management problems require the involvement of multiple users, and the connection of several levels of jurisdiction, this is an area that requires further work.

The distinction between co-management and *multistakeholder* processes is not clear. Some of the literature treats co-management as a mechanism to enable local-level users to participate in management, whereas multistakeholder bodies are often used as a tool, more broadly, for public participation (Berkes 2002). However, the second part of the NRTEE definition seems to include stakeholders and multistakeholder processes within the scope of co-management. This analysis is consistent with cases such as the Lofoten cod fishery in Norway, one of the best documented examples of co-management, but one which also relies on multistakeholder processes.

Civic science refers to science with an infusion of democracy. It is science that is political, transparent and responsible; science that is open to citizen input. Lee (1993: 161) characterizes civic science as “irreducibly public in the way responsibilities are exercised, intrinsically technical, and open to learning from errors.” Lee’s concept of learning is closely related to adaptive management, the resource management science that starts with the assumption that environment is inherently unpredictable and that scientific information will always be incomplete. Given inherent uncertainties, adaptive management proceeds by using policies as experiments from which to learn.

All policy issues, including the management of migratory marine resources, bring together a “community” of players, hence the term *policy communities*, also referred to as *policy networks* (Carlsson 2000). Policy communities provide cross-scale linkages by connecting local issues with regional and international agencies. A relatively well known type of policy community is what Haas (1990) has termed *epistemic communities*. The original example was a network of scientists, government experts and NGO representatives who enabled the Mediterranean Action Plan. Members of epistemic communities share principled beliefs, notions of validity, and policy goals that cut across political boundaries. Haas pointed out that the Mediterranean Action Plan brought together countries that are often in conflict, indicating that epistemic communities were significant in overriding such differences. The key to the success of such communities seems to be developing “a common approach to understanding” of a problem, and a common approach and a set of priorities for dealing with it.

Governance is said to be *polycentric* in structure if it has multiple overlapping centers of authority. Folke et al. (2002) observe that such a “diversified decision-making

structure allows for testing of rules at different scales, and contributes to the creation of an institutional dynamic important in adaptive management.” Polycentric organization helps combine a degree of autonomy with overlaps in authority to deal with intersecting domains of public policy. Many areas of public policy do not fall neatly into one jurisdiction or one authority. Rather, they lie at the intersection of several centers of action and authority. Thus, no one entity or agency can encompass the scale of these domains. But the agencies can cooperate and, with the help of intermediary institutions, the efforts of each entity can contribute to the solution of the problem (McGinnis 2000). Polycentric solutions have been applied to domains such as policing and crime prevention, but it has not been applied (to our knowledge) to the solution of problems of migratory marine resources.

Institutional interplay draws attention to the linkages among institutions, both at the same level of social and political organization and across levels (Young 1999). It focuses on cross-scale interactions, and the linkage of institutions *horizontally* (across geographical space) and *vertically* (across levels of organization). The simplest kind of vertical institutional linkage is co-management between a resource user community and the government. A multistakeholder body creates horizontal linkages among the players. It may create vertical linkages as well, if there is potential for sharing management rights and responsibilities between the government and stakeholders.

The concept and terminology of institutional interplay, with horizontal and vertical cross-scale linkages, allows for the great many possibilities in which institutions may interact in resource and environmental management (Young 1999). These concepts are currently being applied in two regions of the world, Southeast Asia and the Arctic, under the International Human Dimensions Programme (Young 1999). Both of these areas provide ample opportunity to both develop and apply theory.

For example, in dealing with cross-scale environmental problems such as persistent organic pollutants (POPs) in the Arctic, institutional interplay has included horizontal linkages among the indigenous communities, and among their regional and national organizations. It has also included vertical interplay in the way local concerns (pollutant loads in marine mammals and fish, see Kuhnlein, this volume) have been

transmitted to national and international levels, culminating in the international protocol on POPs.

In summary, there are a number of alternative approaches in dealing with issues such as the management of migratory marine resources. These include multi-level co-management arrangements and multistakeholder bodies; civic science involving policy networks such as epistemic communities; polycentric institutions; and the institutional interplay approach that focuses on horizontal and vertical linkages. Although each of these approaches has its own literature and practitioners, they also have a number of characteristics in common. Each of them is an approach to deal with complexity, and more specifically, with complex adaptive systems (Gunderson and Holling 2002). Thus, they all deal with aspects of complexity such as self-organization, uncertainty and scale (Berkes et al. 2003).

Concern with cross-scale issues is probably the over-riding interest in all four kinds of approaches. Learning and adaptive management are probably the most important processes to make these cross-scale approaches work. It is not surprising, therefore, that civic science has a learning component (Lee 1993), and that institutional interplay is seen as an extension of co-management (Berkes 2002). There are attempts to combine adaptive management and co-management into what Folke et al. (2002: 20) have called *adaptive co-management*, “a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organized process of trial and error.”

Discussion and Conclusions

This paper started with the idea that social-ecological resilience can be built through cross-scale linkages which can enhance adaptive learning. Resilience is an “emerging property” of complex systems, and a key property according to some recent analyses (Gunderson and Holling 2002). Commons thinking has been evolving to deal with resources as complex systems problems. Commons research evolved through the critique of the “tragedy of the commons” model used “to paint a disempowering, pessimistic vision of the human prospect,” and to rationalize central government control

or privatization of all commons (Ostrom et al. 1999). Commons research over the last 20-30 years has documented in considerable detail the self-organization and self-regulation capability of communities of resource users to solve the exclusion and subtractability problems of the commons. “Tragedy of the commons” was shown to be the consequence of free-for-all, open-access conditions -- not of common property.

However, research also showed that community-based resource management is vulnerable to external pressures on local systems. In particular, community-based resource management was often insufficient and incapable of dealing with problems of migratory marine resources. That raised the questions: Is commons theory limited to local-level, community-based resource management? Or does it provide insights into the solution of global as well as local commons problems, including those involving migratory marine species that cross regional and international boundaries?

There are no quick answers to these questions. But the general direction of the emerging lessons is that commons thinking has been evolving to deal with marine resources as complex systems problems. The commons literature has been turning to the examination of self-organization, uncertainty and scale, all of which are concepts of complex adaptive systems theory (Gunderson and Holling 2002).

Self-organization has been a major theme in commons research for years, in contrast to the assumption of disorganized commoners incapable of communication and negotiation. Spontaneous organization of commons users, without the intervention of governments or the free-market, can be inferred from the historical evidence of long-standing commons institutions (Ostrom 1990), as well as from the recently emerging ones (Berkes et al. 2003).

Uncertainty is a somewhat more recent theme, at least in the commons literature. It follows the shift in the ecology and resource management literature, from the notions of equilibrium, predictability and control, to the notions of multi-equilibrium, unpredictability, and lack of control (Berkes et al. 2003). Emphasis on Adaptive Management and the Precautionary Principle are two important pieces of evidence for this new thinking in the management of marine ecosystems and fisheries.

Scale matters, in both natural and social systems. The complexity theory dictum, “more is different”, applies very appropriately to the study of fish and marine mammals

that cross the boundaries of areas fished by communities and nations of fishermen. What are the implications of cross-scale institutional linkages for the management of migratory marine resources?

The institutional interplay idea, as an extension of co-management and multistakeholder processes, and the conceptual tool of horizontal and vertical institutional linkages provide a powerful approach to deal with the scale issue. The use of polycentric institutions to deal with inter-regional and international commons is an untested idea. But civic science involving epistemic communities has a promising track record already, and the idea of policy networks or policy communities in general provide a potential alternative.

Perhaps the major lesson from examining these alternatives is the emphasis on the ability of a society or management system to build capacity for learning and adapting -- the resilience approach (Gunderson and Holling 2002). The conventional approach of bilateral or multilateral international agreements, based on biological and economic controls, seems to be limited in building such capacity. Perhaps this is why Arctic environmental management and marine resource management have started to use alternative approaches for international commons management, such as scale-matching, adaptive management and stakeholder participation, to help build capacity for learning and adapting.

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