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ABSTRACT

In the Canada–United States transboundary region, ecological ideas and the concept of 'ecosystem management' are being increasingly used in discussions of Great Lakes issues, and to a degree, they are incorporated into programs of binational cooperation focused on the Lakes. Conceptual underpinnings for 'ecosystem management' are derived from ecophilosophy, ecology/ecosystem science, and political ecology. The application of ecosystem management in various Great Lakes programs is noted. While the concept is beginning to be used in practice, the larger implications of the concept have not been realized. The International Joint Commission (IJC) has played a crucial facilitating role to advance Basin-wide discussions about the concept and its application in practice.

INTRODUCTION[1]

'Ecosystem management' is a phrase that is coming into use. Like 'environmental management,' with which it is often contrasted, it may eventually be defined primarily by what gets done under its heading. For the time being, it reflects a growing disquiet about some trends among the changes underway in the world combined with insights into the proper relationships that humanity must attain with their one and only biosphere.

During the past two decades, the phrase 'environmental management' came into widespread use. Various interpretations of its meaning became evident among environmental agencies and advocacy groups. Most often, the phrase referred to regulatory and other measures for reducing pollution discharges into water, air, or landfills serving as environmental sinks. In the private sector, the phrase was directed to actions by the upper management of individual companies to use resources more

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1. Much of this work was carried out through the International Center for Research on Environment and Development in Paris under the direction of I. Sachs, and it is incorporated into work by the International Foundation for Development Alternatives in Geneva.

efficiently, thereby reducing the volume of wastes to be handled and, in a number of cases, enhancing profits.

Interpretations of 'environmental management' were also based on conclusions about the proper relationship that should be maintained between environment and development. This was much discussed in international circles, where 'environmental management' came to refer to the need to manage socioeconomic development strategies so that they would also be environmental sound, hence sustainable. The term 'ecodevelopment,' coined at the 1972 United Nations Conference on Human Environment at Stockholm to refer to this kind of environmental management, was subsequently elaborated as a strategy that gave priority to meeting the basic needs of people directly while enhancing their community self-reliance in ways that were environmentally sustainable.[2] Similar ideas for industrialized countries were discussed under the heading of a 'conserver society,' one that emphasizes greater efficiency in resource use, more economic self-reliance at national, regional and community levels, and respect for the regenerative capacities of ecosystems.[3]

In 1980, the World Conservation Strategy formulated three goals for ecological sustainability: maintenance of essential ecological processes, conservation of biotic diversity, and the sustainable use of renewable resources.[4] The theme of 'sustainability' has become a central one following the report of the World Commission on Environment and Development (the Brundtland Commission) in 1987.[5] A global strategy statement being prepared for the 1990s has incorporated ecological sustainability into a basic set of principles for sustainable development.[6] Increasingly, environmental management and ecosystem management are being contrasted as ideas about the relationships needed between environment and development have evolved. The former is associated with environmental protection through modest reform measures. 'Ecosystem management' is associated with ecological sustainability, and a general belief that more substantial societal change is required to achieve it.

This paper first surveys some of the conceptual underpinnings that seem inherent in the phrase 'ecosystem management.' Underlying ideas derive from philosophical issues, the different 'schools' of ecology that are discernible within the ecological sciences, and some political ecol-

2. *See, e.g.*, K. Valaskakis *et al.*, The Conserver Society: A Workable Alternative for the Future (1979).

3. International Union for the Conservation of Nature *et al.*, World Conservation Strategy (1980). A number of countries and jurisdictions within countries subsequently prepared their own conservation strategies.

4. World Commission on Environment and Development, Our Common Future (1987).

5. International Union for the Conservation of Nature *et al.*, Caring for the World: A Strategy for Sustainability (forthcoming) (2nd draft, 1990).

6. *See generally* W. Fox, Towards a Transpersonal Ecology: Developing New Foundations for Environmentalism (1990) (presenting a thorough review and critique of ecophilosophies).

ogy used to advocate societal reforms. Some similarities and differences between 'ecosystem management' and the concepts of comprehensive water resources management and integrated river basin development will be noted.

In the Canada–United States transboundary region, ecosystem notions emerged during the mid-1970s in the context of binational cooperation on the Great Lakes. Ecosystem language is now extensively used in discussions about Great Lakes issues, and it has appeared in several, but not all, of the binational agreements pertaining to the Great Lakes. There is need to examine the extent to which ecosystem thinking has gone beyond the rhetoric of agencies and advocacy groups to help direct the measures being taken to address Great Lakes issues. Observations from this perspective will be made on current programs and some new initiatives being promoted for the Great Lakes, and on some implications for governance. Finally, a few concluding observations will be made about the role of the International Joint Commission (IJC).

ECOLOGISM: PHILOSOPHY, SCIENCE, AND POLITICS

'Ecosystem management' is inspired and informed by a mix of ideas drawn from 'ecophilosophy,' ecosystem science, and political ecology. The particular mix depends on the context within which ecosystem management is being discussed, especially with reference to the definition of purposes or problems for which ecosystem management is the solution. The main ideas which form this underpinning for ecosystem management are summarized below.

Ecophilosophy

'Ecophilosophy' is a generic term used in reference to a growing array of writings about the relationships of humans and their natural world. A common theme is the need to reject traditional anthropocentric views about human dominance over and exemption from many natural processes and accept instead the realization that humans are members of ecosystems upon which they are totally dependent for their survival. Ecophilosophers thus distinguish themselves from 'environmentalists' whom they see as believers in the traditional views.[7]

A variety of typologies have been brought forward to make this distinction. One that distinguishes between 'shallow environmentalism' and 'deep ecology' has held center stage almost since it was introduced in 1973 by the Norwegian philosopher A. Naess.[8] The adjectives 'shallow'

7. *See generally* B. Devall & G. Sessions, Deep Ecology: Living as if Nature Mattered (1985); A. Naess, *Intuition, Intrinsic Value and Deep Ecology*, 14 The Ecologist 201 (1984); A. Naess, Ecology, Community and Lifestyle (1990).

8. Naess, Ecology, Community and Lifestyle, *supra* note 8, at 72.

and 'deep' were originally intended to convey a gentle questioning of the underlying beliefs and values of people involved in environmental disputes.[9] They have often become pejorative distinctions in some polemics which have since ensued.[10]

Environmental ethics have been the focus of much discussion, although some of it has gone well beyond ethics into matters of cosmology, ontology and epistemology. The ethical issues have been posed in terms of the extent to which moral consideration, involving recognition of some kind of natural rights, should be extended to non-human beings. Related issues are the criteria for deciding this, and the resulting obligations placed upon humans in return. Some proponents would extend the obligations only to 'sentient beings,' that is, creatures giving evidence of having some conscious awareness or the capacity to feel pain. This view has been associated mainly with proponents of animal rights.[11] Others see the logical necessity of including all forms of life, including some considered not too congenial by humans.[12] Other proponents wish to extend recognition with attendant human obligations to forms of biological organization beyond individual organisms, such as plant and animal communities and ecosystems.[13] Nash, in an extensive description of the evolution of these various views, notes that they can be seen as part of an historically expanding concept of rights from proponents who share "common cultures with liberal traditions based on natural rights ideology [which] made the conceptual leap from recognizing oppressed people to recognizing exploited nature less difficult."[14]

There are also issues about what kind of rights the non-human entities have by virtue of their existence. Some apprehension can arise whenever it is assumed that some kind of collective rights for ecosystems take precedence over individual human rights. The inherent political danger in this should be noted.[15] For the deep ecologists, however, the rights

9. *E.g.*, G. Bradford, How Deep is Deep Ecology? (1989).

10. *E.g.*, P. Singer, Animal Liberation: A New Ethics for Our Treatment of Animals (1975); T. Regan, The Case for Animals Rights (1983).

11. *E.g.*, P. Taylor, Respect for Nature: A Theory of Environmental Ethics (1986).

12. For a discussion of these views under the heading of "autopoetic ethics," see Fox, *supra* note 7, at 165. All these views are, or seem to be, based on arbitrary distinctions.

13. R. Nash, The Right of Nature: A History of Environmental Ethics 123 (1989). *See also* A. Bramwell, Ecology in the 20th Century: A History 5 (1989)(commenting on the historically persistent "ethnic map" of ecologists confined largely to Britain, Germany and North America).

14. For example, "it becomes very difficult to explain why killing of people is not a virtuous act. We are, after all, a destructive species . . . whose numbers have grossly exceeded whatever level would be optimal for the biotic community." M. Warren, *Environmentalism and Environmental Rights*, *in* 2 Environmental Ethics 61 (1989). *See also* Bramwell, *supra* note 13 (tracing the existence of ecologism as a hidden agenda in The Third Reich). Bramwell's forebodings are expressed in such chapter titles such as "Was There a Generic Fascist Ecologism?," in Ch. 8, at 161–74; Ecology: A German Disease?, Part 3 heading at 175–208.

15. Naess, Ecology, Community and Lifestyle, *supra* note 7, at 28.

that should be acknowledged, at least in principle, are "the equal right to live and bloom"[16] and "the freedom of all entities to unfold in their own ways."[17] This is an insight that ultimately derives from a personal, experiential identification with the natural world and a strong sense of interconnectedness with it. In contrast to the mystical tradition where the fundamental unity of existence is experienced in some Oneness of Being in which all form dissolves, this experience of nature results in an acute realization of the existence of, and impartial identification with, all entities in one's surroundings.[18]

The importance of ecophilosophy for ecosystem management lies in the critical reexamination it brings to bear upon the assumptions underlying management. More deference is required towards Nature and management should focus on adapting human activities to fit better with natural processes.

Ecology/Ecosystem Science

As the central discipline for ecosystem science, ecology is relied upon to help guide management actions. As in other fields, there are several 'schools' of ecology, each based upon views about the proper approaches for analyzing ecosystems. The different approaches can be associated with distinctive 'root metaphors,' social constructs that provide different images about the workings of the natural world.[19]

In addition, intellectual disputes arise between traditional scientific reductionists and systems theorists. The former will accept 'ecosystem' at best to be an informing concept, helpful for analyses of phenomena that exist in nature only as interacting populations. The latter accept ecosystems as entities which exist in their own right, have self-organizing behaviors which display emergent properties, exhibit a sense of strategy in their own development and possess their own evolutionary histories.[20]

Four 'schools' to which ecosystem managers might turn for guidance are as follow:

16. Fox, *supra* note 6, at 268.

17. *Id.*

18. "Every generation . . . writes its own description of the natural order, which generally reveals as much about human society and its changing concerns as it does about nature." D. Worster, Nature's Economy: The Roots of Ecology 292 (1979).

19. The word *ecosystem* was coined to reflect the belief "that the best way to analyze ecosystems was through the flows of energy as if they were physical systems." Worster, *supra* note 18, at 301; *see also* R. McIntosh, The Background of Ecology: Concept and Theory 98 (1985). The trophic dynamics approach to ecosystem analyses reflects this view. *See infra* notes 24–25 (noting systems theorist views).

20. "In their most recent theoretical model, ecologists have transformed nature into a reflection of the modern corporate industrial system." Worster, *supra* note 19, at 292.

(a) Trophic dynamics, based on an industrial enterprise as a root metaphor.[21] Ecosystems are composed of organisms that serve the roles of producers, primary and secondary consumers, and decomposers. The organisms are involved in intense competition within and between populations which results in degrees of specialization in their functions (niche) within the over-all ecosystem. Ecosystems evolve structures characterized by a few species which dominate the system to the point of influencing the quality of the environment within which other species survive. From time to time ecosystems are subject to catastrophic change which is really part of some larger scale or longer time period processes, rather like business enterprises going bankrupt during recessions but starting up again afterwards.[22] The productivity of the organisms and the efficiency of energy transformations in the food webs reflect the biogeochemical cycling of nutrients and the flows of energy through the system. This is the familiar textbook explanation of ecosystems. Analyses from this perspective can guide the management of ecosystems for the extraction of resources in sustainable, nondestructive ways.

(b) Conservation biology, based on the sense of community as a root metaphor. Community obligations require effective action to halt human-induced extinctions of plants and animals, paying special attention to the most vulnerable of the non-human beings sharing ecosystems with us. This perspective provides guidance for managing ecosystems to maintain or enhance biodiversity by establishing systems of protected areas, or maintaining remnant populations in zoos or botanical gardens. This school of ecology is avowedly normative and conservation activities are often pursued with a great sense of urgency.[23]

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21. Explaining the ecosystemic functions that cause periodic, localized catastrophic changes in ecosystems, C.S. Holling referred to the forces of fires, storms, pests, and senescence as the "creative destruction" phase of a four phase model of ecosystem dynamics. He notes that the term was borrowed from Joseph Schumpeter who used it to interpret the economic depression of the 1930s. *See* C.S. Holling, *The Resilience of Terrestrial Ecosystems: Local Surprise and Global Change, in* Sustainable Development of the Biosphere 306 (W. Clark & R. Munn eds., 1986).

22. *See, e.g.*, E. Wilson, *The Biological Diversity Crisis*, 35 BioScience 700 (1985); M. Soule, *What Is Conservation Biology?* 38 BioScience 337 (1985). Soule articulates functional and normative postulates for conservation biology which he sees as a "crisis discipline" in which one must act without having all the facts, and use intuition as well as information to make decisions. *See also* M. Soule, *Conservation: Tactics for a Constant Crisis*, 253 Sci. at 744–50 (1991).

23. *See, e.g.*, R. Steedman & H. Regier, *Ecosystem Science for the Great Lakes: Perspectives on Degradative and Rehabilitative Transformations*, 44 Canadian J. Fisheries & Aquatic Sci. 95 (1987). The properties of overly stressed ecosystems have been discussed by a number of scientists, including D. Rapport et al., *Ecosystem Behavior Under Stress*, 125 Am. Naturalist 617 (1985); D. Schaeffer *et al.*, *Ecosystem Health: I Measuring Ecosystem Health*, 12 Envtl. Mgmt. 445 (1988); D. Rapport, *What Constitutes Ecosystem Health?*, 33 Persp. Biology & Med. 120 (1989).

(c) Stress-response ecology, based on a medical analogy of an ecosystem physician as a root metaphor. Ecosystems are viewed to be open, self-organizing systems, vulnerable to stresses which are revealed in general distress syndromes. Ecosystems become degraded by excessive human use or abuse of them over time. The symptoms of human induced stresses can be identified and their causes diagnosed. Often these diagnoses can be linked to particular sources which can be targeted for remedial measures. This perspective provides guidance for rehabilitative management to remove or reduce human stresses upon ecosystems and permit them to recover through natural internal processes.[24]

(d) Non-equilibrium systems dynamics and catastrophe theory, based on a cosmological or Gaian metaphor. Ecosystems are self-organizing, evolutionary systems driven by solar energy. They must dissipate this energy and over time they develop more complex organizational structures to do so. The changes can be continuous or episodic (catastrophic), meaning that an ecosystem maintaining itself at some steady-state level for a period of time may be reorganized suddenly to a new level of structure better able to dissipate energy.[25]

Besides the above 'schools,' other perspectives on ecosystems cut across those of the 'schools.' Hierarchy theory in ecology addresses the 'vertical' interconnections of subsystems (or holons) within systems. Landscape ecology focuses more on 'horizontal' interconnections and ecosystem processes among patches, edges and corridors that give rise to patterns on the landscape.[26] The perspectives on ecosystems also vary with the geographic scale and time horizons adopted for ecosystem analyses.

Human Ecology

This is a multi-disciplinary field in the social sciences which adopts a humans-in-environment systems perspective and various concepts from biological ecology to understand human society and also the changing conditions of ecosystems. It draws most heavily on social anthropology and human geography, since these fields include knowledge about biophysical resources as necessary factors for understanding human organization and socio-economic change; elements of biology and medicine are particularly evident in studies of the negative impacts certain environments have on human health and well-being.[27] One school of

24. For work by proponents of this school, see R. Ulanowicz, Growth and Development: Ecosystem Phenomenology, Springer-Verlag (1986); P. Kay, *A Non-Equilibrium Thermodynamic Framework for Discussing Ecosystem Integrity*, 15 Envtl. Mgmt. 483 (1991).

25. *See, e.g.*, T. Allen & T. Starr, Hierarchy: Perspectives for Ecological Complexity (1982); R. Forman & M. Godron, Landscape Ecology (1986).

26. *E.g.*, E. Moran, The Ecosystem Concept in Anthropology (1984).

27. *See* A. Hawley, Human Ecology: A Theoretical Essay (1986).

human ecology drew upon earlier views of plant succession to describe phenomena of ethnic mobility in cities, and it has since tried to codify human ecology as a major field of sociology which utilizes biological and ecological concepts.[28]

Political Ecology

O'Riordan presented a typology of environmentalism that distinguished between 'technocentrism' and 'ecocentrism' and variations within each.[29] The typology still appears helpful. The 'Cornucopians' among the technocentrists are the perennial optimists, convinced that human ingenuity and will combined with increasing technological expertise can overcome problems and meet the challenges of the future. Their main fear is of failure because of too much pessimism and despair, arising in part because of the doom and gloom context within which so many environmental and other problems are discussed. Ecological problems are not dismissed. It is just that they must be seen in a much more global and evolutionary sense.[30] By contrast, the 'environmental managers' seem rather restricted and unimaginative. They are characterized as people secure in their convictions that economic growth and resource exploitation can continue indefinitely providing that clear standards for environmental protection are promulgated, enhanced techniques for benefit-cost analyses and impact assessments are adopted, and adjustments in prices, fees, or taxes are made to address particular problem situations.

The 'deep ecologists' have produced a 'platform' of basic principles that reflect what they see as the common ground among them. The platform celebrates the flourishing of all life, including that of diverse human cultures. It touches more sensitive issues by noting that this goal would be achieved best by a considerable reduction in human numbers, along with policy measures to reduce excessive human interference with the non-human world. For deep ecologists, it is up to each individual to decide how these principles can be applied for actions to be taken in particular situations they face, but the principle of nonviolence should be followed.[31] Otherwise, no one has taken the time to elaborate the connection

28. *See* T. O'Riordan, Environmentalism (1981).

29. For example: "The integrity, basic health and strength, and wholeness of Nature cannot be seen by those who are not whole themselves . . . the Earth's environment is remarkable stable, self-correcting, and able to overcome relatively minor disturbances that are imposed on it by ignorant and still primitive humans . . . our main problem is that we lack sufficient knowledge about the long-term trends of an evolving planetary society. We have no experience on which to draw. . . . For now, we must realize that we are merely suspended between old problems and new opportunities, that we are in transition between old and new social values, between old and new technologies, between economic retrogression and progress, between political polarization and co-operation in governing the planet." F. Feather, G-Forces, Re-Inventing the World: The 35 Global Forces Restructuring Our Future 243–44 (1989). This is a view of Gaian proportions.

30. Naess, Ecology, Community and Lifestyle, *supra* note 8, at 6.

31. *Id.* at 13.

between the basic principles of [deep ecology] and the specifics of a singular real-world situation. And this is a shame, because, if there is to be any test of the worth of ecophilosophy, this is it. So here is an area which much work can be done![32]

The ecocentrism reflected by advocates of small-scale, community-based self-reliance using 'soft technologies' reflects some common ground among views held by supporters of 'green politics.' A more radical version of this has long been advocated by Bookchin who laid down the challenge over a decade ago:

> for a revolution which will produce politically independent communities whose boundaries and populations will be defined by a new ecological consciousness, communities whose inhabitants will determine for themselves within the framework of this new consciousness the nature and level of their technologies, the forms taken by their social structure, world views, life styles, expressive arts, and all the other aspects of their daily lives.[33]

Based on the philosophy of 'social ecology' which "proposes a principle of ecological wholeness . . . a dynamic unity of diversity in which balance and harmony are achieved by ever-changing differentiation," human society must transform itself to become a social ecological system within a natural ecological system, with an ecological sensitivity that perceives the balance and integrity of the biosphere as an end in itself.[34] Such a society will have critically reshaped its system of needs, seeking greater simplicity but more spontaneity, it will be based on small communes formed by affinity groups, it will have cooperative institutions in all areas of social life, and decisions will be arrived at through face-to-face democratic discussions in town or neighborhood assemblies.

Toward Sustainability

'Sustainability' as defined by the Brundtland Commission is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[35] There are some basic ecosystemic requirements for sustainability. Sociocultural requirements include those needed to fulfill the ecosystemic requirements and others to maintain the social-cultural integrity of the society to be sustained. These in turn raise a number of issues, including the normative assumptions underlying the notion of sustainability, the identification of

32. M. Bookchin, Toward an Ecological Society 45 (1980).

33. Renewing the Earth: The Promise of Social Ecology 5 (J. Clark ed., 1990).

34. World Commission on Environment and Development, *supra* note 4, at 8.

35. *See, e.g.*, J. Gardner, *Decision-Making for Sustainable Development: Selected Approaches to Environmental Assessment and Management*, 9 Env't Impact Assessment Rev. 337 (1989); H. Daly, *Toward Some Operational Principles of Sustainable Development*, 2 Ecological Econ. 1 (1990).

what precisely is to be sustained, and the implications for societal change entailed by answers to these questions.[36] One attempt to summarize the normative goals and principles of sustainability is summarized in Table 1.[37]

TABLE 1: Sustainability

Basic Value Principles	The continued existence of the natural world is inherently good. The natural world and its component life forms, and the ability of the natural world to regenerate itself through its own natural evolution, have intrinsic value. Cultural sustainability depends upon the ability of a society to claim the loyalty of its adherents through the propagation of a set of values that are acceptable to the populace and through the provision of socio-political institutions that make realizations of these values possible.
Key Characteristics of Sustainability	Sustainability is a normative ethical principle. It has both necessary and desirable characteristics. There is no single version of a sustainable system. Both environmental/ecological and social/political sustainability are required for a sustainable society. Sustainability is a process, not a state. It will often be easier to identify unsustainability than sustainability.
Principles for Sustainability	Principles for environmental/ecological sustainability deal with the protection of life support systems of air, water and soil; the protection and enhancement of biotic diversity; and the protection and enhancement of the productivity of renewable resources. Rehabilitative measures for badly degraded ecosystems may be required. Some principles for socio-political sustainability follow from those for environmental/ecological sustainability. These include keeping the scale of human activities and their accumulative effects to within the carrying capacity of the planetary biosphere; using methods to minimize energy and material use per unit of economic activity and to reduce noxious emissions; and making arrangements to bring environmental concerns more directly and extensively into decisions in all sectors. Other principles concern society directly. They address the need for socio-political and economic equity among people; provisions to protect all people from extreme want and from vulnerability to economic coercion; assurance of an open and accessible political process; and maintenance of the basic freedoms and justice associated with democratic societies.

Adapted from J. Robinson *et al., Defining a Sustainable Society: Values, Principles and Definitions*, 17 Alternatives 36 (1990).

36. J. Robinson *et al., Defining a Sustainable Society: Values, Principles and Definitions*, 17 Alternatives 36 (1990).

37. For example, the International Foundation for Development Alternatives' Dossier and Turning Point 2000. *See also* The Living Economy: A New Economics in the Making (P. Ekins ed., 1986).

Implementation of these principles would require many of the measures advocated for 'conserver societies,' including 1) reductions in the use of various materials combined with greater reuse and recycling; 2) 'zero discharge' of toxic compounds; 3) measures to improve the efficiency of the end use of energy resources; 4) urban redesign to increase densities as well as the quality of living; 5) more ecologically-sensitive use of landscapes and associated resources; and 6) different approaches to defining work, security, and leisure. Community level experiments to address these are under way throughout North America and elsewhere in the industrial world.[38]

Some of the larger implications, however, have not been addressed to the same extent in the context of global interdependence. As noted by Robertson, a new development path "should be systematically enabling for people [to enhance their self-reliance and self-development], be systematically conserving of resources and environment, treat the world's economy as a multi-level one world system with autonomous but interdependent parts at all levels, and be supported by up-to-date economic ideas."[39]

The goal is to enhance cooperative self-reliance rather than greater dependencies among socio-economic units at different scales. Thus, the principal functions of each larger, higher level economic unit from the household through community to the region, nation, and the world is to enable its component sub-economies to be more self-reliant and more conserving.[40] Robertson discusses some of the many implications of this in terms of revised notions of work, organization, money, taxes, and new financial institutions.

Dobson has detected a distinctive political ideology emerging as 'ecologism' and the notion of a sustainable society.[41] Social movements and political parties of various stripes draw upon these ideas for inspiration and for formulating positions on particular issues. Otherwise they usually avoid the fractious process of seeking to elaborate and articulate more complete statements of their political philosophy and programs to which all their members might be expected to agree. Different shades of green can be discerned among public figures. Environmentalism and power-holding political parties are cast in the light green end of the spectrum. Among the darker greens, the belief in the necessity for radical social and political change contrasts with their reliance (so far) on traditional liberal-democratic means of bringing it about.[42] Bramwell also commented "that the apparent contradictions of the ecological movement can

38. J. Robertson, Future Wealth: A New Economics for the 21st Century 1 (1990).
39. *Id.*
40. A. Dobson, Green Political Thought (1990).
41. *Id.* at 23.
42. Bramwell, *supra* note 14, at 13.

be resolved by seeing it as forming a new political category in its own right, with a history, right wings and left wings, with leaders, followers and a special epistemological niche all to itself."[43] Somewhat in contrast, Hayes has interpreted environmentalism in the United States to reflect the age of consumers. Quality of life is being demanded now that the need for basic necessities has been met by an advanced industrial society.[44]

ECOSYSTEM MANAGEMENT: AN INTERPRETATION

Ecologism not only provides diverse ideas to inform ecosystem management, it also provides some mutually inconsistent ones. Some scientists see nested sets of hierarchies among and within ecosystems; political ecologists see interdependence suggesting that there is a strong sense of equality since each component of an ecosystem is necessary for the viability of the others. Social ecologists find evidence of unity-in-diversity, spontaneity, and non-hierarchical relationships in ecosystems; these are guidelines for organizing society.[45] Ecophilosophers generally believe that unity and stability in ecosystems exist and are associated with a high diversity of species; scientists have for the most part rejected the 'diversity-stability' proposition,[46] albeit after long debate amid considerable semantic confusion.

It is not unusual to have proponents of social doctrines look to nature to confirm their views. That nature seems to confirm contrasting and conflicting views suggests that more subtle processes of psychological projection and reification are at work. Ecology as a science has various underlying social constructs, or root metaphors, that lead to different schools of thought about how ecosystems are best understood. These prescientific gestalts are themselves rooted in the culture of a society, and their degree of acceptance may be partly determined by cultural trends or ideological preferences.

Worster notes that ecology has helped shape views about humans-in-nature and that the 'moral ambivalence of ecology' can be traced back to two traditions which emerged in the 18th century.[47] The 'arcadian' tradition advocated a simple, humble life for people to restore them to peaceful co-existence with other organisms, whereas the 'imperial' tradition aimed to acquire knowledge and skills to achieve human domination over nature.[48] Worster has further noted that "behind the per-

43. S. Hayes, Beauty, Health, and Permanence: Environmental Politics in the United States, 1955–1985 (1987).

44. *See, e.g.*, Bookchin, *supra* note 33.

45. D. Goodman, *The Theory of Diversity-Stability Relationships in Ecology*, 50 Q. Rev. Biology 237 (1975).

46. Worster, *supra* note 18.

47. *Id.* at 2.

48. D. Worster, *The Ecology of Order and Chaos*, 14 Envtl. Hist. Rev. 1 (1990).

sistent enthusiasm for ecology lies the hope that this science can offer a great deal more than a pile of data. It is supposed to offer a pathway to a kind of moral enlightenment that we can call, for the purposes of simplicity, 'conservation.'"[49] McIntosh comments:

> Although ecologists had long asserted that ecological science was significant in offering insights about, and to human societies, they were ill prepared to cope with the abrupt seizure of the name and its extension to include all aspects of environmental concern, often leaving behind ecological concepts and canons of evidence which had been developed over the decades.[50]

With the emergence of ecologism as a political ideology, the word 'ecosystem' continues to carry doctrinal baggage its originator had hoped to avoid.[51] The systems theorists' notion of 'ecosystem' as an entity in nature which exhibits self-organizing capabilities, has an implicit strategy for its own development and possesses a history, and challenges scientific beliefs about the sufficiency of reductionism for scientific explanation. Implicitly, it also challenges beliefs about a world without limits that sanctions continuous technology and market-driven corporate growth. Disregarding the word and the concept will not, however, resolve the issues raised by it.[52]

In light of the above, it is not surprising that the phrase 'ecosystem management' carries with it considerable ambivalence. The notion fits rather awkwardly with some versions of political ecology. For Cornucopians it would be far too myopic while for the 'ecocentrists' the presumptions of 'management' raise the spectre of the managerialism which they believe generated the kinds of environmental and other problems that their philosophical probings are trying to overcome. It fits much better with the 'environmental managers,' but with the danger that the new ecological expertise to be brought to bear through management will be

49. McIntosh, *supra* note 19, at 1.

50. The word was coined by A.G. Tansley in 1935 to express a physical concept in which the study of energy flows and transformations in nature would become the central focus of inquiry. The intent was to rid the field of ecology from 'organismic philosophy' reflected by the notion of natural communities and put it on a par with thermodynamic physics. *See* Worster, *supra* note 18, at 301.

51. Worster comments on the abandonment of 'ecosystem' in favor of "a nature characterized by highly individualistic associations, constant disturbance, and incessant change [that] may be more ideologically satisfying than Odum's ecosystem with its stress on cooperation, social organization and environmentalism." Worster, *supra* note 48, at 11.

52. In this context, 'ecosystem management' would be at the service of resource development by adopting strategies that make use of resources with increasingly less natural qualities resulting, for example, in intensified high grading of forests, or the 'fishing-up' of fish stocks of certain size or quality. *See* H. Regier & G. Baskerville, *Sustainable Redevelopment of Regional Ecosystems Degraded by Exploitive Development, in* Sustainable Development of the Biosphere, *supra* note 21, at 75.

directed towards seeking more effective ways of exploiting ecosystems for resources.[53]

In general, however, the increasing use of the phrase 'ecosystem management' seems to reflect a partial abandonment of some underlying beliefs associated with the exploitative uses of nature for purely utilitarian purposes. It also rejects the underlying confidence that scientific and technological expertise can always resolve problems of impending scarcities or limits, providing that the right mix of price or other incentives is offered by governments. This trend is associated with a growing recognition of the importance of ecological understanding for guiding human uses of environmental resources; an awareness that humans must see themselves as integral components of complex, interdependent ecosystems related to one another over a wide range of temporal and spatial scales; and acceptance of the conclusion that other living components of ecosystems, or even ecosystems *per se*, have inherent value in and of themselves, regardless of their immediate usefulness to humans as resources.

The implications are that in moving away from a narrow anthropocentric, utilitarian ('resourcist') stance towards a more biocentric view of the world, management of ourselves takes precedence over the manipulation of nature. Issues in dispute, given this changing world view, include the extent to which major changes are required in personal lifestyles, institutional structures and behaviors, and in community socioeconomic relationships at various scales of interdependence. 'Environmental management' is on the modest reform end of the spectrum, relying as it does on advocating improved technological efficiencies, materials recycling, 'green consumerism,' environmental impact statements, and reliance on market incentives. A question is whether, or to what extent, 'ecosystem management' requires more, and if so, what else has to be done?

The notion of ecosystem management applied to lakes and river basins has one conceptual similarity to, and one main conceptual difference from, the notion of comprehensive water management and integrated river basin development. The similarity is the adoption of a systems perspective that requires taking into account complex interrelationships among people, biota, land, and water in order to make decisions about change. The difference is that the central issue is not that of managing water and its use as an economic commodity, but of directing human behaviors to become more appropriate to the living systems of which they are a part and upon which their survival in sustainable societies depends.

Some water resource managers view ecosystem management as a major add-on, or include-in requirement for their profession:

53. United Nations' Economic Commission for Europe, Ecosystem Approach to Water Management 6 (1989).

> [R]ecently another water management function has appeared. It consists of maintaining ecological equilibrium in nature, improving and restoring landscapes, and conservation and rehabilitation of large natural complexes where water is a component of vital importance. In order to respond adequately to this demand the very objectives need to be examined and water management systems themselves accordingly re-formulated.[54]

From the environmental management perspective, the emphasis would be one of degree only. Provisions can be made to consider fish and wildlife habitat, or to reduce pollution as part of the reconciliation of competing uses of water or other developments in a given river basin. The habitat issue, however, is usually linked to traditional views about fish and wildlife in which only those species desired for sport or profit are considered. This would be deeply offensive to ecocentrists. Pollution control, too, would be compatible with ecosystem management, but associated notions of 'assimilative capacity' would have to consider effects on all organisms, not just people and the few fish or wildlife of value to them. Given the varying sensitivities among organisms to different pollutants, ecosystem management would entail serious measures to achieve 'zero discharge' of toxic contaminants and perhaps all pollutants, a goal that economic analyses for water management would find extreme.

Ecosystem management measures would, however, have to address many of the same operational issues that are faced by water and other resource managers for achieving multiple objectives on a regional scale. Boundaries are one such issue. River basins are not always the most appropriate regions for managing water supply and waste treatment services,[55] nor are they always the most appropriate bioregions for ecosystem management.[56] The issue of choosing the right mix of policy instruments must also be faced. As people are seen to be members of eco-

54. For reviews of the limitations inherent in the notion of integrated river basin management, *see* N. Wengert, A Critical Review of the River Basin as a Focus for Resources Planning Development, and Management, *in* Unified River Basin Management (American Water Resources Association, R. North *et al.*, eds. 1982); *The River Basin Concept as Seen From a Management Perspective in USA, in* Strategies for River Basin Management: Environmental Integration of Land and Water in a River Basin 299 (J. Lundqvist & U. Lohm eds, 1985).

55. *See, e.g.*, J. Agee & D. Johnson, *Introduction to Ecosystem Management, in* Ecosystem Management for Parks and Wilderness 1 (1988). The coming together of advocacy groups to address issues on The Greater Yellowstone Ecosystem and the Crown of the Continent Ecosystem are responses to this dilemma. *See also*, D. Rohlf & D. Honnold, *Managing the Balance of Nature: the Legal Framework of Wilderness Management*, 15 Ecology L. Q. 249 (1988).

56. E. Ostrom, Governing the Commons: The Evolution of Institutions for Collective Action (1990); D. Bromley, Environment and Economy: Property Rights and Public Policy (1991).

systems, the concept of property rights and associated duties also arises.[57] The question of ownerships of bits and pieces of ecosystems would have to be re-thought in terms of the applicability of the concept of individual ownership, or the major conditions for stewardship that would be entailed by it, to assure sustainability. The issues of inter-institutional arrangements remain as vexatious as ever, as do the ground rules for governance and the involvement of people in decisions affecting not just them, but 'their' ecosystem.

ECOSYSTEM MANAGEMENT AND THE GREAT LAKES

In the Canada–United States transboundary context, ecosystemic notions emerged during the mid-1970s in discussions about directions to be taken in programs overseen by the International Joint Commission (IJC) and the Great Lakes Fishery Commission (GLFC). One conclusion from the 1976–1977 Canada–United States Inter-University Seminars for the Great Lakes was the need for governing authorities to adopt a much broader systems perspective to guide the development of remedial measures for pollution and fisheries management. This conclusion led to a series of Great Lakes ecosystem rehabilitation studies that explicitly adopted the ecosystem stress-response approach to their analyses.[58]

At the same time, the former Research Advisory Board to the IJC prepared a report in 1978 which pointed to the need for an integrative framework to relate diverse problems and activities, concluding that "[t]his necessary integrative framework is an ecosystem approach."[59] The phrase 'ecosystem approach,' rather than ecosystem management, remains in use for much discourse about the Great Lakes. While perhaps more vague, it avoids the negative connotations associated with the word 'management.'[60] Vallentyne, who introduced the phrase to the IJC in 1978,

57. *See, e.g.*, G. Francis *et al.*, Great Lakes Fishery Commission Technical Report No. 37, Rehabilitating Great Lake Ecosystems (1979); H. Harris *et al.*, Great Lakes Fishery Commission Technical Report No. 38, Green Bay in the Future—A Rehabilitative Prospectus (1982); G. Francis *et al.*, Great Lakes Fishery Commission Technical Report No. 43, A Prospectus for the Management of the Long Point Ecosystem (1985).

58. Research Advisory Board, International Joint Commission, The Ecosystem Approach vii (1978).

59. Negative connotations associated with 'management' include its association with the belief of quick technical fixes for environmental problems, top-down planning by experts with no involvement from affected publics, or professional manipulation of planning or decision processes to serve political or corporate interests.

60. J. Vallentyne & A. Beeton, *The 'Ecosystem Approach' to Managing Human Uses and Abuses of Natural Resources in the Great Lakes Basin*, 15 Entl. Conservation 58 (1988). The authors also point out that this shift in the point of view "is actually quite radical. . . . It calls for a change in the entire field within which opportunities and problems are examined, a change from a view of environment in a political or people-oriented context to a view of politics in an 'ecosystem' context." *Id.*

has more recently noted that it "means an integrated set of policies and managerial practices that relate people to 'ecosystems' of which they are a part rather than to external resources or environments with which they interact."[61] The approach is characterized by synthesis or integrated knowledge, a holistic perspective interrelating systems at different levels of integration, and actions that are ecological, anticipatory, and ethical in respect of other systems of Nature.

In 1979, the IJC sponsored a Workshop on Anticipatory Planning for the Great Lakes which was organized by the United States and Canadian co-convenors of the Inter-University Seminars. It, too, documented the need for more comprehensive, systemic approaches to Great Lakes issues. To a degree, 'ecosystem' was seen at that time to be a code word for adopting a comprehensive systems perspective to address an array of issues in the Great Lakes Basin, which was otherwise being viewed in the tradition of integrated river basin development.[62] 'Ecosystem' is sometimes still used in this way.

Recent overviews of the situation in the Great Lakes can be found in Caldwell,[63] in the joint study by The Conservation Foundation (United States) and the Institute for Research in Public Policy (Canada)[64] and in a more popularized account by Weller.[65] These works reflect the continuing and growing interest in the Great Lakes Basin and, especially, in matters concerning the health and well-being of the aquatic ecosystems. There has also been a growing interest in the notion of 'an ecosystem approach' and what it entails. Following along from the earlier Great Lakes ecosystem rehabilitation studies,[66] Lee and others[67] compared 10 examples of ecosystem approaches being applied in planning for different purposes and on different scales within the Basin. The applications were at the levels of policy, strategies, and tactical plans. The examples were compared with respect to the extent they (a) place primary emphasis on ecological phenomena; (b) adopt boundaries that reflect ecological integrity; (c) use mapping, monitoring, and modeling to assess ecological states and processes; and (d) consider ecological self-regulation and responsiveness. Eight of the ten examples were consistent with these criteria, thereby helping to specify some ways in which the ecosystem approach can be applied in practice.

61. 1 Science Advisory Board, International Joint Commission, Workshop Report on Anticipatory Planning for the Great Lakes, Summary; 2 Science Advisory Board, International Joint Commission, Workshop Work Group Reports (1980).

62. Perspectives on Ecosystem Management for the Great Lakes (K. Caldwell ed., 1988).

63. Conservation Foundation & The Institute for Research in Public Policy, T. Colborn *et al.*, Great Lakes, Great Legacy? (1989).

64. P. Weller, Freshwater Seas: Saving the Great Lakes (1990).

65. *See* works cited *supra*, note 57.

66. B. Lee *et al.*, *Ten Ecosystem Approaches to the Planning and Management of the Great Lakes*, 8 J. Great Lakes Res. 505 (1982).

67. W. Christie *et al.*, *Managing the Great Lakes Basin as Home*, 12 J. Great Lakes Res. 2 (1986).

Christie and others[68] report on the results of an "Ecosystem Approach Workshop" involving about 60 people who were "broadly representative of Great Lakes society." The authors declared that the emergence of an ecosystem approach" is the most recent phase in a historical succession of management approaches from *egocentric* to *piecemeal* to *environmental* and now to an *ecosystem approach."*[69] Various obstacles to implementing it were noted, including lack of a holistic perspective, predominance of 'egosystem' (i.e. self-serving, uncaring) thinking, and the lack of a preventive approach for addressing problems. A large number of specific suggestions were made concerning a) the acquisition and use of scientific data; b) institutional change; c) the costs for resource use; d) education and public awareness; and e) citizen participation, access and communication. For the most part, these could be viewed as modest proposals for reforms, but at least for some participants, they were based on rationales consistent with ecophilosophy and environmental ethics.

The ecosystem approach has also been viewed as a sign of a movement away from "conventional exploitative development" to a "reform sustainable redevelopment" directed towards a "desirable, productive man-nature ecosystem with good development and husbandry practices."[70] This redevelopment is a prerequisite for sustainability, and the Great Lakes provide good examples of both the need for sustainable redevelopment and some beginning efforts to address it.

Concepts and vocabulary from both ecology and ecologism are used in reference to formal intergovernmental programs and in the lobbying activities mobilized by nongovernmental organizations and groups. Examples are summarized below.

Great Lakes Water Quality Agreement, 1978

Ecological language is reflected most explicitly in the language of the Great Lakes Water Quality Agreement of 1978, updated by the 1987 Protocol. Some highlights follow.

Purpose: The purpose of the Parties to the agreement is "to restore and maintain the physical, chemical and biological integrity of the waters of the Great Lakes Basin Ecosystem."[71] The Great Lakes Basin Ecosystem is defined to mean "the interacting components of air, land, water and living organisms, including man, within the drainage basin of the St. Lawrence River at or upstream from the point at which this river becomes

68. *Id.* at 4.

69. *E.g.*, H. Regier et al., *Rehabilitation of Degraded River Systems, in* Proceedings of the International Large River Symposium, 106 Canadian Special Publication of Fisheries & Aquatic Sciences 86 (1989).

70. Protocol to Amend the Great Lakes Water Quality Agreement of 1978, November 18, 1987, U.S.-Can., art. II [hereinafter *GLWQA*].

71. *Id.* at art. I(g).

the international boundary between Canada and the United States."[72] Interestingly, 'integrity' itself is not defined in the Agreement.

Lake ecosystem objectives: Ecosystem objectives are to supplement water quality objectives expressed in chemical or physical terms. For Lake Superior, the 1987 Protocol stated that the lake "should be maintained as a balanced and stable oligotrophic ecosystem with lake trout as the top predator of a cold-water community and the *Pontoporeia hoyi* as a key organism in the food chain."[73] The Parties are now consulting on the development of objectives for Lake Ontario.[74]

Impairment of beneficial uses: This means a change in the chemical, physical or biological integrity of the Great Lakes System sufficient to cause any one of the following:

(i) restrictions on fish and wildlife consumption;
(ii) tainting of fish and wildlife flavor;
(iii) degradation of fish and wildlife populations;
(iv) fish tumors or other deformities;
(v) bird or animal deformities or reproductive problems;
(vi) degradation of benthos;
(vii) restrictions on dredging activities;
(viii) eutrophication or undesirable algae;
(ix) restrictions on drinking water consumption, or taste and odor problems;
(x) beach closings;
(xi) degradation of aesthetics;
(xii) added costs to agriculture or industry;
(xiii) degradation of phytoplankton and zooplankton populations; and
(xiv) loss of fish and wildlife habitat.[75]

As can be seen, a number of these criteria imply the need for biomonitoring and ecological reference sites in nondegraded areas. These criteria provide guidance for the development of remedial action plans for the identified 'areas of concern,' i.e. some 43 badly degraded nearshore harbors, river mouths, and connecting channels which have not met water quality objectives.

Ecosystem health indicators: These are to help assess the extent to which specific objectives for the ecosystem are being achieved. With respect to Lake Superior, the health indicators are to be a) stable, self-

72. *Id.* at Supplement to Annex 1(3).
73. Ecosystem Objectives Work Group, [Proposed] Ecosystem Objectives for Lake Ontario (1990).
74. GLWQA, *supra* note 70, at Annex 2, 1(c).
75. GLWQA, *supra* note 70, at Annex 11, 4(a).

reproducing stocks of lake trout, free from contaminants that adversely affect the trout themselves or the quality of their harvested products; b) an average production of more than 0.38 kilograms of trout per hectare per year; and c) present levels of the amphipod crustacean *Pontoporeia* defined as a range for the numbers of individuals expected from standardized samples taken above and below 100 meters depth.[76] Comparable indicators are being discussed for the other lakes.

Early warning system: Components of an early warning system to anticipate future toxic substances problems include, besides chemical and toxicological studies, "further development and use of reproductive, physiological and biochemical measures in wildlife, fish and humans as health effects indicators and the establishment of a data base for storage, retrieval and interpretation of the data."[77] The Parties are also to "establish action levels to protect human health, based on multimedia exposure and the interactive effects of toxic substances."[78]

Wetlands: "Significant wetland areas in the Great Lakes System that are threatened by urban and agricultural development and waste disposal activities should be identified, preserved and where necessary, rehabilitated."[79]

There is circumstantial evidence that the statement of purpose for the Agreement with its reference to 'integrity' came from the 1972 United States Federal Water Pollution Control Act Amendments which were intended to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" by 1985.[80] Interestingly, the statement of purpose, first articulated for the Great Lakes Water Quality Agreement in 1978, appeared not to have provoked questioning of either its meaning or intent until a decade later when the IJC and the GLFC convened a workshop at the urging of some of their scientific advisors to examine the concept of ecosystem integrity.[81] In preparation for this workshop, Regier and France[82] reviewed the proceedings of a symposium convened by the

76. *Id.* at Annex 12, 5(j).

77. *Id.* at 6.

78. *Id.* at Annex 13, 3.

79. 33 U.S.C § 1251(a) (1976).

80. Great Lakes Fishery Commission, Special Pub. No. 90-4, An Ecosystem Approach to the Integrity of the Great Lakes in Turbulent Times (1990).

81. H. Regier & R. France, *Perspectives on the Meaning of Ecosystem Integrity in 1975, in* An Ecosystem Approach to the Integrity of the Great Lakes in Turbulent Times, *supra* note 81; *See also* T. Jorling, *Incorporating Ecological Principles into Public Policy,* 2 Envtl. Pol'y & L. 140 (1976); A. Lind & G. Glass, *Environmental Law and Policy Versus the Hydrocycle.* 10 J. Great Lakes Res. 135 (1984).

82. Ecosystem Approach to the Integrity of the Great Lakes in Turbulent Times, *supra* note 81. The SAB has recommended that "the people of the basin clarify the desirable attributes of ecosystems that would characterize 'integrity,' including such factors as sufficient protected pristine nature, carefully husbanded productive waters and lands, and beautifully maintained urban areas. Science Advisory Board, 1989 Report to the International Joint Commission 34 (1989).

United States EPA in 1975 to interrelate two concepts of 'integrity,' i.e. as a desirable characteristic of natural ecosystems, and as a moral or cultural principle. They detected five varying interpretations of 'integrity' which reflected differing degrees of reform that was entailed by them. At one extreme, 'deep reform' was required in order to restructure human organization and activities to conform with natural biogeochemical cycles, and maintain ecosystemic conditions that reflect low levels of human-induced stress. At the other, more pragmatic extreme, 'integrity' might be a code word to help slow the rate of degradation of a resource.

Strong normative connotations are still associated with the notion of integrity. The word has been interpreted to mean ecosystems which are fully functioning in some mature, self-organizing way combined with human uses of them which do not disrupt this functioning. There is an element of choice and preference with regard to the particular characteristics of ecosystems people may wish to retain; the term cultural integrity has been used (somewhat misleadingly) to refer to the management and use of ecosystems to maintain both their integrity and some preferred characteristics.[83]

Water Quantity Issues

Since 1977, and as a result of four References given to it,[84] the IJC has been involved with issues concerning lake level fluctuations, diversions, and uses. While a number of studies are directed towards rather narrow technical objectives, the objectives are sometimes addressed from a quite broad viewpoint in the reports from the IJC. For example, the final report on diversions and consumptive uses of waters from the Great Lakes drew the attention of the Parties to the need to address issues in a future of discontinuous change associated with climate change, world food supplies, and the "fundamental shift in the economies of the United States and Canada with the move to the post-industrial or electronic age."[85] The Commissioners raised the question of the preparedness of institutions to respond to a broad range of societal concerns and values, and to unexpected change. They urged governments to consider future water policies for the Great Lakes, noting that "the waters must be protected, conserved and managed with insight, determination and prudence if they are to continue to play the role they have played in the past."[86]

83. Lake Erie regulation, Docket No. 103 (1977); Diversions and Consumptive Uses, Docket No. 104 (1977); Great Lakes Basin Water Supply, Levels and Flows, Docket No. 106 (1977); and Great Lakes Levels, Docket No. 111 (1986).

84. International Joint Commission, Great Lakes Diversions and Consumptive Uses 48 (1985).

85. *Id.*

86. L. Dworsky & D. Allee, *An Agenda for the Management of the Great Lakes on a Long Term Ecosystem Basis, in* The Great Lakes: Living with North America's Inland Waters 21 (American Water Resources Association ed., 1988).

While there has apparently been no governmental response to these statements, Dworsky and Allee used this IJC report to conduct a three year simulation exercise with students at Cornell University.[87] The students worked under a directive from a hypothetical 'Ecosystem Study Board' to carry out background studies that would help the two countries move closer to "comprehensive, integrated, multipurpose water and related land and environmental management-ecosystem management"[88] to which the countries have subscribed for over a half century. This wording suggests that 'ecosystem management' is nothing but a new phrase for an older view, something most ecophilosophers would challenge.

The current IJC Levels Reference Study makes use of a systems dynamics framework to address a broad range of questions associated with the effects of lake level fluctuations. In a progress report for Phase I of the study,

> it is argued . . . that the Great Lakes–St. Lawrence is an ecosystem which has to be approached as a functional whole, recognizing its high diversity, its interconnectedness and interdependence, its high rates of change and the need for integration of conflicting forces. Only recognition of these factors will allow for effective public policy.[89]

Also noted in this report: "Among the valuable conclusions reached in Phase I, the most significant discoveries arose in defining the problem, its origins and its current context."[90] The report concluded that:

> the essence of the nature-human complex is inescapably systemic; that an ecological dynamism deserves priority consideration before taking any action on water level fluctuations; that misperceptions and misunderstandings of the water fluctuations phenomenon and our ability to affect it abound; and, that the extant bi-lateral and hierarchical governance poses impediments to concerted and coherent collaboration.[91]

Phase II of the study will continue to work on some of these problems, and the revised directive from IJC for Phase II calls for a set of guiding principles which would "consist of broad policy statements, reflecting

87. *Id.*

88. Living With The Lakes: Challenges and Opportunities, Progress Report to the International Joint Commission 9 (1989).

89. *Id.*

90. *Id.* at i.

91. International Joint Commission, Levels Reference Study, Phase II Plan of Study 3.7.1 (1990).

the views of a wide range of people in the Basin" to help assess actions to be taken and improve cooperative decisionmaking.[92]

Joint Strategic Plan for the Management of Great Lakes Fisheries

The Great Lakes Fishery Commission has an executive role in coordinating the control of sea lampreys in the Lakes, it funds fisheries research, and it facilitates cooperation among federal, state and provincial fish management agencies. The GLFC has established Lake Committees for each Lake. Through annual meetings, supplemented with task groups meeting intermittently throughout the year, the Lake Committees exchange information on the state of the fisheries in each jurisdiction and on restocking programs, and they also negotiate inter-jurisdictional allocations of shared fish stocks, such as walleyes in the western basin of Lake Erie.

The Strategic Plan was approved in 1980 by the 12 fish management agencies with responsibilities for different portions of the Great Lakes. Its stated goal is:

> [t]o secure fish communities, based on foundations of stable self-sustaining stocks, supplemented by judicious plantings of hatchery-reared fish, and provide from these communities an optimum contribution of fish, fishing opportunities and associated benefits to meet needs identified by society for wholesome food, recreation, employment and income, and a healthy human environment.[93]

A number of Great Lakes fishery issues were also described and strategic principles and procedures were spelled out to guide the implementation of the Plan. Following a review of progress made by 1986, the Lake Committees were assigned the following objectives in order of priority:

- to define objectives for the structure and function of fish communities within each of the Great Lakes by 1988 (with measurable parameters),
- to identify environmental and other issues which may prevent achievement of the fish community objectives for each Great Lake (give immediate attention to standardization of chemical contaminant analysis),

92. Great Lakes Fishery Commission, A Joint Strategic Plan for Management of Great Lakes Fisheries (1980). In 1989, representatives from the Great Lakes Indian Fish and Wildlife Commission and the Chippewa–Ottawa Treaty Fishery Management Authority also endorsed the Plan.

93. One of the first state-of-the-lake reports produced was Lake Superior: The State of the Lake in 1989, Great Lakes Fishery Commission Special Pub. No. 90-3 (M. Hanson ed., 1990).

- to develop comprehensive consultation procedures by 1988 for achieving consensus among agencies when management activities will significantly influence the interests of more than one jurisdiction, and
- to produce state-of-the-lake reports for each Great Lake by 1990 and every three years thereafter.[94]

Decisions about fish community objectives are being made by each Lake Committee. To date, after nearly a decade of consideration, fish community objectives have been agreed upon for Lakes Superior and Ontario.[95] They are expressed in terms of quantified yields of preferred fish stocks based on historical data on yields and fluctuations, supplemented by objectives for maintaining stocks of forage fish, restoring depleted stocks of other native fish, and controlling sea lampreys. The statement for Lake Superior also addresses habitat objectives in terms of restoration of damaged spawning habitats, no-net-loss for the remaining productive habitats, and a reduction of contaminants in all fish to levels below consumption advisory levels. Consultations on fish community objectives for the other Lakes continue.

The GLFC has also established a Habitat Advisory Board to develop guidelines for fish habitat management and planning in the Great Lakes. The Board recognizes the need to find ways of having fishery interests and concerns included in actions by non-fishery agencies, and actions taken under the Great Lakes Water Quality Agreement through, for example, the remedial action plans.[96] The GLFC and the IJC both are concerned with introductions of exotic species into the Lakes. The recent appearance of zebra mussels (*Dreissena polymorpha*) has led to a renewed demand that ocean-going ships be required to exchange their ballast waters in mid-ocean. A healthy fishery is one sign of a healthy ecosystem, and it is also a goal that garners wide public support.[97]

Conservation of Biodiversity

Besides the badly degraded 'areas of concern' recognized under the Great Lakes Water Quality Agreement, there is "another kind of 'area of concern,' namely, high quality nearshore and coastal zone sites having

94. T. Busiahn, Great Lakes Fishery Commission Special Publ. No. 90-1, Fish Community Objectives for Lake Superior (1990); Lake Ontario Committee, Fish Community Objectives for Lake Ontario, *in* Minutes of Annual Meeting (Great Lakes Fishery Commission) 21 (1989).

95. Habitat Advisory Board, Great Lakes Fishery Commission Special Pub. No. 87-1, Guidelines for Fish Habitat Management and Planning in the Great Lakes (1987).

96. International Joint Commission & Great Lakes Fishery Commission, Exotic Species and the Shipping Industry: The Great Lakes-St. Lawrence Ecosystem at Risk 9 (1990).

97. G. Francis, *quoted in* P. Smith, Towards the Protection of Great Lakes Natural Heritage Areas iv (Heritage Resources Centre—University of Waterloo Technical Paper No. 2, 1987). One of the earlier Great Lakes Ecosystem Rehabilitation Studies had examined the protective management issues for the Long Point complex on the north shore of Lake Erie. *See* Francis, A Prospectus for the Management of the Long Point Ecosystem, *supra* note 57.

important, sensitive ecological values in need of strengthened and/or extended protective management . . . there is no comparable commitment by governments and nongovernmental organizations to address this need from a comprehensive, basin-wide perspective."[98] To help mobilize such commitment, information from various sources has been compiled to give an overview of protected natural heritage areas along the nearshore, coastal zone, and island archipelagos of the Great Lakes. The term 'natural heritage area' is a generic one used with reference to a number of administrative categories (such as parks, refuges, wildlife areas, environmentally significant areas) protected under different legal, policy, and/or administrative arrangements by different federal, state/provincial, regional and local government agencies and by private organizations.

Along the Canadian side of the Lakes, 123 areas have received formal designation for protection under one of a dozen different administrative categories for protected natural heritage areas. Another 209 areas have been identified, sometimes repeatedly, by systematic surveys carried out over the past 20 years or so as ones worthy of protection for their ecological values, but they have not yet received it. Many may now be lost to development.[99] A comparable tally for the United States side of the Lakes located some 260 designated natural heritage areas as well as a number of other sites identified as ones worthy of protection.[100] These results clearly reveal the extent to which a multi-jurisdictional and multi-organizational set of protected natural heritage areas is already in place. Collectively, they serve to protect examples of the range of biodiversity to be found along the Lakes, but the extent to which the full range of biodiversity has been 'captured' under these protected areas is unknown.

The challenge now is to define some over-all goal for the conservation of biodiversity, refine the information system needed to provide a Great Lakes bioregional perspective on priorities for further conservation actions, and mobilize conservation agencies and citizen groups to take further measures. These issues were discussed at a consultation meeting convened by the IJC's Science Advisory Board in 1988. It was postulated that the goal should be a system of protected areas which, collectively, protect sufficient examples of the full range of natural diversity (defined at the level of eco-regions, habitats/communities, and species of plants and animals) to be found around the Great Lakes. In addition, some of the protected natural heritage areas should be used for monitoring sites or refer-

98. Smith, *supra* note 97.

99. P. Weller, Natural Heritage Areas and Programs in the U.S. Great Lakes States: Report to Science Advisory Board (1989). The State Natural Heritage Programs maintain priority lists of unprotected sites.

100. *See* G. Francis, *The Concept of Marine Protected Areas Applied to the Great Lakes, in* Marine Ecological Areas in Canada (Canadian Council on Ecological Areas ed., 1990).

ence areas for Great Lakes programs, and for international environmental monitoring programs.[101]

In 1990, The Nature Conservancy (United States) and the Nature Conservancy of Canada initiated a joint project to develop the Great Lakes Heritage Data Network. It will be modeled after TNC's "Biological and Conservation Data System," used by State Natural Heritage Programs.[102] The BCD system was adopted by Quebec in 1989 and by Ontario in 1991. When fully developed, the two provincial conservation data systems can be linked electronically with those for the eight Great Lakes states to provide, for the first time, a Great Lakes–St. Lawrence perspective on opportunities and priorities for the conservation of biodiversity. In 1991, in cooperation with the nature conservancies, the Center for the Great Lakes launched a binational 'Great Legacy Program' to foster stakeholder involvement for developing, promoting, and implementing a strategy to conserve natural areas along the Great Lakes–St. Lawrence.[103] These nongovernmental, private sector initiatives promise to add a major new dimension to the 'ecosystem approach' for the Basin.

BEYOND THE RHETORIC

'Ecosystem management' and the various ideas that inform or inspire it, are much more discussed than practiced. The language of ecologism appears in much academic discourse, in preambles to agreements and in the conclusions or recommendations of planning studies. As noted in 1988 by Caldwell, "there is much greater agreement that a basinwide ecosystem approach is needed than there is on how to achieve it."[104] The situation is not much different today.

There are, however, some working examples. The remedial action plans being prepared for 'areas of concern' declared under the Great Lakes Water Quality Agreement draw upon ecosystem stress-response analyses of problems,[105] combined with deliberate choices by stakeholder groups

101. *See, e.g.*, R. Jenkins, *Information Management for the Conservation of Biodiversity, in* Biodiversity 231 (1988). See also the continual up-dates on the BCD system in TNC's Biodiversity Network News.

102. Acquisitions of important wetlands are already being carried out through the Eastern Habitat Joint Venture under the North American Waterfowl Management Plan (1986). These initiatives are endorsed implicitly under Annex 13 of the GLWQA, and specifically by recommendations from the International Joint Commission's Science Advisory Board in their 1989 report.

103. Caldwell, *supra* note 62, at 2.

104. *See* works cited *supra* note 23.

105. The approach being taken to RAPs follows that proposed in the earlier Great Lakes Ecosystem Rehabilitation studies, as is particularly evident in Green Bay in Lake Michigan. The Green Bay RAP and the Hamilton Harbour RAP in Lake Ontario are seen as two of the best examples in terms of their scientific and technical analyses and processes for achieving stakeholder agreements during the planning phase. Implementation will provide the real test.

about the kinds of futures they would like for these areas. These future images are expressed in aesthetic, social, and ecological terms.[106]

The emergence of management objectives expressed in terms of healthy and productive ecosystems is a significant development.[107] They draw upon several of the 'schools' of ecology, and at least to some degree, environmental ethics. Public support will rest largely on human health concerns as well as on quality of life ideals.[108] Achieving these objectives will require much more biomonitoring than has been done so far. The array of scientific, technical, and social issues associated with the design of monitoring systems are beginning to be addressed for the Great Lakes.[109]

The initiatives now being taken towards conserving biodiversity are able to build upon the considerable accomplishments represented by the existing systems of protected natural heritage areas around the Lakes, and these initiatives clearly reflect the normative values associated with conservation biology. It will be necessary at some point to consider the larger, regional landscape mosaics, of which protected areas are just a part, in order to effectively conserve some species. Landscape ecology can give some policy guidance for this.

Two other 'schools' of ecology have not been drawn upon to a great extent, but they do offer some insights into problems. Gilbertson drew upon human ecology, combined with critical pathway analyses, to describe some of the 'labyrinthine interactions' of social systems and toxic contaminants dispersing through aquatic ecosystems that resulted in the extreme problems in the Niagara Region.[110] Feeny and others have drawn upon social anthropology in studies of common property regimes, includ-

106. The statements of lake ecosystem objectives under the GLWQA and fish community objectives under the fisheries management plan convey some image of the desired conditions. In 1989, the International Joint Commissions' Science Advisory Board recommended that information on the status of lake trout and *Pontoporeia hoyi* be extended to serve as an ecosystem objective for oligotrophic waters of other lakes, and that walleye and mayfly larvae serve the same function for mesotrophic waters. *See* Biological Surrogates of Mesotrophic Ecosystem Health in the Laurentian Great Lakes: Report to Science Advisory Board (1990).

107. Hayes, *supra* note 43. The elimination of the discharge of toxic substances in toxic amounts, a major objective in the GRWQA (art. II(a))—which may have been taken directly from 33 U.S.C. 1251(a)(3)—has not been achieved. Some legal, administrative and scientific research by nongovernmental organizations has recently been carried out to propose a strategy for achieving this. *See* National Wildlife Federation & Canadian Institute for Environmental Law and Policy, A Prescription for Healthy Great Lakes: Report of the Program for Zero Discharge (1991).

108. *E.g.*, Fish Community Health: Monitoring and Assessment in Large Lakes, 16 J. Great Lakes Res. at 493–669 (1990); H. Regier, *Indicators of Ecosystem Integrity*, Paper to the International Symposium on Ecological Indicators, Fort Lauderdale, Fla. (Oct. 1990); J. Cairns *et al.*, A Proposed Framework for Developing Indicators of Ecosystem Health for the Great Lakes Region: Report to International Joint Commission (1991).

109. M. Gilbertson, *The Niagara Labyrinth—The Human Ecology of Producing Organochlorine Chemicals*, 42 Canadian J. Fisheries & Aquatic Sci. 1681 (1985).

110. S. Feeny *et al.*, *The Tragedy of the Commons: Twenty-Two Years Later*, 18 Hum. Ecology 1 (1990); F. Berkes *et al.*, *The Benefits of the Commons*, 340 Nature 91 (1989); F. Berkes, *The Common Property Resource Problems and the Creation of Limited Property Rights*, 13 Hum. Ecology 187 (1985).

ing one that has evolved among commercial fishermen in Lakes Erie and St. Clair.[111] Slocombe has adopted a non-equilibrium systems perspective to develop a "sociobiophysical evolution model."[112] Applied to an overview of history in the Great Lakes Basin, critical spatial and temporal variables associated with sudden change and restructuring in the economic and biophysical components of the Basin were identified. The potential for using non-equilibrium thermodynamics models to analyze quantitative changes in the energy/mass flow networks in aquatic food webs[113] has apparently not yet been applied to the Great Lakes, but it could contribute considerably to the understanding of food web dynamics, a critical set of ecosystemic processes.[114]

The institutional arrangements for governance in the Great Lakes basin evolved over time to meet earlier problems and opportunities as they were perceived in their day. The resulting specialization in mandates and expertise within each of the major jurisdictions in the Basin limits the ability of any one agency or other organization to respond to the holistic perspectives and changed understandings inherent in the realization that humans are members of ecosystems. These issues are discussed at length in Caldwell and are perhaps one reason why many proponents of ideas from ecologism so routinely call for radical change without clear specifications of what is to be done, or how.[115] Dobson commented on the "agnosticism with respect to social organization" as a weakness in green politics generally.[116] While this unwillingness to specify organizational arrangements may be a tactical posture to keep options open, it could also reflect a belief that social organization is critically dependent upon customary beliefs, and that 'social structure' is little more than repetitive patterns of human interactions sanctioned by the beliefs.[117] Thus, striving for modifications in institutional structures or practices may be less effective in bringing about social change than acting on the underlying system of beliefs and values.

The most visible changes are increasingly being made at more local, community levels in the Great Lakes Basin. Few communities are without some kind of environmental, consumer, or social activist groups promoting environmental quality, social equality, and conserver society

111. D. Slocombe, *Assessing Transformation and Sustainability in the Great Lakes Basin*, 21 GeoJournal 251 (1990).

112. *See* F. Wulff & R. Ulanowicz, *A Comparative Anatomy of the Baltic Sea and Chesapeake Bay Ecosystems, in* Network Analyses in Marine Ecology (1989).

113. Toxic Contaminants and Ecosystem Health: A Great Lakes Focus (M. Evans ed., 1988).

114. Caldwell, *supra* note 62.

115. Dobson, *supra* note 40.

116. *See, e.g.*, A. Giddens, The Constitution of Society (1984).

117. *See generally* J. Lerner, Environmental Constituency Building: Local Initiatives and Volunteer Stewardship, 13 Alternatives 55 (1986).

values, often with sustainability as a rationale.[118] These activities can be seen as an expression of the learning society called for by Milbrath, for example.[119] Networking by nongovernmental organizations or groups and their linking together in some cases as a kind of binational constituency 'for the Lakes' has been one of the most noticeable developments during the 1980s. It is they, rather than administrative agencies operating under budget uncertainties, that are more likely to bring about change, with organizational innovations to express it and with the sustainability theme providing some guidance for directions.

Thus, there are some indications of a going beyond the rhetoric to introduce ecosystem management in practice within the Great Lakes Basin. However, in the public discourse about what else should be done, the full implications of the concept have not yet been realized.

THE ROLE OF THE INTERNATIONAL JOINT COMMISSION

Formally, the IJC has a modest role in overseeing References and reporting back to the two federal governments. It has, in effect, had a continuing role in the Great Lakes for over 25 years. Given the interrelatedness of Great Lakes issues, the varying scales and durations which are exhibited by them, and some new thinking about what must be done, the IJC can at first sight appear modest to the point of irrelevancy. This would be misleading.

While it is the case that the Parties to the Great Lakes Water Quality Agreement have reassumed direct responsibilities for Great Lakes programs under the 1987 Protocol to the Agreement,[120] the IJC continues to play a crucial role as a facilitator for some of the developments noted above. Through its advisory boards and their many task forces and working groups, government officials, academics, and increasingly nongovernmental groups have been able to come together from around the Basin to discuss issues. These discussions in turn led to other initiatives, which are not always under the umbrella of the Commission. Reports from IJC sponsored seminars and workshops are publicly available, if not always widely distributed.

118. L. Milbrath, Envisioning a Sustainable Society: Learning Our Way Out (1989). A learning society is one which promotes the values and institutional forms that encourage learning from experience at all levels of society.

119. Some outside observers had been urging the Parties to confer more leadership responsibilities upon the Commission. *See, e.g.*, L. Dworsky, *The Great Lakes 1955–1985, in* Perspectives on Ecosystem Management for the Great Lakes, *supra* note 62, at 59.

120. This was first seen in the Second Biennial Report (1984) discussed in Perspective on Ecosystem Management for the Great Lakes, *supra* note 62, at 4. *See also, e.g.*, International Joint Commission, *supra* note 84.

The biennial meetings on Great Lakes Water Quality, in which the advisory boards report to the Commission, have had increasing public involvement over the past decade, to the point that they are beginning to serve as a major gathering for the Great Lakes constituency of support groups. In its reports to governments arising from these meetings, the Commission has become a strong advocate for measures that are required to promote the intent of the Agreement and the ecosystem approach it entails.[121] In its facilitation role, the Commission promotes consultations, informal negotiation, and occasionally mediation, all of which are important for dispute resolution through preventive measures.[122] IJC seems to succeed in this role to the extent that Commissioners and their staff do not seek too much credit for success.

CONCLUSION

'Ecosystem management' poses a special challenge to boundaries. Boundaries associated with jurisdictions, administrative districts, and ownerships artificially transect ecosystems. While the international boundary is important for historical and other reasons, in the case of the Great Lakes it has also served as a perceptual and psychological boundary, impeding the development of a shared understanding of a major bioregion. The IJC, in its facilitating role, has helped this boundary to be surmounted. In 1985, an independent review of the Great Lakes Water Quality Agreement described the Agreement as "an evolving instrument for ecosystem management."[123] The Agreement continues to serve this role. The Commission's general experience with formal dispute resolution, as well as the experience with informal facilitation arrangements associated with this Agreement, needs to be better understood, especially given the much larger, more extensive problems inherent in boundaries vis-a-vis ecosystems.

In addition, a larger set of arrangements for Great Lakes governance is also evolving. This is reflected by the number of other bilateral agreements pertaining to the Lakes and by the appearance of more organizations taking up Great Lakes issues. One review of the binational agreements, which provide important elements if the 'framework' for governance for the Great Lakes, noted that:

121. A. Dorcey for example, has called for more recognition of the pervasiveness of bargaining in water management and the need to provide organizational arrangements to facilitate it. *See* A. Dorcey, *The Myth of Interagency Cooperation in Water Resource Management*, 12 Canadian Water Resources J. 17 (1987).

122. U.S. National Research Council & The Royal Society of Canada, The Great Lakes Water Quality Agreement: An Evolving Instrument for Ecosystem Management (1985).

123. Rawson Academy of Aquatic Science, Towards an Ecosystem Charter for the Great Lakes–St. Lawrence 7 (1989).

> for the most part, principles of international law and those principles derived from the [Great Lakes] bilateral agreements attempt to define the outer limits of behavior that remain internationally acceptable rather than the achievement of longer-term goals, such as joint stewardship over shared resources, inter-generational equity, or the maintenance of environmental or ecosystemic integrity.[124]

To provide broad guidance for what should be sought through these various agreements, an Ecosystem Charter for the Great Lakes–St. Lawrence was proposed. It draws upon the principles of sustainability for guiding human actions within their Great Lakes Ecosystem home, and points some directions which 'ecosystem management' should take. Such a statement to which individuals and organizations can be asked to commit themselves can also serve to define a broad framework agreement to give goals and policy guidance for cooperative actions under the existing, more specific agreements.

This could help stimulate the 'horizontal' networking relationships required to overcome the boundaries that impede ecosystem management on a regional scale. The IJC would still be required to exercise some oversight function. Perhaps this is an idea whose time has come.

124. *Id.*