International Journal of Water Governance 1 (2016) 91–110
DOI: 10.7564/15-IJWG84

The aquatic invasion: Assembling transboundary governance capacity for prevention and detection

Debora L. VanNijnatten

Associate Professor and Chair, Department of Political Science

Wilfrid Laurier University, Canada
E-mail: dvannijnatten@wlu.ca

This case examines the transboundary governance architecture for addressing the problem of aquatic invasive species in the Great Lakes Basin. The analytical focus is on the contribution of institutions and networks to transboundary cooperative capacity and the promotion of effective working arrangements with respect to prevention and early detection. We utilize the four indicators employed in this special issue – functional intensity, nature of compliance mechanisms, stability and resilience and legitimacy – to assess the functions and operation of institutions and networks. We find that the transboundary governance architecture for aquatic invasive species is functionally intense, operating in the sphere of cooperation and often harmonization across both informal networks and more formal institutions. This architecture also utilizes a range of compliance mechanisms which have served to bring about greater harmonization of requirements, particularly for preventing the introduction and transport of new invasive species around the Basin. These efforts and activities are broadly seen as legitimate, due to concerted consensus-building and public information campaigns conducted by the networks, as well as enhanced participation in transboundary policy processes. The stability and resilience of this architecture, buoyed over recent decades by institution-network connections, is however being undermined by ongoing austerity measures.

Keywords: Transboundary cooperation; Great Lakes; Aquatic invasive species; Institutions and networks; Indicators

Just as the metaphor of an "invasion" implies, the introduction of non-native aquatic species into the Great Lakes Basin has unfolded much like a foreign attack and subsequent occupation. Transported into the Basin, often in the ballast water of ocean-going ships bringing goods from around the globe, invasive species can rapidly gain an ecosystem foothold and become established. In many cases, the impacts on ecosystems and native species have been catastrophic. For example, the non-native sea lamprey, one of the earliest invaders in the Basin dating back to 1921, has been responsible for a marked decline in trout populations; each lamprey has the capability of killing 40 pounds of native trout in one year (White House Council on Environmental Quality, 2010, p. 23). In addition,

zebra mussels, first noticed in Lake St. Clair in 1988, have the unfortunate ability to colonize native endangered freshwater mussels, smothering them (Ontario Ministry of Natural Resources, 2012, p. 10). Both zebra and invasive quagga mussels have altered native fish habitat conditions by changing weed growth patterns, phytoplankton availability and nutrient levels. The economic costs are also staggering; the total Canadian economic impact of zebra mussels, for example, has been calculated at between $75-91 million CDN per year (Marbek, 2010, p. 4). The North American Commission for Environmental Cooperation (2008), meanwhile, estimates that economic losses, including the costs of environmental impacts caused by invasive species, exceed $100 billion annually in the U.S. alone.

The policy challenge for governments in the Great Lakes Basin is three-fold: prevention of new invasions; early detection and eradication (where possible) of new infestations; and management/containment of established populations of non-native species such that their impact is mitigated. These tasks are made hugely challenging given the many vectors of invasion and pathways of diffusion; clearly, transboundary cooperation is required. This paper examines the transboundary governance architecture currently in place to address aquatic invasive species in the Great Lakes Basin, with a focus on prevention and early detection. In keeping with the aims of this special issue of the International Journal of Water Governance, we are concerned here with understanding the conditions that contribute to transboundary cooperative capacity and promote effective working arrangements in water basins. While we acknowledge the breadth and often indeterminate nature of the concept of "governance" as encompassing a multitude of collaborative arrangements and activities in situations of interdependency (Pierre & Peters, 2000; Teisman, Van Buuren, Edelenbos, & Warner, 2013), we focus here on institutions and networks as foundational for transboundary governance, given their role in framing and structuring policy discourse as well as providing opportunities or constraints for policy actors. We utilize indicators aimed at assessing the functions and operation of the institutional and network architecture – namely functional intensity, nature of compliance mechanisms, stability and resilience, and degree of legitimacy – in order to discover the system's ability to promote prevention and early detection/eradication.

The analysis below unfolds in three sections. The first section provides additional background on aquatic invasive species as a transboundary environmental problem in the Great Lakes, and situates the Basin experience in the context of efforts to address aquatic invasions at other scales, including North America and Europe. The nature of the policy challenges involved is also described in more detail. The second section then surveys the transboundary governance architecture for invasive species, highlighting the system of informal networks and formal institutions, and showing how they have interacted on prevention and early detection activities. Finally, in the third section, these institutions are evaluated using the four institutional indicators of transboundary governance capacity.

What we find in this analysis is that the transboundary governance architecture for aquatic invasive species is functionally intense, operating in the sphere of cooperation and

often harmonization across both informal networks and more formal institutions. This transboundary architecture has had some success in bringing about greater harmonization of enforceable regulations across jurisdictions to prevent the introduction of new invasive species into the Basin, though early detection and eradication efforts are at an earlier stage of cooperation. These regulatory and cooperative efforts, as well as basin-wide efforts by the International Joint Commission and other transboundary bodies, are broadly seen as legitimate, due to concerted public information campaigns conducted by the networks and enhanced participation in network and institutional processes. However, the stability and resilience of this architecture, which has been buoyed over recent decades by overlapping memberships and institution-network process connections, is being endangered by ongoing austerity measures.

1. Aquatic invasive species in the great lakes basin and beyond

The challenge posed by aquatic invasive species is multi-scalar in nature, encompassing global, regional and local pathways and vectors, and requiring policy responses that operate across these scales. Through human intervention and influence, the physical barriers that once encouraged the evolution of regionally distinct biodiversity have been breached, resulting in the movement of species across Basins, across regions and even across the globe, far from their normal habitat. In some cases, the new arrivals are so successful at adapting to their new habitat that they profoundly disrupt local ecologies. Invasive species may compete with native organisms for food sources, they can alter ecosystem structures and threaten native species through local extinction due to interbreeding, and they can be a vector for parasites (Commission of the European Communities, 2008, p. 4). In fact, alien invasive species are considered to be among the most significant factors associated with threats to biodiversity, along with climate change, overexploitation and pollution (Millenium Ecosystem Assessment, 2005, p. 8). Calls for coordinated action to immediately address invasive species have echoed around the world, from the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to the Convention on Biological Diversity and the Invasive Species Specialist Group of the International Union for the Conservation of Nature, to all major institutions of the European Union[1] and the North American Commission for Environmental Cooperation (CEC).

In the North American context, the CEC has argued that the continent is "extremely vulnerable" to the introduction of invasive species from abroad, given its integration into the global economy. In addition, its vast intercontinental transportation systems offer ready pathways for species invasion across Canada, the U.S. and Mexico, through commercial

[1] Concern has been expressed by all bodies of the EU, including the European Parliament, the Committee of Regions, the Environment Council and the European Economic and Social Committee. The DAISIE project supported under the Sixth EU Research Framework has identified 10, 822 non-native species in Europe, and it was estimated that 10-15% of those have negative ecological or economic impacts.

or recreational interactions (Commission of European Communities, 2008, p. 1). Further, its vast coastlines and large bodies of freshwater place the continent at high risk of invasion (Department of Fisheries and Oceans, 2004). Invasive species are considered the second most important driver of native species extinction on the continent after habitat change, given impacts resulting from competition for food, space or reproductive sites, and the introduction of parasites/disease (Commission of European Communities, 2008, p. 2). Significantly, no other freshwater system in North America has been invaded as frequently as the Great Lakes (Pugnucco, Maynard, Fera, Yan, Nalepa, & Ricciardi, 2015).

Above, we characterize the policy challenge for governments in the Basin as threefold: 1) prevention; 2) early detection and rapid eradication; and 3) long-term containment and mitigation. This "three-stage hierarchical approach" emerged out of negotiations on the Convention on Biological Diversity (2002), and is viewed as the international "gold standard" in invasive species management. The most important aim is to prevent the introduction of new aquatic invasive species into the Great Lakes Basin ecosystem in the first place; clearly, prevention is the most cost-effective approach to dealing with organisms not yet arrived, given that these organisms are practically impossible to eradicate once they are established (White House Council on Environmental Quality, 2010, p. 22). The activities of individual Basin users need to be regulated in very specific ways, to minimize the risk of new introductions of invasive species via ship ballast water and ballast tanks, canals and recreational boating, trade in live organisms, sale of live fish for food, as well as unintentional or intentional release by the aquarium and bait industries. Further, a range of risk assessment, surveillance and monitoring programs need to be put in place, in addition to mechanisms for direct and timely information-sharing. Science-based risk assessment of species and pathways of introduction can provide early warning of potential threats. In conjunction, regulation and listing of specific potential invasive species need to be coordinated across the Basin.

Moreover, monitoring programs need to be able to detect an introduction or possible introduction, inform other parties of the infestation, and respond quickly to eradicate the infestation. Rapid response programming needs to be formulated – including informational, administrative and coordinative infrastructure – in order to eliminate small infestations before they become firmly established (Great Lakes Echo, 2010).

Given that there are more than 180 aquatic invasive species already established in the Basin (see Figure 1, which is cumulative), there is also a need to put in place programs that can track the movement of these new species around the Lakes, prevent their further spread and contain their activities in order to maintain the health of the Basin ecosystem. Programs to evaluate candidate species that would likely be invasive should they arrive in this region are also necessary. Critical to controlling species already present is encouraging a wide range of research efforts aimed at examining habitat impacts, as well as creating the technologies and processes for minimizing the impacts of species already present.

All of the activities associated with prevention, early detection/eradication and management require a high level of transjurisdictional cooperation that allows for common action, particularly where the infestation is spread across jurisdictions or is located within

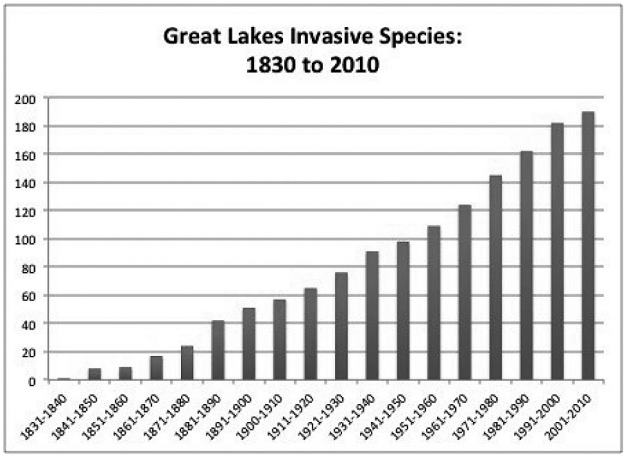

Figure 1.
Source: Graphic by Greta Johnsen/Data from NOAA)

shared waters – which is most often the case in the Great Lakes. Across these tasks, it is important to have the effective exchange of information, a sharing of resources, coordinated research and implementation of management actions, as well as harmonized policy goals and even, in some cases, regulations. Given the necessarily limited scope of analysis here, we focus primarily on transboundary cooperation in the first two areas, prevention and early detection.

2. Institutions, networks and the transboundary governance of invasives in the great lakes basin

As in the framework paper for this special issue, this case analysis treats institutions and networks as analytically foundational to an understanding of the nature and strength of transboundary governance. The key roles of institutions and networks in coordinating and constraining behaviour (Lowndes & Robert, 2013), reducing transaction costs and encouraging commitment to policy goals (Buchanen & Keohane, 2006, p. 1) have been have been examined extensively by those studying the design of common pool resource management (e.g., Anderson & Grewal, 2000; Ostrom, 1990), international environmental architecture (e.g., Biermann, Pattberg, & Zelli, 2010; Hearns, Paisley, & Henshaw, 2013; Keohane & Victor, 2011), socio-ecological systems (Berkes, Colding, & Folke, 2003) and water governance (Grigg, 2011; Organization for Economic Cooperation and Development [OECD], 2011).

Institutions are defined here as sets of *rules* shaping or constraining the behaviour of actors, while networks, which can be understood as sets of *relations* that form structures, may also constrain or enable actors (Hafner-Burton, Kahler, & Montgomery, 2009, p. 560).

In studying institutions, we aim to identify those rules that are codified (vested with public authority) or are inherent in standard operating procedures and socially shared understandings created outside official sanctioned channels (Lowndes and Roberts, 2013). The analytical focus of networks is on the ways in which agency officials, civil society and experts are linked through channels of information exchange and discussion, socialization and diffusion (Slaughter, 2004). The point of studying networks is to identify patterns of relationships which might serve as "hubs, cliques, or brokers" of interest and which can impact decision-making (Hafner-Burton et al., 2009, p. 560).

The Great Lakes Basin features a broad-reaching, multi-layered governance architecture for addressing invasive species, one characterized by a complex system of formal and informal rules and networks of policy-makers and scientists. Farrell and Heritier (2003, p. 580) have observed that, while the nature of networks may be influenced by the formal framework within which they operate, formal institutions may also undergo change as a result of repeated informal interactions. Such has been the case with aquatic invasive species governance in the Basin; networks of scientists and policy-makers have worked, through peer dialogue and consensus building, to alter and augment existing formal agreements in such a way that they address aquatic invasives in particular ways. As formal institutions have responded, the networks have reformulated their agenda and objectives, pressing on new fronts, in a manner which Farrell and Heritier describe as "recursive" (Ibid). This case thus allows us to study the operation and effectiveness of a dynamic transboundary governance architecture that combines the formal and informal, as well as more established and newer elements.

2.1. Intergovernmental Networks and Institutions

In 2012 the Canada-United States Great Lakes Water Quality Agreement (GLWQA) was revised, and one of the most significant changes was to add Annex 6 dealing with Aquatic Invasive Species (AIS). This policy and programmatic undertaking involved the insertion of new language directing the Canadian and American governments to prevent the introduction of invasive species, to eradicate current existing AIS within the Basin, and to control and reduce the spread of existing AIS (GLWQA Annex 6, A). The three-stage hierarchical approach has thus been incorporated into the formal Basin regime, and is subject to the reporting and other process mechanisms in the Agreement.

Indeed, the incorporation of specific tasks related to AIS into the binational regime – with deadlines attached – represents a significant departure from the previously existing policy approach. Early references to this problem used the term "biological pollution" in the context of vessels traversing the Great Lakes. At the time, it was meant to address pathogens only. In the 1978 and 1985 versions of the GLWQA, invasive species were addressed only in a cursory way, referring to the need to undertake research to determine the threat of AIS on ballast water and their impacts on other species and habitat.[2] Prevention,

[2] These provisions can be found in the 1987 version of the Great Lakes Water Quality Agreement in Annex 6, 1 (b) and Annex 17, 2 (i).

control and management efforts were not specifically dealt with. This move to formalize requirements under the binational Agreement, we observe here, can be attributed to the work of policy and scientific networks which emerged in the 1990s. These were critical to early transboundary efforts to address invasives – in terms of scoping out the urgent nature of the policy problem, identifying the best actions to take out of the range of available policy options, and then getting these onto the binational policy agenda.

In 1988, in a letter to the two federal governments, the Great Lakes Fisheries Commission called attention to the serious threat to native fisheries posed by non-native species carried into the Basin in the ballast water of ocean-going ships, and recommended that the governments limit future introductions via this vector of invasion (Ridenour Letter, August 4, 1988). Members of the Commission, as well as the networks of agency and policy officials from around the Basin associated with its research and management committees as well as its program-specific "working arrangements," already had experience dealing with the invasive Atlantic sea lamprey. This call to action was seconded by the U.S.-Canada International Joint Commission (IJC), established under the 1909 *Boundary Waters Treaty*, which also sent letters to both governments noting the need for immediate action on ballast water management.

In 1991, the Great Lakes Commission – a body established to articulate and coordinate the interests of states and provinces around the Basin – created the Great Lakes Panel on Aquatic Nuisance Species. The Panel's mandate was "to coordinate the development of education, research and policy to prevent new aquatic invasive species from entering the Great Lakes Basin, and to control and mitigate those AIS populations already established" (Great Lakes Commission, 2013). The panel is a unique network, given that it was created under U.S. legislation (the *Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990*) but operates in a binational capacity with representation from national, state and provincial governments as well as regional agencies, user groups, local communities, tribal/aboriginal authorities, commercial interests, and the university/research community. It is aimed at advising government policy makers, coordinating their policy responses across territorial boundaries, and informing/educating policy actors and the broader public. Significantly, the GLPANS has provided input into the US federal Great Lakes Restoration Initiative and the Aquatic Nuisance Species Task Force, both domestic inter-agency networks discussed in the next section (Great Lakes Panel on Aquatic Nuisance Species, 2011).

In all of its communications and in the committee mandates, the Panel has emphasized the need for coordinated prevention, rapid response and surveillance measures. To kickstart these efforts, the Panel released research documents highlighting the key role of ballast water in the transport of invasive species into the Basin, as well as a priority list of work that needed to be done to investigate different methods for ballast water management (Great Lakes Panel on Aquatic Nuisance Species, 2008). Other documents recommended specific invasive species that should be prioritized in management efforts (Great Lakes Panel on Aquatic Nuisance Species, 2007). An overarching focus was on the development and application of risk assessment protocols, and the better management of information around the Basin.

At the regional level, the problem of aquatic invasive species was also garnering attention, with an acknowledgment by the North American Commission for Environmental Cooperation that, "North American ecosystems are being silently overrun by potentially devastating alien invasive species" (Commission of European Communities, 2000, p. 43). The CEC proposed a "comprehensive approach to this trinational problem," through an evaluation of major pathways for biological invasion and formulating "carefully targeted" measures to eliminate future introductions in aquatic ecoregions, particularly in the Great Lakes. Over 2001-2003, the CEC's Aquatic Invasive Species project commenced, with the organization hosting three meetings on preventing AIS introductions by "closing pathways" between the three countries, and gathering and sharing relevant information (Commission of European Communities, 2003, p. 13). To guide these activities, a Trinational Aquatic Alien Invasive Species Working Group (TAAISWG) was created, composed of representatives from basin-level networks and domestic agencies, including Canada's Department of Fisheries and Oceans and the interagency National Invasive Species Council in the US. The CEC's work was intended to complement the IJC's work in this area (Commission of European Communities, 2000, p. 51).

The International Association for Great Lakes Research (IAGLR), which dates back to the mid-1960s, is a "member-run professional association" made up of researchers studying the Great Lakes and its watersheds. The aim of this network is both to support research on the Great Lakes but also to "increase scientific outreach to inform public policy and decision-making" (International Association of Great Lakes Research, 2005). Significantly, in 2002, IAGLR released a "science translation" report, entitled Research and Management Priorities for Aquatic Nuisance Species in the Great Lakes, which characterized the aquatic invasive species threat as "one of the greatest risks to the health and productivity of our coastal marine ecosystems and the Great Lakes." The report advocated for a major increase in federal funding devoted to invasive species, in particular for technologies and management strategies for ballast water treatment, interdiction of foreign vessels and the establishment of information and risk assessment systems to track and identify future invaders. The report also indicated that governments needed to devote more attention to other vectors of invasion, such as aquaculture, the bait industry, and the aquarium industry.

The work of these networks fed into the policy deliberations of bodies associated with the International Joint Commission. The GLWQA requires that the IJC report biennially (and now triennially after the 2012 revisions) to the federal, state and provincial governments concerning progress towards achieving Agreement objectives, as well as the effectiveness of programs and other measures undertaken pursuant to it (Article 7.k). The Commission may also provide advice and recommendations on any matter related to the quality of the boundary waters of the Great Lakes system (Article 7.l). In the course of what was known as the "biennial priorities process," each Biennial Report set out several priorities for guiding the work of the Commission Boards over the succeeding two years, after which Work Groups are formed to study the problem or issue, and make recommendations for further action. These would then feed into the next Biennial Report. The process will now unfold on a triennial basis.

In its 2004 Biennial Report, the Commission urged the two governments "to issue a standing reference to the Commission to coordinate prevention measures to help halt this invasion (of aquatic species) to the Great Lakes" (International Joint Commission, 2004, p. vi). Heavy emphasis was placed on ballast water management, with the Report making specific recommendations to the two governments to finalize national, mandatory, harmonized provisions. While the reference itself was rejected, the ballast recommendations were accepted by the two governments. Aquatic invasive species did not again take centre stage until the 2007-2009 priority-setting and work group process, when the focus turned to formulating a binational rapid response policy framework (International Joint Commission AIS Rapid Response Work Group, 2010). However, the 2009 biennial report did not mention invasive species and it was not until the 2011 Biennial Report that the two governments were urged to "use a revised Great Lakes Water Quality Agreement as a vehicle for the development and deployment of binational protocols for rapid response before invasive species enter the lakes" (International Joint Commission, 2011, p. 3).

Interestingly, the Review of the GLWQA, conducted over 2004-2007, did not suggest specific components of a bilateral regime though it indicated that creation of a separate Annex for invasive species was warranted. Indeed, aquatic invasive species was noted as one of the three most pressing issues, along with climate change and impacts from urbanization, which the Agreement was ill-prepared to address (IJC, 2007).

The new binational regime in Annex 6 of the 2012 revised GLWQA directs the two national governments to adopt a "prevention-based approach, informed by risk assessments" in the development and implementation of programs and other measures to eliminate new AIS introductions. These measures are to include ballast water discharge programs, risk assessments, associated regulations, and the coordination of implementation strategies and rapid response initiatives. The Annex also prioritizes scientific collaboration encompassing risk assessment for determining vectors and pathways of AIS movement, prevention programs, technologies for controlling AIS, barrier methods and habitat impacts (GLWQA, Annex 6, C 1-8). More concretely, within the first three years of the Agreement, the parties must:

a) develop species watch lists;
b) identify priority locations for surveillance;
c) develop monitoring protocols for surveillance;
d) establish protocols for sharing information;
e) identify new AIS; and
f) coordinate effective and timely domestic and, where necessary, binational response actions to prevent the establishment of newly detected AIS.

Of note is the very broad way in which "aquatic invasive species" are defined - i.e., as "any non-indigenous species, including its seeds, eggs, spores or other biological material capable of propagating that species" – which provides a political and policy rationale for a potentially very broad-based transboundary governance regime.

Significantly, the addition of Annex 6 was accompanied by the establishment of a new Basin-wide institution, the Annex 6 subcommittee, which was brought into the GLWQA priority-setting and planning process. The Annex 6 Committee is co-led by Fisheries and Oceans Canada and the U.S. Fish and Wildlife Service, and appears to act as an umbrella organization bringing together federal, state and provincial agencies responsible for invasive species management, aboriginal authorities, but also existing networks including the Great Lakes Commission, the Great Lakes Fishery Commission and the Great Lakes and St. Lawrence Cities Initiative. The priorities guiding the work of the Annex 6 subcommittee, and any task groups created for specific initiatives, are set through an iterative process involving the subcommittee, the Great Lakes Executive Committee (with a similar multistakeholder membership), the IJC and other stakeholders. Reporting on progress involves the same dynamic (Binational.net, Annex 6 Invasives).

It is also worth mentioning the role that the International Joint Commission's Ecosystem Indicators project has played in highlighting the aquatic invasive species problem in the Great Lakes. Through its Science Advisory and Water Quality Boards, the IJC has sought to identify a limited number of ecosystem indicators which are believed to be "especially important" to the health of the Basin and indicative of progress made in protecting and restoring shared waters (International Joint Commission Work Group on Ecosystem Indicators, 2013, p. 1). In deliberations on the indicators, aquatic invasive species indicators received "top" vote scores in the winnowing process (ibid, 5).

2.2. Domestic Legislation and Policies

Domestic legislation and policies are not "transboundary" of course; in the most basic sense, their intent is to shape the behaviour of domestic actors in specific ways in order to achieve particular policy goals defined by national or subnational decision-makers. At the same time, it is very difficult, for example, to understand the degree to which the transboundary regime exhibits functional intensity, or compliance with international goals, without looking at how those goals have been applied within countries. This article cannot provide a comprehensive examination of domestic implementation but it can offer a brief glimpse into legislation and regulations in areas covered by the transboundary regime (see Table 1). What we suggest here is that the American regime has been more well developed than the Canadian until recently, with a framework of national laws and regulations (particularly with regard to prevention) that are implemented by both federal and state agencies, as well as various mechanisms designed to coordinate these activities. Recent legislative and regulatory additions in Canada have solidified the Canadian policy regime, with explicit efforts made to harmonize provisions with the U.S. The second observation is that subnational provisions dealing with aquatic invasive species have been quite uneven around the Basin, but are beginning to look somewhat more similar.

Both the U.S. and Canada have implemented ballast water provisions which make the exchange of ballast water at sea mandatory in order to minimize the chances of transport of invasives into the Basin. Canada introduced voluntary guidelines for ballast water

Table 1
National Initiatives, Canada and the United States

Jurisdiction	National Strategy	Mandatory Requirements
United States – federal	National Invasive Species Management Plan (under NISC – see table 2)	National Invasive Species Act 2007: focus on prevention of invasive species from entering the Great Lakes through ballast water (reauthorized and amended the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990) Aquatic Nuisance Prevention and Control (16 USC Chapter 67) focuses on ballast water management, coordination of federal research, developing and undertaking environmentally sound control methods, and provision of research and technology programs Ballast Water Management for Control of Nonindigenous Species in the Great Lakes and Hudson River (33 C.F.R. – 151)
Canada – federal	Canadian Action Plan to Address the Threat of Aquatic Invasive Species (2004), under An Invasive Alien Species Strategy for Canada	Aquatic Invasive Species Regulations 2015 (pursuant to Fisheries Act): prohibits importation, possession, transportation and release of listed species, allows deposit of deleterious substances for control and eradication purposes Ballast Water Control and Management Regulations TP13617E, 2012 (pursuant to Canada Shipping Act which protects the marine environment from damage due to navigation and shipping activities)

management in 1989, after which the U.S. Coast Guard issued mandatory regulations in 1993 requiring ballast exchange for ships traveling to the Great Lakes. These were amended in 2004 and again in 2005 to make ballast water management and reporting mandatory in all US waters (Transport Canada, 2010). In 2000, the application of the Canadian guidelines was expanded to cover all waters under Canadian jurisdiction, and in 2004 the mandatory *Ballast Water Control and Management Regulations* were put in place, with the aim of harmonizing "to the maximum extent possible" the provisions with those in the U.S. and at the international level (Transport Canada, 2010).

The prevention and control of AIS requires programs at all levels, as well as coordination among them. The U.S. has made considerable attempts at horizontal and vertical coordination (see Table 2). In the Canadian case, initiatives designed to foster inter-agency coordination have been more ad hoc under the Canadian Action Plan, but a higher level of coordination across levels of government is foreseen under the new Aquatic Invasive Species Regulations. The regulations were themselves developed collaboratively with the existing National Aquatic Invasive Species Committee, a working-level task group under the Canadian Council of Fisheries and Aquaculture Ministers which includes provincial and territorial agency representatives. Fisheries and Oceans Canada will continue to work with other jurisdictions as well as non-governmental organizations to coordinate implementation activities, such as enforcement, compliance promotion, and identification of species for listing in the Regulations (Canada Gazette, 2015).

Subnational provisions dealing with invasive species are uneven but are gradually becoming more similar over time; discussions occurring alongside the GLWQA Annex 6

Table 2
Horizontal Coordination Initiatives in the United States

Name	Lead	Agencies/Actors Involved	Date Initiated
National Invasive Species Council	Agriculture, Commerce and Interior	Defense; Treasury; Human & Health Services; Trade: Homeland Security; EPA; State; International Development; NOAA; Transportation	1999
Federal Invasive Species Advisory Committee	Interior	Some state agencies, but primarily non-governmental, university and private sector	2000
Aquatic Nuisance Species Task Force	Fish & Wildlife Service and NOAA	US Coast Guard; Army Corps of Engineers; EPA; State; Transportation; National Park Service; Bureau of Land Management; National Forest System * Regional Panels (e.g., Great Lakes Region) also include state officials	2002
Great Lakes Restoration Initiative	White House Council on Environmental Quality	Agriculture; Commerce Health & Human Services; Homeland Security; Housing & Urban Development; US Army; Interior; Transportation; EPA	2009

processes and other basin-wide forums may be encouraging more coordinated approaches. In the US, aquatic invasive regulations can differ widely in terms of how the possession, transport, importation, sale, purchase and introduction of invasive species is regulated, what select species these regulations are applicable to, and how pathways for diffusion are regulated (e.g., recreational boating). The regime in Michigan, for example, is broader than that in Ohio.[3] Previously in Canada, provincial regulatory schemes establishing rules on the possession, sale and stocking of species differed across the country, but the new federal Aquatic Invasive Species Regulations are designed to bring about a higher level of uniformity in provisions. In Ontario, of most interest here given its Great Lakes location, the province has introduced into the Legislature an *Invasive Species Act* in late 2014; this Act would provide a more comprehensive set of authorities under which regulations aimed at the prevention and control of AIS could be formulated. The scope and nature of these authorities are similar to those provided stateside.

3. Institutional indicators of transboundary governance capacity

This discussion above tracks the evolution of both the formal and informal components of the aquatic invasive species transboundary governance architecture. Networks have operated through deliberation, persuasion and consensus-building to articulate a widely accepted narrative about the nature and urgency of the invasive species problem

[3] Please see the comparisons of state regulations on the National Invasive Species Information Centre website (Law and Regulations) http://www.invasivespeciesinfo.gov/laws/main.shtml

and, in many cases, the specific actions that should be taken to address it. Formal institutions have then set out tasks that governments in the region must undertake, based at least in part on these network deliberations and campaigns. Both coordinated and independent programs have been put in place by the U.S. and Canadian governments, the eight state governments, the two provincial governments, and at other regional and local levels. In this way, more informal policy and scientific networks have been instrumental in encouraging the establishment of formal requirements, and have moved to advocate on new aspects of policy, initiating the process all over again.

In this section, we evaluate the strength of this dynamic architecture of formal and informal institutions and networks, using the four indicators set out in the framework paper to this special issue: functional intensity, nature of compliance mechanisms, stability and resilience, and degree of legitimacy. Once again, our overall aim is to provide a measure of the ability to support effective transboundary cooperation – in this case, prevention and early detection of AIS.

3.1. Functional intensity

The "functional intensity" of transboundary institutions serves as a broader indicator of the extent to which institutions and networks are engaged in deeper forms of collaboration, those which require greater engagement and commitment from state and non-state actors (VanNijnatten, 2006). Functional intensity is measured on a spectrum ranging from less intense linkages such as information-sharing and consultation, to more intense activities such as cooperation, harmonization and even integration. Given the focus here on prevention and detection of AIS, the whole range of shared activities are required – information-sharing, joint development and adoption of risk-assessment protocols, joint development and operation of monitoring and surveillance frameworks and, in some cases, the harmonization of regulations (e.g., ballast water practices and the regulation of the ornamental horticulture trade).

Contrary to what one might expect under the governance architecture described above, which incorporates significant informal as well as newer elements, it exhibits relatively high functional intensity. Early transboundary efforts under the GLPANS and IAGLR seemed to "leapfrog" past the least functionally intense stages (i.e., information-sharing and consultation) in favour of cooperation and in some cases harmonization – activities focused on working together to create shared programs with clear objectives, with the aim of bringing about a compatibility of actions across jurisdictions.

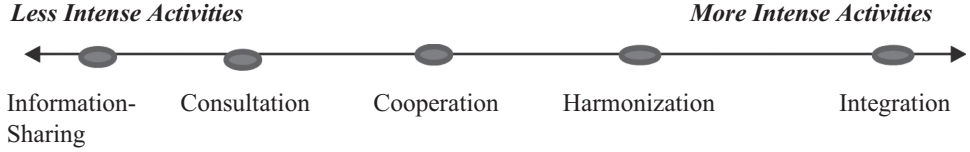

Figure 2. Functional Intensity Spectrum
Source: VanNijnatten, 2006

In this respect, it might be argued that the relatively high level of functional intensity in newly created networks can be attributed to the fact that these networks were created at the initiative of well-established transboundary institutions, such as the Great Lakes Commission. Relatedly, the significant efforts made on the US side in the late 1990s-early 2000s to achieve inter-agency coordination and harmonization on invasive species – through the Aquatic Nuisance Species Task Force, the National Invasive Species Council and the Federal Invasive Species Advisory Committee, all with the full support of national legislation, helped to ensure that functionality went significantly beyond information-sharing and consultation around the Basin.

The binational regime envisioned under Annex 6 of the GLWQA is one characterized by harmonization, stopping short of creating an integrated regime but putting in place the bases for consistency of goals and interoperability of programs.

3.2. Nature of Compliance Mechanisms

In an international context, a key concern is understanding how we might incentivize compliance on the part of those subject to transboundary policy goals or requirements. Here, too, we utilize a spectrum to show "the range of the possible" incorporating "soft" (voluntary) and "hard" (non-voluntary) components. Our understanding in this special issue is that a wide range of compliance mechanisms are needed, that these different forms of compliance can reinforce each other, but that harder compliance mechanisms (e.g., regulations) often serve as an effective support for cooperative activities.

Early in the development of the transboundary governance architecture for AIS (beginning in the 1990s), the policy and research networks were instrumental in creating and propagating a narrative about the immediacy and seriousness of the invasive species problem, and building consensus about the need for governments and users of the Basin to take action. Moreover, the action advocated by networks such as GLPANS was specific in terms of *what* should be done, i.e., prioritization of specific alien species, endorsement of a risk assessment process and a call for rapid response under the leadership of certain federal agencies. This occurred prior to and alongside discussions about what should be done at the binational level by the IJC under the Biennial Priorities Process, its Rapid Response WorkGroup and the renegotiation of the GLWQA sometime later.

While this network architecture did not bind governments, policy actors or Basin users, it was instrumental in cultivating relationships across the science-policy divide, and

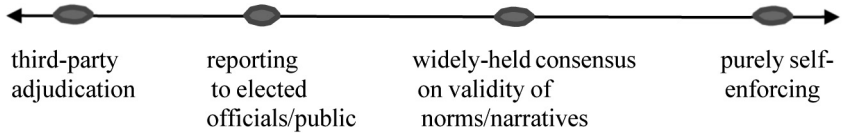

Figure 3. Compliance Spectrum
Source: VanNijnatten, Johns, Friedman and Krantzberg (2015), "Assessing the Adaptive Capacity in the Great Lakes Basin: The Role of Institutions and Networks," International Journal of Water Governance, this issue.

creating a set of self-enforcing norms encouraging a specific kind of action. The compliance mechanisms in place under the revised Annex 6 on Invasive Species are somewhat stronger, now relying on progress reporting and accountability measures. Reporting on progress in fulfilling specific objectives and mandates is a well-established enforcement mechanism in the Great Lakes environmental governance regime, as it provides high public visibility in terms of political and public expectations.

The strongest enforcement mechanisms reside within the legislation and accompanying regulations in individual national and subnational jurisdictions; these provisions were informed by and bear the hallmark of basin-level network and institution discussions. Now that a harmonized basin-wide regime for ballast water has been put in place, discussions have turned to other vectors, risk assessment and rapid response programming. As a result, there are some signs of enhanced coordination, particularly at the subnational level.

The result is a multi-faceted compliance regime in which reporting protocols and regulatory requirements are increasingly buttressing narratives and consensus on how to address the continuing challenges posed by aquatic invasive species.

3.3. Stability and resilience

Stability and resilience can be assessed through reference to "staying power" or longevity, particularly in the face of changing political and economic conditions, as well as adaptive capacity. One tentative but potentially significant observation in this particular case is that the overlapping nature of the network structures and binational institutions active on this policy issue builds some level of stability into the governance framework. Although a full network analysis mapping the relational ties between actors cannot be carried out here, secondary evidence from examining membership lists and anecdotal information from interviews suggests that inter-agency and inter-community linkages cut across the different networks and institutions, serving to support the transboundary architecture. This has created a considerable degree of consistency of knowledge, effort and message over time. One real difficulty here, however, pertains to network "departures"; personnel changes particularly within government agencies may weaken network ties. Another difficulty is the kind of "institutional congestion" that so concerns observers of international institutions (e.g., Najam, Papa, & Taiyab, 2007); there are many mechanisms focused on managing invasive species, both within jurisdictions and across them, and the task of coordination is immense.

When applied to an institution or network, resilience can be understood as the degree to which a socio-ecological system is capable of self-organization, learning, and adaptation (e.g., Berkes et al., 2003). This case shows the evolution of ideas, their transfer across networks and into transboundary institutions associated with the IJC and the GLWQA, and their adoption into formal requirements, over time. The networks, which have been so instrumental to the formulation of policy and research priorities, do not appear particularly rigid in terms of dialogic process. While messages have been relatively consistent, new scientific findings and policy options are constantly entering into, being digested and diffused

outward by the networks. Further, the clear mix of scientific, policy and agency personnel in membership networks ensures the flow of ideas and best practices around the network.

Not only does our stability and resilience indicator reflect the ability of institutions and networks in the aquatic invasive species case to survive the passage of time, but also to endure despite changing conditions – whether political, economic (budgetary) or environmental (Levitsky & Murillo, 2009). In the current climate, the fiscal situation of both national and subnational governments is perhaps the most significant factor influencing the transboundary enterprise. Almost every recent document emanating from the networks and institutions studied here notes budget cuts as threatening the very foundation of their binational projects. Because most of the mechanisms profiled here are funded out of discretionary agency envelopes, which are themselves subject to jurisdiction-specific idiosyncratic cuts, it may be difficult for them to continue the full range of activities they have undertaken over the past two decades. A 2013 report by IAGLR declared that:

> A major federal funding increase of at least $30 million per year for the Great Lakes region is needed to push for rapid progress towards solutions to the problems outlined in this document [on invasives management]. The piecemeal and relatively small annual funding requested by the Administration and provided by Congress, and the funds available through Canadian agencies, are not sufficient for substantive progress.

Indeed, the spring meeting of the GLPANS focused almost exclusively on the funding problem, specifically exploring alternatives to federal funding that could be more sustainable (Great Lake Panel on Aquatic Nuisance Species, 2013, p. 4). The reason for this is clear; for example, as a result of federal funding cut backs, the National Aquatic Nuisance Species Clearinghouse has been closed. The AIS Database developed by the National Clearinghouse is now part of the New York Invasive Species Clearinghouse and will remain on-line and searchable, but no new publications will be added to the database. Moreover, in a 2009 letter to federal officials, the GLPANS noted that, "the Panel has seen its federal funding diminish progressively over time to the point where it has become difficult to convene meetings and execute our mandate under federal statute" (Great Lake Panel on Aquatic Nuisance Species, 2009). The very real risk here is that when cuts are replicated across the national and subnational jurisdictions which support the transboundary governance regime, both horizontally and vertically, this erodes the material capacity of the regime through "death by a thousand cuts."

3.4. Degree of Legitimacy

This indicator, too, can be understood to have various dimensions, including formal-legal (accountability) and process (procedural) aspects. With formal institutions, it is easier to locate and assess accountability mechanisms, but in a transboundary context, where there is more reliance on informal rules and network interactions, legitimacy can be decidedly murky.

In the transboundary context, given the lack of any process of 'constitutionalization' of institutions and networks, process values – such as transparency and inclusiveness of

decision-making – take on added importance. A notable feature of this case is the horizontal and vertical inclusiveness of both networks and the IJC-related processes. In its Guiding Principles, the IJC notes that it "employs joint fact-finding as a foundation for building consensus and determining appropriate action" (IJC Principle 6). Great emphasis is also placed on "the engagement of state, provincial and municipal governments and other authorities" (Principle 7) and drawing on "expertise from a diversity of sources" (Principle 13). The Biennial (now to become the Triennial) Priorities process serves, to some extent, to bring together various communities and policy actors in an effort to canvass information and build consensus on recommendations for the two governments.

The informal reporting and information-sharing carried out by the networks is complemented by the formal reporting requirements under the revised 2012 GLWQA. Moreover, the well established requirements to consult with the public in the Biennial Priority Process and during the activities of the specific projects, such as the IJC Ecosystem Indicators, ensure that a wide range of information is available to interested stakeholders. If there is a downside here, it is the overwhelming amount of information provided by so many different bodies.

4. Conclusion

This special issue of the International Journal of Water Governance aims to investigate the conditions that contribute to transboundary cooperative capacity and promote effective working arrangements in water basins. Specifically, we focus on the functions and operation of the institutional and network architecture, by applying indicators which assess its functional intensity, the nature of compliance mechanisms employed, its stability and resilience, and the degree of legitimacy it has garnered.

The institutional and network architecture associated with aquatic invasive species prevention and early detection has evolved in a dynamic and "recursive" fashion. There is an informal webbing of overlapping policy and scientific networks (e.g., Great Lakes Panel on Aquatic Invasive Species and its committees) that is now several decades old; these networks have created a mesh of connections which overlay a wide range of agency actors and scientific communities, drawing them into research activities, attempts at program harmonization and policy advocacy. As a result of these network activities, more formal mechanisms are being put in place. Specifically, a clearer set of objectives and firm mandates have been established under existing institutions, namely Annex 6 of the 2012 Great Lakes Water Quality Agreement; and through the International Joint Commission's Priorities and Work Group Process as well as its Ecosystem Indicators project. These are supported by legislative and regulatory provisions that have emerged across both national and subnational governments and give some force to basin-wide objectives, though (particularly at the subnational level) not necessarily in identical fashion.

This transboundary architecture is functionally intense, operating in the sphere of cooperation and often harmonization across both informal networks and more formal institutions. This architecture has had some success in bringing about greater harmonization

of enforceable regulations across jurisdictions to prevent the introduction of new invasive species into the Basin, though early detection and eradication efforts are at an earlier stage of cooperation. These regulatory and cooperative efforts, as well as broader efforts by the International Joint Commission and other transboundary bodies, are broadly seen as legitimate, due to concerted public information campaigns conducted by the networks and enhanced participation in network and institutional processes. However, the stability and resilience of this architecture, which has been buoyed over recent decades by institutional-network connections, is being severely tested by ongoing austerity measures.

References

Anderson, T. L., & Grewal, J. B. (Spring 2000). Property rights solutions for the global commons: Bottom-up or top-down? *Duke Environmental Law & Policy Forum*, *10*(2).

Berkes, F., Colding, J., & Folke, C. (Eds.). (2003). *Navigating social–ecological systems: Building resilience for complexity and change*. Cambridge, England: Cambridge University Press.

Biermann, F., Pattberg, P., & F. Zelli. (2010). *Global climate governance beyond 2012: Architecture, agency and adaptation*. Cambridge, England: Cambridge University Press.

Binational.net, Canada-United States Collaboration for Great Lakes Water Quality.

Buchanan, A., & Keohane, R. O. (2006). The legitimacy of global governance institutions. *Ethics and International Affairs, 20*(4), 405–437.

Canada Gazette. (June 17, 2015). Aquatic invasive species regulations: Interpretation. *Archived*, *149*(12). Retrieved from http://canadagazette.gc.ca/rp-pr/p2/2015/2015-06-17/html/sor-dors121-eng.php

Commission of European Communities (CEC). (2008). *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Towards an EU strategy on invasive species*. 3/12/2008 COM(2008) 789 final. Retrieved from http://www.eumonitor.nl/9353000/1/j9vvik7m1c3gyxp/vikqhn2a5szo

Convention on Biological Diversity. (2002). *Guiding principles for the prevention, introduction and mitigation of impacts of alien invasive species that threaten ecosystems, habitats or species annexed to Decion VI/23*. Sixth Conference of the Parties, The Hague, The Netherlands, April 19, 2002.

Department of Fisheries and Oceans. (2004). *A Canadian action plan to address the threat of aquatic invasive species*. Canadian Council of Fisheries and Aquaculture Ministers Aquatic Invasive Species Task Group. Retrieved from http://www.dfo-mpo.gc.ca/Science/enviro/ais-eae/plan/plan-eng.htm

Farrell, H., & Hèritier, A. (2003). Formal and informal institutions under codecision: Continuous constitution-building in Europe. *Governance*, *16*(4), 577–600.

Great Lakes Commission. (2013). *Great Lakes panel on aquatic nuisance species*. Retrieved October 7, 2013 from http://www.glc.org/ans/panel.html

Great Lakes Echo. (2010). *Great Lakes water quality agreement: Aquatic invasive species*. June 11, 2010. Retrieved from http://greatlakesecho.org/2010/06/11/great-lakes-water-quality-agreement-aquatic-invasive-species/

Great Lakes Panel on Aquatic Nuisance Species. (2007). *Introduction for the Great Lakes Panel Priority Invasive Species List, Research Coordination Committee*. Retrieved from http://glc.org/files/projects/ais/GLP-RCC-PriorityInvasiveSpeciesList20071.pdf

Great Lakes Panel on Aquatic Nuisance Species. (2008). Letter from GLPANS to Gary Frazer and Timothy R.E. Keeney Co-Chairs, ANS Task Force (G-17J) Re: Urgent need for effective federal regulations to prevent the discharge of organisms from vessels declaring ballast and no ballast on board, February 22, 2008. Retrieved from http://projects.glc.org/ans/documents/08-02-22-GLPBWRectoANSTF-Final.pdf

Great Lakes Panel on Aquatic Nuisance Species. (2009). Letter from GLPANS to USEPA Great Lakes National Program Office (G-17J) Re: Great Lakes Restoration Initiative, August 19, 2009. Retrieved from http://www.glc.org/ans/documents/09-08-19-Comm-Priorities%20Dissemination-Cover-GLRI-Final-Sub.pdf

Great Lakes Panel on Aquatic Nuisance Species. (2011). *Policy coordination committee mission statement and guidelines*. Approved May 3, 2011. Retrieved from http://www.glc.org/ans/pdf/GLP_PCC_Mission&Guidelines11.pdfs

Great Lakes Panel on Aquatic Nuisance Species. (2013). Meeting of the Great Lakes panel on aquatic nuisance species: Agenda. *Funding for aquatic invasive species (AIS) programs session*. Retrieved May 8, from http://www.glc.org/ans/pdf/13-05-03-GLP%20Meet-May-2013-Duluth_final%20draft_printed.pdf

Great Lakes Water Quality Agreement—Agreement Review Committee. (2007). Report to the Great Lakes Binational Executive Committee. Volume 1. Retrieved from http://publications.gc.ca/collections/collection_2012/ec/En164-21-1-2007-eng.pdf

Grigg, N. S. (2011). *Governance and management for sustainable water systems*. London: IWA Publishing.

Hafner-Burton, E. M., Kahler, M., & Montgomery, A. (2009). Network analysis for international relations. *International Organization*, *63*, 559–92. Retrieved from http://people.reed.edu/~ahm/Projects/SNAIR/NAIR.pdf

Hearns, G. S., Paisley, R. K., & Henshaw, T. W. (2013), "*Institutional architecture and the good governance of international transboundary waters*" Global Transboundary International Waters Governance Initiative, University of British Columbia, Paper 06. Retrieved from http://www.internationalwatersgovernance.com/uploads/1/3/5/2/13524076/institutional_arch_paper_06_august_2013_1.pdf

International Association of Great Lakes Research. (2005). *IAGLR five-year plan 2005–2010*. Retrieved from http://www.iaglr.org/docs/5yearplan05.pdf

International Joint Commission. (2011). *Fifteenth Biennial report: Executive summary and recommendations*. Retrieved October 17, 2013, from http://www.ijc.org/files/publications/15biennial_report_summary_web-final.pdf

International Joint Commission AIS Rapid Response Work Group. (2010). *Binational aquatic invasive species rapid response assessment and planning. International Joint Commission Work Group Activities*. 17th International Conference on Aquatic Invasive Species. San Diego, CA August 31, 2010. Retrieved from http://www.icais.org/pdf/2010abstracts/Mark_Burrows.pdf

International Joint Commission. (2004). *Twelfth Biennial report on Great Lakes water quality*. Retrieved from http://www.ijc.org/files/publications/C200.pdf

International Joint Commission Work Group on Ecosystem Indicators. (2013). *Great Lakes water quality agreement 2012–2015 priority cycle.* Technical Report on Ecosystem Indicators: Assessment of Progress Towards Restoring the Great Lakes, July 2013: FINAL. Retrieved from http://www.ijc.org/files/publications/Technical%20Report_Eco%20Indicators_2013.pdf

Keohane, R. O., & Victor, D. G. (2011). The regime complex for climate change. *Perspectives on Politics*, *9*(1), 7–23.

Levitsky, S., & Murillo, M.V. (2009). Variation in institutional strength. *Annual Review of Political Science*, *12*, 115–133.

Lowndes, V., & Roberts, M. (2013). *Why institutions matter: The new institutionalism in political science*. London: Palgrave McMillan.

Marbek. (2010). *Assessing the economic value of protecting the Great Lakes: Invasive species prevention and mitigation*. Final report submitted by Marbek to Ontario Ministry of the Environment. Retrieved November from http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@subject/@greatlakes/documents/nativedocs/stdprod_086942.pdf

Millenium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Biodiversity synthesis*. Washington, DC: World Resources Institute. Retrieved from http://www.millenniumassessment.org/documents/document.354.aspx.pdf

Najam, A., Papa, M., & Taiyab, N. (2007). *Global Environmental Governance: Key challenges to effective global environmental governance.* International institute for sustainable development*,* April 5, 2007. Retrieved from http://www.eoearth.org/view/article/153013/

North American Commission for Environmental Cooperation. (2000). *North American agenda for action 2000–2002*. A three year program plan for the Commission for the Commission for Environmental Cooperation. Montreal. Retrieved from http://www.cec.org/Storage/32/2378_OperationalPlan00-02_en.pdf

North American Commission for Environmental Cooperation. (2003). *Closing the pathways of aquatic invasive species across North America: Overview and resource guide*. Montreal. Retrieved from http://www3.cec.org/islandora/en/item/2068-closing-pathways-aquatic-invasive-species-across-north-america-en.pdf

North American Commission for Environmental Cooperation. (2008). *North American Mosaic: An overview of key environmental issues.* Montreal: Secretariat of the Commission for Environmental Cooperation. Retrieved June 17, 2015 from http://www3.cec.org/islandora/en/item/2349-north-american-mosaic-overview-key-environmental-issues-en.pdf

Organization for Economic Cooperation and Development (OECD). (2011). *Water governance in OECD countries: A multi-level approach*. OECD studies on water. OECD Publishing. Retrieved from http://www.waterforum.net/Content/Artikel/4000-5000/4243/OECD_rapport_water_governance_130220104537.pdf

Ontario Ministry of Natural Resources. (2012). *Ontario invasive species strategic plan*. Government of Ontario. Retrieved from https://dr6j45jk9xcmk.cloudfront.net/documents/2679/stdprod-097634.pdf

Ostrom, E. (1990). *Governing the commons: The evolution of institutions for collective action*. Cambridge, England: Cambridge University Press.

Pierre, J., & Peters, G. B. (2000). *Governance, politics and the state*. New York, NY: St. Martin's Press.

Pugnucco, K., Maynard, G. A., Fera, S. A., Yan, N. D., Nalepa, T. F., & Ricciardi, A. (2015). The future of species invasions in the Great Lakes-St. Lawrence River. *Journal of Great Lakes Research*, *41*(1), 96–107.

Ridenour, J. M. (1988). Letter to Honourable George Schultz, U.S. Secretary of States, August 4, 1988. Retrieved March 2, 2014 from http://www.ijc.org/php/publications/pdf/ID2.pdf

Slaughter, A. M. (2004). *A new world order*. Princeton, NJ: Princeton University Press.

Teisman, G., van Buuren, A., Edelenbos, J., & Warner, J. (2013). Water governance: Facing the limits of managerialism, determinism, water-centricity, and technocratic problem-solving. *International Journal of Water Governance*, *1*, 1–11. Retrieved from http://www.internationalwatergovernance.com/images/stories/pdf/internationalwatergovernance/IJ WG4.pdf

Transport Canada. (2010). A guide to Canada's ballast water control and management regulations TP 13617 E. Retrieved July 10, 2015, from https://www.tc.gc.ca/eng/marinesafety/tp-tp13617-menu-2138.htm

VanNijnatten, D. L. (2006). Towards cross-border environmental policy spaces in North America: Province-State linkages on the Canada-U.S. border. *AmeriQuests* (Special issue on Quebec and Canada in the Americas), *3*(1).

White House Council on Environmental Quality. (2010). Great Lakes restoration initiative action plan FY 2010-FY2014. Retrieved February 10, from http://greatlakesrestoration.us/pdfs/glri_actionplan.pdf