

1-1-2008

Climate Change and Regulatory Fragmentation in the Great Lakes Basin

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Alejandro E. Camacho, *Climate Change and Regulatory Fragmentation in the Great Lakes Basin*, 17 *Mich. St. J. Int'l L.* 139 (2008).

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CLIMATE CHANGE AND REGULATORY FRAGMENTATION IN THE GREAT LAKES BASIN

*Alejandro E. Camacho**

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The Great Lakes Basin is facing a range of environmental threats that imperil its viability as a vital resource hub for humans¹ and for a broad array of flora and fauna. Over the past few decades, scholars have suggested, and various governmental institutions have established, a suite of regulatory changes to Great Lakes governance that purport to foster more effective regulation and address existing regulatory fragmentation. Unfortunately, these attempts at regulatory experimentation have further fragmented resource management. Furthermore, they have failed to apply a systematic, scientific method of evaluation to determine which regulatory schemes truly are the most effective at achieving conservation and other resource management goals. This weak commitment—even resistance—to regulatory accountability hinders improvement both in resource management and in regulatory design.

The modern reality of climate change makes the need for regulatory adaptation and collaboration even more pressing. Like the strained Great Lakes ecosystem, American natural resources law has been and continues to be threatened by a suite of pressures—with anthropogenic climate change raising anew questions of the law’s ability to adapt. To address the considerable variables and concomitant uncertainty wrought by a swiftly changing climate, not only must local, state, federal, and international authorities adapt our regulatory institutions and laws to address changing environmental conditions; they must also foster the adaptive capacity and flexibility of our regulatory institutions and laws

* Associate Professor of Law, Notre Dame Law School. I would like to thank Professor David Favre and the Michigan State University Journal of International Law for inviting me to participate in this engaging symposium. I would also like to thank Dan Cory and Andrea Fowler for their excellent research assistance.

1. See National Oceanic and Atmospheric Administration, About Our Great Lakes: Great Lakes Basin Facts, <http://www.glerl.noaa.gov/pr/ourlakes/facts.html> (last visited Aug. 19, 2008).

themselves. The Great Lakes Basin, and its multitude of overlapping and contradictory regulatory vehicles, serves as a fitting case study for this larger trend in environmental law of regulatory fragmentation and inadaptability, and of the threat raised by the limited capacities of existing institutions to adapt to climate change.

I. GREAT LAKES DECLINE AND THE ADVENT OF CLIMATE CHANGE

The resources of the Great Lakes Basin have been subject to increasing pressures over the past several decades, but a warming climate is projected to transform the resources and economy of the Basin in the near future. Water levels in the Great Lakes have been declining since 1973.² Lakes Michigan and Huron have fallen approximately three-and-a-half feet, and Lake Erie over three feet, since 1997.³ Though historically the Great Lakes' water levels have limited fluctuation, since 1973 this variation has generally increased.⁴ Rising temperatures are also a problem: the historically cold temperatures of Lake Superior have increased four degrees over the past three decades.⁵ So water levels are declining, fluctuation is increasing, and temperatures have generally been increasing.

The quality of the water is also under stress. The U.S./Canadian Great Lakes Water Quality Agreement identifies forty-three areas of concern in terms of water quality and human health.⁶ The sources of

2. See Cynthia E. Sellinger et al., *Recent Water Level Declines in the Lake Michigan-Huron System*, 42 ENV'T. SCI. TECH. 367, 372 (2008).

3. *Id.* at 367.

4. GREAT LAKES REGIONAL ASSESSMENT, PREPARING FOR A CHANGING CLIMATE: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE 29–30 (Peter J. Sousounis & Jeanne M. Bisanz eds., 2000).

5. Jay A. Austin & Steven M. Colman, *Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback*, 34 GEOPHYSICAL RESEARCH LETTERS 1 (2007). Between 1895 and 1999, temperatures in the Great Lakes region increased by 0.7° C, nearly double the national average. LINDA MORTSCH ET. AL., CLIMATE CHANGE AND WATER QUALITY IN THE GREAT LAKES REGION: RISKS OPPORTUNITIES AND RESPONSES 5 (2003).

6. Agreement Between the United States of America and Canada on Great Lakes Water Quality, U.S.-Can., Apr. 15, 1972, 23 U.S.T. 301, *superceded by* Agreement Between the United States of America and Canada on Great Lakes Water Quality, U.S.-Can., Nov. 22, 1978, 30 U.S.T. 1383, *amended by* Agreement to Amend the Great Lakes Water Quality Agreement of 1978, U.S.-Can., Oct. 16, 1983, 35 U.S.T. 2370, *amended by* Protocol to Amend the Great Lakes Water Quality Agreement of 1978, U.S.-Can., Nov. 18, 1987, T.I.A.S. 11551 [hereinafter GLWQA].

pollution are not unique to the Great Lakes Basin: acid rain is a major contributor of toxins;⁷ sediments from agriculture,⁸ forestry, and construction contribute heavy metals to the system;⁹ and combined sewage overflows during storm events have led to the influx of raw sewage into the Great Lakes.¹⁰ The numbers of beach closings and advisories have been increasing; for example, increased bacteria levels exceeding health and safety standards led to a ten percent increase in beach closings from 2005 to 2006.¹¹ Sixty-two percent of cities in the region, according to a recent study, are in violation of the Clean Water Act standard for Combined Sewage Overflows.¹² Non-point sources, though harder to identify, are also major contributors to decreased water quality.¹³

Biological resources are also experiencing considerable pressure. Many fish stocks have been decreasing over the long term.¹⁴ For example, the IPCC has determined that climate change may already have caused a decrease in cool, turbid Great Lakes habitat, which is in turn responsible for a decline in walleye productivity.¹⁵ Additionally, half of the Basin's historic wetlands have disappeared, along with sixty percent of historic forestland,¹⁶ and the Basin contains a number of

7. See U.S. ENVTL. PROT. AGENCY, AREAS OF CONCERN IN THE GREAT LAKES—ST. LAWRENCE RIVER BASIN, <http://www.epa.gov/glnpo/aoc/> (last visited Aug. 21, 2008) (click on individual “areas of concern” located on the map for detailed information) [hereinafter AREAS OF CONCERN].

8. *Id.*

9. *Id.*

10. Influxes of storm water also contribute high amounts of E coli bacteria. See Sandra L. McLellan et al., *Distribution and Fate of Escherichia coli in Lake Michigan Following Contamination with Urban Stormwater and Combined Sewer Overflows*, 33 J. OF GREAT LAKES RES. 566, 566–67 (2008).

11. See MARK DORFMAN & NANCY STONER, TESTING THE WATERS: A GUIDE TO WATER QUALITY AT VACATION BEACHES 1–2 (2007) (“The major factors leading to the increase in 2006 appear to be heavy rainfall in some areas . . . and unaddressed bacteria-laden stormwater and sewage pollution that contaminate beachwaters”).

12. Great Lakes Forever, Clean Water Fact Sheet, http://www.greatlakesforever.org/html/media/media%20docs/chicago_2005/glfcleanwaterfactsheet2005_final.doc (last visited August 21, 2008).

13. See AREAS OF CONCERN, *supra* note 7.

14. See, e.g., ENV'T CANADA & U.S. ENVTL. PROT. AGENCY, STATE OF THE GREAT LAKES 2007 5 (2007) (stating preyfish abundances are deteriorating).

15. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007, WORKING GROUP II REPORT: IMPACTS, ADAPTATION AND VULNERABILITY 624 (2007) [hereinafter IPCC WGII REPORT 2007].

16. GREAT LAKES COMMISSION, WETLANDS RESTORATION: REGIONAL PRIORITIES FOR

endangered species including the lynx, the gray wolf, and the peregrine falcon.¹⁷ The Great Lakes are also threatened by a minimum of 180 exotic aquatic organisms discovered since the 1800s, primarily introduced through ballast water from cargo ships. These invasive species include most notably the zebra mussel, the sea lamprey, the spiny water flea, the Asian carp, the rusty crayfish, the Eurasian water milfoil, and phragmites.¹⁸

Anthropogenic climate change will exacerbate these already considerable threats on water levels, water quality, and biota. Generally speaking, scientists are projecting substantial increases in air temperatures,¹⁹ water temperatures,²⁰ evaporation,²¹ and decreased water levels within the Great Lakes Basin.²² Although data varies slightly between studies, Lakes Michigan and Huron, for example, are projected to decline approximately four and a half feet by 2050 due to the combined effects of increased evaporation, decreased precipitation, stream runoff, and groundwater contributions to tributary streams.²³ As water levels are expected to decrease, demands on water are expected to increase as humans and the natural environment experience, and begin

THE GREAT LAKES 1 (2007), available at <http://www.glc.org/restore/pdf/Wetlands2007.pdf>. In addition to wetland and forest losses, the region only has small remnants of other habitat types such as savannah or prairies. See *id.* These changes in habitat type and extent have contributed to the loss of numerous plant and animal species throughout the Great Lakes basin. See *id.*

17. U.S. ENVTL. PROT. AGENCY, CLIMATE CHANGE, WILDLIFE, AND WILDLANDS CASE STUDY—GREAT LAKES AND UPPER MIDWEST 2–3, http://www.epa.gov/climatechange/wyecd/downloads/CS_glum.pdf (last visited Sept. 25, 2008) [hereinafter EPA CASE STUDY].

18. Over 180 non-indigenous species had been discovered in the Great Lakes by 2005, notably the zebra mussel, sea lamprey, the spiny water flea, the rusty crayfish, the Eurasian water milfoil, and viral hemorrhagic septicemia. See GREAT LAKES ENVTL. RESEARCH LAB., NOAA, AQUATIC INVADERS AND THE GREAT LAKES: SIMPLE QUESTIONS, COMPLEX ANSWERS 1–2 (2007), available at <http://www.glerl.noaa.gov/res/Programs/ais/>.

19. See e.g. MORTSCH ET AL., *supra* note 5, at 5. Some projections show spring and summer temperatures in the Great Lakes region potentially increasing by as much as 9° F (5° C) and 7.2° F (4° C), respectively, by 2050. *Id.*

20. Mean annual lake surface evaporation could increase by as much as 39% by 2050 due to an increase in lake surface temperatures. *Id.* at 38. This will present particular concern during summer and autumn, which are already characterized by low stream flow, and when increased precipitation may not offset increased evaporation. *Id.* at 35.

21. *Id.* at 38.

22. See, e.g., B.M. Lofgren et al., *Evaluation of Potential Impacts on Great Lakes Water Resources Based on Climate Scenarios of Two GCMs*, 28 J. OF GREAT LAKES RES. 537 (2002).

23. *Id.*

to adapt to, the effects of climate change, including nationally reduced snow packs,²⁴ worldwide rising sea levels,²⁵ and declining aquifers.²⁶

Climate change will affect water quality as well by increasing the concentration of pollutants in watercourses.²⁷ Water-borne disease is expected to increase as temperatures in the Lakes increase and become more hospitable to bacteria.²⁸ Increased temperatures will also result in decreased oxygen levels in the water.²⁹

The effects on biological resources are similarly problematic. As water levels decline, wetlands are expected to decrease both in quantity and quality.³⁰ Such a decline in wetland area not only removes available

24. See, e.g., Philip W. Mote et al., *Declining Mountain Snowpack in Western North America*. 86 BULL. AM. METEOROLOGICAL SOC'Y 39, 48 (2005) (stating climate change will undoubtedly lead to water shortages in other parts of the U.S., particularly the West, where temperatures are expected to increase 3.6° to 9° F (2° to 5° C) over the next 100 years); IPCC WGII REPORT 2007, *supra* note 15, at 633 (stating that 41% of Southern California's water supply is expected to be in jeopardy by the 2020s due to the effects of reduced snowpack).

25. IPCC FOURTH ASSESSMENT REPORT: CLIMATE CHANGE 2007, WORKING GROUP I REPORT: THE PHYSICAL SCIENCE BASIS 7, 13 (2007) (finding mean sea levels have risen approximately 12 to 22 cm. since the 1890s and are expected rise almost 18 to 59 cm. by 2100); Stefan Rahmstorf et al., *Sea-Level Rise: A Semi-Empirical Approach to Projecting Future*, 315 SCIENCE 368, 369 (2007) (observing that based on more recent data the IPCC's projections might be conservative and global sea level could rise as much as 50 to 140 cm. by 2100).

26. Declining aquifers will be a problem in interior states. In the Ogallala Aquifer region—which includes portions of South Dakota, Nebraska, Wyoming, Colorado, Kansas, Oklahoma, New Mexico, and Texas—groundwater recharge is expected to decrease by more than 20 percent with a 4.5° F (2.5° C) increase in temperature. IPCC WGII REPORT 2007, *supra* note 15, at 629. In the Ellensburg basin of the Columbia Plateau in Washington, aquifer recharge rates could decrease by as much as twenty-five percent. PETER H. GLEICK ET AL., WATER SECTOR ASSESSMENT TEAM OF THE NATIONAL ASSESSMENT OF THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE, WATER: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE FOR THE WATER RESOURCES OF THE UNITED STATES 59 (2000).

27. See MORTSCH ET AL., *supra* note 5, at 51–64. Small, shallow lakes may disappear, increased summer algae may cause taste and odor problems with drinking water, and waterborne diseases are likely to increase. *Id.* at 64, 53, 57. Under warmer conditions, it is also likely to be more costly to meet water quality goals. *Id.* at 54–55. Lower flows and lower lake levels will mean that water bodies can accept smaller concentrations of pollutants before they become contaminated, thus, violations of low flow criteria would increase. *Id.* at 54. Runoff, moisture and weathering reductions could cause changes in chemical export from watersheds and alter chemical concentrations in streams. *Id.* at 51. Decreased soil flushing would result in delayed recovery from acid rain events and enhanced sulfur and nitrate export following droughts. *Id.*

28. *Id.* at 57, 74.

29. NOAH D. HALL & BRET B. STUNTZ, CLIMATE CHANGE AND GREAT LAKES WATER RESOURCES 10 (2007).

30. MORTSCH ET AL., *supra* note 5, at 64–65 (stating that changing climate conditions

habitat for wetland species but also for lake species, including most fish that use wetlands at some point in their life cycle for breeding or shelter.³¹ Forest habitat is likewise expected to be diminished: the EPA expects a seventy percent decline in Michigan forest generally, and as much as fifty to seventy percent of Great Lakes forest is expected to disappear in the next four decades.³²

The timing of biological events and species ranges will also be affected by climate change.³³ Diminished feeding and nesting opportunities for migratory birds are the most commonly cited example; birds that feed on insects may become less productive as prey insect patterns are forced to change.³⁴ Furthermore, habitat loss for many species will accelerate. Birds (including duck species), native crayfish, and snails are expected to be few in number in some small lakes.³⁵ Cold-water fish habitat for species such as whitefish and trout will decrease; some studies have projected half of the cold-water fish habitat to be diminished, and some warm water species such as smallmouth

will alter the timing and lessen the amount of water flowing through wetlands, affecting flushing, sedimentation, nutrient input, and duration of ice cover). Lower lake levels may cause an increase in fires and oxidation of wetland bottoms. *Id.* at 65. Decreased wetland area not only removes available habitat for wetland species but also for lake species, including most fish that use wetlands at some point in their life cycle for breeding or shelter. Peter Sousounis & Patty Glick, ClimateHotMap.org, The Potential Impacts of Global Warming on the Great Lakes Region, Critical Findings for the Great Lakes Region from the First National Assessment of the Potential Consequences of Climate Variability and Change, <http://www.climatehotmap.org/impacts/greatlakes.html> (last visited Oct. 25, 2008). At least 32 of the 36 species of fish in the Great Lakes depend on coastal wetlands to successfully reproduce. *Id.* Falling water levels will exclude fish from the coastal marshes, which supply habitat for breeding, shelter and food. *Id.*

31. *Id.*

32. EPA CASE STUDY, *supra* note 17, at 6. As temperature and moisture increase, forest area and composition will shift. *Id.* In Michigan, for example, changes in climate could cause forested areas to change little—or decline by as much as fifty to seventy percent. *Id.*

33. GEORGE W. KLING ET AL., CONFRONTING CLIMATE CHANGE IN THE GREAT LAKES REGION 45 (2003) (“Conservative estimates project a 19 to 39% decline in ducks by the 2030s in response to lost breeding and migratory habitats, as well as declines in aquatic plants on which ducks feed.”). Although some resident bird species may benefit and new species may enter the region, a 29% net loss in forest bird diversity is projected. Sousounis & Glick, *supra* note 300 (stating cold water fish habitat for species such as walleye and trout will decrease—with some studies projecting half to be lost—and some warm water species, such as smallmouth bass, may also disappear); EPA CASE STUDY, *supra* note 17, at 6 (“Warm-water fish, both native and introduced, could experience longer growing seasons and flourish in a warmer climate.”).

34. KLING ET AL., *supra* note 33, at 55.

35. *Id.*

bass, ironically also might disappear.³⁶ However, other warm water species may flourish as water temperatures increase.³⁷

The collateral economic effects of such biological harm are just as disconcerting. Though projections of the impacts of climate change on the Great Lakes economy are still nascent, it appears that climate change is likely to have a considerable economic impact on a wide range of industries and economic drivers in the Great Lakes Basin area. The Union of Concerned Scientists has estimated a fifty percent reduction in hydropower generation in the region by 2050 due to decreased water levels.³⁸ Recreational fishing, hunting, and bird watching are each multi-billion-dollar industries in the Great Lakes Basin, and all expected to be damaged by reduced biological resources, water levels, and water quality.³⁹ Similarly, the multi-billion dollar timber industry is likely to be negatively impacted by decreased timber yields,⁴⁰ and aesthetic concerns may even affect real estate prices along the lakeshores.⁴¹

In short, it is very likely that warming will serve as an accelerating stressor in the Great Lakes Basin, adding to the many existing stressors that already have substantially impaired the Great Lakes' natural resources. This acceleration is likely to occur even if all national governments were to coordinate sweeping regulatory limits on future greenhouse gases. Adaptation to the persisting effects of increased greenhouse gases appears to be an inevitable necessity.

So how will the nations, states, and cities that comprise the Great Lakes Basin, and rely on it as an ecological and economic driver, adapt to climate change? Though the foregoing brief summary of projected effects provides some idea of the potential effects of climate change on the Great Lakes, considerable uncertainties permeate these existing projections. As with the ecological effects of climate change, many of the potential economic effects are unclear and possibly confounding.

36. *Id.*

37. EPA CASE STUDY, *supra* note 17, at 6.

38. KLING ET AL., *supra* note 33, at 55. Commercial shipping is already hindered by low water levels in the Basin's shipping channels, but commercial shipping seasons might be extended as ice cover decreases on the lakes. See MORTSCH ET AL., *supra* note 5, at 47.

39. KLING ET AL., *supra* note 33, at 55; MORTSCH ET AL., *supra* note 5, at 74. Hydropower generation is anticipated to be reduced by at least fifteen percent in the region by 2050. KLING ET AL., *supra* note 33, at 55.

40. *Id.* at 49, 65.

41. *Id.* at 47, 89.

For example, commercial shipping is already hindered by low water levels in the Basin's shipping channels and this is likely to continue, but commercial shipping seasons might be extended as ice cover decreases on the lakes. Indeed, more may be unknown about the effects of climate change than is known. This unprecedented uncertainty prevents scientists and regulators from having the capacity to draw conclusions from historically analogous situations—exacerbating the already considerable difficulty of regulating and managing these complex systems.

II. THE PATCHWORK OF GREAT LAKES GOVERNANCE

Faced with uncertainty that eclipses even the projected substantial effects on natural resources in the Great Lakes Basin, the ability of existing natural resource governance to manage such uncertainty and adapt quickly as new information arises or circumstances change becomes vital.⁴² Government institutions also must be able to investigate, learn, and act at appropriate ecosystem scales, and leverage the different proficiencies of local and larger-scale regulatory institutions.

Unfortunately, though the institutions in the Great Lakes Basin are many, they are incredibly fragmented and lack any systematic mechanisms that could provide the adaptive capacity to respond to and manage the uncertainties of climate change.⁴³ Beyond the many

42. Adaptation is particularly necessary in the Great Lakes Basin because the long retention times of Great Lakes water and the relatively small drainage basin make the area especially vulnerable to climate change. See U.S. ENVTL. PROT. AGENCY, GREAT LAKES FACTSHEET NO. 1 in THE GREAT LAKES, AN ENVIRONMENTAL ATLAS AND RESOURCE BOOK, <http://www.epa.gov/glnpo/atlas/gl-fact1.html> (last visited Aug. 21, 2008) (stating that water entering Superior is retained for approximately 191 years, Michigan for 99 years, Huron for 22 years, Erie 2.6 years, and Ontario 6 years); See also E. McBean & H. Motiee, *Assessment of Impact of Climate Change on Water Resources: a Long Term Analysis of the Great Lakes of North America*, 12 HYDROL. & EARTH SYST. SCI. 239, 239 (2008).

43. See HALL & STUNTZ, *supra* note 29, at 25–26:

[T]he numerous international treaties, federal statutes, interstate compacts, handshake agreements, Supreme Court cases, inconsistent state laws, and patchwork of common law rules and local decisions have left the waters of the Great Lakes with few meaningful protections from diversions and overuse. Water conservation and resource protection are still not required of many water users. Prohibitions on diversions are vulnerable to legal challenges and political repeal. And while there are numerous regional governance mechanisms, none has the authority to fully provide comprehensive adaptive management of the Great Lakes from changing climate

common law rules that courts in each state and province in the Great Lakes Basin have adopted,⁴⁴ many local communities, states, and provinces have promulgated their own statutory and regulatory programs to address water use and environmental protection.⁴⁵ However, these regimes are fragmented by source, resource, and jurisdiction.

Various regional governance regimes have been created to rectify the fragmented nature of the existing local, state, and federal regulation, but all of these effectively ignore most environmental and economic concerns other than water use. The Great Lakes Basin Compact between the Great Lakes states and provinces created the Great Lakes Commission.⁴⁶ However, its function is only to gather data and make recommendations regarding research and cooperative programs about water use; the Great Lakes Basin Compact and any Commission recommendations expressly have no binding effect.⁴⁷

Through the more recent Great Lakes Charter of 1985⁴⁸ and its Annex,⁴⁹ the Great Lakes states and provinces adopted yet another informal agreement that has never been approved by the U.S. Congress or the Canadian Parliament. It created the Council of Great Lakes Governors, an assembly for coordinating the states' and provinces' activities.⁵⁰ Beyond its questionable enforceability, it too is limited in scope as it only seeks to manage and regulate new or increased consumptive water uses, foster information gathering and dissemination

conditions.

44. *See id.* at 30–31. For example, U.S. states have adopted common law riparian rights regimes to govern water consumption and usage, which generally allow for “reasonable” surface water uses. *Id.*

45. *See id.* at 31 (“[E]very Great Lakes state has implemented some form of an administrative water use system by statute. . . . The scope and standards of the Great Lakes states’ water management laws vary greatly, resulting in much inconsistency and little certainty in water resource protection.”).

46. *See* Great Lakes Basin Compact, Pub. L. No. 90-419, 82 Stat. 414 (1968), available at <http://www.gllc.org/pubs/conv.htm>.

47. *See id.* art. IV, VI, 82 Stat. 414–16.

48. *See generally* The Great Lakes Charter: Principles for the Management of Great Lakes Water Resources, Feb. 11, 1985, available at <http://www.cglg.org/projects/water/docs/GreatLakesCharter.pdf>.

49. *See generally* The Great Lakes Charter Annex: A Supplementary Agreement to the Great Lakes Charter, June 18, 2001, available at <http://www.cglg.org/projects/water/docs/GreatLakesCharterAnnex.pdf>.

50. Council of Great Lakes Governors, Overview, <http://www.cglg.org/Overview/index.asp> (last visited Oct. 25, 2008).

on such activities, and make recommendations to the various states concerning how to deal with water management issues.

Lastly, the recently enacted⁵¹ and much-lauded St. Lawrence River Basin Water Resources Compact (more commonly known or referred to as the Great Lakes Compact)⁵² and its associated non-binding Great Lakes–St. Lawrence River Basin Sustainable Water Resources Agreement (which incorporates Quebec and Ontario into the Compact’s regime) further fragment the regulatory institutions that govern the Great Lakes. The Great Lakes Compact only addresses water quantity management questions. It goes further than the other agreements by prohibiting most diversions from the region⁵³ and sets a decision making standard⁵⁴ for states to implement regarding new or increased water withdrawal, to which signatory states must abide. It also requires monitoring and reporting of withdrawals by local governments,⁵⁵ which state governments must then report to the regional authority to be included in a publicly accessible inventory of water uses.⁵⁶ However, the Compact simply focuses on water quantity management of future uses and does not regulate existing water uses, water quality, or biological resources. Although it is a significant step toward water management on a regional basis, this proposed Compact is still a fairly weak limitation.

51. All of the signatory states’ legislatures had ratified the Compact by July 9, 2008. See Council of Great Lakes Governors, Great Lakes–St. Lawrence River Basin Water Resources Compact Implementation, <http://www.cglg.org/projects/water/CompactImplementation.asp#State%20Legislative%20Activity> (last visited Oct. 25, 2008). The Compact was approved by the U.S. Senate on Aug. 1, 2008. S.J. Res. 45, 110th Cong. (2008). The bill was then passed by the U.S. House of Representatives on Sep. 23, 2008 and signed into law by President Bush on Oct. 3, 2008. See A joint resolution expressing the consent and approval of Congress to an interstate compact regarding water resources in the Great Lakes - St. Lawrence River Basin, Pub. L. No. 110-342 (2008).

52. Great Lakes–St. Lawrence River Basin Water Resources Compact, Dec. 13, 2005, available at http://www.cglg.org/projects/water/docs/12-13-05/Great_Lakes-St_Lawrence_River_Basin_Water_Resources_Compact.pdf [hereinafter Great Lakes Compact]. An associated non-binding agreement incorporates Quebec and Ontario. See Great Lakes St. Lawrence River Basin Sustainable Water Resources Agreement, Dec. 13, 2005, available at http://www.cglg.org/projects/water/docs/12-13-05/Great_Lakes-St_Lawrence_River_Basin_Sustainable_Water_Resources_Agreement.pdf.

53. Great Lakes Compact, *supra* note 52, § 4.8.

54. *Id.* § 4.11.

55. *Id.* § 4.1.

56. *Id.*

International efforts to address the Great Lakes are plentiful and splintered as well. These include the International Joint Commission (IJC) created by the Boundary Waters Treaty of 1909,⁵⁷ which has the authority to adjudicate and regulate very large proposed water withdrawals from the area,⁵⁸ but again is focused only on water quantity. The Great Lakes Water Quality Agreement⁵⁹ did give the IJC more authority regarding air quality, water quality, and water levels, albeit in only a monitoring and reporting capacity. Under the 1987 protocol, the IJC reviews lake-wide management plans created by a collaborative body involving state, provincial, and federal agencies with jurisdiction over water quality issues with the goal of producing a comprehensive ecosystem approach to water quality management in the Great Lakes.⁶⁰ The IJC analyzes a wide range of environmental impacts and has recently taken up the issue of the effects of climate change on the region.⁶¹

Yet another bi-national regulatory regime is the Convention on Great Lakes Fisheries of 1955.⁶² It established the Great Lakes Fisheries Commission, which coordinates research on fisheries and some control activities (most prominently the attempts to reduce the invasive sea lamprey population).⁶³ In a rare provision of collaborative management, the Convention does attempt to facilitate cooperation among state, tribal, and federal agencies, but is only concerned with fisheries.

Likewise, federal efforts by the governments of Canada and the U.S. are numerous and fragmented. Just focusing on the U.S. demonstrates the breadth of overlapping regulatory activity for managing the Great

57. Treaty Between the United States and Great Britain Relating to Boundary Waters, and Questions Arising Between the United States and Canada, U.S.-G.B., Jan. 11, 1909, 36 Stat. 2448, available at <http://www.ijc.org/rel/agree/water.html>.

58. Cf. HALL & STUNTZ, *supra* note 29, at 27 ("As may be expected, the Senate had never consented to refer a matter for a binding decision in the history of the Boundary Waters Treaty.").

59. GLWQA, *supra* note 6.

60. *See id.*

61. *See, e.g.*, GLWQA, *supra* note 6.

62. Convention on Great Lakes Fisheries between the United States of America and Canada, U.S.-Can., June 6, 1955, 6 U.S.T. 2836, available at <http://www.glfsc.org/pubs/conv.htm>.

63. *See* Great Lakes Fisheries Commission, About Us, <http://www.glfsc.org/home.php> (last visited June 13, 2008); Great Lakes Fisheries Commission, Sea Lampreys: A Great Lakes Invader, <http://www.glfsc.org/lampcon.php> (last visited June 13, 2008) ("Ongoing control efforts have resulted in a 90% reduction of sea lamprey populations in most areas, creating a healthy environment for fish survival and spawning.").

Lakes' resources. Certainly, the U.S. Supreme Court can weigh in on the Basin; it has in the area of western water law conflicts. In the Great Lakes there has only been one recurring conflict that the U.S. Supreme Court has addressed—the Chicago diversion. Chicago diverts a substantial amount of water, and the Supreme Court has held that limited diversions are acceptable in that circumstance.⁶⁴

Various federal statutes also provide a web of regulatory programs that govern the Great Lakes. An incredible number of different federal agencies have jurisdiction over a multitude of environmental and natural resource matters. According to a 2003 General Accounting Office report, just at the federal level over 148 separate programs have been created to deal with different segments of the Great Lakes' resources.⁶⁵ Besides the EPA's many activities, the Fish and Wildlife Service regulates endangered species, migratory birds, and interstate fishery resources and manages Fish and Wildlife Refuges in the region. The Forest Service and National Park Service manage the area's federal forest lands and park lands. The National Oceanic and Atmospheric Agency conducts research and is the natural resource trustee agency for aquatic and coastal zone natural resources. The Army Corps of Engineers operates civil works projects and regulates wetlands under the Clean Water Act's section 404 permit program. The Coast Guard regulates pollution from ships, introduction of exotic species, and oil spills. The list goes on.⁶⁶

Beyond the Federal Clean Water Act, Clean Air Act, and the many other general federal laws for protecting the environment, there are many statutes that are specifically tailored to the Great Lakes Basin. For example, similar to the Great Lakes Compact, the Water Resources Development Act of 1986 gives each Great Lakes governor a veto

64. *Wisconsin v. Illinois*, 449 U.S. 48, 49 (1980); *Wisconsin v. Illinois*, 388 U.S. 426, 427 (1967); *Wisconsin v. Illinois*, 289 U.S. 395, 401 (1933); *Wisconsin v. Illinois*, 281 U.S. 696, 696-97 (1930); *Wisconsin v. Illinois*, 281 U.S. 179, 198 (1930); *Wisconsin v. Illinois*, 278 U.S. 367, 420 (1929).

65. U.S. GEN. ACCOUNTING OFFICE, GREAT LAKES: AN OVERALL STRATEGY AND INDICATORS FOR MEASURING PROGRESS ARE NEEDED TO BETTER ACHIEVE RESTORATION GOALS 4 (2003), available at <http://www.gao.gov/new.items/d03515.pdf>.

66. For example, the Department of Agriculture assists landowners with non-point source pollution prevention and control on agricultural operations; the U.S. Geological Survey conducts biology, geology, mapping, and hydrology research and assessment programs in the Great Lakes Region; and the Agency for Toxic Substances and Disease Registry funds epidemiologic research.

power over water diversions.⁶⁷ Also, the Great Lakes Fishing and Wildlife Restoration Act⁶⁸ provides for research and restoration projects, but as a result of its narrow focus on wildlife, it deals with only a very limited set of problems. It does incorporate some more promising regulatory aspects, such as cooperative inter-agency databases and cooperative monitoring. However, these programs are still very much in an embryonic stage of development.

As a response to the excessive fragmentation of these federal, state, and local programs, yet another regulatory apparatus was established—the Great Lakes Regional Collaboration. In 2004, President Bush through Executive order recognized the Great Lakes as a “national treasure,” and helped establish the Great Lakes Regional Collaboration by creating the Great Lakes Interagency Task Force (ITF), which seeks to coordinate the activities of many of the federal agencies with jurisdiction over the Great Lakes.⁶⁹ Led by the EPA, the Great Lakes Regional Collaboration includes the ITF, the Great Lakes Governors’ Council, the Great Lakes and St. Lawrence Cities Initiative,⁷⁰ Native American tribes, and a task force of members of Congress from the Great Lakes region. The chief product of this Regional Collaboration has been a detailed strategy, developed and published in 2005, purporting to protect and restore the Great Lakes.⁷¹

However, to date the Great Lakes Regional Collaboration has ignored water management and consumption issues, and tellingly the Collaboration’s strategy fails to even mention (let alone consider) the possible effects of climate change.⁷² Furthermore, in contrast to the Bush Administration’s strong statements in its Executive Order in support of restoration, the President’s proposed budget for 2009

67. Water Resources Development Act of 1986, Pub. L. No. 99-662, 100 Stat. 4082 (1986) (Most of the provisions in this Act are codified at 33 U.S.C. § 2201 et seq.; however, additional chapter citations include 42 U.S.C. § 1962, 23 U.S.C. § 104, 16 U.S.C. § 688aa, 48 U.S.C. § 1662, 26 U.S.C. § 9505, 43 U.S.C. § 390b, and 16 U.S.C. § 3501).

68. Great Lakes Fishing and Wildlife Restoration Act, 16 U.S.C. §§ 941-941g (1990).

69. Exec. Order No. 13,340, 69 Fed. Reg. 29,043 (May 18, 2004).

70. The Great Lakes and St. Lawrence Cities Initiative is a bi-national advocacy and coordination of local officials for advancing the protection and restoration of the Great Lakes and the St. Lawrence River. See Great Lakes and St. Lawrence Cities Initiative, <http://glslcities.org/aboutus.htm> (last visited Aug. 22, 2008).

71. See GREAT LAKES REGIONAL COLLABORATION, STRATEGY TO RESTORE AND PROTECT THE GREAT LAKES (2005), available at <http://www.gllrc.us/strategy.html>.

72. See *id.*

includes significant cuts in restoration proposals for the Great Lakes.⁷³ As such, most restoration projects initially proposed as part of the Collaboration's strategy would have to be discarded or significantly reduced.

III. THE NEED TO COORDINATE AND ADAPT GOVERNANCE

Though the patchwork of regulatory programs and institutions are dizzying, and though the infrastructure to coordinate and adapt these regulatory activities is weak, there are some promising features in some of the more recent initiatives. While only concerned with water use, the Great Lakes Compact does improve on past efforts by providing for coordinated water resources management between states and provinces. Moreover, the Great Lakes Compact does seek to launch a publicly available, regional inventory of large water uses. The Compact also includes declarations regarding a desire to incorporate adaptive management and would require a five-year period of review of cumulative impacts of water use that seeks to consider new information or changed circumstances (perhaps including any changes wrought by climate change).⁷⁴ It appears that the Compact is a step forward toward using information gathered from regulatory successes and failures to inform the regulatory program and regulatory decisions. Similarly, the Great Lakes Water Quality Agreement's Lakewide Management Plans⁷⁵ serve as a valuable move forward through the adoption of a collaborative regional watershed approach to address water quality, biological, and climate change concerns.

Finally, though only focused on the United States, the Great Lakes Regional Collaboration does seek to coordinate state, local, federal, and Native American efforts, and tries to take a limited regional management approach in the Great Lakes Basin. Rather than each agency continuing to work independently, the regional collaboration seeks to harmonize a range of water quality plans, biological strategies,

73. Press Release, National Parks Conservation Association, White House Budget Leaves Great Lakes Programs on 'Thin Ice' (Feb. 7, 2008), available at http://www.npca.org/media_center/press_releases/2008/020708_how08budgetresponse.htm; OFFICE OF MGMT. & BUDGET, EXECUTIVE OFFICE OF THE PRESIDENT, BUDGET OF THE UNITED STATES GOVERNMENT, FISCAL YEAR 2009 (2008), available at <http://www.gpoaccess.gov/usbudget/fy09/browse.html>.

74. Great Lakes Compact, *supra* note 52, § 3.4.

75. Lakewide Management Plans (LaMPs) in the Great Lakes Region, <http://www.great-lakes.net/lakes/ref/lamps.html> (last visited Oct. 20, 2008).

and requests for line items from Congress. Additionally, it seeks to create a coordinated information gathering process that would become public and create a useful tool for monitoring and perhaps adaptation.

Fundamentally, however, these approaches only modestly increase the adaptive capacity of the regulatory institutions that govern and manage the resources in the Great Lakes Basin. Even with the various regional and international regimes presiding over the Great Lakes, Great Lakes Basin governance is still incredibly fragmented by jurisdiction and by resource. The most advanced regional governance regime, the yet-to-be enacted Great Lakes Compact, would still be state administered. Over twelve federal U.S. agencies are active within the Great Lakes through over 140 separate programs (not to mention their Canadian analogs). Most analyses, regulation, and management of the Basin's resources separately address water quantity, water quality, and biological resources.⁷⁶

Given the extreme division, overlap, and even conflict in authority, it is unsurprising that climate change effects on the Great Lakes have been largely ignored. It also leaves the Great Lakes Basin susceptible to regulatory gaps, and ensures a lack of coordination of activities or sharing of information. Ultimately, it also provides little prospect for these institutions to manage the large-scale effects and considerable uncertainty to follow from climate change.

Perhaps most importantly, none of these regulatory programs or institutions integrates robust monitoring, let alone protocols that seek to take information gleaned through monitoring to adapt previous regulatory decisions. This lack of adaptive capacity is not only present at the level of individual permits or plans but also for the regulatory programs themselves. There are a multitude of programs that influence the management and use of Great Lakes Basin resources; yet each of these programs lacks well-defined goals or benchmarks by which one can systematically evaluate the effectiveness of the program at achieving those objectives. This sort of evaluation is simply not done. On a more basic level, even the more promising recent regulatory initiatives are ignoring climate change. This head-in-the-sand approach is the antithesis of monitoring and adaptation.

76. Even jurisdiction over biological resources is fragmented between marine, terrestrial, and freshwater ecosystems.

The disregard of, or even resistance to, regulatory accountability and adaptation that exists in regulatory institutions that govern the Great Lakes will likely be exacerbated by anthropogenic climate change. The changes that are projected to occur to the natural system are of a greater order of magnitude than any prior stressors of the Great Lakes.⁷⁷ The accompanying massive uncertainty that exists may make any given existing regulatory strategy ineffective. Any strategy designed in the present with limited information, and neither coordinated with other strategies, nor monitored, nor adapted as circumstances change, could quickly become ineffective, obsolete, or even counter-productive.

Regulators must have the data, tools, and incentives to adjust regulatory institutions to respond to new information or changed circumstances, in particular to address the quick and formidable challenges being raised by climate change. This transformation requires collaborative, regional ecosystem-based planning, decision making, and action. Substantial resources must be dedicated to building the information infrastructure to supply Great Lakes officials and stakeholders with vital data that builds the capacity of regulatory institutions to respond to climate change. Information gathering and decision making must be tightly coordinated, focusing landscape-wide across jurisdictional lines to reduce regulatory fragmentation. More fundamentally, government institutions in the Great Lakes Basin must become more adaptive by adopting and incorporating into decision making rigorous monitoring, comprehensive information gathering and dissemination, and periodic assessment and adaptation. Creating these more nimble regulatory processes is the only reasonable way to make Great Lakes regulatory institutions capable of functioning within the projected volatility and uncertainty of climate change.

77. See generally J.B. Ruhl, *Climate Change and the Endangered Species Act: Building Bridges to the No-Analog Future*, 88 B. U. L. REV. 1 (2008).