SCHOOL OF LAW
CASE WESTERN RESERVE UNIVERSITY

Canada-United States Law Journal

Volume 28 | Issue

Article 48

January 2002

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GOVERNING HUMAN INTERACTIONS WITH MIGRATORY ANIMALS, WITH A FOCUS ON HUMANS INTERACTING WITH FISH IN LAKE ERIE: THEN, NOW, AND IN THE FUTURE

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I. INTRODUCTION

We submitted this paper in response to Henry King's novel and difficult request for a perspective relevant to the interest of experts in law on the legal aspects of managing migratory species that wander across jurisdictional boundaries. Each jurisdiction has a management agency with responsibilities for "optimizing" the interactions between migratory species and humans. Each of the relevant management agencies is unique, as each agency must contend with a unique mix of groups of people with a number of direct or indirect interests in a unique mix of stocks or populations of migratory species. Here, we discuss what we infer to be key features in this conceptual complexity from a broad legal perspective. We focus mostly on migratory creatures in the Great Lakes/St. Lawrence River Basin and take an *ecosystem approach.* For us, this approach requires that we employ a number of compatible perspectives on the complex issue of how the population(s) of migratory species and humans with different interests in these species interact and how that interaction might be changed through human management processes. An ecosystem approach to migratory animals in an explicit sense began to emerge in this part of the world around 1968; we use

our current understanding of that approach to review what has gone before in recent centuries and to predict what will follow the present.

In order to sketch a broad perspective within which to address one general kind of migratory animal – migratory fish – we will look at three kinds of migratory animals. We will then quickly focus on the migratory fish of the Lake Erie Basin for empirical content in order to contain the scale and complexity of this essay.

This paper traces the biological and policy aspects of migratory species. We attempt to make clear that "management" of such species presents multitudinous challenges owing especially to the scale of species' migration. In sum, migrations often encompass a number of political jurisdictions and coordinated management is rare to non-existent. Hence, we make a call for new approaches and sketch out some possibilities.

We explain, and, we hope, clarify, certain key underpinning scientific concepts. Seeing clearly and understanding the environmental issues that have brought the Lake Erie Basin (as an example of many such areas) to its current condition requires knowledge from a number of domains, including biology, ecology, and politics. This important knowledge holds keys for conceiving potentially effective plans and policy directions as well as implementing them.

Currently, governance regimes concerning fish in the Great Lakes are in flux. In the past, the main emphasis in the governance of human activities related to fish species in the Great Lakes Basin has been on the "middle level" of organization through command-and-control regulatory structures. Unwanted booms and busts of fish populations have nevertheless occurred, so we consider two complementary approaches that appear to us to have been emerging in recent decades. One approach starts from a bottom or lower level of governance organization and reaches upward to interconnect with a middle level now modified to place less emphasis on command-and-control capabilities. The other approach starts from a higher level and reaches downward to the middle and through it to a local level. We will explore this three-level interactive approach to the governance of human interactions with migratory species. Imaginatively, we will focus on the applicability and usefulness of such an approach for the management of Lake Erie migratory fish stocks, in the past, present and future.

Five ecological perspectives are commonly, if implicitly, invoked by contemporary managers:

1. life history and population dynamics of each of the more valued stocks of the more valued species;
2. trophodynamic or predator-prey interactions of different species of fish and other kinds of organisms;
3. risk of extinction of a particular stock;

4. use of mass-production fish hatcheries in attempts to compensate for insufficient reproductive success of a valued stock; and
5. self-maintaining ecosystem integrity.

A complementary set of five ecological perspectives appears to us to be under consideration, perhaps only implicitly, by strategic thinkers among the researchers, managers and administrators in the Basin:

1. ecosystem dynamics in which major self-organized associations of species may vie for dominance in the overall ecosystem, as with a benthic association linked to the bottom of a lake or large river and a pelagic association linked to offshore surface waters;
2. the temperature preferences of different species, which appear to be 'hard-wired' genetically, as related to seasonal spatio-temporal features of the habitat;
3. the migratory propensities of different species, which may be based on some 'hard-wired' behavioral features related to critical habitat requirements of some life history stages;
4. reconstruction or rehabilitation of critical habitats needed for spawning and nursery purposes and clearing of obstacles from a migratory route to such habitats; and
5. general habitat features that permit the self-organization of preferred associations of fish species as such.

The different legal aspects of the agencies responsible for managing migratory species are based in part on a set of ecological perspectives that before now have implicitly emphasized the first set of perspectives sketched above. In this paper, we will explore legal perspectives that may link to the latter set of five.

II. WANDERING BEINGS AS UTILITARIAN, RECREATIONAL, ESTHETIC OR SACRED THINGS

Many living things are not sedentary throughout all stages of their lives. Many land plants are sedentary in an adult stage but have wind-blown or animal-borne seeds, each of which is a young stage of that living thing. Many animals are active in a more purposeful way, seeking out desirable habitat and food that may be found in different locales in different seasons of the year. Comparably, water currents carry many plants and water-borne organisms such as plankton over large distances.

Different humans may attach different kinds of importance to particular living things. Some beings may be useful or harmful in a purely utilitarian sense; those values may be approximately quantified in monetary units.

Other beings may be of interest to sport recreationists; in that case, the value of those beings may be approximated by determining, for example, the number of days of angler pleasure derived from the presence of fish. Some may be aesthetically attractive or offensive; in this case, any quantification may be suspect. Still other beings may be valued in their own right as evolutionary creations or as sacred in a spiritual way, and here attempts at quantification may be dismissed as sacrilegious. Formal quantification may be performed in an attempt to limit the need for subjective decisions by decisionmakers, but this may involve prior burial of the subjectivity within the presuppositions on which the quantifier bases the quantification algorithm, perhaps to the distress of particular stakeholders who may feel that their values have been implicitly slighted. Thus, quantification, in and of itself, does not resolve the subjectivity issue unless all the stakeholders have concurred in an informal way with all the particulars of the assumptions that go into the formulation of the quantification algorithm. While some species may be useful, recreational, esthetic and sacred, there are perhaps million of other species that may never have attracted human attention at all. Also, some species once cherished in one environmental context may be despised as pests in another.

"Useful Beings:" Waterfowl, Fish, and Ungulate Mammals

For migratory birds like waterfowl (geese, ducks, swans, etc.), vast flyways fanning out to the North are commonly used as the relevant aerial domain for crossjurisdictional joint management.[1] Within these flyways the shallow waters and wetlands are particularly desirable habitats for waterfowl. With some waterfowl, the shallows of Lake Erie may serve as a marshalling place in the spring and fall migrations between wintering areas to the South and summering areas to the North.[2] The shallows also serve as reproductive and summering areas for some southerly species and as feeding and wintering areas for some northerly species of waterfowl. An important point: Lake Erie and its Basin do not offer year-round habitat for most individuals of any species of waterfowl. So, one of the implications for waterfowl

[1] In the Convention for the Protection of Migratory Birds, Aug. 16, 1916, U.S.-G.B (for Canada), 39 Stat. 1702, the parties recognize that "[m]any species of birds in the course of their annual migration traverse certain parts of the United States and the Dominion of Canada;" the Convention implies that the relevant domain of management of these species covers the entirety of the jurisdictional boundaries of both countries. *See also* NORTH AMERICAN WATERFOWL MANAGEMENT PLAN, 1998 UPDATE: EXPANDING THE VISION 37 (1998), *available at* http://www.nawmp.ca/pdf/update-e.pdf.

[2] *See, e.g., Birdwatching: Become a Lake Erie Wingwatcher!*, at http://www.sandusky.net/recreation/bird.html (last visited May 28, 2002).

managers of our Basin is that local and regional waterfowl managers have to fit into a larger spatial and temporal management domain.

For fish (sturgeon, lake trout, walleye), we focus on a notion of the Lake Erie Basin as a special context for some management purposes. A Basin like this is usually demarcated in part by the height of land, where a falling raindrop has equal probability of flowing toward Lake Erie or to a different water body in a contiguous Basin. There seems to be no convention in place concerning where to draw this Basin's boundary line in the in-flowing Detroit River or even further upstream; the out-flowing Niagara River has Niagara Falls as a convenient natural demarcation that may be deceptively distinct. Some stocks of Lake Erie's lake whitefish and sturgeon migrate into the Detroit River to spawn.[3] One or more walleye stocks migrate up the Detroit River, eastward along the south shore of Lake St. Clair and up the Thames River to spawn.[4] Some of the young of blue pike, which is now extinct, were apparently washed over the Falls into Lake Ontario; perhaps some adult blue pike swam up the Welland Canal to spawn in Lake Erie.[5] So from a perspective of the wandering fish of Lake Erie, the upstream and downstream boundaries of the relevant domain cannot be demarcated precisely on a map.

Unfortunately, while political jurisdictions usually have sharply demarcated spatial boundaries, sharp ecological boundaries are the exception. Even still, it would serve jurisdiction-based legal experts well if particular migratory species could be described as relating to clearly quantified spatial boundaries of *some* type. For example, a migratory species may congregate seasonally in quite restricted locales, say for reproduction or for staging a migration event, and then wander widely between such events.

For wandering mammals (e.g., deer, moose) in the Basin of some centuries ago, the seasonal habitats and wanderings related to particular features of the terrestrial, stream, beaver meadows and wetland parts of the ecosystems. Unlike bison, the deer and moose did not migrate long distances. Indeed, along parts of the south shore of Lake Erie, the tributaries are short so that individual moose and deer that once lived there may well have wandered back and forth across the height of land that separates the Great Lakes Basin from the Ohio River Basin, and occasionally over the ice across Lake Erie.

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[3] *See* J.J. Kay & H.A. Regier, *An Ecosystemic Two-Phase Attractor Approach to Lake Erie's Ecology*, *in* STATE OF LAKE ERIE: PAST, PRESENT AND FUTURE 511, 523 (M. Munawar et al. eds., 1999).

[4] *See id.*

[5] The blue pike is believed to have reproduced only in Lake Erie. *See* STANFORD H. SMITH, EARLY CHANGES IN THE FISH COMMUNITY OF LAKE ONTARIO 4 (Great Lakes Fishery Comm'n, Technical Rep. No. 60, 1995), *available at* http://www.glfc.org/pubs/TechReports/Tr60.pdf.

The Challenges of "Managing" Migrating Species

The necessary scale of the "spatial management unit" is very different for these three types of wandering animals as they relate to Lake Erie and beyond. For mammals such as deer and moose, a minimum scale might be 5,000 square miles. For fish, the scale might be 50,000 square miles; for birds, perhaps 500,000 square miles. Thus, the intra- and inter-jurisdictional decision-making process takes on a different form for the different kinds of animals. The larger the scope of the spatial management unit, the more private property owners, local communitarian stewards and jurisdictional administrators need to be involved in the decision-making and enforcement process. Consequentially, the higher the levels of government that become involved in the process, the more formal the decision-making process becomes. In this respect the fish of Lake Erie are "managed" in an inter-jurisdictional way that is intermediate between the management organizations in place for waterfowl and mammals. These animals may all interact ecologically within a locale of the Basin, say, in the waters and wetlands of a shallow bay, and individual humans may relate to all three kinds in a complicated way, but the management processes have been separate in practice.

There have always been some humans with particular interests in certain species who have migrated seasonally to come into contact, or to stay in contact, with that species. Aboriginals still retain some of this migratory behavior, often leaving their reserves to harvest duck, deer and walleye in nearby lands and waters in which they enjoy treaty-based usufructuary rights or privileges.[6] Commercial fowlers, hunters and fishers continue to practice some migratory behavior in the Lake Erie Basin and elsewhere. Recreationists migrate to locales in which their preferred species is accessible to viewing or capture, or perhaps even as a trophy for which to compete amongst themselves in a fish derby. Spiritual naturalists may make pilgrimages to particular sacred locales. Each of these kinds of human migratory behavior has its own particular learned choreography, and the whole set can become quite complex, especially for a manager who attempts to keep these different classes of human migrators spatially and temporally separated from one another in order to minimize conflict between them. Arranging for such human migratory activities and then administering them in detail is one of the primary responsibilities of a conventional fish or wildlife management agency.

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[6] *See, e.g.*, Treaty with the Ottawa, Ect., March 28, 1836, U.S.-Ottawa/Chippewa Nations, 7 Stat. 491, *available at* http://www.lib.cmich.edu/clarke/washington1836.htm (last visited May 22, 2002) [hereinafter Treaty of 1836]; U.S. v. Michigan, No. M-26-73 (W.D. Mich. filed Jun. 11, 1985) (consent decree).

With respect to concerted efforts toward sharing, enjoying, protecting and revering valued wandering and migratory animals like those mentioned above, each species may require a specific protocol based on an understanding of the spatio-temporal features of that species' life history. The protocol should make sense at a number of different levels of organization within the governance system: the individual property owner, the municipality, the state or province, the nation state, the continent and beyond.

As a historic generalization, the relative difficulty of "managing" different kinds of interaction between humans and valued creatures is in the order, high to low, as follows: commercial harvester, recreational hunter/fisher/fowler, naturalist enjoyer, and spiritual communer. Unless the most difficult of these political and/or socioeconomic management challenges (relating to commercial harvesting) is done effectively and sufficiently, humans with the other three kinds of interests may be cheated of their rights by those who are more difficult to manage. Perhaps the particular difficulty with commercial fishers relates to the politically privileged position enjoyed by entrepreneurs; the aquacultural entrepreneurs may now be challenging the commercial capture fishers for the most privileged position.

However, other interests and parties have already preempted the rights enjoyed by commercial harvesters. The destructive and polluting activities of foresters, farmers, builders, industrialists, shippers and developers on land and in the water, and over which natural resources managers typically have little control and knowledge, have often destroyed the essential and scarce habitat of these valued migratory beings.

In prior years, the main approach to "managing" commercial and recreational harvesters of a particular valued fish species has been to constrain the harvesting process by forcing fishers to use progressively less efficient capture techniques and/or to restrict fishing to seasonal periods and to habitat locales when and where the organisms are not particularly vulnerable to capture,[7] thereby limiting mortality. The standard response of the harvesters has been to improve the efficiency of those techniques that are still legally permitted or to invent new techniques. The management response has been to outlaw some of these new efficiencies and/or inventions, and the spiral has continued. Gradually, starting with commercial harvesters and then extending to recreational harvesters, the size of harvest permitted a particular harvester has been progressively limited, and then the number of licensed harvesters has been capped or reduced. In some

[7] *See, e.g.*, Fisheries Act, s.8, 1868 S.C. (31 Vict.) 177, 180 (closed season for lake and river trout), s.9, 1868 S.C. at 181 (closed seasons for whitefish). *See also* MARGARET BEATTIE BOGUE, FISHING THE GREAT LAKES: AN ENVIRONMENTAL HISTORY, 1783-1933 187-190 (2000).

instances, a kind of market mechanism was used to allocate "individual transferable quotas" (ITQs) among fishers and recover a "resource rent" to the state as the "owner" of the resource. Small spatial refuges for a particular season may have been extended to a larger year-round refuge. Or, commercial harvesting in certain regions may have been phased out entirely. Overall, the current trend in the management of Lake Erie fisheries is a pragmatic mix of most of these strategies. With respect to fish, the recreational harvesters are currently politically dominant, while the commercial fishers, naturalist enjoyers and any spiritual communers are sub-dominant.

III. ECOSYSTEMIC PERSPECTIVE ON MIGRATORY FISH IN LAKE ERIE

Most of the native fish species in Lake Erie once had relatively predictable migratory behaviour related to seasonal meteorological and hydrological patterns in the lake's Basin. The space-time migratory paths of different species were not random with respect to each other, but exhibited a degree of inter-species choreography. The choreographed regularities accommodated both antagonistic and mutualistic propensities of particular stocks. One of the consequences of two centuries of careless abuse of this ecosystem by European settlers and their descendants was a loss of much of the complex earlier patterns and regularities by the 1950s. Migratory patterns that bear some resemblance to earlier patterns and some newer patterns may be currently self-organizing,[8] as we sketch below.

The complex migratory patterns of fish in the year A.D.1600 or B.P. 400 was, for example, a product of creative evolution that occurred during the past million years or more in what is now the Great Lakes/St. Lawrence River Basin (GL/SLRB) and in what are now the headwaters of river basins to the south and west of the GL/SLRB. During this long period, wandering rivers were a more constant feature of this landscape than were stationary lakes. As a glacier advanced southward it filled the lakes with ice and scoured out the lake bottom; the resident fish had to adapt to the smaller lakes that formed at the southern face of the glaciers and to the rivers that flowed southward from the edge of the glacier. As a glacier melted and the lakes became free of ice, the fish re-invaded the lakes (this occurred a number of times in recent geological history).[9] During this period, some kind

[8] *See* J.J. Kay & H.A. Regier, *supra* note 3, at 527 (M. Munawar et al. eds., 1999).

[9] *See* WILBUR HARTMAN, EFFECTS OF EXPLOITATION, ENVIRONMENTAL CHANGES, AND NEW SPECIES ON THE FISH HABITATS AND RESOURCES OF LAKE ERIE 3 (Great Lakes Fishery Comm'n Technical Rep. No. 22, 1973), *available at* http://www.glfc.org/pubs/TechReports/Tr22.pdf.

of an association of fish species that included most of those now present in Lake Erie must have continued as an association that migrated southwards and then northward again at irregular intervals.

During this million-year span, rivers dominated over lakes as habitat for predecessors of fish now in the Basin. So the species that thrived in Lake Erie four centuries ago were mostly *obligative riverine* for some critical life history stages and *facultative lacustrine* for more tolerant stages. The relatively rare spawning and nursery areas were usually in the more riverine parts, whereas relatively abundant feeding and resting areas for sub-adults and adults were more typically in the lacustrine portions.

One cannot just glance at a geographic/hydrographic map of the Lake Erie Basin and identify what are here termed the riverine and lacustrine parts of the aquatic ecosystem. The key feature that makes a part of an aquatic ecosystem riverine is the presence of strong horizontal water currents; conversely, a part is lacustrine in the absence of those currents.

All parts of this aquatic ecosystem also have vertical currents. In riverine parts these may be called turbulences; they peak in the main channel during spates and floods. In lacustrine parts, vertical currents are strongest when the water is all the same temperature from top to bottom and the whole mass is stirred by strong winds. In Lake Erie, vertical currents tend to peak seasonally during the equinoctial storms of spring and fall when all the water is isothermal.[10] These events challenge the survival capabilities of fish, which usually seek out some less violent parts of the ecosystem at such times. But these events also scrub spawning gravels and rocks clean and inundate flood plains and wetlands; both events are very important for the successful spawning and nursery purposes of a variety of fish species.

In the Lake Erie Basin, the in-flowing Detroit River, the numerous tributaries draining the watershed and the out-flowing Niagara River are all riverine in nature; all of these are two-sided rivers. But there are also strong, relatively persistent currents along many stretches of shoreline due to a number of factors, such as gravity pulling water down slope from Detroit to Buffalo, wind blowing mostly from the western half of the compass, and the effect of the earth's rotation or Coriolis force. Where such strong currents flow laterally along shore quite persistently, a riverine form of local ecosystem self-organizes, as akin to a one-sided river.

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[10] *See* Henry A. Regier & James J. Kay, *An Heuristic Model of Transformations of the Aquatic Ecosystems of the Great Lakes-St. Lawrence River Basin*, 8 J. AQUATIC ECOSYSTEM HEALTH 3, 6 (1996), *available at* http://www.fes.uwaterloo.ca/u/jjkay/pubs/rk/reg.html. The term "isothermal" means "of, relating to, or marked by equality of temperature." WEBSTER'S NEW COLLEGIATE DICTIONARY 609 (1979) [hereinafter WEBSTER'S].

Parts of the lake that do not experience relatively persistent strong lateral currents have a lacustrine kind of ecological organization. Such parts include the offshore waters of the Central and Eastern Basin.

The Western Basin of Lake Erie is a complex mosaic of riverine and lacustrine associations of species. Where an island or a reef acts as a partial dam for the water flowing eastward from the Detroit, Rouge, Raisin and Maumee Rivers, the rate of water flow increases over and around such partial barriers, and provides opportunity for a riverine association of organisms to settle down and thrive.

In addition to the riverine and lacustrine kinds of aquatic ecosystem, a third major ecosystem type in the region is the coastal wetlands. In Lake Erie, these were largely located at the mouths of the larger steams, and were thus a more localized version of estuary than the whole Western Basin. Because of seasonal meteorological phenomena, the flow of tributaries increases in spring and water levels in rivers and the lake rise to flood the coastal wetlands. Such flooding events provide temporary spawning and nursery habitats for some migratory species of fish (*i.e.*, the northern pike and muskellunge), at least if the floodwaters are allowed to drain away gradually as was once the case.

IV. CATEGORICAL TAXONOMIC DISTINCTIVES VERSUS FUNCTIONAL INTERRELATEDNESS

In "Nature," we perceive no such things as a straight line, a discrete boundary, an impenetrable barrier, an enclosed volume, a pure substance, or a persistent complex of propensities. This may also be true with respect to "Culture." Any scientific approach, formal convention or legalism that presupposes the existence of such abstractions will run into difficulties, both sooner *and* later.

In the 1730s Carl von Linné of Sweden formulated a nested schema of plant taxonomy[11] that was subsequently extended to animals and other kinds of organisms. His approach was extremely categorical, starting with an assumption that any individual living being is a member of a *species* that, in turn, was invested with a unique essence due to the direct agency of a Creator.[12] In the 1850s, the empirical work of Charles Darwin of England undercut the notion of a permanent unique essence as a categorical

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[11] *See Carl Linnaeus*, *at* http://www.ucmp.berkeley.edu/history/linnaeus.html:
Carl Linnaeus, also known as Carl von Linné or Carolus Linnaeus, is often called the Father of Taxonomy. His system for naming, ranking, and classifying organisms is still in wide use today (with many changes). His ideas on classification have influenced generations of biologists during and after his own lifetime, even those opposed to the philosophical and theological roots of his work.

[12] *See id.*

characteristic of a living thing,[13] but some other features of the Linnean taxonomic conventions survived for more than a century after Darwin's shift from a categorical creational to a functional evolutionary perspective in science.[14] Evolutionists are now searching for an alternative scientific notion to that of *species* and other designations of the nested Linnean taxonomic schema such as *genus, sub-family,* and *family.*[15]

With respect to Great Lakes fish, and especially those of the Lake Erie Basin, taxonomists have never been able to agree fully on how to classify all the individual fish into uniquely different *species.* Early efforts of classification relied on anatomical features of adult fish,[16] only to be followed later by physiological, ecological, behavioral, developmental, genetic and genomic criteria.[17] All of this was based on a working definition of a species as a population of interbreeding individuals that was genetically isolated to a certain extent from other populations of interbreeding individuals.[18] No matter how complex the set of classificational criteria became, unique objective identification that was satisfactory to all the relevant scientific experts of the species to which some organisms were members has proven to be unachievable for a few species flocks in the Lake Erie Basin.[19]

Taxonomic Distinctiveness in Lake Erie Fish

The fish of Lake Erie can be separated into different piscine families, all of which have names that end with the suffix *–idae*; their respective sub-families have names that end with *–inae.*[20] For example, the *Salmonidae* or

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[13] *See generally* CHARLES DARWIN, ON THE ORIGIN OF SPECIES BY NATURAL SELECTION, OR THE PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE, *available at* http://www.literature.org/authors/darwin-charles/the-origin-of-species/ (last visited May 21, 2002).

[14] *See Carl Linnaeus*, *supra* note 11.

[15] *See, e.g.*, PHILIP D. CANTINO AND KEVIN DE QUEIROZ, PHYLOCODE: A PHYLOGENETIC CODE OF BIOLOGICAL NOMENCLATURE 3, *available at* http://www.ohiou.edu/phylocode/PhyloCode.pdf.

[16] *See, e.g.*, Frank Magallanes, *History of Ichthyology*, *at* http://www.angelfire.com/biz/piranha038/taxon.html (last visited May 30, 2002).

[17] *See Taxonomy: The Study of Classification*, *at* http://www.learn.co.uk/default.asp?WCI=Unit&WCU=2808 (last visited Jun. 7, 2002).

[18] Note the definition of "species" in WEBSTER'S, *supra* note 10, at 1108: "A category of biological classification . . . comprising [of] related organisms or populations potentially capable of interbreeding."

[19] *See, e.g.*, DARWIN, *supra* note 13 ("No one definition [of the term "species"] has as yet satisfied all naturalists; yet every naturalist knows vaguely what he means when he speaks of a species.").

[20] The terms *stock*, *species*, *genus*, *sub-family*, and *family* are all used here in the way that they have been used in recent decades in Lake Erie. If some quite different convention comes

salmonid family has two sub-families in the Lake Erie Basin, *Salmoninae* and *Coregoninae*:

- *Salmoninae* has two native *chars* (lake trout and brook or speckled trout), an exotic *trout* (brown trout) and several exotic *salmon* (rainbow trout or steelhead, coho and chinook salmon). In the Lake Erie Basin the native chars occur as stocks, each with particular habitat preferences and external features, especially at spawning time. Such stocks were recognized as different by informed fishers since time immemorial. For example, a Dr. T. Garlach built a hatchery in Cleveland in the 1850s to rear and sell a particular breed of "prize brook trout."[21]
- *Coregoninae* has a cluster or swarm of types that includes lake whitefish, lake herring, cisco or chubs, and round whitefish. Their commercial value has always differed markedly, with the relative consumer preference being roughly in the above order. In contrast, round whitefish may have been tossed back in the water until recent decades, when they were sold to pet food manufacturers.[22]

Interbreeding can occur naturally, or can be induced artificially, *among* some species of *Salmoninae* and *Coregoninae*, but not *between* those two sub-families. Such interbreeding may have been fostered by the ecological consequences of intense fisheries; we speculate that fixed gear that intercepted a spawning run captured some fish and delayed others, so that the surviving spawners of a particular stock may not have arrived on an ancestral spawning site at the appointed time and may have spawned with another stock that arrived later through a kind of behavioral capture process that has been termed "shoal trapping." Also, intense modifications of fish habitat may have fouled a particular ancestral spawning site, and its spawners may then have wandered to other sites and mingled with the spawners there.[23] The *reproductive isolation* between different *stocks* of a *species* was the first

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to displace that modified Linnean convention, as now seems likely, then the text above will need to be translated into that new perspective.

[21] *See* HENRY REGIER ET AL., THE ECOLOGY AND MANAGEMENT OF THE WALLEYE IN WESTERN LAKE ERIE 31 (Great Lakes Fishery Comm'n, Technical Rep. No. 15, 1969), *available at* http://www.glfc.org/pubs/TechReports/Tr15.pdf.

[22] Round whitefish have virtually no commercial value unless more desirable fish are scarce. *See* LARUE WELLS & ALBERTON L. MCLAIN, LAKE MICHIGAN: MAN'S EFFECT ON NATIVE FISH STOCKS AND OTHER BIOTA 44-46 (Great Lakes Fishery Comm'n, Technical Rep't No. 20, 1973).

[23] *See* REGIER, *supra* note 21, at 68-69.

to be seriously impaired, as was observed in Lake Erie in the 19th Century.[24] Then the reproductive isolation between species within particular *genera* within *sub-families* was reduced. In extreme cases, the reproductive isolation between genera within sub-families may even be completely disintegrated. Ecologists expect that overall reproductive success will continue to diminish as reproductive isolation is broached; interbreeding between stocks within a species may lead to some impairment of reproductive success, but the impairment will be less than when different species interbreed.[25]

What has been said above has a parallel in the *Percidae* or percid family. In Lake Erie, the many different percid species, each presumably with a number of stocks, are separated into three generic types: (1) the yellow walleye, grey sauger and blue pike or yellow, grey and blue pike-perches; (2) the yellow perch; and (3) a complex of numerous darters and darter-like species.

Taxonomic complexities, like those with the *Salmonidae* and *Percidae*, also appear in the *Catostomidae* or suckers and red horses; the *Cyprinidae* or carps and minnows; the *Esocidae* or pike and muskies; and the *Centrarchidae* or black bass and sunfish family. Other families, as they manifest themselves in Lake Erie, appear to be less complex: *Acipenseridae* or sturgeons; and *Ictaluridae* or catfish and bullheads.

We note in retrospect that attempts to manage the fisheries of Lake Erie, or anywhere in the Great Lakes Basin, have always been faced with the intractable problem of identifying the relevant natural and cultural differences within the fish association. The commercial and recreational markets both distinguished between qualities of fish at the species level, and sometimes even at the stock level within species.

Attempts to Manage Distinctiveness

The common, if implicit, management ideal was to try to distinguish these creatures at the level of a reproductively-isolated stock and manage each stock in an appropriately sustainable way. Thus, an implicit or explicit emphasis was on

- ensuring access by a stock to its historic spawning habitat;
- protecting the spawning habitat from degradation that would have threatened healthy incubation and the hatching of eggs;
- preventing cultural interference with fish during the several stages of spawning rituals;

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[24] *See id.* at 67.
[25] *See id.* at 66-67.

- protecting the nursery habitat for the young; and
- preventing deliberate or incidental capture by fishers of juvenile and sub-adult fish.

This fine-scale approach was always more an ideal than an achievable reality; it proved to be impracticable because of the interactions of cultural and natural factors far beyond the purview of fishery managers. Some informed stakeholders recognized this by the 1850s, and they proposed a technological fix – fish hatcheries.[26] This "fix" inadvertently contributed to the broaching of the reproductive isolation between the human-procured stocks and species to the disadvantage of wild stocks. From 1900 to 1950, excessive reliance was placed on fish hatcheries; this techno-fix merely compounded the problem and was subsequently shown to be almost totally ineffectual.[27] Indeed, the overall hatchery program as conducted may have exacerbated problems with the fisheries.

V. MORE ON THE ECOLOGY AND MANAGEMENT OF MIGRATORY FISH IN LAKE ERIE

There are few, if any, species of fish in Lake Erie that do not possess an annual migratory pattern. With some stocks of some species, the spatial extent of its migration may be a few inches for some species, less than a mile for others, and the stocks of yet another species may migrate as much as two hundred miles.[28] An annual pattern typically includes four main kinds of habitat each of which has special features that are of limited occurrence in the waters of the Basin:

1. *spawning* areas or "grounds" (only one or two species have floating eggs), on which eggs are deposited and then develop and hatch;
2. *nursery* areas, where the young have some protection while they are poorly developed anatomically and/or physiologically and behaviorally defenseless;
3. *feeding* area, in which there is abundant food of an appropriate type; and
4. *resting* or refuge areas, to which they can escape and survive in a resting state if and when their preferred habitats become unbearable, whether due to variances in seasonal temperatures or because of lack of oxygen in a layer of stratified water.

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[26] *See* H.A. Regier & W.L. Hartman, *Lake Erie's Fish Community: 150 Years of Cultural Stresses*, 180 SCIENCE 1251 (1973).

[27] *See, e.g.*, Regier & Hartman, *supra* note 26, at 1251.

[28] *See* Kay & Regier, *supra* note 3, at 524.

In any particular year within the 19th and 20th Centuries, the relative sizes of these four kinds of habitat for the most valued species ranged from quite limited with respect to *spawning* to somewhat less limited with *nursery* to more abundant with *feeding* and somewhat less abundant with *resting* areas. Thus the relative sizes of habitats for a particular species may have been *spawning<nursery<resting<feeding*. For most of the valued Great Lakes stocks, the absolute sizes of the *spawning*, *nursing*, and *resting* habitats decreased progressively over time until the 1950s, with some recovery since then. The trend through time with respect to *feeding* areas relevant to different valued stocks has been more complex. As a general rule for fish the world over, extinctions of particular stocks have more often been caused by inaccessibility, destruction and degradation of habitat (particularly of *spawning* and *nursery* habitats) than by the destructive and excessive use of fisheries.

Suppose that a fish of a particular stock of, say, lake whitefish matures sexually to spawn at age 4. The migratory history of it and those fish of its year class in the population, starting as fertilized eggs, will exhibit the following season-related sequence in its first five full years of life: *spawning*, *nursery*, *feeding*, *resting*; *feeding*, *resting*; *feeding*, *resting*; *spawning*, *feeding*, *resting*; and *spawning*, *feeding*, *resting*. (With lake whitefish, *spawning* occurs in Fall and Winter, *nursery* in Spring and Summer, *feeding* in Spring, Summer and Fall, and *resting* in Winter) The survivors of this particular year class will continue with an annual *spawning-feeding-resting* sequence until the last survivor dies. In the absence of human harvests, some whitefish may have survived to senility and then ceased to spawn.

If a particular lake whitefish stock opted through the evolutionary process to remain in the Eastern Basin of Lake Erie and its tributaries, the four habitats would all be in different parts of the Eastern Basin and tributaries. In comparison, another stock of lake whitefish that spent the warmest part of Summer in the deeper, colder waters of the Eastern Basin but then migrated westward through the Central Basin in fall to reach the Western Basin and even as far as the Detroit River for spawning in late fall would commence a reverse migration through the Central Basin in Winter and Spring.[29]

As mentioned before, there may never have been, and may not now be, a species of fish that was sedentary to the same locale, say, one acre of lake or one hundred yards of stream, anywhere in Lake Erie (sculpin near springs in headwater streams may have been an exception). Within a species, the preference for specific habitat of post-juvenile fish tends to become narrower with size and age. This approximate generalization may be consistent with a

[29] *See id.* at 523.

rule of thumb that juvenile fish tend to have "r" features while old fish tend to have "K" features, as a version of Theodore Dobzhansky's generalization.[30] To understand these concepts, we generalize to employ "r" to include fecund, short-lived, rapidly maturing and small fish, while "K" includes those which are less fecund, slow-growing, longer-lived, and larger. Furthermore, there is a very approximate direct relationship, at least in respect to the fish in the Great Lakes Basin, between the length of an annual migratory route and the fish's size at sexual maturity.

Within each of a number of families of fish in the Lake Erie Basin there is a range of species that manifests a vague r to K ecological spectrum. Human exploiters of fish – anglers, commercial fishers, commercial aquaculturists, home aquarists and bait fishers – have different preferences that can be related to particular but overlapping ranges of the K to r spectrum, with the highest demand for K and the lowest for r. Aboriginal fishers, for example, may have preferred fish of a size toward the K side of the mid-range between K and r extremes, regardless of whether the fish was for domestic food, ceremonial use or trade. So partial separation in the fish-related objects of interest of different human interest groups can be inferred to provide another opportunity for "niche differentiation" among those differences.

The stocks in which spawning individuals can be classified as high-K, large in size and with long migratory routes, are here designated as KLM stocks. KLM stocks of different families include the following: lake sturgeon (acipenserid); ling (lotid); lake whitefish, lake trout, steelhead, coho and chinook (salmonids); common white sucker (catostomid); Asian carp (cyprinid); walleye (percid); channel catfish (ictalurid); and largemouth and smallmouth bass (centrarchids).

As a general inference from the above heuristic, the recreational anglers and their charter boat skippers who are interested in Lake Erie fish tend to have been the most selectively focused on KLM stocks. Starting in the late-19th Century, a gradual process has been underway to legally designate such stocks as "sport fish"[31] eventually to be exclusively reserved for anglers. Presumably, it is just a matter of time until the sturgeon, Asian carp, walleye and channel catfish are reserved for Aboriginals and anglers. Legal regulations continue to evolve to relate meaningfully to cultural changes in how humans with different interests share the attributes of the fish association and reflect continuing conflicts among these interests.

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[30] *See, e.g.*, Henry A Regier & James J. Kay, *A Heuristic Model of Transformation of the Aquatic Ecosystems of the Great Lakes – St. Laurence River Basin*, 5 J. AQUATIC ECOSYSTEM HEALTH 3, 9 (1996).

[31] *See* Henry A. Regier & Vernon C. Applegate, *Historical Review of the Management Approach to Exploitation and Introduction in SCOL Lakes*, 29 J. FISHERIES RES. BD. CANADA 683, 688 (1972).

Furthermore, starting in the mid-19th Century, the more responsible practitioners of commercial fishing and then of recreational angling in the Lake Erie Basin came to take a direct interest in all the migratory/life history phases of their preferred fish species. The most assertive anglers have campaigned to protect "their" sport fish from harvest by Aboriginals and commercial fishers in all habitats and to protect or rehabilitate the preferred habitats for reproduction.[32] Since many anglers are credulous about the potential benefits of the small fish hatchery as a techno-fix for poor stream quality, they would include in the area to be protected not only areas of habitat in which a stock may remain for a period of time but also the routes by which the stock migrates from one habitat to another.

However, a number of Native Reserves located in the watersheds of the Grand and Thames Rivers possess usufructuary treaty rights in waters in which Lake Erie KLM stocks once migrated to spawn.[33] In some cases, these rights are some two centuries old.[34] Starting in the mid-20th Century, certain Aboriginal Tribes and groups of Tribes have acted to re-assert their treaty rights to capture (for domestic consumption, ceremonial use and commercial trade) their fair share of fish stocks and species that frequent the geographically-specified waters of their treaty rights at any time of the year. Currently, the First Nation with a community on Walpole Island in the St. Clair River is litigating for recognition of treaty rights to fish in large areas of waters of southeastern Lake Huron, northwestern Lake Erie and their connecting and tributary rivers.

With respect to the Lake Erie Basin, there may not be a single case of a KLM stock that may naturally have limited itself in its migratory wanderings to the area within a particular state, province or Indian Reserve as designated formally by inter-jurisdictional boundaries.[35] With respect to any particular stock as such in our Basin, there seems to be no formal, stock-specific protocol to share the harvests or any other valued features among all the different kinds of interested humans with some explicit or tacit rights to that stock.

There is, however, a widely shared if tacit view that the fishers of a particular jurisdiction in which a stock spawns have a preferential right to a larger share of the allowable sustainable harvest for that stock than have

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[32] *See* HUBERT GALLAGHER & JOHN VAN OOSTEN, INTERNATIONAL BOARD OF INQUIRY FOR THE GREAT LAKES FISHERIES, REPORT AND SUPPLEMENT 76-77 (1942).

[33] *See Indian Claims Commission Proceedings (1995), at* http://www.indianclaims.ca/download/icp3_eng.doc.

[34] *Id.*

[35] The "inter-jurisdictional boundaries" around an Indian Reserve may imply a set of two concentric limits: the package of rights and responsibilities is most complete within the core Reserve itself; in nearby off-reserve waters the rights and responsibilities are less complete and may relate to sharing usufruct rights with non-Aboriginals.

fishers of jurisdictions in which that stock may spend other stages of its migratory life history. Such a special right may be rationalized as a *quid pro quo* for other ecosystemic benefits foregone in maintaining an open migratory route to the spawning areas and preserving the spawning and nursery habitats in healthy conditions, as such habitats are far less abundant in the Lake Erie Basin than the feeding and refuge habitats needed along other stages of the migration route.

Early Conservation Measures

For several centuries now, fishers and their administrators have shared an ethic, sometimes formalized as law, that one was not to interfere with the part of the life history (of a year class of a valued stock) that involves the late stages of migration to the spawning grounds, spawning rituals, and the habitat of developing eggs. To that end, they determined that fixed fishing gear should not be set so as to intercept more that a fraction of the returning run of spawners to the stock's spawning grounds.[36] In streams, any dam should have fishways that can be ascended by the spawners.[37] Fishing directly on the spawning grounds during the spawning process was generally forbidden outright, except for the Aboriginals, who might spear a few for ceremonial purposes.[38] In the Lake Erie Basin, spawning-related conservation practices have always received some attention to the extent that disruptive activities were sometimes criminalized. However, enforcement of these laws has generally been lax.[39]

Another conservation practice relating to spawning and reproduction was practiced centuries ago in Europe: they did not harvest the fish of a year class intensively until it had reproduced once or twice successfully. It happens that fish younger than the age of first reproduction are generally worth less to commercial fishers than somewhat larger fish. Anglers, too, prefer larger to smaller fish, at least if they are robustly active. However, the flesh quality of truly old and senile fish is generally inferior, though their craggy physiognomies may be quite striking. So a traditional rule of thumb – to limit human exploitation to fish that have already had the opportunity to

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[36] *See, e.g.*, Fisheries Act, ch. LX, § 7(11), 1868 (31 Vict.) S.C. 177, 180 (Can.) [hereinafter 1868 Act] ("Except in the manner known as fly-surface-fishing with a rod and line, salmon shall not be fished for . . . at any . . . salmon leap, nor in any pool where salmon spawn.").

[37] *See id.*, s.12, 1868 S.C. at 182 ("Every dam, slide, or other obstruction across or in any stream . . . that a fish-pass should exist, [the owner shall provide] a durable and efficient fishway . . ."). *See* also BOGUE, *supra* note 5, at 175-76.

[38] *See id.*, s.7(10), 1868 S.C. at 180 ("No salmon shall be captured within two hundred yards of the mouth of any tributary creek or stream which salmon frequent to spawn.").

[39] *See, e.g.*, BOGUE, *supra* note 5, at 177.

reproduce – has been practiced in Lake Erie. This rule has generally been codified in law,[40] but enforcement has seldom been rigorous.

The construction and maintenance of fish ladders around dams was attempted for several decades in the late 19th Century.[41] The first half dozen generations of primitive mill dams were washed out by the intense flooding that followed upstream agricultural and urban developments in these tributaries. However, the first flood-proof dams generally did not incorporate effective fish ladders into their designs, and the migratory stocks that had used upstream spawning grounds were informally written off. In recent decades, many of these obsolete dams have been breaking down or have been deliberately removed, thus making available old spawning grounds for exploratory spawners. Unfortunately, the detested sea lamprey also found suitable spawning grounds in these re-opened streams.

The Use of Fish Hatcheries

Both of the old conservation traditions mentioned above were indirectly undercut by a rediscovery of fish hatcheries in the 1850s and their subsequently rapid and continuing technical development. By the end of the 19th Century, these hatcheries were perceived by their protagonists to be a fully efficacious techno-fix for poor conservation of fish and their habitats.[42] With the advent of hatcheries, the barring of fishing on spawning runs ceased to be a big issue, as fishing on the spawning grounds was seen as a good way to capture sexually ripe fish to strip for fertilized eggs for the hatcheries.

However, the use of hatcheries as a techno-fix, especially in the Lake Erie Basin, was mostly an abject failure until late in the mid-20th Century. Besides failing to preserve valued stocks that were threatened, hatcheries were used to rear and stock exotic species like the Asian carp that was quickly perceived as a pest and brought exotic fish diseases into the Basin.[43] In addition, the gene structure was altered based on stocking priorities. Hatcheries gradually became less prominent after 1920, when some 20 hatcheries operated in the Lake Erie Basin; those that survived after 1950 may have done so because of political patronage rather than any conservation purposes.[44] It should be noted, however, that hatcheries provided for

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[40] *See, e.g.*, 1868 Act, s.13(9), 1868 S.C. (31 Vict.) at 184.

[41] *See* BOGUE, *supra* note 5, at 218.

[42] *See* BOGUE, *supra* note 5, at 57.

[43] *See* H.J. MacIsaac, *Biological Invasions in Lake Erie*, *in* STATE OF LAKE ERIE, *supra* note 3, at 305, 311.

[44] *See* Regier & Applegate, *supra* note 31, at 689. ("By 1945 the heart had gone out of the artificial propagation movement . . . Hatcheries were quietly closed as politically appropriate times, though some continued to operate . . . long enough to experience revitalization in the 1960s.")

fisheries to exist in the face of extreme habitat degradation, and today, they are used to rear threatened and endangered species.

More sophisticated and specialized hatcheries for a few stocks of a few species were constructed or re-constructed in recent decades. Unlike their predecessors, their primary purpose was not to mass-rear fry to provide enough fish for subsequent commercial harvests.[45] With efforts to rehabilitate spawning and nursery habitats of valued stocks of indigenous species, hatcheries obtained new eggs from elsewhere, then hatched and reared them to a post-fry stage, to create new stocks to replace those lost decades before. Specialized hatcheries have also served a role for put-grow-and-take practices with non-native salmonids much favored by some anglers, found to be a bother by commercial fishers and shunned as offensive by some Aboriginals.

We infer in retrospect that a century of evolving hatchery technology before 1950 did, on the balance, more harm than good. Like so many cases of proffered techno-fixes, the solution *became* the problem, an environmental as well as a political one. During the past two or three decades, new hatcheries are being used to help undo the damage in which earlier hatcheries were complicit. At least that is the hope of impatient anglers. Their desires are three-fold: they want lots of sport fish now, they want them to grow large quickly, and they want them to be indiscriminate with respect to fishing lures and quickly strike anything that is sent down to them.

What passed for fisheries management in Lake Erie in the 1870s implicitly relied most strongly on preventing serious interference with spawning; it was habitat-oriented. Primary reliance then switched to fish hatcheries, which were closely linked to political patronage in that hatchery personnel were political appointees in some jurisdictions. Various interest groups were successful in lobbying for limiting access to particular fish species in certain times and places through a version of zoning, and this regime was gradually expanded. Even though the need for command-and-control regulations on fishery practices was recognized, progress in this approach was slow and inconsistent. Meanwhile, pollution of the waters was being combated mostly from the perspective of the health of humans as being threatened by contaminated domestic water and fouled beaches.

Along with industrial, transportation and agricultural pollution, all four of the early fisheries approaches – protecting natural spawning and rearing, releasing massive amounts of fry from fish hatcheries, regulating proper fishing practices, and zoning human access to fish – failed to prevent Lake Erie from sinking into abject ecological degradation by the 1950s.[46] Even if effective command-and-control regulation had been enacted prior to that

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[45] *See id.*

[46] *See, e.g.*, Regier & Hartman, *supra* note 26, at 1252.

time, the information needed to track the boom-and-bust behaviour of the stocks of interest – lake herring, blue pike, smelt – was simply not available. This was a direct result of the weak and informal means of fisheries management that had emerged with more reliance on tacit collaboration among different fishers and interest groups.

In the 1950s, the Lake Erie native fish association "hit the wall." Lake sturgeon, lake trout, lake whitefish, lake herring and blue pike dropped out of the association entirely or almost entirely. With the exception of the blue pike,[47] all of these native species have been recovering during the past two decades. Non-native species now part of the Lake Erie association include smelt, alewife, gobies, carp, goldfish and sea lamprey. None of them in themselves are now highly valued by all fishery interests; the first two are valued by salmonid anglers and the next three serve as prey or forage for the first two, and thus may also be valued by salmonid anglers.[48] With the continuing lack of effective management of the ballast waters of ship vessels and with climate change and other global threats, it seems likely that more exotic fish species will find a role in Lake Erie. Based on past experience, most of these exotics will have undesirable features.

The Degradation of Fish Stocks: A Short History

When Europeans took their first fish from Lake Erie around 1650,[49] large lake trout weighed 75 pounds. Lake trout were not valued by commercial and artisan fishers as highly as were lake whitefish,[50] because the latter was easier to preserve to maintain high flesh quality.[51] Also, small whitefish were found in lake trout stomachs, so the lake trout were excoriated for preying on the sheep-like whitefish, and calls for efforts to control these

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[47] The blue pike is believed to be extinct in Lake Erie. *See* P.A. Ryan et al., *Recent Trends in Fish Populations in Eastern Lake Erie in Relation to Changing Lake Trophic State and Food Web*, *in* STATE OF LAKE ERIE, *supra* note 3, at 241, 242. Some scientists, such as Phil Ryan and colleagues, speculate tentatively that yellow walleye, a close relative of blue pike, now shows a kind of pelagic behavior different from earlier more benthic walleye and reminiscent of the blues. So genetic introgression of blues into the walleye may have occurred about 1960 and some of the genetic evolutionary legacy of blue may still be playing a role in the Lake Erie fish association.

[48] *See, e.g.*, D.W. Einhouse et al., *Consumption of Rainbow Smelt by Walleye and Salmonine Fishes*, *in* STATE OF LAKE ERIE, *supra* note 3, at 291, 294.

[49] Joachim Moenig, The Lake Trout of Lake Erie: A Historical Review 4 (1971) (unpublished paper, University of Toronto) (on file with the *Canada-United States Law Journal*).

[50] BOGUE, *supra* note 5, at 154.

[51] *All About Fish Oil*, *at* http://www.iherb.com/fishoil.html (the soft, poly-unsaturated fats of lake trout, now recommended so highly by nutritionists, oxidized quickly to give the flesh a rancid taste.).

predators were made.[52] Until the 1870s there was no market for sturgeon flesh and roe;[53] large sturgeon were so powerful that they tore up nets of cotton and linen that they encountered and were pests to be caught and removed with specially-constructed large mesh nets as part of a pest-control program.[54] With rising catches through increasing fishing pressure on lake whitefish due to growing demand in the fish trade, the catch of large whitefish per commercial net fell, resulting in a commensurate increase in fishing costs.[55] Beginning in 1876, the abundant lake herring, not previously valued highly as a food fish, increased in value and became a major target of commercial fishers.[56] With refrigeration and more rapid transport of fish to market, lake trout became more valuable.[57] This process of "fishing-up" continued without pause until about 1960; by then, the Lake Erie fishery relied almost entirely on small, short-lived fish. [58] The total catch of fish by Lake Erie commercial fishers did not decrease over the decades, and the value of small, short-lived fish gradually increased in the absence of competition in the market of larger fish of more valued species.

The loss of Lake Erie's rich fish species diversity began as early as 1850s. Unintentional overfishing was entrained in part by the "common pool, common property" nature of the magnificent fish resources and the absence of any well-informed comprehensive governance regime that extended over all the relevant jurisdictions. Intentional over-fishing of lake trout and sturgeon, perceived to be pests, was triggered by the ready availability of higher-valued stocks of lake whitefish when markets were still small and transport was slow.[59] Other human assaults in the form of pollution from farming industry and urban settlement added to the lake's destruction. Thousands of milldams in tributaries blocked the migratory wanderings of many fish stocks.[60] Direct invasion of exotic species was facilitated through human-constructed canals and indirect invasion by ships' ballast water.[61] Furthermore, to create new fisheries, fisheries experts deliberately introduced

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[52] *See* Moenig, *supra* note 49.

[53] BOGUE, *supra* note 5, at 158.

[54] Regier & Hartman, *supra* note 26, at 1249.

[55] BOGUE, *supra* note 5, at 151.

[56] *Id.* at 156.

[57] *See* Moenig, *supra* note 49, at 7.

[58] *See* HARTMAN, *supra* note 9, at 22; W.J. Christie, *The Ecosystem Approach to Managing the Great Lakes: The New Ideas and Problems Associated With Implementing Them*, 26 U. TOL. L. REV. 279, 281 (1995).

[59] *See* BOGUE, *supra* note 5, at 158.

[60] *See id.* at 145-146.

[61] *See* H.J. MacIsaac, *Biological Invasions in Lake Erie*, *in* STATE OF LAKE ERIE, *supra* note 3, at 305, 308.

some fish species into the inter-connected Great Lakes, and some of these species eventually became pests.[62]

As close as they were to the hub of spreading canals, railways and roads of the growing U.S. and Canadian integrated economy, it is not surprising that Lake Erie and Lake Ontario were already severely damaged by human enterprise and activity in the 19th Century. The degradation continued until the mid-20th Century, when much of Lake Erie, especially along the south shores, had degraded into a slum-like state that has been described as a kind of ecosystemic "death"[63] Five decades later, following remediative efforts that cost billions of dollars,[64] the Lake Erie ecosystem now exhibits some desirable features that bear some resemblance to those of a century ago,[65] while other features are puzzling and may not be politically acceptable.

The salmonids, and especially lake whitefish, are now more abundant in Lake Erie than they were some decades ago. Some stocks of lake whitefish have re-established spawning migrations from the Eastern to the Western Basins. But the deeper hypolimnetic waters of the Central Basin are again losing their oxygen in the summer; these "dead zones" presumably pose a threat to young whitefish migrating from the Western to the Eastern Basin.

In view of society's many and sometimes conflicting goals for Lake Erie, the current challenges for governance of human interactions with fish in the Lake Erie Basin are formidable!

VI. NATURAL AND CULTURAL LAWS

Suppose that a *law* is a conceptual construct about a feature of perceived reality that was previously laid down and is currently taken to be fixed. Based on observation of Nature and an accepted protocol of scientific practices, a scientist may infer a "natural law" as that scientist's conceptual construct, and he or she may succeed through appropriate rhetoric to induce other scientists, and subsequently the laity, to accept the "truth" of that natural law within some specified context. In parallel, based on observation of Culture and an accepted protocol of legal practice, a lawyer may infer a cultural law and may succeed through appropriate rhetoric to induce other lawyers and the laity to accept the "truth" of that cultural law, within some specified context.[66] At any moment in time, both natural and cultural laws

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[62] *See id.* at 309.

[63] *See* BOGUE, *supra* note 5, at 26.

[64] The current estimated cost of cleaning up the Great Lakes is estimated to be at around $380 million dollars per year. Claudia Copeland, *Great Lakes Water Quality: Current Issues, at* http://cnie.org/NLE/ CRSreports/Natural/nrgen-10.cfm (May 17, 1996).

[65] *See* Regier & Kay, *supra* note 10, at 3.

[66] "Nature" and "Culture" are here taken to be organizational polarities that we invoke about ourselves, other living things and in all of reality, all as commonly perceived in our part

act to forestall particular possibilities rather than all possibilities, or to induce particular actions rather than all actions. For us, there is no conceivable set of natural and/or cultural laws that could reduce what we perceive as evolutionary reality, including both living and non-living features, to a deterministic mechanism.

In both Nature and Culture, what humans with the appropriate inclination identify as laws may be perceived to enable the emergence of a balance between rights and responsibilities (freedoms and constraints, privileges and obligations, egotism and altruism, selfishness and selflessness, inward-looking and outward-looking, forward-looking and backward-looking) on the part of all living things, at various levels of systemic organization. Absent some degree of persistent regularity (due to a compatible set of long-lived structures, conventions, principles, rules, regulations) and the emergence of reciprocal complementarity as sketched above, a living cultural or natural thing could not exist. With appropriate complementarities and regularities on the part of a living thing in interaction with its environmental habitat or institutional setting, and other compatible conditions, a living thing may enjoy health and integrity.

If we perceive that the ultimate realities of both Nature and Culture are evolving in non-deterministic ways that are not fully foreseeable, then any *law*, whether it relates to Nature or Culture or to an interaction of those two aspects of reality, is a tentative and temporary construct. For example, the set of organizational laws specific to a particular atmospheric high-pressure ridge that moves eastwardly over Lake Erie, say, is operative only for a few days. Another set of laws that guide a particular wave in Lake Erie at the water surface may persist from the wave's inception on the windward edge of the lake as it progresses across the lake, perhaps with partial interference from a wave train due to a prior wind from a different direction, until the wave dissipates or reflects partially on the leeward edge. Yet another set of laws (including abiotic, anatomical, physiological, genetic, behavioral) governs a particular individual lake trout from its stage as a fertilized egg to its death at whatever age. These three cases relate to features of the Lake Erie Basin ecosystem, and the set of laws for each derives from the interaction of cultural and natural polarities – air, water, genome, organism, population, species, community, sub-ecosystem, *et cetera* – at all self-organizational levels of this ecosystem.

Some of the more generalized natural and cultural laws that were once entered into our scientific and legal books were subsequently found to be

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of the world. In view of recent scientific and scholarly developments, we personally do not know how to address the question of whether Nature and Culture differ in essence so that these poles are forever distinctly different, and proceed here on a pragmatic, working assumption that the two are complementary.

faulty or obsolete and were deleted, superceded or simply ignored. More will be retired and new ones will be added; some of the former will be resurrected and retired again later. Optimistically we proceed with this line of argument here with a sense that the natural and cultural laws inferred and reified with respect to the Lake Erie Basin ecosystem have generally been increasingly more true than false.

As with our notion of *reality*, we refer to the term *ecosystem* as relating to a complex reality that is never fully fixed. The term does not have a definitive universalistic meaning but only derives meaning from a particular context as understood within the particular association or network of users of that term. For our Lake Erie narrative case study, *ecosystem* refers to relevant phenomena studied conventionally and compatibly, *inter alia*, in ecology, economics, epidemiology, social geography and participatory governance. Nowadays, "ecosystem" is widely used by opinion leaders in a connotation that extends its definition far beyond the meaning given the term by self-disciplined experts in those specialized fields of study.

Consider the natural and cultural realities of Lake Erie and its hydro-geographic Basin. Both the natural and cultural features of this basin ecosystem have been changing rapidly in unpredictable ways during the past two centuries. Regardless of how good our capabilities in natural and social sciences were or might have been, many of the natural and cultural changes could not have been predicted on the basis of such ecosystemic science. New events happened that had never occurred anywhere before, and normal science is powerless to predict indeterministic innovations, though it may be able to explicate such phenomena after the fact, as in forensic science.

In the last two centuries, formalized constructs of natural law or cultural law may have never played a dominant role in the overall "governance" of the natural and cultural ecosystemic phenomena involved in the interactions between mobile humans, vagile creatures and fugitive lifeless things within any particular jurisdiction within our Basin – or so it seems to us in retrospect. Both the natural and cultural features related to such hunting, fowling and fishing have been evolving and adapting rapidly in ways that have been so new, complex and transient that they out-stripped the slower due process conventions through which the scientific and legal professions infer, accept and reify natural and cultural laws. Natural and cultural realities have been emerging too swiftly for the normal pace of the formalization of ecosystemic insights; this would have happened regardless of the level of funding that might have been made available to scientists and lawyers. Such rapid evolutionary change creates new realities and thus new ignorances about emergent reality; currently our ignorance may be increasing more rapidly than our understanding.

However spotty the governance process may have been, the hunting, fowling and fishing conducted in the Lake Erie Basin appears never to have

been so unacceptable that they triggered widespread political uproar among the general populace of any of the relevant jurisdictions. Many conflicts festered and occasionally erupted with respect to opportunistic harvesting of non-sedentary resources between states and between nations that share the area of this Basin. Occasionally a conflict triggered discrete involvement by diplomats, measured participation by a country's coast guard, and limited police action.[67] Sometimes a shared legal commitment was enforced through coordinated action of law enforcement officers from a number of jurisdictions.[68] There were many incidents of "friction" concerning migratory fish, but these were not simply "smoothed over" through invocation and imposition of detailed, formalized versions of trans-boundary natural or cultural laws.

So how have hunting, fowling and fishing for migratory animals been governed in the Lake Erie Basin? A kind of shared folk wisdom seems to have pervaded human denizens of this Basin. We have tried to protect the natural generative processes of valued "natural resources;" furthermore, we have tried to prevent the cultural generative processes of things that harm valued living and non-living things. Over the many decades we have moved the main focus of our management activities to the immediate realities of the inception of the relevant goods and bads as is consistent with an implicit "precautionary principle."[69] Fortunately, the acts of inception of goods and bads tend to be localized spatio-temporally and such generative locales can readily be discovered and are therefore amenable to protective, remediative and preventive intervention by informed humans. Unfortunately, this kind of natural/cultural folk wisdom did not suffice to forestall the severe ecosystem degradation of Lake Erie and its Basin, though it may have helped to postpone by some decades (perhaps from the 1930s to the 1950s) the evil day

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[67] One such instance was the "Pelee Island incident" of May 8, 1894, wherein Captain Edward Dunn of the Canadian patrol ship *Petrel* arrested approximately 50 wealthy American businessmen for fishing in Canadian waters without licenses. Each vessel was subsequently fined $40, plus costs. BOGUE, *supra* note 5, at 231. In contrast, the American tug *Grace* was seized for fishing off the Canadian coast; this incident led to the involvement of the U.S. Department of State and the British Foreign Office. After prolonged litigation, damages were paid to the owners of the vessel. *Id.*

[68] *See, e.g.*, BOGUE, *supra* note 5, at 310.

[69] The "precautionary principle" encapsulates the idea, as stated in the 1992 Rio Declaration, that "[w]here 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." *Report of the United Nations Conference on Environment and Development*, Annex I, Rio Declaration on Environment and Development, Principle 15, U.N. Doc. A/CONF.151/26 (Vol. 1), 31 I.L.M. 874 (1992), *available at* http://www.un.org/documents/ga/conf151/ aconf15126-1annex1.htm (last visited May 18, 2002) [hereinafter Rio Declaration].

of the collapse of particular fish species and of the valued healthy manifestation of the Lake Erie ecosystem.

VII. RIGHTS AND WRONGS

Since time immemorial, self-organized entities in Nature and Culture have balanced inward-facing with outward-facing or looking into the past and looking into the future in a way that Arthur Koestler characterized as Janus-like.[70] Recent scientific studies of evolution have corroborated what has been argued for a century now: that which may be perceived by a superficial glance as selfishness and selflessness are equally natural as well as being cultural with respect to human interactions.[71] External disciplinary action may be helpful in correcting unbalanced cases of selfishness and perhaps also of selflessness. From an ecosystemic perspective, we perceive no sharp distinction or boundary between these complementarities.

Consider an area of private property or of legal jurisdiction each with legally-drawn, sharply-specified boundaries. Many desirable goods and services and many undesirable bads and disservices in natural/cultural ecosystems pay little heed to the existence of sharply drawn boundaries around some spatial property or jurisdiction. Natural goods and services include such things as clean air and water as well as valued creatures such as fish and birds. Natural bads/disservices include poisons in air and water and in the flesh of edible creatures. For many fishers, cultural goods and services include relatively selective biocides to control the exotic sea lamprey and cultural bads/disservices include toxic wastes from industry, including the hazardous contaminants released in the wastes of companies that carelessly produce desirable biocides.

A private property owner owns a bundle of rights and responsibilities that are specified formally only in part. An owner of property or an administrator of a jurisdiction ultimately has no choice: some of both the benefits of goods and services and the costs of bads or disservices, whether natural or cultural, must be shared with other "stakeholders." There are choices on how sharing will happen. If it is done fairly (with "due process") then the negotiation and administration costs (that is, the transaction costs) incurred to achieve the agreed balance between rights and responsibilities may be "manageable." However, institutional and bureaucratic inertia, which tend to be high, generally do not adapt as quickly as ecosystem processes. In practice, democracies may adapt appropriately more rapidly to such challenges than other forms of government. Nevertheless, democracies have experienced

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[70] *See*, e.g., Regier & Kay, *supra* note 10, at 12.

[71] *See generally* RICHARD DAWKINS, THE SELFISH GENE (1989); Ernst Mayr, *Darwin's Influence on Modern Thought*, 283 SCIENTIFIC AM. 78 (2000).

great difficulties in achieving a lasting balance in any particular case with an aquatic ecosystem. The mix of goods and services and bads or disservices has been evolving so rapidly that it exceeds the tempo of the information services – science and scholarship, as in the preceding section above – and the appropriate governance process to allocate the goods and bads among all stakeholders. Also, the effects of new goods and bads may interact with effects of the old goods and bads to change important features of the latter, thus requiring re-allocation of the old goods and bads.

The allocation of a culturally-created "bad" has increasingly focused on forcing the creator of the "bad" to internalize the remediation costs as a part of the innovator's normal responsibility that is consistent with both a precautionary principle and notions of fairness. This may be a complement to the practice of patenting a culturally-created good in order to permit capture of much of the benefit by the innovator as a part of an innovator's normal right. Unless fishers conscientiously employ "good" fishing practices, fish and their habitat are harmed in ways that are difficult to document. Careless or poorly-informed fishers who are trying to shave short-term costs are unlikely to volunteer information about their own destructive practices. But even careful fishers may resist providing clear information on their fishing practices when they are engaged in competitive fishing because they perceive their future success to hinge on secrecy or a monopoly of such understanding. Few fishers happily welcome an objective sampler on their trips when fishing competitively.

With respect to the management of human uses of natural resources, a simplistic and partial understanding of frequently-experienced difficulties was exaggerated by Garrett Hardin in 1968 as a *tragedy of the commons*.[72] Using many historical and contemporary case studies, Hardin showed that a "tragedy of the commons" could occur when a "resource" (e.g., harvestable yield of goods, assimilative capacity for bads) is freely accessible and open to use by anyone.[73] But such extreme openness was not a common occurrence historically in natural/cultural ecosystems anywhere in the world. The socio-ecologists corrected some of the shortcomings of Hardin's rather generalized description, etiology and corrective treatment and provided cases of a *comedy of the commons*.[74] But the socio-ecologists' contributions have been less appealing to neo-liberal conservatives with an urge to privatize than was Hardin's original piece. So Hardin's "tragedy" continues in the form of misinformation or disinformation in some political circles. Ill-informed

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[72] *See generally* G. Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

[73] *See* Thomas Dietz et al., *The Drama of the Commons*, *in* NATIONAL RESEARCH COUNCIL, THE DRAMA OF THE COMMONS 3, 3-4 (Elinor Ostrom et al. eds., 2002).

[74] *See id.* at 4.

privatization may entrain unbearably high transaction costs, which a private property owner may try to externalize unfairly to others. Elinor Ostrom and others now include consideration of both tragedies and comedies in their study of commons-oriented governance regimes, and refer to a balanced approach as a *drama of the commons*.[75]

Processes of allocation of goods and bads among stakeholder humans and other creatures permeate all of Nature and Culture and must be addressed systemically. No technical legal fixes or silver bullets will suffice in specific cases, let alone in generic ones. And no universalistic systemic solutions to this issue will be found, if reality is perceived as a complex of evolving living things in a four-dimensional, nested spatio-temporal mosaic. But a set of partial guidelines to a balance of rights and responsibilities can perhaps be inferred for different classes of ecosystemic phenomena. In practice, such guidelines depend on both *a priori* deontological and *a posteriori* consequentialist ethical principles as well as on esthetic and spiritual considerations. Such considerations are seldom teased apart in the course of decision-making; instead, a kind of decent pragmatism tacitly subsumes them. We proceed here in such a pragmatic if optimistic way.

VIII. FORMAL LEGAL STRUCTURES AND PROCESSES CURRENTLY IN PLACE FOR THE PROTECTION OF LAKE ERIE FISH

One of the most significant challenges for managing the Laurentian Great Lakes derives from interests of the multiple jurisdictions with authority and control over them. The set of actors is different for each lake. Lake Erie presents perhaps the most interesting and challenging case because four state, one provincial, and two national, and a multitude of local and municipal governments all play roles in regulating this water body.[76] (Aboriginals of both the Anishinabek and Haudenosaunee cultures may be reinstituting old confederacies and governance related to fishing rights that they are gradually re-asserting.)[77] Myriad agencies, from the local level to the binational, seek to regulate particular pieces of activity, from resource harvesting to pollution discharge to recreational practice to environmental conservation. Ferreri and Taylor observe that the large number of entities with overlapping authority over some of the Basin create "jurisdictional stress," that stands as a

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[75] THE DRAMA OF THE COMMONS, *supra* note 73.

[76] The states and provinces involved in Lake Erie governance are: Pennsylvania, New York, Ohio, Michigan, and Ontario.

[77] *See, e.g.*, UNITED ANISHNAABEG COUNCIL, ANISHNAABE GOVERNMENT: AGREEMENT-IN-PRINCIPLE 35, § 5.14.1(g) (1998), *available at* http://www.ainc-inac.gc.ca/pr/agr/anagcv_e.pdf.

"formidable obstacle to consensus building."[78] This challenge can be seen in the earliest attempts a collaborative management. According to Francis and Regier:

> At the institutional level, there have been impressively long lead times between some first expressions of need for new institutions and their eventual creation . . . A first call for the St. Lawrence Seaway came from an 1894 waterways conference, and 65 years later a binational agreement was reached to construct it. In contrast, the Boundary Waters Treaty came about in a record time of about 15 years (i.e., between the first call for some such agreement at an 1894 irrigation conference and the signing of the treaty in 1909.)[79]

Calls for some kind of fisheries agreement for the Great Lakes, which would have included the authority to develop and enact fisheries rules that would be uniformly implemented and enforced throughout the Great Lakes Basin, date back to 1875.[80] Indeed, twenty-seven commissions and conferences were convened to study the matter over an 80-year period prior to the establishment of the Great Lakes Fishery Commission in 1955.[81] The first interstate conference took place in Detroit in 1883.[82] The assembled representatives put forward 13 recommendations, but none of them were adopted.[83] The first international gathering was held in New York City in 1891.[84] Much work was done to formulate regulations to protect the lakes' fisheries, but again, neither the States nor the Province of Ontario adopted any of them.[85]

Meanwhile, as these policy coordination efforts went on, enforcement vessels began to take up Canadian boundary enforcement very seriously. However, the huge number of American commercial operators fishing in Canadian waters ("poachers") simply overwhelmed the patrol boats' ability to deter illegal activity. Beginning in 1888, Canada posted patrol boats in Lake Erie to confiscate gear used by Americans illegally fishing in the less-

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[78] C. Paola Ferreri, William W. Taylor & John M. Robertson, *Great Lakes Fisheries Futures: Balancing the Demands of a Multijurisdictional Resource, in* GREAT LAKES FISHERIES POLICY AND MANAGEMENT: A BINATIONAL PERSPECTIVE 539, 545 (William W. Taylor & C. Paola Ferreri eds., 1999).

[79] George R. Francis & Henry A. Regier, *Barriers and Bridges to the Restoration of the Great Lakes Basin Ecosystem, in* BARRIERS AND BRIDGES TO THE RENEWAL OF ECOSYSTEMS AND INSTITUTIONS 281 (Lance H. Gunderson et al. eds., 1995).

[80] *See* GALLAGHER & VAN OOSTEN, *supra* note 32, at 102.

[81] Francis & Regier, *supra* note 79.

[82] *See* BOGUE, *supra* note 5, at 184.

[83] *See* GALLAGHER & VAN OOSTEN, *supra* note 32, at 30.

[84] *See* BOGUE, *supra* note 5, at 193.

[85] *See id.*

intensively fished Canadian waters.[86] First, the *Cruiser* attempted to run down lawbreakers and confiscate their nets and gear,[87] but it was too slow and was replaced in 1894 by the *Petrel*, commanded by Captain Edward Dunn.[88] A determined sort of a man, he confiscated hundreds of illegal nets annually, but opined that it was a mere "drop in the bucket."[89] The Americans were apparently quite clever in outmaneuvering the single enforcement vessel. The *Vigilant*, faster still, replaced the *Petrel* in 1905 and was also commanded by Captain Dunn.[90] When a collision occurred with a miscreant boat, two American lives were lost.[91] This loss seemed to bring about a reduction in illegal activity. The American government then added its weight by contributing a revenue cutter to track offenders.[92] The Canadian agents' enforcement arsenal was further strengthened when, in 1907, they were finally given authority to arrest offenders.[93]

In 1908, the U.S. and Great Britain (acting for the Dominion of Canada) drafted a treaty to regulate the boundary waters fisheries and to create an international fisheries commission.[94] Initially conceived of as a joint regulatory authority with rulemaking powers, the final fisheries-related product called for a "draft-and-recommend" process.[95] Even that was too much for some powerful parochial fisheries' interests. The treaty never went into effect, and the draft was eventually set aside.[96] Habitat, biological diversity, and water quality all continued to worsen.

Another attempt to join the countries in fisheries management was undertaken in 1946 in the Convention between the United States of America and Canada for the Development, Protection and Conservation of Fisheries of the Great Lakes.[97] It too failed when the U.S. Senate did not ratify it.[98] In retrospect, we can wonder whether the inter-jurisdictional attempts sketched above would have worked well in practice. They may have implicitly

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[86] *Id. at* 308.
[87] *See id.* at 217-218.
[88] *See id.* at 70-71.
[89] *Id.* at 309.
[90] BOGUE, *supra* note 5, at 309.
[91] *Id* at 309-310.
[92] *See id.* at 310.
[93] *See id.*
[94] *See id.* at 192-93.
[95] *Id.* at 313.
[96] *See* Margaret Ross Dochoda & Michael L. Jones, *Managing Great Lakes Fisheries Under Multiple and Diverse Authorities, in* SUSTAINING NORTH AMERICAN SALMON: PERSPECTIVES ACROSS REGIONS AND DISCIPLINES 221, 225 (Catherine W. Mecklenburg, T. Anthony Mecklenburg & Lyman K. Thorsteinson eds., 2002); BOGUE, *supra* note 5, at 192-193.
[97] *Id.*
[98] *See id.*

assumed unrealistic regularities and predictabilities in the fish association and aquatic ecosystem. Francis and Regier, to wit:

> It becomes highly speculative to consider what it would take to make the entire institutional and organizational overlay for the Great Lakes Basin ecosystem functionally compatible with the dynamics of the ecosystem. The continual appearance and accumulation of "environmental problems" can be seen as symptoms of systemic dysfunctionalism in the relationship among society and ecosystem. The adaptive changes required can be specified only in general terms, such as the restoration and maintenance of ecosystem integrity and an ecologically sustainable society.[99]

The speed at which these biological systems change greatly exceeds the rate of change in political, or at least in bureaucratic, systems. Efforts have nonetheless been made to adapt rules and institutions.

In 1954, with the lakes in a dire environmental condition (extinct stocks, exotic invasions, pollution, and bankruptcy of some fisheries) resulting in severe social disruption, the U.S. and Canada signed the Convention on Great Lakes Fisheries,[100] which authorized the creation of the Great Lakes Fishery Commission (GLFC).[101] The GLFC's mission consists of sea lamprey control,[102] research,[103] and coordination among regulatory agencies,[104] leaving the mission of hands-on fish regulation and management to individual state and provincial jurisdictions.[105]

IX. CURRENT LAKE ERIE FISHERIES GOVERNANCE

We perceive an illusion of governmental control, ostensibly science-based and utilizing knowledge of expert scientists and technicians who have the confidence of the governance network. All participants in the decision-making process share a general commitment to "adaptive management" and to expect the unexpected.[106] Management tends to focus on fisheries issues

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[99] Francis & Regier, *supra* note 80, at 281.

[100] Convention on Great Lakes Fisheries, Sept. 10, 1954, U.S.-Can., 6 U.S.T. 2836, T.I.A.S. 3326, *available at* http://www.glfc.org/pubs/conv.htm (last visited May 17, 2002).

[101] *Id.*, art. II(1).

[102] *Id.*, art. IV(d).

[103] *Id.*, art. IV(a).

[104] *Id.*, art. IV(b).

[105] *Id.*, art. X.

[106] *See* George Francis, *Flexible Governance*, *in* AN ECOSYSTEM APROACH TO THE INTEGRITY OF THE GREAT LAKES IN TURBULENT TIMES 195, 195-96 (Clayton J. Edwards & Henry A. Regier eds., 1988) (Great Lakes Fishery Comm'n Spec. Pub. No. 90-04), *available at* http://www.glfc.org/pubs/SpecialPubs/Sp90_4.pdf.

in "real time" in that harvest levels and allocations are assessed and fixed with respect to "inventory" that is already in the lake, as young-of-year and juvenile fish are assiduously monitored. The approach consists mostly of "virtual population analysis" where the "virtual" means that it not based on "real" data but on some "less-than-real" assumptions on population dynamics. The precautionary principle is invoked, apparently, and not in a formal way tactically or strategically.

Canada

North of the border, the legal basis for "fisheries management" continues to be unresolved, both in theory and in practice. A key document, drafted in the 1890s, that proposed the devolution of some of the governance responsibilities for fisheries from the federal to the provincial level was apparently lost soon after its writing; merely a passing reference to it in another document is used as the legal basis for whatever was in that missing document. The Canadian federal, Ontario provincial, and the Quebec "national" governments, and the two implicit confederations of Aboriginal peoples – Anishinabek and Haudenosaunee – each have a different understanding of this federal-to-provincial devolution.[107] These inter-jurisdictional differences, which go back more than a century, have not been resolved, and there does not seem to be a political will at this point in time to sort them out.

In the mid-1980s, with the concurrence from the federal Canadian government, the Conservative Ontario government of the time instituted a system of "individual transferable quotas" (ITQs) for the commercial fisheries in the Great Lakes.[108] It was implemented in steps over a number of years, starting with Lake Erie because fishers in that lake had already been moving voluntarily in that general direction. At that time the commercial fishers did not welcome ITQs fully, and imposed three conditions on the government in exchange for their compliance: (1) that final decision-making on certain legal issues with regards to commercial fisheries should not be devolved from the Ontario Minister's office; (2) that more reliable estimates be inferred for total allowable catches (TACs); and (3) that legal enforcement be strict but fair and more overt than was previously done. The government did not fully meet those conditions during the ITQ's imposition. Subsequent New Democrat, Liberal, and another conservative government continued the

[107] *See* Henry Regier, *An Emerging Fisheries Issue in Ontario: Governance or What? in* UNIVERSITY OF TORONTO, REPORT OF A MAY 14, 1999 WORKSHOP ON EMERGING ENVIRONMENTAL ISSUES IN ONTARIO 48, 51 (Environmental Monograph No. 15) (H.E. Munn ed., 1999), *available at* http://www.utoronto.ca/env/em-15.pdf.

[108] *Id.*

devolution, as various aspects of the administration of these fisheries, especially those related to data collection, were given over to organized groups of commercial fishers. However, no public assessment has been made of how this overall process of combined use of a market mechanism with devolution of administrative responsibilities with the commercial fisheries has played out to date. In the meantime, researchers serving the interests of Aboriginal First Nations have emphasized inequities in all of this privatization process, especially with respect to Aboriginal fishers; some half-hearted efforts have been able to blunt those inequities.

Meanwhile the Canadian and Ontario governments drafted an *ad hoc* Canada-Ontario agreement concerning administration of fisheries in the late 1980s.[109] However, it lapsed in the 1990s with a series of events that could have provided grist for several episodes of the satirical CBC TV series, the *Royal Canadian Air Farce*.[110] A new Canada-Ontario agreement may currently be in the negotiation stage.

The Canada Fisheries Act,[111] now about 150 years old, includes two sections on fish habitat: one on water quality[112] and one on water quantity.[113] As with fishing, *per se*, the federal and Ontario provincial governments have been fiddling – politically, bureaucratically and legally – with these two sections for over a century and cannot seem to get it right. The water quality sections[114] have been delegated, more or less, to Environment Canada (EC). EC, in turn, has temporarily delegated parts of the water quality section to the Ontario Ministry of the Environment (MOE) under occasional five-year arrangements called Canada-Ontario Agreements (COAs), focusing its own efforts on Canadian commitments under the binational Agreement for Great Lakes Water Quality (GLWQA).[115] A new COA is being negotiated in 2001-2002 and may be endorsed formally in 2002;[116] its main point seems to be

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[109] That is, the 1988 Canada-Ontario Fisheries Agreement.

[110] *Royal Canadian Air Farce* (CBC television broadcast series, 1993-). The *RCAF* is a comedy show composed of vignettes; it is currently the highest-rated TV show on the CBC. For more information, go to http://airfarce.com/info/history.html (last visited May 17, 2002).

[111] Fisheries Act, ch. LX, 1868 S.C. (31 Vict.) 177 (Can.) [hereinafter 1868 Act]. *See also* Fisheries Act, R.S. ch. F-14 (1985) (Can.) [hereinafter 1985 Act]. The 1868 Act has never been repealed.

[112] *See* 1868 Act, s.14, 1868 S.C. at 184-185.

[113] *See id.*, s.12, 1868 S.C. at 182.

[114] *See* 1985 Act, ss.35-43.

[115] Agreement on Great Lakes Water Quality, U.S.-Can., April 15, 1972, 23 U.S.T. 301, *amended* Nov. 22, 1978, 30 U.S.T. 1383, *amended by* Protocol, Nov. 18, 1987, T.I.A.S. No. 11,551 [hereinafter GLWQA].

[116] *See* Environment Canada, *The Draft New Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem, at* http://www.on.ec.gc.ca/coa/2001/intro-e.html (last visited May 20, 2002).

that further implementation of the GLWQA should proceed only partially and gradually.[117]

The watersheds of the more inhabited parts of Ontario all have "conservation authorities" (CAs), that were created by the provincial government mostly in the 1950s to help municipalities cope with joint concerns about water: flooding hydrology, water for domestic and recreational use, and reforestation of sandy moraines and plains to protect aquifers.[118] The CAs may all own and administer dams for purposes of domestic and recreational water supplies as well as for flood control; very few of these dams have effective fish ladders. These CAs, and the municipalities that they serve, have always been torn between pro-conservation and pro-development interests. With some exceptions, the CAs did not welcome the GLWQAs of 1972,1978 or 1987, and some may have deliberately chosen not to cooperate under those agreements. Some have polluted "hot spots" that were never formally designated as Areas of Concern. The pro-development forces were clearly dominant in the 1980s and 1990s, but some balance may be re-emerging. In recent years, a few CAs have become active in the Remedial Action Planning and the implementation of the plans for Areas of Concern in their watersheds.

In the 1990s, Fisheries and Oceans Canada negotiated to devolve some responsibilities related to water quantity aspects of fish habitat to the CAs,[119] without offering adequate financial resources for these purposes.[120] Furthermore, Environment Canada and Ontario's Ministry of the Environment may devolve some responsibilities related to water quality aspects of fish habitat to the CAs, presumably again with inadequate transfer of financial resources. Meanwhile, it is not clear how the CAs will balance their under-financed new pro-conservation responsibilities with a continuing pro-development emphasis by municipalities.

In the late 1990s, Ontario's Conservative government started to devolve self-management and/or privatization to other sectors of the fisheries besides

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[117] *See* ENVIRONMENT CANADA, CANADA-ONTARIO AGREEMENT RESPECTING THE GREAT LAKES BASIN ECOSYSTEM: DRAFT FOR PUBLIC COMMENT 4 (2001), *available at* http://www.on.ec.gc.ca/coa/agreement_pdf/fa-e.pdf (last visited May 20, 2002) ("Implementation of this Agreement will contribute to meeting Canada's obligations under the [GLWQA].").

[118] The Conservation Authorities Act, which gives the power for the Ontario provincial government to protect watershed resources using regional "conservation authorities," was enacted in 1946. *See* Conservation Ontario, *Corporate Profile*, *at* http://www.conservation-ontario.on.ca/profile/profile.htm (last visited May 20, 2002).

[119] *See* Regier, *supra* note 107, at 49; Lakehead Conservation Authority, *New Fisheries Agreement*, *at* http://www.lakeheadca.com/y98fish.htm (last visited May 31, 2002).

[120] *See* Margaret Ross Dochoda, *Authorities, Responsibilities and Arrangements for Managing Fish and Fisheries in the Great Lakes Ecosystem*, *in* GREAT LAKES FISHERIES POLICY AND MANAGEMENT, *supra* note 78, at 93, 95.

the commercial fishers: bait; aquaculture; outfitters and fishing lodges; recreational angling; and fish hatcheries for stocking purposes. Some weak co-management agreements between particular First Nations and the Ontario regime are coming into place.[121] But there are still some important questions that need to be asked: is any or all of this devolution informed by any insight into what has gone before? Is it proceeding on the assumption that all of these kinds of fisheries are ecologically, economically and culturally independent so that each can operate independently of all the rest? Who knows? To make progress, more studies are needed to help us better understand the interactions between societies, ecosystems, and the fisheries. If some governance trends of the 1990s continue in Ontario, then both the water quality and quantity aspects of the fish habitat will be delegated in part to the Conservation Authorities. Concurrently, some administrative aspects of the harvest and culture of fisheries will be devolved to organized interest groups, perhaps some six in all. The marketplace is coming to be used increasingly for allocation of the relevant resources to duly licensed entrepreneurs. How these will all relate to the governance of Lake Erie fisheries as such may have been given little or no consideration. The interactions among all these kinds of fish-related interests may be too complex for rationalistic bureaucratic decisionmaking with command-and-control regulations, even if that approach were not already obsolete for other reasons. A process, or a suite of processes, of participatory democratic decisionmaking to resolve conflicts by representatives from each group of stakeholders, has not been initiated.

The United States

The situation on the U.S. side of the border has been and continues to be even more complicated, largely because of the much larger number of jurisdictions involved. The Tenth Amendment of the U.S. Constitution declares that those powers not given to the U.S. are reserved to the states (and "to the people")[122] and those "reserved" powers would presumably

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[121] *See Aboriginal Fisheries Strategy, at* http://www.dfo-mpo.gc.ca/communic/FISH_MAN/AFS_e.htm (last visited May 25, 2002).

[122] *See* U.S. CONST. amend. X. But certain constitutional powers dealing with interstate commerce and the formation of treaties still lie with the federal government. Consider this statement from a letter by a member of the U.S. Department of State's Office of the Legal Advisor:

> Article 1, Section 10 [of the U.S. Constitution] does not . . . prohibit U.S. States from coordinating their legitimate regulatory authorities in a non-binding manner with those of a neighboring nation or province, especially where such coordination does not impinge on the authority or the foreign relations of the United States.

Dochoda & Jones, *supra* note 96, at 230. Note also that

include fisheries management. So, in addition to the federal government, eight states[123] have a measure of sovereignty over a portion of Great Lakes' waters and shoreline. We begin this discussion with a taste of relevant history.

In addition to the power of the Tenth Amendment, the American free-market capitalist paradigm resulted in the continuation from settlement times of open access to unregulated fisheries, long past the time when it was clear that regulation was desperately needed to conserve them. From the early days, the states made it clear that they were the primary authorities when it came to fisheries governance.[124] While the states were unambiguous in their position that they were in charge of the fisheries, they were mostly happy to participate in federally-sponsored hatchery programs because they saw benefits (more fish) with minimal concomitant burdens. Even so, in the 1890s, Michigan prohibited federal collection of spawn for the hatcheries program, and state law enforcement agents arrested federal employees.[125]

From then into the modern era, until the new approach adopted through the implementation of the 1981 Strategic Great Lakes Fisheries Management Plan, the management framework in Lake Erie was piecemeal: Michigan, New York, Ohio and Pennsylvania regulated fisheries in their own waters with their own rules and regulations. Likewise on the Canadian side, Ontario also regulated its own fisheries with its own set of rules. Each jurisdiction's regime included a mix, always with some idiosyncratic features, on limitations on entry, assigned fishing zones, season restrictions, gear restrictions, bans on catching sport species, catch quotas, and the like.[126] Some coordination did occur in close seasons in some years, but it was rather informal.

As stocks of commercially valuable species in the various lakes "crashed," a shift from a primary emphasis on commercial to recreational fishing took place. Michigan's Department of Natural Resources led the change in the mid-1960s. Other states followed suit, and by the end of the 1970s, the new fisheries management priority was in place in all U.S. waters of the Great Lakes.

> [e]ven then, the U.S. constitution does not guarantee that commitments embedded in legally blinding conventions will always take precedence over domestic laws . . . Small wonder, then, that many other countries find the United States a difficult partner when it comes to the creation and implementation of international regimes.

Oran R. Young, *Institutional Interplay: The Environmental Consequences of Cross-Scale Interactions*, *in* THE DRAMA OF THE COMMONS, *supra* note 73, at 263, 277

[123] Those states are: Minnesota, Wisconsin, Illinois, Michigan, Indiana, Ohio, Pennsylvania, and New York.

[124] BOGUE, *supra* note 5, at 184, 311.

[125] *Id.*

[126] *See, e.g., id.* at 180.

U.S. anglers have been much more active with respect to the percids than their Canadian counterparts, likely a function of the larger number of anglers in the U.S. and the value they place on fishing. Anglers supported the creation of a recreational fishery of non-native salmon, while the commercial fishers preferred rehabilitation of native lake whitefish and lake trout. As politically-powerful anglers have successfully suppressed commercial fisheries on walleye and yellow perch within the large shallow bays of the other lakes in recent decades, regulation concerning fisheries in Lake Erie soon followed in that direction.

In the late 1970s, until 1985, Michigan's Fisheries Division (MFD) devoted substantial energy to litigation and negotiation on the subject of Native fishing rights under the 1836 Treaty between the United States and the Chippewa and Ottawa Nations.[127] When a negotiated and court-ordered settlement between the state, the federal government and three tribes was reached in 1985, the Michigan waters of Lakes Huron and Michigan were divided into zones in an effort to separate tribal and recreational fishers.[128] Catch quotas were set for tribal subsistence and commercial fishers.[129] Licensing, harvest quotas, and gear restrictions for all other fishers are set by the MFD.[130] Additional energies were consumed in the late 1990s while the agreement was under renegotiation. A new framework was agreed to late in 2000.[131] Division staffers are now involved in preparing for inland hunting,

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[127] *See generally* Treaty of 1836, *supra* note 6. *But see also* People v. LeBlanc, 248 N.W.2d 199 (Mich. 1976). In *LeBlanc*, the Michigan Supreme Court reversed the lower-court ruling that convicted a full-blooded Indian of fishing without a commercial license and with fishing with a prohibited gill net. The court ruled that that conviction for fishing without a commercial license could not stand because it interfered with his fishing rights under the Treaty of 1836, and that the conviction for using a gill net could stand only if prohibition against use of gill nets was necessary for environmental protection purposes and did not discriminate against treaty Indians.

Further, in U.S. v. Michigan, 471 F.Supp. 192 (W.D. Mich. 1979), *remanded by* 623 F.2d 448 (6th Cir. 1980), *reheard on remand*, 520 F.Supp. 207 (W.D. Mich. 1981), the Court scolded the State of Michigan for attempting to over-step the treaty by implementing and enforcing its own fishing regulations in ways that nullified the treaty. The justices held that such regulations and laws that interfered with Native fishing rights under the Treaty were null and void. For further case law, *see, e.g.*, Attorney General v. Hermes, 339 N.W.2d 545 (Mich. App. 1983); People v. Jondreau, 384 Mich. 539 (1971).

[128] *See, e.g.,* MICHIGAN PUBLIC INFORMATION & EDUCATION COMMITTEE, MICHIGAN'S 1836 TREATY FISHERY GUIDE 5 (1999), *available at* http://www.glifwc.org/publications/guide.pdf.

[129] *See generally* U.S. v. Michigan, No. M-26-73 (W.D. Mich. filed Jun. 11, 1985) (consent decree).

[130] *See id.*

[131] *See* Jennifer Dale, *1836 Tribes, Michigan Negotiate New Great Lakes Fishing Agreement, at* http://www.glifwc.org/publications/winter00/fishing_agreement.htm (last visited May 22, 2002). *See also 1836 Consent Agreement Press Release* (Aug. 7, 2000), *at* http://www.dnr.state.mi.us/SubIndex.asp?LinkID=369&Sec=fish (last visited May 25, 2002).

fishing, and gathering rights litigation, as it is anticipated that suit will be filed in the near future (a draft complaint is being circulated).

As progress is made on one front, however, protection of the fisheries is losing ground elsewhere. Michigan's situation stands as an example of the management approach employed by the Lake Erie states. For example, the MFD is now faced with its second significant staff cutback in five years. In 1997 it lost 17% of its staff, all experienced professionals, through an early retirement program.[132] It is anticipated that a recently-announced early retirement option will reduce the staff by at least another 10%.[133] Furthermore, it would be difficult to find someone in the natural resources community who disagreed with the observation that 11 years under Governor John Engler has brought greatly diminished environmental regulation generally. For example, while all other states issued fish advisories related to hazardous contaminants in fish flesh, Governor Engler fought them, fearing, it is supposed, damage to the state's tourism industry.[134] Early in his tenure, he split the regulatory agency, the Department of Natural Resources, placing the policy making and permitting offices directly under his control in the new Department of Environmental Quality.[135] According to a study done by the Lone Tree Council, almost no wetland-filling permits were denied during this period, making the Michigan Wetlands Protection Act[136] ineffective at best, and a mockery at worst. Similarities can be seen in the other states and Ontario during this time frame, suggesting that the Great Lakes Basin and its fisheries are not adequately protected.

Joint Governance Through Binational Partnerships

Visionary thinkers, both policy makers and scientists, could see the need for a Basin-wide management system as well as some uniform rules related to fisheries within each lake, and they advocated that approach. As noted previously, the numerous meetings held during the past 125 years by various

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[132] *See* Keith Schneider, *The DNR/DEQ Split: "Cost-Saving" Measure Costs Millions More*, *at* http://www.mlui.org/pubs/glb/glbfa98/glb-su.fa9815.html (last visited May 22, 2002).

[133] *See* GARY S. OLSON, MICHIGAN SENATE FISCAL AGENCY, GOVERNOR ENGLER'S FY 2002-03 BUDGET: SUMMARY AND ANALYSIS OF MAJOR RECOMMENDATIONS 4 (2002), *available at* http://www.senate.state.mi.us/sfa/Publications/AnnualReports/GovRec/GovsRec2003.pdf. The proposal would allow an early retirement option for certain senior state employees; the program will save the budget $50.0 million by ensuring that only one of four retirees is replaced.

[134] *See Michigan Challenges EPA on Fish Consumption Advisories*, *at* http://www.great-lakes.org/7-1-97.html (last visited May 30, 2002).

[135] *See* Schneider, *supra* note 132.

[136] *See specifically* Natural Resources and Environmental Protection Act, Part 303 (Wetlands Protection), §324.30307, 1994 Mich. Pub. Act 451.

U.S. states, the states and Ontario, and by the U.S. and Canadian federal governments to attempt to create uniform regulations for each lake agreed to by all jurisdictions consistently ended in failure. As described by historian Margaret Beattie Bogue in some detail, parochial interests, as well as fear that some other jurisdiction's interests would prevail under uniform rules, invariably prevented the adoption of such rules.[137] When Lake Erie "hit the wall," the parties were finally prepared to give limited authority to an international organization. In 1954, a positive step in this direction was taken with the creation of the Great Lakes Fishery Commission (GLFC).

A cooperative fisheries management structure has evolved under the aegis of the GLFC. In 1966, the existing informal Lake Committees were re-instituted under the Commission for each of the five main lakes.[138] Committee members include a formal representative from each of the state and provincial fisheries agencies with responsibilities on that lake. Starting in the 1980s, treaty-based groups of Aboriginal fishing communities that are served by their own "commission" have also had formal representation on the relevant Lake Committee.[139] Up to this point in time, only the Aboriginals south of the Canada-U.S. border (the American Indian tribes) have had such representation, but this may occur north of the border in the future.

This affiliation worked so well that the Great Lakes states declined the opportunity in 1976 to form a Regional Fishery Management Council under the U.S. Fishery Conservation and Management Act.[140] Instead, the states came together with Ontario to develop a Strategic Great Lakes Fishery Management Plan (SGLFMP, commonly referred to as the "Joint Strategic Plan")[141] signed formally in 1981; the federal fishery agencies participated helpfully in this process.[142] The Joint Strategic Plan strengthened the fishery governance community commitment to the lake committee process.

Indeed, the system may have "turned the corner" and adopted a framework that could actually result in something approaching ecosystem-

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[137] *See* BOGUE, *supra* note 5, at 187-188.

[138] The Lake Erie/Lake St. Clair Committee was originally structured as the Lake Erie Committee and its Lake St. Clair subcommittee; the Lake Ontario Committee and its Upper St. Lawrence River subcommittee was eventually restructured in the same manner. *GLFC Council of Lake Committees, at* http://www.glfc.org/lakecom/clc/ clcprod.htm.

[139] The Chippewa-Ottawa Treaty Fishery Management Authority has seats on the Superior, Michigan and Huron Lake Committees, and the Great Lakes Indian Fish and Wildlife Commission has a seat on the Lake Superior Committee. *Members of the Council of Lake Committees, at* http://www.glfc.org/lakecom/clcmem.htm (last visited June 1, 2002).

[140] *See* Dochoda & Jones, *supra* note 96, at 231.

[141] Great Lakes Fishery Commission, Strategic Great Lakes Fishery Management Plan (1981).

[142] Ontario and the Canadian government had formulated a Strategic Plan for Ontario Fisheries (SPOF), in the mid-1970s, which served as a kind of model for the SGLFMP.

based management when the states and Ontario created the Plan.[143] Since the Plan's adoption in 1981, the Lake Committees of the GLFC and their associated Technical Committees, together with other interested stakeholders, have worked to develop goals and objectives to conserve each lake's fishery. The members of the Lake Committees are fishery agency managers.[144] The Technical Committees are composed of agency biologists, and they provide advice to the Lake Committees regarding the appropriate quotas for perch and walleye and other fish community issues, as related to the Fish Community Objectives (FCOs).[145] Government and tribal representatives work together on the Lake to develop the FCOs[146] Progress in achieving the objectives should provide a basis to subsequently monitor and measure improvement of a lake's ecological state. As an additional step under the FCOs, the Technical Committee of each Lake Committee develops recommendations for the consideration of the full committee for total allowable catch (TAC) for particular lake species in particular sections of a lake. A revision of Fish Community Objectives has recently been completed for Lake Erie. The Lake Committees meet annually. Other stakeholders, such as commercial and recreational interests, provide input at these annual gatherings that are open to the public. In theory, a "state of the lake" conference is held every five years for each lake. Without the force of law, these arrangements are implemented through consensus decision-making. Reports are that this governance process has been particularly successful for Lake Erie.

In addition the Joint Strategic Plan calls on the GLFC to act as arbitrator when the parties are unable to achieve consensus on a point of difference.[147] This provision, added in 1986, suggests that the Commission has gained the requisite credibility in the fishery management communities. It has been invoked on two occasions thus far,[148] but the Commission has declined to act in that manner, instead choosing to informally facilitate alternative dispute resolution processes. Most recently, in 1992, the GLFC was asked to arbitrate yellow perch allocation arrangements.[149] The arbitration process

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[143] GREAT LAKES FISHERY COMMISSION, STRATEGIC GREAT LAKES FISHERY MANAGEMENT PLAN (1981) [hereinafter SGLFMP], *superceded by* GREAT LAKES FISHERY COMMISSION, A JOINT STRATEGIC PLAN FOR MANAGEMENT OF GREAT LAKES FISHERIES (1994) and (1997), *available at* http://www.glfc.org/fishmgmt/sglfmp97.htm [hereinafter Joint Strategic Plan].

[144] *See id.*

[145] *See id.*

[146] *See* GREAT LAKES FISHERY COMMISSION, A JOINT STRATEGIC PLAN FOR MANAGEMENT OF GREAT LAKES FISHERIES (1997), *available at* http://www.glfc.org/fishmgmt/sglfmp97.htm [hereinafter Joint Strategic Plan].

[147] *See id.*

[148] *See* Dochoda & Jones, *supra* note 96, at 231.

[149] *See id.*

was delayed by Canadian concerns that its Department of Fisheries and Oceans (DFO) staffer serving on the arbitration panel might be called upon to cast a potentially tie-breaking vote.[150] Despite the delay, the parties eventually reached agreement, so the arbitration request was dropped.[151]

The governance of fisheries may be converging on the governance of fish habitat and ecosystem quality in general. An example of environmental problem solving that involves local stakeholders is that of the International Joint Commission's Remedial Action Plan (RAP) process.[152] Starting in the mid-1980s, the IJC's Great Lakes Water Quality Board identified, from among many degraded locales, some 43 Areas of Concern (AOCs) around the basin and on some tributaries where environmental quality was seriously impaired and the objectives of the GLWQA were not met.[153] In 33 of the 43 areas, broadly representative stakeholder groups were formed to develop RAPs for their AOC.[154] Conceptually, a shift in effective governance was underway. Recognizing the interests and knowledge of the stakeholders, on the one hand, and the importance of their buy-in to actions that might be taken to protect the lakes, individuals and representatives from environmental groups, industry, and state and local government worked together to forge plans to renew the health of aquatic locales within the lake and the lake as a whole.

How is Lake Erie governance faring on the ground? The GLFC conducted a survey of perceptions of plan implementation in 1995.[155] In general, survey respondents maintained support for the plan and its strategies, although it was believed by many that new issues had emerged that should be addressed.[156] Frustration with the process was evident, however. A respondent involved in the Lake Erie governance group observed:

> The Lake Erie Committee and agency performance to meet the objectives of the committee are very satisfying to me. Fish community objectives – (fish management planning) – has been a most frustrating and unsatisfactory experience, not because of agency

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[150] *See id.*

[151] *See id.*

[152] *See* John H. Hartig & Michael A. Zarull, *A Great Lakes Mission*, *in* UNDER RAPS: TOWARD GRASSROOTS ECOLOGICAL DEMOCRACY IN THE GREAT LAKES BASIN 5, 9 (John Hartig & Michael A. Zarull eds., 1992).

[153] *See id.* at 7.

[154] *See id.* at 17.

[155] Memorandum from Margaret Dochoda on the Results of SGLFMP Implementation Review Survey 1 (Jan. 29, 1996) (on file with the Canada-United States Law Journal).

[156] Margaret Dochoda, Great Lakes Fishery Commission, Successes and Problem Areas in Implementation of the Joint Strategic Plan for Management of the Great Lakes Fisheries 4 (Feb. 23, 1996) (unpublished manuscript, on file with the *Canada-United States Law Journal*).

> or committee performance but because the entire Lake Erie ecosystem – the trophic system – is changing as we work. We have no basis in experience to make predictions, we can speculate where community [*sic*] is going but we have no predictions that allow us any level of confidence on time line or actual species composition of next stable association of fishes.[157]

This is a problem that needs to be addressed, perhaps indirectly through adaptive management. In any case, this comment sets out the challenges of managing a dynamic system.

Why has the combination of science and politics failed to guide the lake ecosystem to sustainability, where the latter term does not imply "steady state" but rather the absence of human-induced, disastrous surprises?

X. COMMON PROPERTY/POOL RESOURCES REGIMES: BOTTOM-UP CO-MANAGEMENT?

Theory

In many areas of the planet, natural resource governance now proceeds as a combination of governments, non-governmental organizations (NGOs) and interested individuals cooperating in some kind of partnership. Many mechanisms are employed to facilitate this new, more inclusive, and, it is hoped, more successful, approach to resource conservation. Such mechanisms are normally devised and employed in response to a crisis situation involving a common property or pooled resource. The phrase "common property resource" (CPR) is coming to be widely used as code for a generic kind of socio-ecological governance institution. With respect to ecological aspects, CP may refer to "common pool;" with respect to social aspects, CP may refer to "common property." An epistemic community/peer group/invisible college has emerged in recent decades with respect to this generic phenomenon.[158] All of the CPR experts appear to use that term as code for a complex evolving phenomenon and distance themselves from any categorical, linear definition of any one of the three terms or any combination of them. According to Berkes and Folke:

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[157] *Id.* at 47.

[158] Researchers with some expertise in fisheries issues and active in this network in North America include Fikret Berkes, Susan Hanna, Bonnie McCay, Elinor Ostrom and Evelyn Pinkerton. Many are members of International Association for the Study of Common Property, P.O. Box 2355, Gary, IN 46409, USA, email: iascp@indiana, Internet: http://www.iascp.org.

> *Common-property (common-pool resources)* are defined as a class of resources for which exclusion is difficult and joint use involves subtractability . . . Institutions have to deal with the two fundamental management problems that arise from the two basic characteristics of all such resources: how to control access to the resource (the exclusion problem), and how to institute rules among users to solve the potential divergence between individual and collective rationality (the subtractability problem).[159]

Countless versions of an implicit CPR approach to governance have emerged among humans during the past million years. From an ecological perspective this CPR construct overlaps with such notions as niche differentiation among organisms of different species, the complementarity of selfishness and selflessness within successful selective processes in evolution.

In the past, formal studies that test this approach to governance within the CPR epistemic community seem to have been limited mostly to small socio-ecological systems or small Cultural-Natural Ecosystems (CNE) in which the immediate users of a CPR are empowered to participate actively in the relevant governance process.[160] In cases where the local CNE is nested and inter-meshed within a larger regional CNE, a co-management form of CPR governance may emerge. Where such co-management forges an explicit link between local governance and regional or national governance, the adjective "cross-scale" may be added to the co-management term.[161]

However, the CPR approach has seldom been extended to governance of fisheries in which different sectors of a "fishery" (ceremonial, artisan, recreational, extensive capture commercial and intensive aquaculture commercial fishers) place different demands on the available resources. Furthermore, the CPR approach has seldom been applied to cases of migratory and/or straddling stocks of fish that are subject to harvest by a complex of fishers on all sides of the boundary of a jurisdiction that plays a prominent role in the inter-jurisdictional governance of the relevant CNE.

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[159] Fikret Berkes & Carl Folke, *Linking Social and Ecological Systems for Resilience and Sustainability, in* LINKING SOCIAL AND ECOLOGICAL SYSTEMS: MANAGEMENT FOR BUILDING RESILIENCE 1, 6 (Fiket Berkes & Carl Folke eds., 1998) [emphasis theirs].

[160] For example, in Tracy Dobson, *Community Participation in Natural Resources Management in Malawi: Charting a New Course for Sustainability*, 1998 COLO. J. INT'L ENVTL. L. & POL'Y 153, the author evaluates attempts to introduce such management approaches in a struggling developing nation.

[161] With Oran Young's approach to governance regime formation, inter-jurisdictional "co-management" arrangements can be crafted to include "cross-scale interactions." *See generally* Young, *Institutional Interplay: The Environmental Consequences of Cross-Scale Interactions, in* The Drama of the Commons, *supra* note 122, at 263.

By using a form of "stakeholder analysis," the International Development Research Centre in Canada and the International Union for the Conservation of Nature and Natural Resources has been able to successfully extend the CPR approach to the governance of these multisector/multidemand fisheries.

There is a growing literature on international and global CPR regimes.[162] Many versions of CPR governance and of co-management hybrids are currently operative with respect to governance of subsystems, including the fisheries, of the Cultural/Natural Ecosystem of the Great Lakes/St. Lawrence River Ecosystem. But it has been difficult to apply it to cases of migratory and/or straddling stocks of fish because the exclusion and subtractability aspects cannot be addressed directly. As of yet, there has been no attempt to identify and describe a representative subset of such governance capabilities related to fisheries in our Basin.

Application to Lake Erie

In light of what we understand to be the free-flowing dialogue in the Lake Erie committees and the lack of rigid formality, it may be useful to consider developing cross-scale co-management groups for each major stock of each major species. In keeping with CPR principles followed elsewhere, their memberships should include representatives from all stakeholder groups from both sides of the inter-jurisdictional border that the stock crosses in its migrations. Selection of members should assure that some of the specialized expertise needed for particular problems, *i.e.*, lamprey control. The chair could be given some supervisory authority for capturing, processing and transmitting data to relevant agencies. Moreover, a well-designed monitoring system needs to be implemented.

It may be tacitly accepted that the unsettled state of the governance of Lake Erie fisheries is due partly to the unsettled state of the Lake Erie ecosystem generally and partly to the shifting balance in political power between the different types of fishers within each jurisdiction. So, flexibility as is characteristic with CP-related co-management may be a virtue.

XI. CODE OF CONDUCT FOR RESPONSIBLE FISHERIES AND THE TECHNICAL GUIDELINES

While local communities have become more deeply involved with and connected to fisheries management processes, we should also consider the usefulness and application of management strategies developed at the global level. In particular, we find that the Code of Conduct for Responsible

[162] *See generally* Fikret Berkes, *Cross-Scale Institutional Linkages: Perspectives from the Bottom Up, in* THE DRAMA OF THE COMMONS, *supra* note 73, at 263-321.

Fisheries (CCRF),[163] developed through the Food and Agricultural Organization of the United Nations (U.N. FAO), could be a useful addition to the panoply of management strategies employed to move to responsible/sustainable fisheries at Lake Erie and elsewhere.

At its 94th Session in 1988, the Food and Agricultural Organization of the United Nations Council decided that

> Sustainable development is the management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such sustainable development . . . conserves land, water, plant genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable.[164]

The international process for formulating the CCRF, was formally initiated in 1991 for the following reasons:

> By the late 1980s it became clear ... that fisheries resources could no longer sustain [recent levels of] rapid and often uncontrolled exploitation and development, and that new approaches to fisheries management embracing conservation and environmental considerations were urgently needed. The situation was aggravated by the realization that unregulated fisheries on the high seas, in some cases involving straddling and highly migratory fish species, which occur within and outside [Exclusive Economic Zones], were becoming a matter of increasing concern.
>
> [FAO's] Committee on Fisheries (COFI) at its Nineteenth Session in March 1991 called for the development of new concepts which would lead to responsible, sustained fisheries.[165]

A complex, interactive process of transnational negotiation commenced in 1991, as special panels were convened by FAO to draft the CCRF and its Appendices.[166] The UN Conference on Environment and Development

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[163] U.N. FAO, *Code of Conduct for Responsible Fisheries* (Oct. 31, 1995), *available at* http://www.fao.org/fi/ agreem/codecond/ficonde.asp [hereinafter CCRF].

[164] U.N. FAO, 94th Sess. U.N. Doc. CL 94/6 (1988).

[165] *Id.*, at Preface.

[166] *See Technical Consultation on the Feasibility of Developing Non-Discriminatory Technical Guidelines for Eco-Labelling of Products from Marine Capture Fisheries*, U.N. FAO, U.N. Doc. FI:EMF/98/4 (1998), *available at* http://www.fao.org/fi/faocons/ecolab/fi-emf4f.asp.

(UNCED) convened in Rio in 1992;[167] 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) was held starting in April 1993,[168] reaching final agreement in 1995;[169] and a Committee on Fisheries (COFI) meeting was held in October 1995.[170]

The 1995 Code of Conduct for Responsible Fisheries and its Technical Guidelines Appendices is intended to be consistent with:

- "Our Common Future," the 1987 Report of the World Commission on Environment and Sustainable Development,[171] chaired by Gro Harlem Brundtland;
- The Rio Declaration[172] and Agenda 21[173] from the 1992 UNCED; as well as
- New elements in the 1995 U.N. Convention relating to straddling and migratory stocks.[174]

The Rio Declaration's Principle 15 is its "precautionary principle:"

> 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

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[167] *See* Center for International Earth Science Information Network, *UNCED Collection*, *at* http://www.ciesin.org/datasets/unced/unced.html (last visited May 18, 2002).

[168] *United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks*, *at* http://www.un.org/Depts/los/fish_stocks_conference/fish_stocks_conference.htm (last visited May 17, 2002).

[169] *Id.*

[170] International Institute for Sustainable Development, *Things to Look for in the Intersessional Period*, 7 EARTH NEGOTIATIONS BULL. 39, § 26 (1994), *at* http://www.iisd.ca/linkages/vol07/0739026e.html (last visited May 18, 2002).

[171] *See generally* U.N. WORLD COMMISSION ON ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, OUR COMMON FUTURE (1987).

[172] *See, e.g., Report of the United Nations Conference on Environment and Development*, Annex I, Rio Declaration on Environment and Development, U.N. Doc. A/CONF.151/26 (Vol. 1), 31 I.L.M. 874 (1992), *available at* http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm (last visited May 18, 2002) [hereinafter Rio Declaration].

[173] *See generally* United Nations Conference on Environment and Development, Agenda 21, U.N. Doc. A/CONF.151/26 (Vols. I-III) (1992), *available at* http://www.un.org/esa/sustdev/agenda21text.htm (last visited May 17, 2002), CCRF, *supra* note 163, art. 3.2(c).

[174] *Id.*, art. 3.2(a), *see generally* Agreement for the Implementation of the Provision of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, U.N. Doc. A/CONF./164/37 (1995), *available at* http://www.un.org/Depts/los/convention_agreements/texts/fish_stocks_agreement/CONF164_37.htm (last visited May 17, 2002) [hereinafter UNCLOS Fish Stocks Agreement].

> scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.[175]

The [UN] Conference on Straddling Stocks and Highly Migratory Stocks (New York, 1992-1995) also developed a consensus on the need to introduce or strengthen the precautionary approach to fishery management, imbedding the concept of its outcome in the draft[176] and outlining elements for its implementation.[177]

The 1995 CCRF contains a few explicit references to the term "sustainable development."[178] The terms "maximum sustainable yield" or "optimum sustainable yield," if used at all, are not prominent. The terms "conservation" and "responsible" are used frequently, but not defined explicitly leaving the reader to infer their meanings from the particular contexts in which they were used.[179]

Article 6 of the CCRF is a list of General Principles of responsible fisheries, with key notions of each principle summarized as follows:

1. Ecosystem approach, a right to fish implies an obligation for ecosystem stewardship;
2. Sustainable development;
3. Over-capacity and excess fishing effort prevention, degraded resources rehabilitation;
4. Scientific information and traditional knowledge to inform management decisions;
5. Precautionary approach to fishing and activities that affect fish habitat;
6. Selective and safe fishing gear;
7. Quality of fish and fish products maintenance;
8. Critical fisheries habitats protection;
9. Integration of fisheries interests into complex coastal area governance;
10. Effective legal measures to ensure monitoring, planning and management;
11. Responsibilities of a nation with flags on fishing vessels;
12. Cooperation in international law and related fisheries institutions;
13. Transparency and timeliness of decision processes;

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[175] Rio Declaration, *supra* note 172, at Principle 15.

[176] *See* UNCLOS Fish Stocks Agreement, *supra* note 174, art. 5(c).

[177] *See id.*, art. 6.

[178] CCRF, *supra* note 163, at Preamble, *see also id.*, arts. 6.2, 10.1.3, 11.1.5, 11.2.2.

[179] *See id.* The word "conservation" (not used in reference to other agreements with the word "conservation" in their titles) is used 60 times in the document; the word "responsible" is used 34 times.

14. Trade consistent with principles of the World Trade Organization;
15. Inter-jurisdictional dispute resolution;
16. Collaboration in governance by capture and culture fisheries;
17. Safe working and living conditions for fisheries personnel;
18. Preferential rights of artisan and small-scale fishers; and
19. Responsible aquaculture.[180]

The Technical Guidelines as Appendices to the CCRF include procedures pertaining to (1) fishing operations;[181] (2) the precautionary approach as applied to capture fisheries and species introductions;[182] (3) integrating fisheries into coastal area management;[183] (4) fisheries management;[184] (5) aquaculture development;[185] and (6) inland fisheries.[186] Hence, the CCRF, along with the relevant applicable guidelines, is intended to relate to any kind of fishery anywhere in the world

One way to perform a quick "check" of the possible relevance of CCRF to a particular fishery in the GL/SLRB would be to convene a panel of relevant experts for a day to examine current fishing, management and governance practices in that fishery with respect to each of the 19 Principles. An example of such a fishery might be the walleye fishery of the western half of Lake Erie. This approach could be termed "top down" in that it would involve efforts to perceive fisheries activities in our Basin within a global context.

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[180] *See generally* CCRF, art. 6.

[181] FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, FISHING OPERATIONS (Technical Guide for Responsible Fisheries, No. 1, 1996), *available at* ftp://ftp.fao.org/fi/document/techguid/fishope1.pdf.

[182] FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, PRECAUTIONARY APPROACH TO CAPTURE FISHERIES AND SPECIES INTRODUCTION (Technical Guide for Responsible Fisheries, No. 2, 1996), *available at* ftp://ftp.fao.org/fi/document/techguid/fishpre2.pdf.

[183] FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTEGRATION OF FISHERIES INTO COASTAL AREA MANAGEMENT (Technical Guide for Responsible Fisheries, No. 3, 1996), *available at* ftp://ftp.fao.org/fi/document/techguid/fishcoa3.pdf.

[184] FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, FISHERIES MANAGEMENT (Technical Guide for Responsible Fisheries, No. 4, 1996), *available at* ftp://ftp.fao.org/fi/document/techguid/ fishman4.pdf.

[185] FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, AQUACULTURE DEVELOPMENT (Technical Guide for Responsible Fisheries, No. 5, 1996), *available at* ftp://ftp.fao.org/fi/document/techguid/ fishaqu5.pdf.

[186] FOOD & AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INLAND FISHERIES (Technical Guide for Responsible Fisheries, No. 6, 1996), *available at* ftp://ftp.fao.org/fi/document/techguid/fishinl6.pdf.

XII. CONCLUSION

We have sought to depict scientific, historical and political understandings of the degradation of the Lake Erie Basin since about 1850. Our discussion lays out the multiple ways in which human intervention, fueled sometimes by greed and lacking adequate knowledge, was the primary driver in the "near-death" of the system; the Basin seemed to be degrading into an ecological state with unnatural, offensive and dangerous features that would likely be irreversible. We have identified examples of apparently successful policy and management interventions that have partially restored its health, in the face of new harmful stresses that are again posing novel threats. We suggest that building on these local successes, along with adapting successful approaches from outside the Basin, and working on multiple levels of governance, including the "grass roots," appears to be a way forward in governing such a complex and dynamic living system.

XIII. ACKNOWLEDGEMENTS

We thank Fikret Berkes, Marg Dochoda, Mike Jones and Donovan Steltzner for help with this exploratory essay. Many references to relevant work by others could and should have been cited.

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APPENDIX II: SELECTED LAWS AND AGENCIES RELEVANT TO GL/SLB GOVERNANCE

Agencies

Binational

International Joint Commission – http://www.ijc.org
Great Lakes Fishery Commission – http://www.glfc.org

Federal

Environmental Protection Agency – http://www.epa.gov
Environment Canada – http://www.ec.gc.ca
National Oceanographic and Atmospheric Administration – http://www.noaa.gov
U.S. Fish and Wildlife Service – http://www.fws.gov
U.S. Geological Survey – http://www.usgs.gov

Tribal

Great Lakes Indian Fish and Wildlife Commission – http://www.glifwc.org
Chippewa-Ottawa Resource Authority (successor to COTFMA) – http://www.1836cora.org

Provincial/State

Great Lakes Commission – http://www.glc.org
Council of Great Lakes Governors – http://www.cglg.org
Department of Fisheries and Oceans Canada – http://www.dfo-mpo.gc.ca
Ontario Ministry of the Environment and Energy – http://www.ene.gov.on.ca/
Michigan Department of Natural Resources, Fisheries Division – http://www.michigan.gov/dnr/ 0,1607,7-153-10364---,00.html
Michigan Department of Environmental Quality – http://www.michigan.gov/deq
Ohio Department of Environmental Protection – http://www.epa.ohio.gov/
Ohio Department of Natural Resources – http://www.dnr.state.oh.us/

Pennsylvania Department of Environmental Protection – http://www.dep.state.pa.us/
Pennsylvania Fish and Boat Commission – http://www.fish.state.pa.us/
New York Department of Environmental Conservation, Bureau of Fisheries – http://www.dec.state.ny.us/website/dfwmr/fish/index.html

Non-Governmental Organizations

Great Lakes United – http://www.glu.org/mainpage.htm

Conventions

Convention for the Protection of Migratory Birds, Aug. 16, 1916, U.S.-G.B (for Canada), 39 Stat. 1702.
Inland Fisheries Treaty, 1908 (withdrawn in 1914).
Treaty Relating to Boundary Waters, Jan. 11, 1909, U.S.-Gr. Brit., 36 Stat. 2448.
Convention on Great Lakes Fisheries, Sept. 10, 1954, U.S.-Can., 6 U.S.T. 2836, T.I.A.S. 3326.
Agreement on Great Lakes Water Quality, U.S.-Can., April 15, 1972, 23 U.S.T. 301, *amended* Nov. 22, 1978, 30 U.S.T. 1383, *amended by* Protocol, Nov. 18, 1987, T.I.A.S. No. 11,551.
North American Free Trade Agreement, Can.-U.S.-Mex., Dec. 17, 1992, 32 I.L.M. 289 (1993).

Federal statutes

Canada

Fisheries Act, R.S. ch. F-14 (1985).

United States

Anadromous Fish Conservation Act of 1965, 16 U.S.C.A. §§ 757a-g (West 2000).
Coastal Zone Management Act of 1972, 16 U.S.C.A. §§ 1451–1464 (West 2000).
Comprehensive Environmental Response Compensation and Liability Act of 1980, 42 U.S.C. §§ 9601-9675 (1994).
Endangered Species Act of 1973, 16 U.S.C.A. §§ 1531-1544 (West 2000).
Estuary Protection Act of 1968, 16 U.S.C. §§ 1221-1226 (1994).

Federal Aid in Fish (Dingell-Johnson Sport Fish) Restoration Act of 1950, 16 U.S.C. §§ 777, 777a-i, 777k-m (1994).

Federal Power Act of 1920, 16 U.S.C.A. §§ 791-825 (West 2000)

Federal Water Pollution Control Act Amendments, 1987, P.L. 100-4, February 4, 1987; 101 Stat. 7 (codified as amended in scattered sections of 33 U.S.C.).

Fish and Wildlife Act of 1956, 16 USCA §§ 742a to 742j, 742j-1, 742j-2

Fish and Wildlife Coordination Act of 1934, 16 U.S.C.A. §§ 661-666 (West 2000).

Fishermen's Protective Act of 1954, 22 U.S.C.A. §§ 1971-1980 (West 2000).

Fish and Wildlife Improvement Act of 1978, 16 U.S.C. §§ 712, 7421 (1994).

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State/Provincial

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