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TITLE: Restoring the Great Lakes: Institutional Analysis and Design

STREAM: Multiple Commons - Water/Watersheds/Irrigation

(1) Introduction

The study of common property resources (CPR) is now a major enterprise on the borders of the disciplines of law, economics and other fields. It has the characteristics of a major paradigm: an International Association with a membership over 600 persons in 50 countries, a biannual conference, and a regular newsletter called the Common Property Resource Digest (www.indiana.edu/~iascp). Much of the early theoretical work focussed on the Tragedy of the Commons and its structural equivalent The Prisoners-Dilemma game (Hardin 1968). More recent work has extended the theory with the aid of extensive field and experimental investigations (e.g. E. Ostrom et al., 1994). Scholars are discovering (and rediscovering) the importance of concepts like customary law, embedded games, and co-management and co-production over a range of resources in a variety of differing sites (e.g. Sproule-Jones, 1993; Scharpf, 1994; Keohane and E. Ostrom, 1994; Pinkerton, 1993; IREE, 1996).

This paper further develops the theoretical work so that it can help to explain the operations and consequences of institutional rules for large scale multiple use resource sites. Existing field work tends to focus on the governance rules for simple resource uses, like fishing or irrigation, in relatively small sites, like a local groundwater system.

The impetus behind the theory developed in this paper is to help understand the operational consequences of the rules for the governance of the Great Lakes water environment. The Great Lakes represent a set of interconnected aquatic ecosystems subject to multiple uses like shipping, fishing, water supply and waste disposal. The five lakes are certainly large, containing approximately 20% of the world's fresh water supply (EPA and Environment Canada, 1995, 3).

A further characteristic of larger scale multiple use ecosystems is that of multiple users, who may possess differing bundles of property rights to own, manage, exploit, exclude, transfer or use the resources in some way. There may be levels and layers of property rights depending, in part, on any particular resource use of the ecosystem. Moreover, the property rights under scrutiny may well

be held by corporate persons, public or private, as well as individual persons that are normally the basic unit in theoretical work on common property. We need, then, to embrace the concept of multiple stakeholders in developing the theory to deal with the Great Lakes situation.

A third salient characteristic of property rights regimes that is included in this paper is that of multiple levels of governance. Property rights are subject to change by and within various legal and political forums (fora). The rights may be considered as operational rules that are subject to collective choice rules about when, how and where the operational rules shall influence the behaviour of property rights holders. Collective choice rules are essentially rules about rules. They may include rules about parliaments, Cabinets, courts and other forums. In considering the way that collective choice rules work in sites like the Great Lakes, we can shift emphasis from a static analysis of property rights to a dynamic analysis of the conditions under which they adapt and change. The concept of multiple levels of analysis is integral to much public choice theory, such as the early work of Buchanan and Tullock (1962), the later work of Vincent Ostrom (e.g. 1991) and Elinor Ostrom (1990, 1994), and some previous work by this author (e.g. Sproule-Jones, 1993).

The paper proceeds as follows. In the next section, I will briefly outline the scope of the multiple uses of the Great Lakes as a whole and describe the most recent attempts to restore the water quality of the most degraded bays, harbours and river mouths on these Lakes. The range of collective choice and operational rules through which these recent attempts known as RAPs (Remedial Action Plans) work will be sketched. Section three develops the concept of multiple stakeholders and their potential property rights. Section four six deals with collective choice rules and presents a framework for the institutional analysis of RAPs and their implementation. Concepts and data used to examine RAPs are described. Section five presents the major findings of the research. The dominant incentives are described as are key exceptions. These reflect the scope of constitutional discretion accorded to the governmental stakeholders granted authority to design the institutional arrangements for plans and their implementation. The major rules at the collective choice level that form the design arrangements are described and evaluated in terms of balancing the interests of the multiple stakeholders. Section eight is a conclusion. It reemphasizes the importance of careful institutional design in the real world, something that is not exemplified on the Great Lakes and which suggests limits to their restoration.

(2) The Great Lakes: Multiple Uses

The law and customs of the settlements around the Great Lakes has reflected, since the earliest European explorations, the law of separable uses. So the common law of fisheries, for example, differed and differs from the common law on navigation and water transport, and when rival uses conflicted, the common law had and has (unless trumped by statute) guidelines as to which use merited priority. The rule of Navigable servitude, for instance, generally permits the uses of shipping and navigation to trump all other uses (Sproule-Jones, 1993).

One key use of the Great Lakes is that of the shipping of goods and people. In the Nineteenth century, hundreds of small harbours were developed, often by private companies, for trade in bulk commodities like iron ore and wheat. Canals, locks and diversions were built to circumnavigate the physical obstacles connecting the Lakes, as in the St. Lawrence, the Niagara and the Soo. Vessel numbers numbered in the thousands; over 1100 sailing vessels were registered

with the Dominion Government alone in the 1850's. Vessel sizes of the newer bulk cargo iron ships increased from 100 to 500 feet by the time the fourth Welland Canal was opened in 1887.

During and after the two world wars the shipping and railroad interests became major competitors in the movement of dry and liquid bulk goods. Today, 70% of the cargoes are exportable grains, but with the development of EU subsidized grain production, tonnage has fallen by 30% since the 1970's and the number of vessels by 50% (to less than 300 in both countries). The development of massive container ships, with drafts exceeding 35 feet and lengths exceeding 700 feet, makes the Seaway itself impossible for these ocean vessels.

Fisheries is a second and again declining use of the Lakes. It reached its zenith at the turn of the century. Then Superior produced 8 million pounds, Erie produced 33 million pounds and Ontario produced over 2 million pounds of whitefish alone as one of a number of commercial species. Today the commercial fishery is based in Lake Erie and consists of only 750 fishers landing 50 million pounds per annum, and the estimated landed value for all Great Lakes is only \$42 million. The recreational fisheries is much more important with estimates of its economic value exceeding \$2 billion (U.S.).

A third major use of the Great Lakes, if not their tributaries and near shores, is that of hydro-electric generation. Hydro-electric power is more significant for Ontario than for the 8 Great Lakes States (or Quebec re the St. Lawrence). 20% of Ontario Hydro power comes from the Niagara, while less than 10% of the power of the 8 states comes from water. The U.S. states have a large number of small generating plants using water. Michigan, for example, has 113 plants but they only produce 1.5% of existing power demand. Nevertheless power has been significant if only as a joint benefit of the construction projects associated with the Seaway.

By far the most important use of the Great Lakes is that of waste disposal. Direct emissions of liquid wastes are, in gross terms, estimated to be some 57 million tonnes. Wastes are also disposed through nonpoint sources, including leachates from over 130 landfill sites considered as hazardous.

The results of the waste disposal are degraded water quality conditions and impaired natural ecosystems. The cultural eutrophication of Lake Erie in the 1960's and the Love Canal incident of the 1970's are the two most well known examples. Four general indicators of the impacts of waste disposal are, first, losses of aquatic habitat and wetlands. Losses exceed current enhancement and restoration programmes, thus continually adding to the estimated 80% loss of habitat and wetlands since early settlement. Second, loadings of persistent toxics result in fish consumption advisories on top predator and forage fish, as well as observed effects of alteration of biochemical function, pathological abnormalities, tumours and reproductive abnormalities in well studied species like herring gull. 38 of 43 Areas of Concern identified as highly degraded by the International Joint Commission report sediments contaminated with heavy metals and persistent organics like PAHs and PCBs. Third, eutrophication is still a concern due to loadings of total phosphorus in 21 Areas of Concern. And fourth, indicators of impacts on human health include studies associating tissue levels of toxic substances with reproductive, developmental, neurological, endocrinological, and immunological effects. More well known are the previously mentioned fish consumption advisories in all Lakes, and beach closings or recreational body contact restrictions in 24 Areas of Concern. It

is impossible to quantify the scale of the costs and benefits of this major use of the Great Lakes, waste disposal.

What became apparent in the 1970's and 1980's was that certain uses of the Great Lakes were severely impaired, curtailed and eliminated by waste disposal. The International Joint Commission (IJC), working through its advisory Water Quality Board, found that 43 so-called Areas of Concern (AOCs) were suffering severe use impairments, and it recommended to the American and Canadian governments that each AOC should develop and implement a Remedial Action Plan (RAP) to restore these uses. Of the original 43 AOCs, 24 are in U.S. waters, 12 in Canada and 7 in jointly held [passageways](#). Table 1 lists the 14 use impairments developed by the IJC; Figure 1 lists the 43 original AOCs (1 was later deleted and another added; both were in Canada)

Table 1: Use Impairments for Areas of Concern

C	Restrictions on fish and wildlife consumption
C	Tainting of fish and wildlife flavor
C	Degradation of fish and wildlife populations
C	Fish tumors or other deformities
C	Bird or animal deformities or reproduction problems
C	Degradation of benthos
C	Restrictions on dredging activities
C	Eutrophication or undesirable algae
C	Restriction on drinking water consumption, or taste and odor problems
C	Beach closings
C	Degradation of aesthetics
C	Added costs to agriculture or industry
C	Degradation of phytoplankton and zooplankton populations
C	Loss of fish and wildlife habitat
C	RAP reviewed by IJC
C	Based on IJC Review, problem definition and description

Source: International Joint Commission, 1991, p. 19.

INSERT FIGURE 1

INSERT FIGURE 2

Remedial Action Plans were to be developed for each AOC by the respective federal and state/provincial governments working with local stakeholders (municipalities, industries, environmentalists, fishers, for example). Canada and Ontario signed a 1985 executive agreement (known as CAO) under which aegis the respective RAPs were to be drawn up in the relevant AOCs with the help of public servants as investigators and writers of the Plans. No one institutional model for the formation of the Plan (called Stages 1 and 2 for the identification of and recommendations to solve the problems) was prescribed. In all cases, the Plans were to be implemented by agencies and other stakeholders within the existing framework of governmental legislation in each country and region. Thus, for example, the primary U.S. legislative rules were to be the Clean Water Act 1987, the Toxic Substance Control Act of 1976, the Safe Drinking Water Act 1986, and a plethora of other Federal and state statutory regulations. The U.S. Great Lakes Critical Programs Act of 1990 requires that RAPs be developed and included in each state's Water Quality Management Plan. In Canada, the importance of Provincial as well as Federal legislative rules in the environmental field is evident. Key rules consist of the (Ontario) Environmental Protection Act of 1971 (as amended), the (Federal) Fisheries Act of 1989, and the 1988 Canadian Environmental Protection Act. Other statutes and the common laws pertaining to resource ownership and uses are also, of course, relevant in both countries.

In essence, then, Remedial Action Plans represent an attempt in 43 polluted sites on the Great Lakes to involve multiple stakeholders, who are multiple users and regulators of the sites to jointly formulate plans to restore some important beneficial uses. The timetable for implementation of the Plans is varying from state to state to province in so far as governmental actions are required in the Plans. The key for our interests is that a variety of forums and institutional designs for solving common pool problems associated with large scale multiple users now exist at a collective choice level on the Great Lakes. These are available for examination.

(3) Multiple Stakeholders

Most of the theoretical work and model construction developed to understand property rights deals with the private property case, where the owner possesses a full bundle of rights including transferability. There are, of course, other stakeholders that may possess some property rights, including public enterprises that are major resource owners in both Canada and the United States (Feldman and Goldberg, 1987).

These stakeholders may all exercise one or more property rights, and all vary in their ease of adaptation from the individual person (including the squatter) through the corporate person to the non-corporate organization. The property rights can include the rights of access and withdrawal, management, exclusion and alienation. Schlager and Ostrom (1992, 252) suggest that these rights have differing legal names or positions (Table 2). We can conclude that any one of our multiple stakeholders can thus be characterized as one of: owner, proprietor, claimant or authorized user, depending on the resource situation in question. Empirically, in a large multiple use resource site one would expect to find any of our three types of stakeholders exercising any of the 4 legal positions suggested by Schlager and Ostrom. The public/private distinction may thus be of little empirical value in assessing the behaviour of stakeholders at least at the operational level of analysis.

Table 2: Rights Associated with Positions¹

	Owner	Proprietor	Claimant	Authorized User
Access and withdrawal	x	x	x	x
Management	x	x	x	
Exclusion	x	x		
Alienation	x			

¹ Schlager and Ostrom (1992, 252)

Property rights are thus rules that have been constructed and used by stakeholders engaged in resources exploitation in some fashion. They consist of a bundle of rules and can perhaps be best understood as an adaptive and adapting framework within which decisions about resource usage are taken.

(4a) Collective Choice Rules

As resources evolve and adapt in dynamic fashions, and as property rights comparably evolve, albeit with lags and leaps, so collective choice mechanisms may also experience dynamic change. Collective choice mechanisms are rules about rules, specifically, rules about how operational decision rules like property rights are reviewed and changed. Collective choice mechanisms themselves may be subject to a third level of rules, called constitutional rules. Constitutional rules govern the processes through which collective choice decisions are taken. They can be relatively simple frameworks like the rules governing household decision-making or relatively complex sets of rules like the national constitutions of Canada and the United States. Rules are, thus, stacked from the operational level through the collective choice to the constitutional level. (Figure 3).

Figure 3: Rule Stacks

Constitutional Rules

Collective Choice Rules

Operational Choice Rules

Some features about rules and rule stacks deserve mention at this juncture. First, rules do not fully determine outcomes or decisions. Individual situations have levels of discretion to make choices and to learn from these choices over time. They may find that, over time, a recurring

pattern of choices is both necessary and optimal. In spot markets, for example, with standardized products and low entry costs, producers may discover over time that marginal cost pricing is their most successful decision choice, as well as necessary to stay in this competitive business. On the other hand, in dynamic natural resource situations, like a harbour or river mouth subject to variations in climate, water flows, nutrient loadings and pollution, owners of a resource like a fishery have a wider range of decision choices and a wider range of uncertainties about the outcomes of these choices. Errors are likely to be more frequent. The property rights regime, no matter of what operational construction, will not eliminate these errors. (It could, of course, amplify them).

Second, many rules at the operational, collective choice or constitutional levels are ignored in practice. They have become simply rules-in-form rather than rules-in-use (Sproule-Jones, 1993), or what Walter Bagehot, the Victorian observer of the British Constitution, once called the "dignified" part of the constitution in reference to the constitutional level of rules (Bagehot, 1964). Examples may help to clarify the distinction between rules-in-form and rules-in-use. Let's use the refrigerator case. One collective choice rule on stakeholder participation could be that all six members of the household have an equal share in decision-making about "replenishment" (shopping) of the resource (food). In practice, however, this rule could become a rule-in-form if one person continuously takes the initiative (with the compliance and then agreement of others) to decide when, where, what and how much to purchase. A new rule-in-use has evolved. The constitution of the household permits this evolution perhaps because it does not spell out an amending procedure or an enforcement mechanism of on-going collective choice rules. It may be hard to get all of the household together to sit down and redefine an agreement that replenishment decisions can and should be taken by one person rather than "the collective". These kind of changes recur in complex real life situations as we saw in our previous examination of water rights.

Third, considerable time and effort is often expended at a "constitutional level" in formulating precise and practical rules about collective choices. These rules would normally comprise rules about the articulation of stakeholder interests, such as selection and representation of stakeholders, and rules for the aggregation of these interests such as time and frequency of meetings and rules (like voting rules) to resolve conflicts. These rules are critical in establishing the power relationships that could manifest themselves in operational decisions. Allied with these particular collective advice rules may be rules about the implementation of decisions, by whom and how and with what solutions, as well as outcomes and measures of outcomes. Implementation of decisions in the form of operational rules and policy outcomes is necessary to make the governance rules a useful system (pun intended).

Finally, collective choice rules, like rules at other levels, are contingent upon their peculiar situational conditions. Not only will a resource (or other good) have its own technical characteristics and, perhaps ecosystemic characteristics, but it will be rooted into particular times and places. These times and places will impose constraints and facilitate opportunities for living systems to evolve and develop. Our trivial refrigerator case is no exception.

(4b) A Basic Framework for Institutional Analysis

The contingencies of time and place may make precise modelling of real world common

pools difficult. But they still permit us to advance a framework rather than a model of decisions situations. The basic framework is presented in Figure 4.

Figure 4: Basic Framework I

INSERT FIGURE 4

This simple framework cannot capture the detail of all common pool characteristics, decisions and effects of decision-making, let alone the rules within which decisions take place. However, it provides us with a skeleton framework to orient our analyses. It essentially hypothesizes that structural variables like property rights can affect ecosystems (or other common pools). However, other situational factors, like the technical characteristics of the resource or the characteristics of human communities that use that resource, can also affect outcomes. These latter relationships are reciprocal too.

A more complex framework is presented in Figure 5. It expands the basic framework in a number of ways. First, it is made expressly applicable to the differing ecosystem and community conditions (the situations) in different Areas of Concern on the Great Lakes. We would anticipate that the particular characteristics of living systems will vary from one AOC to the next. It secondly, expands the rule structures to include the constitutional level of rules in the light of the differing elements in the U.S. and Canadian constitutional frameworks for environmental governance that we have already summarized. It also expressly factors out the rules at the collective choice level into the two broad categories of articulation and aggregation of stakeholders interests. The category of articulation encapsulates one aspect of the representation of a stakeholder in a collective choice decision process. It refers to the participation of a stakeholder (or his/her/its representative) in decision forums. There is some evidence to suggest that the scope of articulation is attenuated in both Canada and the United States in larger scale natural resource situations. (For reviews see Warriner, 1997; Hessing and Howlett, 1997, 105-34). In itself, size is a partial predictor of successful collective action, in that it can reduce the ratio of transaction benefits to costs in larger scale situations (Olson, 1966; Keohane and E. Ostrom, 1994, 403-28). But also the costs of participation may be influenced by boundary rules that can affect the costs of the entry of stakeholders into decision-making (Sproule-Jones and Richards, 1984; Ostrom, Gardner and Walker, 1994). Some boundary rules in RAP decisions, for example, include those limiting sectoral representation on decision forums to one or two representatives per sector (industrial, environmental, etc.)

Aggregation refers to the process of transforming stakeholder preferences, articulated in the decision process, into actions that yield outcomes for the collective management of the ecosystems. For example, many RAP committees will use consensus or unanimity as a basic decision rule for aggregating the articulated interests in committee forums. It means that all represented interests

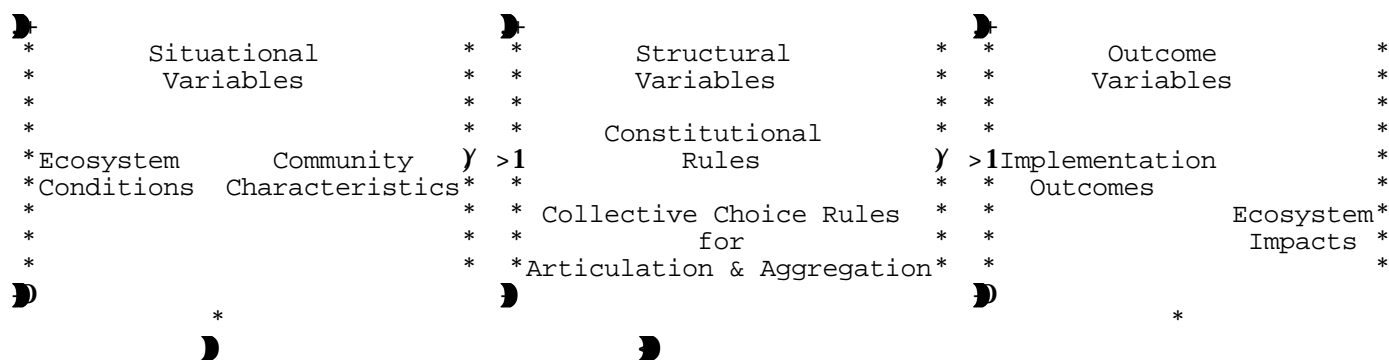
have a (at least temporary) veto on changes from current decision making actions. The rule helps protect the interests of any represented stakeholder but it also raises the transaction costs of making an agreement (Buchanan and Tullock, 1962). It further creates an incentive for opportunism and holdout strategies by participants withholding their necessary consents to decisions. Aggregation processes may or may not include decision making in single forums or by voting procedures.

Articulation and aggregation thus include most aspects of decision-making at a collective choice level. The rules by which they take place are subject to constitutional choice processes that, in our case, are largely given by the various governmental constitutional processes described previously.

The outcome variables include both implementation process variables and actual ecosystem impact variables. The implementation process is distinctly characterized as an outcome variable in this case, because many Remedial Action Plans were formulated with the feasibility of new implementation structures in mind (and hence not, by definition, part of the initial collective choice arrangements). Implementation for many public policies takes place through established processes of administration in government and/or in private sector organizations. Sometimes, however, newer processes are fashioned by the established decision forums to deal with limitations in the implementation processes. So, for example, intergovernmental committees are regularly established by both levels of government in both the US and Canada, when the interdependencies between governments require a more coordinated implementation process. Occasionally, however, and the RAP process is a potential candidate for these situations, a new administrative process is fashioned because of perceived weaknesses in the current processes. Thus implementation variables are included, for our purposes, as a class of outcome variables. More conventional impact variables are also included, although in environmental management there are often uncertain linkages between policy decisions and ecosystem responses due to limits in environmental science knowledge (Sproule-Jones, 1993).

The entire process gets animated by human motives and energies, and such variables, while endogenous to our concerns, would be necessary to include in a formal model rather than a framework of understanding. We reject the relevance of a formal model due to the variety of situational variables extant throughout the Areas of Concern, but we emphasize the explanatory value of our framework nevertheless.

Figure 5: Basic Framework II



(4c) Empirical Methods

The basic framework was tested using three kinds of data. First, a structured survey was mailed to the RAP coordinators in the 43 Areas of Concern. RAP coordinators are public officials, who are either attached to one of the lead agencies that is a stakeholder in an AOC, or a contract employee of one of the lead agencies. His/her duties largely comprise the organization of the processes for writing and implementing the plan for and by (subsets of) the RAP stakeholders. They are thus central figures in the RAP processes, at least in terms of their knowledge of the stakeholders, their priorities, activities and interdependencies. 32 coordinators responded to the survey and 3 follow-up efforts. At the time of the survey, 39 AOCs had coordinators in place.

Second, interviews were conducted in four differing AOCs in order to provide depth, accuracy and examples of the institutional rules and their operation. The interviews included RAP coordinators and chairs/presidents of public advisory groups of stakeholders (the nomenclature of these groups varies). In the Hamilton Harbour case, one of the four AOCs chosen for in-depth analysis, the author of the paper was an original stakeholder for McMaster University and a one-time president of the public advisory group. 14 knowledgeable persons were thus interviewed to supplement and improve upon the survey evidence. The 4 sites chosen were first Hamilton, a case where one federal government and one regional (provincial) government have major legal authority over the harbour. Slightly more complex institutionally was Menominee River, the second case AOC. This site was subject to the legal authority of one federal government and two regional (state) governments, namely Michigan and Wisconsin. The Niagara River which was subject to the authority of 2 federal governments and two regional governments (New York and Ontario) was the third site. And the most complex site institutionally was the St. Lawrence River AOC. This site has 2 federal governments, 2 provincial governments (one, Quebec, a non participant), 1 state (New York), and 2 Indian governments who withdrew from the process after two initial years. A range of institutional/constitutional alternatives were thus included in the in-depth interview sample. These interviews were conducted in 1996.

Thirdly, secondary sources were examined for additional insights. None of these sources were concerned with common property and institutional design per se. They were of three broad types. First, a number of graduate theses provided case study information on the origins and design

of the planning stages of the RAP. (Bixby, 1985; Strutt, 1993; Gunther-Zimmerman, 1994; MacKenzie, 1996) as did as a volume on harbours (Boyle, 1990) and a volume of collected papers on early RAP experience (Hartig and Zarell, 1992). Second, a number of books and papers drew evidence from the Great Lakes and the RAPs to discuss ecosystem and sustainable development policies (especially Caldwell, 1988; Hartig and Thomas, 1988; Colborn, 1990; Hartig, et.al., 1991; Hartig, et.al., 1995; Gebhardt and Lindsey, 1996; Hartig, et.al., 1996). Thirdly, a large number of government documents are produced annually that discuss progress in developing and implementing RAPs. The more useful for our purposes are Eiger and McAvoy, 1992; n.a. 1994; Hartig and Law, 1994; I.J.C., 1997; I.J.C., 1998) and the documents produced by scientists and policy analysts within and for the case study areas.

This particular paper will draw upon the survey work results as supplemented by examples and interview evidence from the case study areas. Figure 6 presents a checklist of variables, organized conceptually by our previously presented basic frameworks, that are used to collect and analyze the data. It is termed a Working Conceptual Framework to indicate that it was a framework for the systematic collection of data from different sources. The next section reviews some of the major findings of the study.

Figure 6: Working Conceptual Framework

Situational Variables (<i>PreConditions</i>)		Structural Variables (<i>Constitutional & Institutional Arrangements</i>)	Outcome Variables
Ecosystem Conditions	Community Characteristics	Aggregation & Articulation	Implementation & Impacts
1. No. Of Impaired Beneficial Uses*	1. Population	1. Selection of Stakeholders	Novel/Single/ Multiple
2. 3 Worst Pollution Problems	2. Income	2. Rules for representation*	Lead/Control
3. Other*	3. Municipal Fragmentation	3. Rules for Aggregation*	Remedies (Sanctions)
	4. School Boards	4. Inclusivity of Rules*	Monitoring/ Indicators
	5. Other Special Boards	5. Role of Fed/Prov agencies	Improved Uses*
	6. Pluralist Index*	6. Role of Writing Team*	Improved Problems*
	7. External Support for Research, etc.	7. Membership Turnover	
	8. Education*		

*Non-Survey Item (in whole or part)

(5) Major Findings

5(a) The Dominating Incentive System

We discovered that the structural variables created a broad incentive system for governmental agencies. Many agencies responded to this system by choosing to pursue their traditional concerns albeit with new resources and public support made possible under the RAP programme. Put differently, the incentive systems under which existing implementing agencies worked, as either regulators or service producers, still dominated their activities. The newer incentive systems, established through the RAP process, were complementary to the on-going incentive systems.

The traditional activities of agencies manifested themselves in a number of ways. First, each of the AOCs had their own particular combination of impaired beneficial uses (see Figure 2). But the RAPs could define their own set of priority problems that might be linked to the beneficial use impairments, and they could identify their own particular set of stressors that needed to be removed in order to improve their own ecological situation. This gave the implementors of each RAP (who are often, as we shall see, collaborators on the authorship of the Plans) sufficient discretion to continue to deal with what they perceived as their major problems. The survey data revealed over 18 different priority problems across the responding AOCs. The cases revealed similar patterns. For example, in the St. Lawrence case, the RAPs could identify a range of restrictions on fish consumption but the linkages to sources of pollution are acknowledged as uncertain. In the face of this uncertainty, the U.S. RAP continued its focus on controlling the scale of point source emissions (especially organics like PCBs) from 3 direct industrial dischargers (ALCOA, Reynolds Metals Aluminum, and General Motors Power Train Division) and on the Canadian side, the RAP continued its focus on discharges, principally inorganics, like mercury and zinc, from two industrial point sources, Domtar Fine Papers and Courtaulds Fibres. These sources of pollution might well be linked to fish consumption advisories but no more than, say, the physical construction of the St. Lawrence Seaway and the associated destruction of wetlands. For whatever reasons, choices in priority problems could be made and were made in the RAPs.

More direct evidence on the activities of the RAP organizations comes from examining the policy outcomes of the process. The RAP coordinators surveyed for our study perceived that the RAP programme was reducing bacterial pollution and lowering point source discharges of toxins like PCBs, and improving beneficial uses in 12 of the AOCs surveyed. But the impact of the RAP program in its first decade was well summarized by one coordinator as follows:

Implementation is an ongoing process because we have existing programmes that came before the RAP process. The RAP process just coordinates the individually mandated existing programs that have been driving the environmental control programs.

In other words, the basic logic of the incentive structures underlying environmental and ecosystem management in the Great Lakes was largely unchanged by the RAP. There were,

however, exceptions to these conclusions, and an examination of them helps to clarify the ways that incentive systems can work.

5(b) Key Exceptions

The institutional arrangements for collective and operational choice of the RAPs were designed to be flexible to fit local situations. However, a consequence of this flexibility was, in some AOCs, an increase in the discretion afforded to local stakeholders involved in collective decision-making. Some policy consequences of the local arrangements turned out to be deficient and others successful at least at the planning as opposed to implementation phases of the program.

Examples of deficient policy consequences include both large and small AOCs. Port Hope on Lake Ontario, is a small harbour on the Canadian side that has one single use impairment, that of contaminated sediments (Hartig and Law, 164-166; Canadian-Ontario RAP Steering Committee, 58-60). Approximately 90,000 m³ of low level radioactive wastes (plus some heavy metals) exist in the turning basin and west slip areas due to the disposal of wastes from the refining and processing of uranium and radium during the 1930's and 1940's. A multi-stakeholder PAC (Public Advisory Committee) working as advisers to a RAP writing Team (a conventional model) helped establish a Stage 1 Report outlining goals, problems and options. The Stage 2 Report on implementation remains to be completed because the disposal options for the contaminated sediment is controlled by a different Canadian Government agency. This agency, Natural Resources Canada, has its own Siting Task Force and its own Community Liaison Group, to find an appropriate remediation option. This is a case where local environmental conditions (waste disposal siting) allied with an unambiguous legislative mandate given to the Atomic Energy Board (regulated through Natural Resources Canada), make the local RAP process peripheral to the restoration of the AOC. A key stakeholder was not included in the collective decision making, and this stakeholder is prepared to play a non-collaborative game to satisfy its monopoly position over nuclear waste disposal.

A small success case is Collingwood Harbour on Lake Huron which became delisted as an Area of Concern in 1994. Through sewage treatment plant optimization, dredging and capping of shipyard slips, and non-point source controls, the local contributions to improved beneficial uses were remediated. The Public Advisory Committee that formulated the RAP with a government writing team, still exists to promote and steer aspects of the RAP not directly linked to the use impairments. These include habitat enhancement, water conservation and public outreach programs (Hartig and Law, 80-83; Canada-Ontario RAP Steering Committee, 31-34). In this second case, local environmental conditions were amenable to an available set of solutions, unlike the Port Hope case. No stakeholder monopoly or opportunism on implementation could jeopardize a fairly rapid implementation (6 years from the Stage 1 start to the Stage 3 submission that led to delisting).

The two largest AOCs in the Great Lakes, measured in terms of population, are the Detroit River AOC and the Toronto AOC. Both are major failures. The discretion afforded to the designers of the respective RAPs allowed institutional arrangements to be constructed that demonstrated major weaknesses in both planning and implementation. In both cases it appears as if size amplified the deficiencies in institutional design.

The Detroit River has 9 impaired beneficial uses, and is subject to major toxic chemical

discharges and contamination plus a long history of degradation manifested in contaminated sediments and destroyed wetlands (IJC, 1991, 3-7). Upstream inputs, especially of PCBs, make some control efforts more difficult, and the existence of a successful Rouge River RAP that discharges into the Detroit River has skewed attention away from their international connecting channel. The magnitude of the pollution problem is manifested in the statistic that there are 14,300 commercial and industrial dischargers connected to the Detroit and Windsor sewage treatment plants, 13,000 of these on the Detroit side alone.

The institutional design was the responsibility of the Michigan Department of Natural Resources (MDNR), under an agreement with the EPA, and the Ontario and Canadian governments. This Department with 6 other agencies began the task of writing the Stage 1 in 1986, and chose to add 4 members of a Binational Public Advisory Council (BPAC) for advice. The BPAC consisted of 40 stakeholders, 20 from each side of the border, chosen by the MDNR. (The original Windsor participants were suggested by consultants for the Ontario Ministry of the Environment; later participants elected by the BPAC members). The Stage II RAP was developed through 4 technical work groups that contained both agency and BPAC members. The stakeholders involved in these processes included few property owners or representatives of the major sectors that could constitute partners for remediation or even clients for regulation. Efforts of the members of the BPAC to expand their roles, for example by prioritizing remediation strategies, were vetoed by the MDNR on the grounds that the role of the BPAC is advising as stated in its charge (Susan Bouzic, MDNR, Minutes of the 29th Meeting of the Detroit River Public Advisory Council, Windsor, August 26, 1992, p. 7, quoted in Strutt, 27). As of 1997, the Michigan Department has withdrawn from its lead agency role and it now considers the BPAC as the primary implementor, notwithstanding its flawed composition (IJC, 1997, 8). The remediation of the AOC itself thus rests on incremental efforts of stakeholders acting individually, a strategy that has proved insufficient in past decades. One government report suggests that only 5% of the Stage 2 RAP is completed (Krantzberg, 38).

The experience of the Toronto AOC is roughly comparable, although the extent of toxic contamination (in discharges and sediments) and the scale of loadings is substantially less than in the Detroit Connecting Channel. The Toronto AOC is essentially an administrative rather than a geographical unit, as it incorporates 6 watersheds and a population exceeding 4 million. As in the Detroit River case, the Toronto Stage 1 Report (Environmental Conditions and Problem Definition) was drafted by an intergovernmental writing team of agency personnel prior to the formation of a public advisory committee. The Ontario and Canadian environmental agencies, charged with institutional design, thus saw themselves as the control centre of this AOC. The Ontario Ministry of Environment formed 10 public advisory committees based on sectors and these committees selected members on a area-wide public advisory committee. At the same time the Federal Government went into competition with its own RAP by establishing a Royal Commission on the Future of the Toronto Waterfront, which later became a permanent Waterfront Regeneration Trust. It duplicated the planning activities of the RAP, but with significantly more resources and publicity. The sectoral committees gradually disintegrated, and while a draft Stage II Report was produced (on implementation strategies), the Ontario government vetoed both its implementation and its coordination. Like Detroit, the remediation thus rests on the incremental efforts of regulators and property owners. A recent report suggests that some 20% of the Toronto Stage II has been completed this way (Krantzberg, 53).

The lead agencies thus demonstrated considerable ignorance or indifference towards the institutional design for remediation. One PAC member could thus conclude (in 1994) that the bureaucracy by and large uses consultant processes as a means of adding or subtracting credibility from issues as they choose (cited in Gunther-Zimmermann, 229).

There are large scale AOCs that belie the proposition that size (and thus complexity) make institutional design inoperable. One is Hamilton Harbour on Lake Ontario. Another is the Cuyahoga River that flows into Lake Erie at Cleveland, Ohio. In the Hamilton case, a non-exclusive group of 50 stakeholders formulated the goals for a Stage I by March 1988 and a government-agency writing team organized itself as technical support for the local endeavours. In most AOCs, the lead government agencies picked its favourite stakeholders and wrote its Stage I Report prior to organizing the stakeholders into a decision making forum. Hamilton reversed this process, a policy that the Ontario Government quickly reversed in other areas when it realized that the stakeholder group could choose solutions antithetical to the interests of the Ontario Ministry of the Environment. The Stage 2 Report was completed (in draft) in 1992, and by way of institutional design, it set up two bodies to oversee implementation by designated responsible organizations. One was a Bay Area Implementation Team of the 14 major implementing organizations. The other was a Bay Area Restoration Council that would produce annual audits of progress toward implementation. Efforts of stakeholders to make the RAP a legal document (and hence subject to writs of injunctive relief to stakeholders) were vetoed by the Ontario government as diminishing their powers. The implementation, as opposed to the planning stages, has demonstrated some of the positive and negative consequences of institutional design that rests on consensus rules, as we still see below. The ecosystem conditions in the Harbour (10 impaired uses, and large scale contaminant pollution from point sources and sediments) also contributed to implementation difficulties.

The Cuyahoga River RAP paralleled the Hamilton Harbour case. The Ohio Environmental Protection Agency designed a Coordinating Committee (CCC) of 35 stakeholders drawn from multiple interests and sectors and gave it express authority to develop a Stage I Plan. The Stage I was completed in 1992 and a draft Stage 2 is being completed. The River drains an agricultural and urban watershed of 1.6 million people, and achieved notoriety in 1967 when it caught on fire. It has some 10 impaired uses (like Hamilton), so its ecosystem difficulties are many, ranging from conventional problems like low dissolved oxygen levels in the water to contaminated sediments from urban runoff (especially PCBs) and rural nonpoint sources (especially pesticides). The implementation report, Stage 2, again involves stakeholder committees working with technical support staff from government agencies. A Cuyahoga River Community Planning organization, funded by three local private foundations, develops programs for public involvement, education and research roughly comparable to the Hamilton Bay Area Restoration Council.

All of these cases suggest that (1) state/provincial and federal environmental agencies in both countries responded to the requirements of institutional design in different ways; that (2) size per se was not a factor in the relative successes of any one AOC; that (3) size was, however, often correlated with more extensive ecosystem impairments that make implementation more difficult; that (4) success was correlated with the active involvement of stakeholders in formulating the RAPs and overseeing its implementation; and that (5) conversely, failure was associated with the

indifference or hostility of environmental agencies with institutional design and/or stakeholder governance.

5(c) Rules for Decision Making

At the level of constitutional choice for establishing collective governance systems for AOCs, we have noted that the IJC allows the respective Federal and state/provincial environment agencies to define the rules for the articulation and aggregation of stakeholder interests and for the implementation of a RAP. The discretion so afforded is wide, and a prevailing pattern of business as usual pervades the planning and implementation of RAPs. Our previous section also noted that exceptions to this system can and do exist.

At an institutional level, state/provincial and/or federal environmental agencies frequently selected and approved stakeholders to participate at the planning stages (RAP Stages 1 and 2). A skewed representation of interests occurred in many AOCs. Our surveys suggest that stakeholder committees systematically included federal, state/provincial municipal representatives plus representatives of industry, policy groups, environmental groups, universities and citizens at large. Of the major users, recreational and shipping interests were frequently not included, and aboriginals were included in only one of our AOCs. (A second case, that of the St. Lawrence, originally included representatives of the Mohawk Governments of Akwesasne, but they withdrew from both the New York and Ontario RAPs largely on the grounds they were not treated as a co-equal government. Because of the constitutional choices exercised by New York State, separate RAPs were devised for both sides of the St. Lawrence and Niagara Rivers). Hamilton was an exceptional case, as we saw. The stakeholders were organized as a group prior to the formation of the Stage 1 Report. Its successful structure was considered to be an accident by the constitutional designers in Ontario, and not repeated elsewhere.

Some 59% of the AOCs made decisions largely by unanimous consent amongst the selected stakeholder advisory group and associated agency representatives. Conversely, disagreements were resolved by plurality or majority voting rules in two-fifths of the AOCs. These decision rules had positive and negative consequences. At the planning stages, the unanimous consent rules gave stakeholders that were included in the decision forums the powers to articulate and press their views to the point of adoption in the Plan. There was a consequent incentive and search for planned solutions that could satisfy all represented users. The process thus approximated a level of economic optimality for multiple use resource situations; the values of the various user interests were balanced by the process. While some opportunistic behaviour is encouraged by consensus decision making (as the price of cooperation) there were options, often high cost spending options, that could be suggested as points of agreement amongst all parties. In the Hamilton Harbour case, for example, some environmental groups objected to piping sewage treatment plant effluent directly into Lake Ontario rather than into the (confined) Harbour itself. The search for a solution then involved technological upgrades to the sewage treatment plants to reduce the loadings of conventional pollutants and avoid the option of Lake assimilation.

At the implementation stage, however, the use of consensus rules amplified the incentives for opportunism amongst parties charged with regulating uses or delivering environmental goods. There could be major costs associated with implementation projects or not. In the Menominee case,

for example, the Chamber of Commerce was able to secure (in 1995 and 1996) the permits for dredging of part of the navigational channel and disposal of these wastes in the Michigan waters of Green Bay. It obtained funding from the City of Menominee (rather than the Army Corps of Engineers) and avoided the open waters dredging disposal regulations of the State of Wisconsin (Michigan has none). The RAP Stage 1 objective to remediate sediment contamination was overlooked. (The Chair of the Citizens Advisory Committee of the RAP was, incidentally, the President of the Chamber of Commerce at that time).

A second example from Hamilton involves the continual delivery of a project by implementors rather than successful renegotiation around the objectives of the RAP. This case involves the removal of 30,000 cubic metres of contaminated sediments (coal tar; PAHs) near the docks of a steel company (Stelco Inc.) Environment Canada proposed a 4 party partnership of Stelco, Ontario Ministry of the Environment, the Hamilton Harbour Commissioners and themselves with some negotiable financing formula. It advanced a variety of technical and financial plans, including an environmental assessment, to which the steel company has continuously objected. Presumably the steel company wishes to avoid any hint of legal liability for contamination of the sediments. After 4 years of continual negotiations, involving the failed interventions of two Ministers (Canada and Ontario) and the Bay Area Restoration Council, the steel company is sustaining its veto. Environment Canada even agreed to replace their steering (negotiating) committee at Stelco's request. All of the public financing of the project (estimated at 90% of the total) is already in place.

The rules for both planning and implementation thus create incentives which, in the planning stages, are generally efficiency-inducing but, at the implementing stages, are inversely inefficiency-inducing. These conclusions rest, of course, on the inclusion of the full range of stakeholder interests in the decision making arenas. That is an issue, as we have seen, at the constitutional level. It was frequently not the chosen strategy of the constitutional designers, the lead environmental agencies.

6. Conclusion

The governance of common pools involves institutional arrangements or rules. In the natural resources situations, societies have developed customary rules, common law and statutory rules, encapsulated in the term "property rights", to ensure a fair and sustainable way to access, use and withdraw from the resource (exploit it). All rules will need to adapt, however, to meet new situations, physical, biological and social. So property rights and other so-called operational rules of conduct are made subject to wider societal processes for adaptation. The wider societal processes involve collective choice rules within which stakeholders, possessing varying bundles of property rights, will articulate and aggregate their interests. Decisions will emanate in the forms of revised operational rules and other outcomes. The dynamic character of common pools and ecosystems reflects and is reflected by the many structures of collective choice rules. The Remedial Action Plans for the 43 Areas of Concern on the Great Lakes are an experiment, in essence, in collective choices.

The collective decision making forums for articulating, aggregating and implementing the collective choices of multiple stakeholders were designed by one or both environmental

departments in each of the two countries. The International Joint Commission permitted a wide variety of designs. The departments were, in turn, either indifferent to or ignorant of the requirements of balancing stakeholder interests in inclusive and open collective choice forums. They preferred to establish forums that reflected their own bureaucratic mandates, although the scope of their discretion at this *constitutional level* was wide enough to permit the adoption of different models for the planning and implementation of RAPs. A skewed distribution of stakeholder interests often ensued.

The decision rules used in the public forums for planning and implementation were mostly based on unanimous consent (or consensual). These rules were largely appropriate for the articulation and aggregation of stakeholder interests at the planning stages. However, they created an opportunity for opportunism at the implementation stages. These dysfunctional strategies occurred in AOCs even when the focuses were constructed on a basis inclusive of all stakeholder interests.

The outcomes of this experience appear to be twofold. First, incremental change under the normal configuration of stakeholder regulations and policies continue. It is *business as usual* despite the RAP process. There are exceptions, however, where the RAP process is succeeding due to careful institutional design. Second, the restoration of the Great Lakes and its ecosystems remains elusive and uncertain.

On a theoretical level, the experience of 43 Areas of Concern suggest that constitutional and institutional design is a major factor in ecosystem restoration, but one to which many government agencies are indifferent, ignorant or simply exploitative. Many models of collective choice that were fashioned on the Great Lakes were inadequate to deal with multiple stakeholders and the adaptation of their property rights to new situations. It is to be hoped that both scholars and practitioners can learn from this experiment.

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