

Commons Theory for Marine Resource Management in a Complex World

Fikret Berkes
University of Manitoba

1. Commons Concept and Theory
2. Lessons from Community-Based Resource Management
3. Migratory Marine Resources as a Special Challenge to Commons Theory
4. Alternative Approaches and Emerging Perspectives
5. Conclusions

1. COMMONS CONCEPT AND THEORY

I carried out my first study of community-based resource management in the mid-1970s in the Cree Indian village of Chisasibi, James Bay, in eastern subarctic Canada. As a recent science PhD, I had no training to appreciate local resource management institutions and traditional knowledge. Worse, as a member of a generation of students under the influence of the “tragedy of the commons” concept, I was predisposed to believing that resources had to be protected from the users by government resource managers and appropriately trained scientists. This belief was shaken somewhat by the results of my studies of Cree fishers and their productive and orderly fishery [BERKES 1977]. This was a subsistence fishery, with no commercial component, carried out in the coastal waters of James Bay. There were no apparent rules or regulations in its conduct. As an indigenous subsistence fishery, it operated outside the sphere of government regulations. Yet, as it turned out, there was indeed a system, and the fishers were self-organized and self-managed, unlike the “tragedy of the commons” [BERKES 1999, chapter 7, summarizes some ten years of work with this fishery].

The “tragedy of the commons” is often a starting point in commons discussions. Until the 1980s, it was the principal way in which commons were considered. Hardin [1968] used the example of an imaginary pasture in Medieval England to which cattle herders have free and open access (i.e. a “commons”). Each herder receives a direct benefit (say +1) from adding one more animal to graze in the pasture, whereas the costs of degrading the pasture are shared by all (a fraction of -1). Thus, each herder has the incentive to put as many cattle on the pasture as he can. Putting more animals on the pasture is the economically rational choice; yet everyone exercising their rational choice leads to the degradation of the pasture—hence the “tragedy.”

The James Bay Cree fishery did not fit this model at all. The fishers were able to decide among themselves on the rules of conduct of the fishery, and were able to persuade more or less everyone to follow those rules. The rules were not written down, and the Cree themselves did not think of them as “rules”. It was simply the “way things were done”. This locally designed fishing system was quite different from biological management systems generally applicable

in subarctic commercial fisheries in Canada.

As regulated by government, commercial fisheries are usually managed by fishing gear and mesh size restrictions, season and area closures (for example, during spawning), and catch quotas. By contrast, Cree subsistence fishers used the most effective gear available, the mix of mesh sizes that gave the highest possible catch per unit of effort by area and by season, and deliberately concentrated their fishing effort on aggregations of the most efficiently exploitable fish. In short, the Cree fishery violated just about every measure used by government managers. In turn, the Cree fishery used a set of practices seldom seen in conventional management: switching fishing areas according to the declining catch per effort; rotating fishing areas; using a mix of mesh sizes to proportionately thin out populations by size and age; keying harvest levels to needs; having a system of master fishers and stewards who informally regulated access and effort; and having a land use system in which resources were used under principles and ethics agreed upon by all [BERKES 1999].

The Cree fishery made me reject Hardin's model. In the meantime, other scholars in various parts of the world were also finding exceptions to the "tragedy of the commons." A consensus was building among scholars, to the effect that Hardin's model applied to the open-access, or free-for-all, exploitation of the commons, but it was not valid for many community-based resource use systems. In fact, Hardin's [1968] own example of the imaginary English pasture was wrong. The medieval English commons, like many other historic commons, were generally used under locally devised regulations. For example, traditional rules of "stinting" limited the number of heads of animals that each owner was allowed to graze on the village pasture. Medieval English commons operated successfully for many centuries, and several economic historians and other scholars have questioned if a "tragedy" of the sort described by Hardin ever occurred widely [FEENY et al. 1990].

It is a well known phenomenon in science that a dominant model or way of thinking (paradigm) persists until the accumulation of new evidence forces a re-appraisal. This is exactly what happened in the case of commons theory between about 1985 and 1990. Hardin had argued that users of a commons are caught in an inevitable process that leads to the destruction of the resources on which they depend. Exceptions to Hardin's thinking were coming from all parts of the world, covering various cultures and resource types—fisheries, wildlife, forests, grazing lands, irrigation and ground water. These various cases of community-based management were brought together in several volumes [NAS 1986; McCAY and ACHESON 1987; BERKES 1989; OSTROM 1990; BROMLEY 1992], and it became necessary to develop an entirely new theory of the commons.

To construct a new theory, first the definitions and concepts had to be made clear. Common property (common pool) resources shared two characteristics: (a) exclusion or the control of access of potential users was difficult, and (b) each user was capable of subtracting from the welfare of all other users [BERKES 1989; FEENY et al. 1990]. These two universal characteristics of commons are referred to as the *exclusion problem* and the *subtractability problem*, respectively. Thus, Ostrom and colleagues [1999] define *common-pool (or common-property) resources* as those "in which (i) exclusion of beneficiaries through physical and institutional means is especially costly, and (ii) exploitation by one user reduces resource availability for others."

Second, the new theory needed to clarify property-rights relationships and regimes [NAS

1986; OSTROM 1990; BROMLEY 1992]. Common property or common-pool resources may be held in one of four basic property rights regimes. *Open-access* is the absence of well-defined property rights. Access is free and open to all. *Private property* refers to the situation in which an individual or corporation has the right to exclude others and to regulate the use of a resource. *State property* or *state governance* means that rights to the resource are vested exclusively in government to control access and regulate use. In *communal-property* (or simply *common-property*) regimes, the resource is held by an identifiable community of users who can exclude others and regulate use. These four regimes are ideal, analytical types. In practice, resources are usually held in mixed combinations of property rights regimes.

The evidence accumulating over the last few decades indicates that three of these property-rights regimes (private property, state property and communal property) may, under various circumstances, lead to sustainable resource use. No particular regime is inherently superior to the others, but one may fit a particular circumstance better than the others. No one particular regime guarantees sustainability; there are successes and failures under all three regimes. Regarding the open-access regime, however, there is general consensus that long-term sustainability is not possible [FEENY et al. 1990].

The one important conclusion from all this work is that common-property is not the same as open-access. There is nothing inherent in commons that would lead to resource degradation. The term *property* refers to social relations, and there are social relations involved in common-property, by definition. These social relations often lead to problem-solving and the formulation of practical rules-in-use—institutions in the terminology of Ostrom [1990]. Hence, the local rules and fishing practices of the James Bay Cree are typical and expected. By contrast, the lack of problem-solving among Hardin's hypothetical English herders, is anomalous and unexpected. Hardin's herders, with free and open access to the pasture, were operating under an open-access regime, and not under common-property.

2. LESSONS FROM COMMUNITY-BASED RESOURCE MANAGEMENT

In theory, and often in practice, community-based resource management can solve the *exclusion problem* and the *subtractability problem*. This does not mean that communal property solutions are necessarily sustainable, any more than private property or state property solutions are sustainable. The key is the ability of a community using a common resource to limit the access of outsiders, and to self-regulate its own harvest. Common property works through incentives. If members of a group are assured that future harvests would be theirs by right, and not end up being harvested by another group, they would have the economic incentive to self-regulate.

Exclusion means the ability to exclude people other than the members of a defined group. Evidence suggests that successful exclusion under communal-property is the rule rather than the exception. But stresses of population growth, technology change, and economic transformation may contribute to the breakdown of communal-property mechanisms for exclusion [BERKES 1989]. The creation of open access by external forces, as in colonialism, and more recently by globalization, is particularly damaging to communal property controls for exclusion.

One of the important conclusions of the literature is that the legal recognition of communal

resource rights is one of the keys to success. An example is Japanese coastal fisheries. Contemporary Japanese coastal sea tenure incorporates traditional village fisheries rights into modern legislation [ASADA 1973; RUDDLE and AKIMICHI 1984]. Without legal protection, conflicts among competing groups are inevitable. Local resource use rights are fragile in the absence of formal property rights, but may still be informally enforced through such means as threats and occasional violence [ACHESON 1981, 1988].

Subtractability refers to the ability of social groups to design a variety of mechanisms to regulate resource use among members. In many cases, resource users have been able to avoid Hardin's "tragedy" by devising self-governing rules, monitoring mechanisms, and sanctions that rely neither on government control nor private property rights. Much of the common property literature addresses this issue, and the ability of groups to make rules-in-use (institutions) to solve the subtractability problem. Ostrom [1990] lists eight design principles for effective community-based institutions (Table 1). An analysis by Agrawal [2002], using Ostrom's principles, as well as those by Wade [1988] and Baland and Platteau [1996], indicates that there may be as many as forty design principles or "critical enabling conditions" that are important for the success of commons institutions.

Common property analysis focuses on institutions, examines access and self-regulation, and poses questions about rights and control over resources. Often it does not directly address the questions of sustainability or conservation of the resource. There is a divergence of opinion on this point. Various authors have analyzed community-based management systems, and interpreted their function in terms of conservation [JOHANNES 1978], conflict management

Table 1. Ostrom's (1990) Institutional Design Principles

- 1) Establishment of clear boundaries that define the resource to eliminate open access conditions.
- 2) Development of context-appropriate rules that recognize no one set of rules will be suitable for each system.
- 3) Implementation of collective choice arrangements in which participants gain a stake in and participate in the creation of the rules and governance structures.
- 4) Monitoring of resource use by appropriators to address issues of subtractability and status of resource.
- 5) Graduated sanctions for appropriators who violate agreed upon rules.
- 6) Establishment of low cost, effective conflict resolution mechanisms to address conflicts among appropriators or between users and officials.
- 7) Appropriators' rights to devise their own institutions, not challenged by higher level institutions.
- 8) Nested institutions to provide a hierarchy of governance structures.

[ACHESON 1981; BERKES 1992], equity of resource access [BERKES 1992; LOBE and BERKES 2003], political control [POLUNIN 1984; CHAPMAN 1987], or the enforcement of cultural values such as sharing [WENZEL et al. 2000].

These various functions of community-based management systems are not mutually exclusive. For example, commons management in a Brazilian lagoon fishery investigated by Seixas and Berkes (2003) served the multiple purposes of conflict management, equity of access, and the maintenance of productivity. Another example is the community-based management of edible kelp or *kombu* on Hokkaido Island. Depleted under an open-access regime in the late 1800s, kelp management under Japanese Fisheries Law and Fisheries Cooperative Associations (FCAs) has addressed both conflict and depletion problems [IIDA 1998].

Based on a large number of community-based resource management cases (more than 4,000 references in the area of fisheries alone, see IASCP 2005), it is probably fair to say that conservation is not usually the primary motive of management. However, one can also say that common property systems, through access limitation and self-regulation, result in the maintenance of productivity of a resource. Hence, whatever the primary motivation may be (power, conflict management, equity, etc.) at the *proximate* level of causation, the end result is the maintenance of the resource at the *ultimate* level.

How do we know they work? There are relatively few examples of both biological and social data being collected at the same time to monitor the state of the resource under different property-rights regimes [POLLNAC and JOHNSTON, this volume]. But there are, of course, still a good number of such cases, including the dugong example of Kwan [this volume]. I have first-hand knowledge of three such studies: a sea-urchin fishery [SMITH and BERKES 1991] and a mangrove area managed for charcoal production [SMITH and BERKES 1993], both in St. Lucia in the Caribbean, and the above-mentioned Cree subsistence fishery in northern Canada [BERKES 1999].

Establishing conservation motives and documenting resource sustainability are both difficult because of the complexity of communities and the fact that resource use systems are seldom static. Community-based resource use systems tend to be dynamic, going through cycles of crisis and recovery and cycles of institutional renewal. Common property analysis certainly does not assume equilibrium, as societies are rarely, if ever, in balance with their resources. Rather than assuming stability and equilibrium, we would be better off assuming that there will be crises and cycles of change. As we do so, the analytical emphasis of research shifts to resilience, and the ability of a society or management system to build capacity for learning and adapting [GUNDERSON and HOLLING 2002; FOLKE et al. 2002; BERKES et al. 2003].

In many cases, community-based management systems are inferred to be successful, not because conservation or sustainability can be shown, but because the commons institutions have survived for long periods through various crises. Examples of such successful commons institutions have received special attention for theory building precisely because they are long-enduring [OSTROM 1990]. Many of them have historical roots, as in Swiss Alpine commons and Japanese village common lands or *iriai*, and Japanese coastal fishery commons [RUDDLE and AKIMICHI 1984]. With each case of long-standing commons institutions, we may not have the full history available. But the long-term survival of a community-based management system is a reasonably good indicator of its sustainability.

However, not all examples of successful communal systems have historic roots or are based on long-standing tradition. In a study of several Turkish coastal fisheries, self-organization and self-governance were found to be evolving over a timescale of about one decade [BERKES 1992]. In Alanya on the Mediterranean coast of Turkey, local fishers developed, in the 1970s and the 1980s, a system based on the rotation of fishing sites by drawing lots. This system was used to regulate the fishery and solve the problem of escalating conflicts over prime harvesting areas [BERKES 1992]. Similarly, the lobster fishing territories in Maine, USA [ACHESON 1988], and the common-property systems in St. Lucia for sea-urchins [SMITH and BERKES 1991] and mangrove [SMITH and BERKES 1993] all have emerged spontaneously in relatively recent times.

The *padu* systems of South Asia provide a set of marine community-based management systems that include both long-standing examples and recently emerging cases. Found in Sri Lanka and the southern Indian states of Kerala and Tamil Nadu, *padu* is a system of rotational fishing spots that are allocated by lottery. They are found in lagoon and estuarine fisheries, mainly for shrimp fisheries. *Padu* systems are species and gear-specific, with rules to define fishing sites and rights holders, often according to social groups or caste groups. The *padu* system in the Negombo Lagoon is recognized under national laws of Sri Lanka. The system goes back at least to the 18th century, and possibly to the 15th [AMARASINGHE et al. 1997]. It has survived several cycles of crisis and recovery, most recently in the 1940s and the 1950s, proving itself to be resilient under pressures of change. The system has seen cycles of institutional renewal, and has shown itself capable of learning and adapting.

By contrast, the three *padu* systems in the Cochin estuary of Kerala are institutions that date back from the 1970s and the 1980s. They arose as a response to the globalization of shrimp markets and the centralization of fisheries management in Kerala. They probably borrow from the same centuries-old South Asian fishery traditions as the Sri Lankan example. But the Kerala *padu* systems are not recognized by the government and are considered “illicit”. These community-based systems serve livelihood, access equity and conflict resolution needs among their members. However, the fishers are unable to address access and subtractability issues in the estuary as a whole because the vast majority of the fishers in the area are not members of the associations that manage the *padu* fisheries [LOBE and BERKES 2004]. This is in contrast to the Sri Lanka case where all fishers, as a condition of their license, are members of the villages that manage the *padu* system and are subject to its rules.

Research over the last two or three decades have documented the sheer diversity of property rights institutions, especially in the older, historically rooted resource management systems. For example, there is an incredibly diverse array of arrangements from island group to island group in the reef and lagoon tenure systems and coastal fisheries of the Asia-Pacific region [JOHANNES 1981; RUDDLE and AKIMICHI 1984; FREEMAN et al. 1991; AKIMICHI 1996].

These commons institutions serve to solve both the exclusion and the subtractability problems of commons management. They show that institutions that are close to the resource, flexible, diverse, and receptive to feedback from the environment, stand a better chance of success than top-down, centralized management systems [WILSON et al. 1994]. Their diversity and widespread prevalence indicate that they have been important institutions for the survival of many societies. There is an increasing recognition that these commons institutions are still

relevant for policy-making in contemporary fisheries management [RUDDLE 1998; JOHANNES 1998]. However, there are certain limitations of the lessons learned from these local-level systems.

Research on commons issues over recent decades has often sought the simplicity of community-based resource management cases to develop theory. For example, Ostrom [1990: 29] comments that her strategy has been to use small-scale common property situations to study “because the process of self-organization and self-governance are easier to observe in this type of situation than in many others.” In reality, however, resource boundaries rarely match social boundaries. Resources tend to be used by competing communities and user-groups. One striking example of this comes from the Mackenzie Delta in the western Canadian Arctic. It is very difficult to reconcile the competing interests of Inuit beluga whale hunters on one hand, and ecotourists who are unappreciative of beluga whaling and its cultural importance to Inuit on the other hand [DRESSLER et al. 2001]. The beluga whale case is a small-scale example of what Ohmagari (this volume) has identified as the fundamental conflict between the view of whales as a recreational resource vs. whales as human food.

A further complication is that communities themselves are not simple entities. The term *community* in community-based resource management is a gloss for a complex phenomenon. Social systems are multi-scale, and the term community hides a great deal of complexity. Idealized images of “coherent, long-standing, localized sources of authority tied to what are assumed to be intrinsically sustainable resource management regimes” [BROSIOUS et al. 1998: 165] are just that—idealized. A community is not a static, isolated group of people. Rather, it is more useful to think of communities as multi-dimensional, cross-scale social-political units.

Globalization has a major impact on local-level resource management through such mechanisms as the creation of international markets. Can a theory of the commons, based on local-level cases, be scaled up to deal with the complexity of communities and social-political networks? Is the theory of commons applicable to regional or large-scale resources? Migratory marine resources pose a special challenge to commons theory and common property resource management by making the exclusion problem and the subtractability problem more difficult to deal with. This is because, with migratory resources, the mechanisms by which a community may limit access and regulate its own resource use become severely limited.

3. MIGRATORY MARINE RESOURCES AS A SPECIAL CHALLENGE TO COMMONS THEORY

The evolving theory of the commons fairly reliably establishes the conditions under which community-based conservation may or may not work [OSTROM et al. 1999; BURGER et al. 2001; DOLSAK and OSTROM 2003; IASCP 2005]. That is, the theory of the commons is now sufficiently developed to enable prediction. However, many of the case studies on which the theory is based focus on single resources that occur within a limited area and are used by relatively few groups. They tend to involve only a small number of homogeneous resource users. However, as we move beyond a community-based resource management situation, the spatial scale of resource use increases, and the heterogeneity of resources and resource users also increases. Thus,

commons governance becomes complex as scale increases.

Is the commons theory robust across the 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 levels of the scale [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 nation. 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 common resources. 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 western Atlantic and one in the eastern Atlantic. Larval surveys indicate two major breeding grounds, one in the Gulf of Mexico and the other in 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 thus 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 within 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.

If that happens, there may be a tendency to fall back on the precautionary principle as a hedge for scientific uncertainty, and simultaneously on ethical principles as a way of dealing with issues that cannot be solved by scientific research. The *Code of Conduct for Responsible Fisheries* and the *Lisbon Principles* are two such sets of principles that mix science, measures for uncertainty, and ethical principles. However, as with bilateral or multilateral agreements, they depend on the voluntary cooperation of nation states in a world in which the distribution of power is badly skewed.

The international process for formulating a Code of Conduct for Responsible Fisheries (CCRF) was initiated formally by the FAO in 1991 in response to the crisis in the management of global fisheries. By the late 1980s, it had become clear that fisheries resources could no longer sustain increasing levels of exploitation, and that new approaches to fisheries management, embracing conservation and environmental considerations, were urgently needed. Unregulated fisheries on the high seas, in some cases involving straddling and highly migratory fish species, were becoming matters of special concern.

FAO's Committee on Fisheries (COFI), at its Nineteenth Session in March 1991, called for the development of new concepts that would lead to responsible, sustainable fisheries. A complex and interactive process of transnational negotiation took place from 1991 to 1995 that involved special panels convened by FAO to draft the Code and its Appendices. The process was partly shaped by the UN Conference on Environment and Development (UNCED), which convened in Rio in 1992, and the UN Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks with respect to the 1982 UN Convention on the Law of the Sea (UNCLOS). A final COFI meeting in October 1995 finalized the 1995 Code of Conduct for Responsible Fisheries.

The Code and its Technical Guidelines were intended to be consistent with UNCED and Agenda 21 of the Rio Declaration, as well as with the 1995 UNCLOS related to straddling and migratory stocks. It embraced the Precautionary Principle contained in the Rio Declaration, Principle 15: "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

The UN Conference on Straddling Stocks and Highly Migratory Stocks developed a consensus on the need to introduce or strengthen a precautionary approach to fishery management, imbedding the Precautionary Principle in the draft of its outcome and outlining elements for its implementation.

The Code of Conduct for Responsible Fisheries is the most comprehensive set of guidelines yet devised. In addition to the Precautionary Principle, the guidelines address (among others)

Table 2. The Lisbon Principles to Promote Sustainable Governance of the Oceans and Coastal Areas. (Source: Costanza et al. 1999)

Responsibility principle	Responsibility to use resources in an ecologically sustainable, economically efficient and socially just manner
Scale-matching principle	Decision-making at the scale of governance which has the most relevant ecological information, which considers actors, and which internalizes costs and benefits
Precautionary principle	The need to take uncertainty about potentially irreversible impacts into account by erring on the side of caution
Adaptive management principle	Monitoring social, economic and ecological systems because they are dynamic and have some level of uncertainty; learning-by-doing
Full cost allocation principle	The need to identify and allocate all internal and external costs and benefits (social and ecological) of alternative uses of resources
Participation principle	The importance of full stakeholder participation in the formulation and implementation of decisions about environment and resources

ecosystem stewardship, dispute resolution, international law, and international trade in fish products. Needless to say, they rely on the voluntary compliance of nation states. The Lisbon Principles for sustainable ocean governance, summarized in Table 2, provide a smaller and more manageable set of guidelines. These include the principles of responsibility, scale-matching, precaution, adaptive management, full-cost allocation, and participatory decision-making [COSTANZA et al. 1999].

In summary, the management of migratory marine resources has tried to pursue progressively more sophisticated technical solutions. By and large, these have not worked satisfactorily. More recently, management has fallen back on the use of the precautionary approach, dealing with uncertainty and other complex systems problems through such principles as the Code of Conduct for Responsible Fisheries and the Lisbon Principles. It is debatable if these measures can solve the problems of regional and global commons as they rely on voluntary compliance at the level of the nation state. As well, they provide sets of ideals established from the top down, without local-level inputs and without providing the institutional mechanisms that can connect the local-level with the regional and international levels.

4. ALTERNATIVE APPROACHES AND EMERGING PERSPECTIVES

Common property theory, in its current state, has little direct application to international conventions and ethical principles. But it does have contributions to make with respect to institutional mechanisms to connect 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, and most of the literature deals only with simple partnerships involving local-level management with government-level management [LIM et al. 1995; NRTEE 1998]. 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. Some examples of the literature on multistakeholder bodies are summarized in Table 3.

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

Table 3. Examples of Multistakeholder Bodies

<p>Lofoten cod fishery, Norway. A co-management arrangement of long standing (<i>Lofoten Act</i>, 1895) in which the Norwegian government has devolved the fishery to the users. District committees of fishermen make yearly regulations and deal with user-group conflicts. Organized on gear-group representation and predominantly union-based (Jentoft 1989).</p>
<p>Barbados Fisheries Advisory Committee. A seven-member body set up by the Fisheries Act to advise the Minister; it includes the various sectors of the fishing industry—fishermen, fish processors, boat owners, and fish vendors (McConney and Mahon 1998).</p>
<p>US Regional Fishery Management Councils. One of several regional bodies consisting of government officials and members of the public who reflect various fishery and coastal environmental interests. Charged with developing management plans for fisheries of the EEZ (McCay and Jentoft 1996).</p>
<p>Great Barrier Reef Management Authority, Australia. The <i>Great Barrier Reef Marine Park Act</i> of 1975 has established an Authority that has the responsibility to seek out regional stakeholders to discuss management plans. Bodies representing the various uses of the reef, with priority going to those most dependent on the Park's resources, assist with ecosystem-based management of the larger reef area (Kelleher 1996).</p>

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 under 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 linkages among institutions, at both 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 of Global Environmental Change [YOUNG 1999]. Both of these areas provide ample opportunity to 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 (for example, pollutant levels in marine mammals and fish; see Kuhnlein, this volume) have been transmitted to national and international levels, culminating in the international protocol on POPs [DOWNIE and FENGE 2003].

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 provides 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 may be 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.”

5. CONCLUSIONS

This paper started with the thesis that views of “commons” have been evolving to deal with marine 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 has 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 question: 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 simple answers to this question. But the general direction of the emerging lessons is that commons thinking has been evolving to deal with marine resources as complex systems problems. Commons literature has increasingly focused on 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 Hardin’s [1968] 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 recently emerging ones [BERKES 1992].

Uncertainty is a somewhat more recent theme, at least in the commons literature. It follows a shift in ecology and resource management literature from notions of equilibrium, predictability and control, to 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 powerful approaches 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 already has a promising track record, 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, which is 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 international marine resource management has started to use the precautionary approach and codes of conduct in dealing with uncertainty

and other complex systems problems—these may help build capacity for learning and adapting. The Lisbon Principles are interesting in that they encompass many of the ideas that come out of the discussion of alternative approaches for international commons management, such as scale-matching, adaptive management and stakeholder participation, all of which potentially contributing to learning.

ACKNOWLEDGEMENTS

I would like to express my appreciation to Nobuhiro Kishigami and organizers of the Monbukagakusho International Symposium for challenging me to address problems that are both large and practical. A number of colleagues have contributed to the development of this paper. In particular, I thank James Savelle for his editorial work, and acknowledge Henry Regier who helped me appreciate what the FAO codes of conduct were about. Henry also brought to my attention, back in 1981, Bob Johannes' masterpiece, *Words of the Lagoon*. This paper is dedicated to the memory of Bob Johannes whose work has influenced a generation of scholars. My work has been supported by the Social Sciences and Humanities Research Council of Canada (SSHRC), and the Canada Research Chair in Community-Based Resource Management.

REFERENCES

- ACHESON, J. M.
 1981 Anthropology of Fishing. *Annual Reviews of Anthropology* 10: 275–316.
 1988 *The Lobster Gangs of Maine*. Hanover, NH: University Press of New England.
- AGRAWAL, A.
 2002 Common Resources and Institutional Sustainability. In E. Ostrom, T. Dietz, N. Dolsak, P.C. Stern, S. Stonich and E.U. Weber (eds.) *Drama of the Commons*, pp. 41–85. Washington DC: National Academy Press.
- AKIMICHI, T.
 1996 *Coastal Foragers in Transition* (Senri Ethnological Studies 42). Osaka: National Museum of Ethnology.
- AMARASINGHE, U. S., W. U. CHANDRASEKARA and H. M. P KITHSIRI
 1997 Traditional Practices for Resource Sharing in an Artisanal Fishery of a Sri Lankan Estuary. *Asian Fisheries Science* 9: 311–323.
- ASADA, Y.
 1973 License Limitation Regulations: The Japanese System. *Journal of the Fisheries Research Board of Canada* 30: 2085–2095.
- BALAND, J., and J. PLATTEAU
 1996 *Halting Degradation of Natural Resources: Is There a Role for Rural Communities?* Oxford: Clarendon.
- BERKES, F.
 1977 Fishery Resource Use in a Sub-arctic Indian Community. *Human Ecology* 5: 289–307.

- BERKES, F. (ed.)
 1989 *Common Property Resources: Ecology and Community-Based Sustainable Development*. Belhaven Press: London.
- BERKES, F.
 1992 Success and Failure in Marine Coastal Fisheries of Turkey. In D.W. Bromley (ed.) *Making the Commons Work*, pp. 161–182. San Francisco: Institute for Contemporary Studies Press.
 1999 *Sacred Ecology: Traditional Ecological Knowledge and Resource Management*. Philadelphia and London: Taylor & Francis.
 2002 Cross-scale Institutional Linkages for Commons Management: Perspectives from the Bottom Up. In E. Ostrom et al. (eds.) *Drama of the Commons*, pp. 293–321. Washington DC: National Academy Press.
- BERKES, F., R. MAHON, P. MCCONNEY, R. C. POLLNAC and R. S. POMEROY
 2001 *Managing Small-Scale Fisheries: Alternative Directions and Methods*. Ottawa: International Development Research Centre. <<http://www.idrc.ca/booktique>>
- BERKES, F., J. COLDING and C. FOLKE (eds.)
 2003 *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge, UK: Cambridge University Press.
- BLOCK, B. A., H. DEWAR, S. B. BLACKWELL et al.
 2001 Migratory Movements, Depth Preferences, and Thermal Biology of the Atlantic Bluefin Tuna. *Science* 293: 1310–1314.
- BROMLEY, D. W. (ed.)
 1992 *Making the Commons Work: Theory, Practice and Policy*. San Francisco: Institute for Contemporary Studies.
- BROSUIS, J. P., A. TSING and C. ZERNER
 1998 Representing Communities: Histories and Politics of Community-based Resource Management. *Society and Natural Resources* 11: 157–168.
- BURGER, J., E. OSTROM, R. B. NORGAARD, D. POLICANSKY and B. D. GOLDSTEIN (eds.)
 2001 *Protecting the Commons: A Framework for Resource Management in the Americas*. Washington DC: Island Press.
- CARLSSON, L.
 2000 Policy Networks as Collective Action. *Policy Studies Journal* 28: 502–520.
- CHAPMAN, M. D.
 1987 Traditional Political Structure and Conservation in Oceania. *Ambio* 16: 201–205.
- COSTANZA, R., F. ANDRADE, P. ATTUNES et al.
 1999 Ecological Economics and the Sustainable Governance of the Oceans. *Ecological Economics* 31: 171–187.
- DOLSAK, N. and E. OSTROM (eds.)
 2003 *The Commons in the New Millennium*. Cambridge, MA: MIT Press.
- DOWNIE, D. L. and T. FENGE (eds.)
 2003 *Northern Lights against POPs: Combatting Toxic Threats in the Arctic*. Montreal and Kingston: McGill-Queen's University Press.
- DRESSLER, W., F. BERKES and J. MATHIAS
 2001 Beluga Hunters in a Mixed Economy: Managing the Impacts of Nature-based Tourism in the Canadian Western Arctic. *Polar Record* 37: 35–48.

- FEENY, D., F. BERKES, B. J. MCCAY and J. M. ACHESON
 1990 The Tragedy of the Commons: Twenty-two Years Later. *Human Ecology* 18: 1–19.
- FOLKE, C., S. CARPENTER, T. ELMQVIST, L. GUNDERSON, C. S. HOLLING, B. WALKER et al.
 2002 *Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations*. International Council for Science, ICSU Series on Science for Sustainable Development No.3. <<http://www.sou.gov.se/mvb/pdf/resiliens.pdf>>
- FREEMAN, M. M. R., Y. MATSUDA and K. RUDDLE (eds.)
 1991 Adaptive Marine Resource Management Systems in the Pacific. Special Issue of *Resource Management and Optimization* 8 (3/4): 127–245.
- GUNDERSON, L. and C. S. HOLLING (eds.)
 2002 *Panarchy. Understanding Transformations in Human and Natural Systems*. Washington DC: Island Press.
- HAAS, P. M.
 1990 *Saving the Mediterranean: The Politics of International Environmental Cooperation*. New York: Columbia University Press.
- HARDIN, G.
 1968 The Tragedy of the Commons. *Science* 162: 1243–1248.
- IASCP
 2005 The International Association for the Study of Common Property. Bibliographies on the Commons. <<http://www.iascp.org/library.html>>
- IIDA, T.
 1998 Competition and Communal Regulations in the Kombu Kelp (*Laminaria angustata*) Harvest. *Human Ecology* 26: 405–423.
- JENTOFT, S.
 1989 Fisheries Co-management. *Marine Policy* 13: 137–154.
- JOHANNES, R. E.
 1978 Traditional Marine Conservation Methods in Oceania and Their Demise. *Annual Reviews of Ecology and Systematics* 9: 349–364.
 1981 *Words of the Lagoon. Fishing and Marine Lore in the Palau District of Micronesia*. Berkeley: University of California Press.
 1998 Government-supported, Village-based Management of Marine Resources in Vanuatu. *Ocean & Coastal Management* 40: 165–186.
- KELLEHER, G.
 1996 Public Participation on the Reef. *World Conservation* 2: 9.
- LEE, K. N.
 1993 *Compass and Gyroscope: Integrating Science and Politics for the Environment*. Washington DC: Island Press.
- LIM, C. P., Y. MATSUDA and Y. SHIGEMI
 1995 Co-management in Marine Fisheries: The Japanese Experience. *Coastal Management* 23: 195–221.
- LOBE, K. and F. BERKES
 2004 The Padu System of Community-based Resource Management: Change and Local Institutional Innovation in South India. *Marine Policy* 28: 271–281.
- MAGNUSSON, J. J., C. SAFINA and M. P. SISSEWINE
 2001 Whose Fish are They Anyway? *Science* 293: 1267–1268.

- MCCAY, B. J. and J. M. ACHESON (eds.)
 1987 *The Question of the Commons: The Culture and Ecology of Communal Resources*. Tucson, AZ: University of Arizona Press.
- MCCAY, B. J. and S. JENTOFT
 1996 From the Bottom Up: Participatory Issues in Fisheries Management. *Society and Natural Resources* 9: 237–250.
- MCCONNEY, P. A. and R. MAHON
 1998 Introducing Fishery Management Planning to Barbados. *Ocean & Coastal Management* 39: 189–195.
- MCGINNIS, M. D. (ed.)
 2000 *Polycentric Games and Institutions*. Ann Arbor: University of Michigan Press.
- NAS
 1986 Proceedings of the Conference on Common Property Resource Management. Washington DC: National Research Council/National Academy Press.
- NRTEE
 1998 *Sustainable Strategies for the Oceans: A Co-Management Guide*. Ottawa: National Round Table on the Environment and the Economy.
- OSTROM, E.
 1990 *Governing the Commons. The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press.
- OSTROM, E., J. BURGER, C. B. FIELD, R. B. NORGAARD and D. POLICANSKY
 1999 Revisiting the Commons: Local Lessons, Global Challenges. *Science* 284: 278–282.
- POLUNIN, N. V. C.
 1984 Do Traditional Marine “Reserves” Conserve? A View of Indonesian and New Guinean Evidence. In K. Ruddle, and T. Akimichi (eds.) *Maritime Institutions in the Western Pacific* (Senri Ethnological Studies 17) pp. 267–283. Osaka: National Museum of Ethnology.
- RUDDLE, K.
 1998 The Context of Policy Design for Existing Community-based Fisheries Management Systems in the Pacific Islands. *Ocean & Coastal Management* 40: 105–126.
- RUDDLE, K. and T. AKIMICHI (eds.)
 1984 *Maritime Institutions in the Western Pacific* (Senri Ethnological Studies 17). Osaka: National Museum of Ethnology.
- SEIXAS, C. S. and F. BERKES
 2003 Dynamics of social-ecological changes in a lagoon fishery in southern Brazil. In F. Berkes, J. Colding and C. Folke (eds.) *Navigating Social-Ecological Systems*, pp. 271–298. Cambridge, UK: Cambridge University Press.
- SMITH, A. H. and F. BERKES
 1991 Solutions to the “Tragedy of the Commons”: Sea Urchin Management in St. Lucia, West Indies. *Environmental Conservation* 18: 131–136.
 1993 Community-based Use of Mangrove Resources in St. Lucia. *International Journal of Environmental Studies* 43: 123–132.
- WADE, R.
 1988 *Village Republics: Economic Conditions for Collective Action in South India*. San Francisco: Institute for Contemporary Studies Press.
- WENZEL, G. W., G. HOVELSRUD-BRODA and N. KISHIGAMI (eds.)
 2000 *The Social Economy of Sharing. Resource Allocation and Modern Hunter-Gatherers*. (Senri

Ethnological Studies 53) Osaka: National Museum of Ethnology.

WILSON, J. A., J. M. ACHESON, M. METCALFE and P. KLEBAN

1994 Chaos, Complexity and Community Management of Fisheries. *Marine Policy* 18: 291–305.

YOUNG, O.

1999 Institutional Dimensions of Global Environmental Change Science Plan. International Human Dimensions Programme (IHDP) Report No. 9, Bonn, Germany.