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Early Lessons of COVID-19 for Governance of the North American Great Lakes and the Baltic Sea

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Abstract: The commitment to advance the protection of the North American Great Lakes and the Baltic Sea continues during the COVID-19 pandemic. The resilience of the research community was displayed as policy decisions were made for the first virtual conferences this year to share scientific findings and expertise in both regions. As this pandemic continues to challenge the world, countries have responded to the threat and continue to deal with the uncertainties of this wicked transboundary problem in many different ways. This article discusses key governance and policy issues that have been revealed thus far that can inform the governance of the transboundary North American Great Lakes and the Baltic Sea. Key lessons from the pandemic include waiting for total scientific certainty to act can lead to fatal consequences and our symbiotic connection with nature. Further insights from the pandemic include the importance of context, science-based leadership, institutional accountability, and acknowledging that nature knows no borders.

Keywords: governance; COVID-19; North American Great Lakes; Baltic Sea; science; policy; precautionary principle

1. Introduction

Researchers in both North America and Europe have long banded together for the protection of the North American Great Lakes and the Baltic Sea, respectively. In the Great Lakes Region, the International Association of Great Lakes Research (IAGLR) has a rich history of scientific collaboration amongst US and Canadian researchers united in examining issues related to the North American Great Lakes, dating back to the 1950s [1]. Last year, at the 62nd Annual Conference (Brockport, NY, USA, 10–14 June 2019), there were more than 700 attendees from 15 countries, 55 sessions and more than 575 presentations [2]. The disciplinary reach of the conference has also evolved from a natural-sciences focus over the years to include social sciences with entire days devoted to governance and public engagement issues, in response to the recognition of governance being a driver of change in the Great Lakes basin [3]. IAGLR's resilience and commitment to Great Lakes research was again demonstrated this year, when for the first time a virtual conference was held during the coronavirus (COVID-19) pandemic.

Similarly, in the Baltic Sea Region, long held annual meetings, such as the European Union Strategy for the Baltic Sea (EUSBSR) Forum have moved online [4]. The commitment to Baltic Sea matters was evident on the events website, which stated that the communication and discussion of the EUSBSR will rally on despite changes in the world. Much thought was put into finding avenues to enable continued interaction and sharing of expertise and resources, such as online networking villages. The Helsinki Commission (HELCOM), the intergovernmental organization tasked with oversight of

the Helsinki Convention (Convention on the Protection of the Marine Environment of the Baltic Sea Area), moved all meetings online and staff continued to work from the safety of their homes. The 58th Meeting of the HELCOM Heads of Delegation was held online on 9–10 June 2020 and considered actions on the update of the Baltic Sea Action Plan (BSAP), the main tool used by HELCOM for Baltic Sea resiliency [5]. At this meeting, the new target year for the achievement of actions in the BSAP was set to 2030 [5], with delay in implementation actions being attributed to gaps in governance [6].

This attention to the forthcoming was also echoed in the IAGLR 63rd Annual conference's theme this year "focusing on the future". The theme of the conference is even more pertinent now, as the COVID-19 pandemic (the pandemic) has disrupted all aspects of life, including the way we gather and communicate science. This has catapulted us into a technology filled, digitally connected high-speed internet future. Now living rooms have become laboratories for sharing the latest scientific discoveries, as well as gyms and prisons, when we are quarantined after overseas research visits. The message is clear; among the many things we should be distancing ourselves from now, Great Lakes and Baltic Sea research is not one of them.

During this time, it is especially important that we do not let COVID-19 destroy the momentum we have gained in Great Lakes and Baltic Sea protection. Lockdowns are affecting monitoring and surveillance in the Great Lakes and the Baltic Sea. Data are lost. We can, however, still document trends through time, the state of the Lakes and the Sea, and prepare to aggressively resume restoration and protection initiatives. The inability to achieve restoration goals in both the Great Lakes and Baltic Sea regions is tied to a greater global phenomenon, where the world water crisis has been deemed a crisis of governance [7]. Amidst this unfolding pandemic, we look at lessons that can be gleaned from the COVID-19 crises response, for application to the governance of the Laurentian Great Lakes and the Baltic Sea and other parts of the world. This paper contributes knowledge to water governance that can be applied globally to the governance of large water bodies.

2. Initial Lessons from COVID-19 Responses

COVID-19 is a transboundary problem that challenges all levels of society, including individuals, communities, nation states and global organizations, such as the World Health Organization (WHO). Established structures have been tested across the globe as problems that occur on multiple scales and disrupt daily life in unfamiliar ways. This transboundary disruption involves numerous actors and multiple and conflicting interests, much like Great Lakes and Baltic Sea stressors, such as eutrophication and climate change. With "wicked" problems such as these, there are no easy solutions to combat the uncertainties and manifold stakeholder values and interests. As we grapple with society's resilience to COVID-19, we ask the question, how can the resilience of the Great Lakes and the Baltic Sea be assured in the face of wicked problems? What can COVID-19 teach us about the process of resilience, i.e., bouncing forward to a new normal position yet retaining the core functions and purposes of both the Great Lakes and the Baltic Sea in the face of stressors or environmental jolts? The literature points out that adaptation to these jolts usually occurs in three phases of anticipation, response and readjustment [8]. The first stage refers to foresight, which is usually interlinked with organizational strategies, the second response phase is linked to organizational values and structures and the last phase occurs after the jolt is over and new steady state is achieved. Since the COVID-19 pandemic is still evolving, this paper focuses on the lessons that can be learnt from these early stages of response to the pandemic for the Great Lakes and Baltic Sea Governance.

3. Results

3.1. Symbiosis, the Art of Cohabiting with Nature

The pandemic is making us rethink our lives in many ways, including our connection to and stewardship with nature. This is especially important in both the Great Lakes and Baltic Sea Regions. The Great Lakes basin is home to approximately 34 million persons (10% of the US population and

30% of the Canadian population) who rely on the lakes for water and recreational uses [9]. Despite repeated warnings, many flouted the social distancing laws to spend time in nature on Memorial Day (25 May 2020) weekend. Images that were hard to reconcile with the nearly 100,000 deaths, showed hordes of people on beaches in the USA, closely together and not wearing masks [10]. A similar scene in Canada had police officers deployed to Trinity Bellwoods Park in Toronto, Ontario to reinforce physical distancing guidelines after "Woodstock"-style crowds of approximately 10,000 gathered there on Saturday 23 May 2020 [11]. There has been a similar defiance of social distancing rules in various areas in the Baltic Sea Region, which is home to 85 million persons [12]. These scenes vividly demonstrate what we already know; nature provides a coveted refuge for all of us.

There is another connection with nature that has been the subject of recent debate. Much like the governing of climate change in the Great lakes and Baltic Sea regions, there is considerable uncertainty around the COVID-19 pandemic, including its causative virus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Whilst there have been numerous theories of its origin, there is consensus in the scientific community that the virus spreading to humans is a natural event, as with preceding coronaviruses. In a correspondence in Nature magazine in April 2020, a team of scientists explained its origin as follows: "We propose two scenarios that can plausibly explain the origin of the SARS-CoV-2: natural selection in an animal host before zoonotic transfer; and natural selection in humans following zoonotic transfer." [13] (p. 450). What they are suggesting is that the virus emerged naturally and thrived through natural selection.

The virus SARS-CoV-2, as with the predecessors SARS and EBOLA that caused global disruptions, spilled over to humans from wild animals inhabiting forests. Stopping the destruction of nature will not only lessen exposure to new pandemics but also reduce the spread of existing diseases, such as malaria, cholera, zika, etc. For example, a recent study found that a 10 percent increase in cleared forest area could lead to 3.3 percent increase in malaria incidence [14]. It was further estimated that international trade (in timber, wood, coffee, tobacco and cotton) is the driver of 20% of malaria risks in heavily deforested areas [15].

Human stewardship of the Great Lakes and the Baltic Sea must be an action-based initiative that builds the resilience of our social–ecological systems in the face of known and unknown threats in what is presently a daily changing context. Applying our understanding of the risks associated with deep uncertainty and disruptive innovation, people can collectively strive to mitigate ecosystem exposure and vulnerability to known stresses, anticipate adaptive responses to unpredicted pressures, and collaborate in the development of public and private sector policies that address positive change. It is with this distributed and collective action that we can overcome COVID-19. It is with this same approach we can overcome damaging social–ecological implications of human disregard to ecosystem integrity. The Great Lakes and Baltic Sea, despite their magnitude, are highly vulnerable, given the intense human pressure put on the natural systems. By nurturing generations of stewards, we foster the resilience so that ecosystem services and ecological integrity are conserved.

3.2. Take Care of Hotspots

COVID-19 was first reported in China in the Wuhan province in December 2019. The World Health Organization reported the first cases in the Eastern Mediterranean Region in the United Arab Emirates on the 29 January 2020 and, on the next day, declared it a public health emergency of international consequence [16]. The virus continued to spread outside of China, and on 11 March 2020, the WHO officially declared it a pandemic. In making the declaration, the Chief of WHO, Dr. Tedros Ghebryesus, stated his deep concern at inaction, saying that the number of cases had increased 13-fold in two weeks [16]. On the 14 December 2020, the official Coronavirus portal of the WHO [17] reported 70,829,855 confirmed global cases of COVID-19, including 1,605,091 deaths. These cases are distributed unevenly around the world and continents, with some countries, such as the United States, Italy, Spain and Brazil having the highest cases in the world. The countries with the fewest cases, such as Taiwan and New Zealand, were lauded for their proactive and early efforts to close down their borders

and strictly enforce social distancing rules. By containing the hot spots of the disease through contact tracing and strict quarantine, they were able to lessen the severity of the problem.

The analogy can be drawn here with Great Lakes Areas of Concern (AOC), the most degraded areas as designated by the International Joint Commission (IJC) and the HELCOM pollution hot spots. There were originally (1987–1991) 43 Areas of Concern, with 5 common ones, 26 in the United States and 17 in Canada. To date there are four hot spots delisted, or fully recovered, in Canada and four in the United States [6]. In the Baltic Sea Region, significantly polluted sites, HELCOM Hot spots (established in 1992) remain, as three quarters (121 out of 162) have been cleaned up as of June 2019 [18]. Progress in delisting the hotspots in both regions has been varied due for many reasons. Whilst there has been much research in the past on progress in delisting hotspots, more concerted resource commitment and active interventions are needed for further and progressive delisting.

Currently, clean up legacy pollution in AOCs and hotspots in the Baltic Sea Region continue. With the Baltic Sea hotspots that remain, more investment is needed to clean up industrial hotspots, as there are several industrial hotspots with no reported investments in cleanup activities [18]. The development and implementation of Remedial Action Plans (RAPs) for most polluted areas (Areas of Concern) using an ecosystem approach has revealed how the restoration of the health of the Areas of Concern leads to waterfront revitalization. Linkages must be better established between cleanup and restoration efforts in AOCs and hotspots and community revitalization efforts. Greater effort must be placed on reinforcing linkages, along with achieving a synergy for sustainable redevelopments that provide substantial economic and social benefits [19]. The Great Lakes basin ecosystem is a global treasure, and its natural capital is worth tens of billions of dollars each year in Canada alone, demonstrating that investment in the protection of this resource is an ethical and financial imperative [20]. The cleanup and restoration of degraded areas of the Great Lakes are also an important economic driver in the revitalization of industrial heartland communities. Investing in the cleanup of the Great Lakes AOCs and Baltic Sea hotspots, similar to investing in COVID-19 resilience, means investing in the revitalization of these communities, including the fact that there is considerable return on investment.

3.3. We Are in This Together, There Are No National Borders

The status map of the COVID-19 that is available on the World Health Organization Website (Figure 1) [17] illustrates vividly that there are no national borders when it comes to the spread of the COVID-19 disease. It was reported in Wuhan, China, and as the map illustrates, this virus has spread to almost every country in the world, hence, its designation as a pandemic.

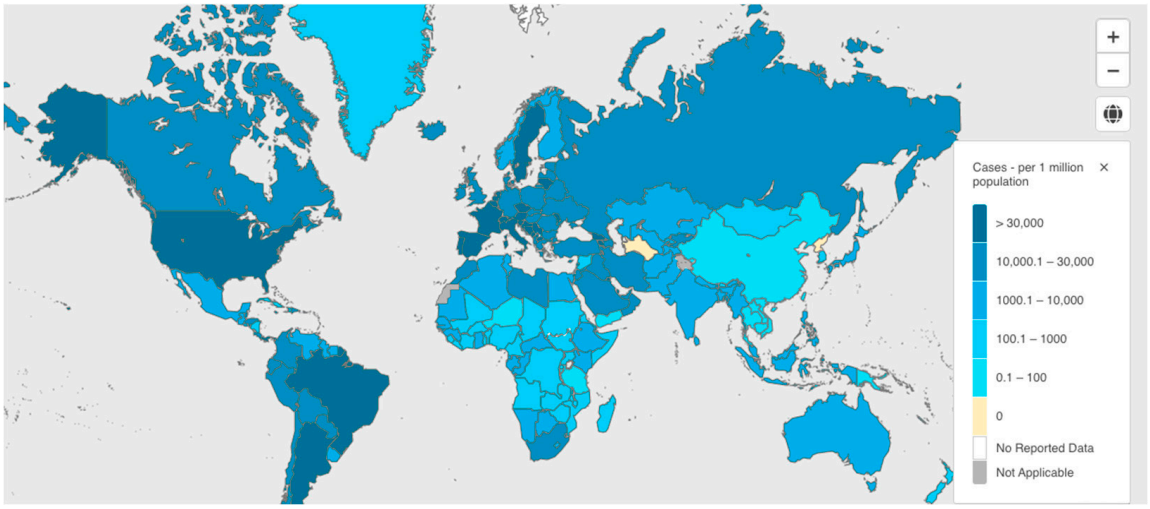

Figure 1. WHO Coronavirus disease (COVID-19) dashboard 14 December 2020 [17].

This global spread shown in Figure 1 has resulted in a call for a universal approach by the UN Secretary General Antonio Guterres: "COVID-19 is menacing the whole of humanity- and so the whole of humanity must fight back . . . individual country responses are not going to be enough" (UN, 2020). His appeal was made to stop the disease from "circling back around the globe" [21].

Likewise, even though there is a political boundary between the USA and Canada that separates the Great Lakes and political boundaries that separated the countries of the Baltic Sea, pollution from all sides circle back to the others, as water respects no political boundaries. Similar to the pandemic response, we can tackle particular hotspots out of altruism, but ultimately it is for personal wellbeing. This thinking can spur further restorative action. As such, it is imperative that governance measures are inclusive. Some of these include the timely sharing of information, the inclusion of a broad representation of society and retaining the binational nature of the International Joint Commission and the intergovernmental nature of HELCOM. We need to govern together, binationally and internationally; the closing of borders can slow down the spread of viruses but closing of borders will not change water pollution from crossing boundaries. Ecosystems health has no borders and their protection and management require all members of society to collaborate to protect the lakes and to restore good ecological status to the Baltic Sea.

3.4. Context Matters

There are numerous charts and websites tracking the spread of the pandemic across the world [21,22]. Everywhere, everyone wants to know the numbers in their countries, their friends' and relatives' countries and to know how their numbers stack up against others. However, as this information shows, context is very important in the interpretation of the data. For example, the United States of America has more COVID-19 fatalities than any other country, with approximately 2,977,677 deaths; therefore, it is, for example, listed number one on the BBC website COVID-19 tracker [22]. However, this can be misleading, as the population of the USA is 330 million. So, if compared to the deaths per one million persons, the USA does not top the list. So here, the question is whether the data mean the same thing and whether the other factors influencing the spread of the disease are the same for different countries. For example, some countries are counting the deaths in care homes (Germany and France) whilst others are not (e.g., UK only started including these numbers from 29 April 2020) [22]. This is possible because there is no international standard on how to record the deaths or their causes. For example, does COVID-19 need to be the main cause of death for it to be recorded, or does any mention of it mean that it is a COVID-19 fatality?

Similarly, context matters in the implementation of the measures of the Great lakes Water Quality Protocol 2012 and for the implementation of measures in the Baltic Sea Action Plan (BSAP). Whilst it is useful to share experiences of restoration of AOC's and hotspots, for example, each AOC and hotspot is listed for many different impairments. Moreover, the local geographical, political, social and economic context of each AOC and hotspot also differs widely. Whilst collaborative governance worked well for the delisting of the Collingwood Harbor, Georgian Bay, Ontario, (the first AOC to be a delisted located on the Canadian side of the lakes), e.g., it might not be the only strategy to work in another AOC. A combination of collaborative governance, investment and clear leadership by the government may be a better option in heavily industrialized areas.

The cleanup of AOCs and HELCOM hotspots has not been an easy task. As with COVID-19, it requires the establishment and continual adjustment of networks of community members focused on reaching consensus among stakeholders, coordinating efforts, and ensuring that the results promote restoration of beneficial uses. It also requires a consensus on how data are interpreted, particularly with respect to restoration of beneficial uses. Even with the compelling case of the Great Lakes and Baltic Sea regions being continentally- and globally significant, natural resources, cleanup has proven incredibly challenging. The restoration of socio-economic health in the face of COVID-19 requires patience and perseverance. For public participants, including a breadth of stakeholders, it has also required considerable patience and perseverance. It took generations to reach the state of pollution

in the 1980s. It is unrealistic to expect to restore all hotspots in just three decades, considering the severity and geographic extent of the problems and the time it takes to involve stakeholder groups in a meaningful way, reach agreement on problems, identify and select remedial and preventive actions, and secure funding for implementation and political commitment. Furthermore, the time it takes for an ecosystem to exhibit a measurable response to management actions affects the perception of progress.

3.5. Science Based Leadership

The study of leadership has been honed to a fine science, yet there is no standard with which to define a good leader. The world is freefalling with the pandemic and no one knows where and when we will land. This uncertain environment is a test for leadership at all levels. However, one thing is certain, good leadership is very visible during this pandemic and the populace notices it. One example that rises is the Prime Minister of New Zealand, Jacinda Arden. She has communicated clearly and demonstrated much humanity in her messaging to the population. For example, in telling the country the new measures to combat the spread of the pandemic, her speech started as follows:

"I'm speaking directly to all New Zealanders today to give you as much certainty and clarity as we can as we fight Covid-19 . . . This is because we are experiencing an unprecedented event—a global pandemic that in New Zealand, we have moved to fight by going hard, and going early . . . . That's why we have to focus on one simple goal—to slow down COVID-19 . . . Already in New Zealand we have warning systems to try and get ahead of problems and hazards . . . Today I am announcing an alert system for COVID-19. The alert system can apply to the whole country, but sometimes, it may only apply to certain towns or cities" [23].

These words illustrate the clear reliance on science in her decision-making process, in pointing to the global pandemic and stating plainly that monitoring through the warning system will guide the decision-making process both in local communities and nationally. This style of leadership is evidently approved by the society, as 84% of the society approved of the Prime Minister's handling of the pandemic [24].

Science-based leadership that relies on tracking and isolating cases has helped to keep numbers low in countries such as Taiwan, Iceland and Australia. These countries are using the scientific information provided by experts as a basis for their decision-making and are doing better than countries who are denying the science and have a substantial delay in response. For example, Tanzania's president declared that the country "has defeated the coronavirus through the power of prayer", though the figures are questioned with examples such as 50 truck drivers testing positive in one day after crossing over to Kenya. This case shows the detriment of not relying on science for decision-making [24].

We can foster resilience in the Great Lakes and the Baltic Sea when action is taken in line with science. In their report on ocean and Great Lakes science and technology, the National Science and Technology Council [25] call for foundational knowledge to address many complex big-water-related challenges and inform decision-making to ultimately strengthen our communities. They point out that no single discipline can comprehensively address complex and pressing problems, and that the components of threats cannot be studied in isolation but must be considered as a part of a dynamic integrated system. For science to prosper in the Great Lakes and Baltic Sea Regions, humans must be integrated as an important element of the natural system and as agents of change to regional, national, and international processes. The inclusion of human dimensions in water governance emphasizes and the relevance of dynamic feedbacks among socioeconomic, biophysical, and biogeochemical systems [26].

RAPs are practicing adaptive management and striving for continuous improvement. This commitment to continuous improvement, based on scientific assessment, reducing uncertainty, and priority setting, has resulted in scientific advancements. These advancements have clearly helped achieve cooperative learning among hotspots through science transfer and capacity building and will be helpful in the restoration of other degraded aquatic ecosystems throughout the world. Collaboration among scientists, business, industry, educators, government agencies, nongovernmental organizations,

Indigenous peoples, and more facilitates the finding of data gaps and uncertainties that are important to policy formulation and decision-making. Applied scientific research for the purpose of fact-based decisions, improves the stakeholders' ability to design and implement policies or programs, and/or influence strategies, planning, and behaviors that affect the environment [27]. The key strengths of such science are co-production of knowledge and co-innovation of solutions. RAPs are a good example of the use of applied science to advance the remediation of the degraded system and protect threatened attributes, which is much needed, given the nature of the threats that COVID 19 elicits.

3.6. Science at the Forefront—Tracking Wastewater Effluent Biomarkers of COVID-19 to Evaluate Community Trends

As the number of COVID-19 cases continues to grow, the world is desperately waiting for a vaccine or an effective treatment. In the meantime, our best tools in preventing the spread of the disease is through innovative and cost-effective ways to identify and manage the emergence or re-emergence of COVID-19 within our communities. We see ongoing challenges with testing for COVID-19, including the availability of reliable test kits, cost logistics and the inherent limitations of current tracking for mildly symptomatic and asymptomatic members of the community. One of the key problems is that we have inadequate data on how many people are actually carrying the virus because testing is difficult, un-reliable—with many false positives or negatives—and with asymptomatic people not being tested. Testing is important in many areas for great lakes restoration, including for wastewater treatment.

Currently, the main focus of wastewater analysis has generally been surveillance substance concentrations entering the wastewater treatment process, to monitor the removal efficiencies of the wastewater treatment processes, and to evaluate wastewater effluent as a point source for environmental contamination [28,29]. A number of parameters are constantly monitored to check if they comply with Wastewater Systems Effluent Regulations SOR/2012-139, Fisheries Act (e.g., cBOD, suspended solids, and total residual chlorine). However, wastewater is multifaceted and contains a wide range of chemical and biological signatures of community activity that is directly correlated with community health [29]. The analysis of wastewater for concentrations of human-use substances, pharmaceuticals, chemicals, exogenous contaminants, and nutrient concentrations has been successfully employed for decades around the globe [30]. It is feasible to use wastewater to improve the routine surveillance of pathogenic enteric viruses, such as norovirus, enterovirus, adenovirus, and rotavirus. These are frequently found in municipal wastewaters worldwide and previous attempts have been made to assess the effects of intervention programs by tracking changes in the abundance and circulation of virus strains in defined geographic regions [29,31].

Relating concentrations of these chemical and biological signatures in wastewater influent streams to population-scale can provide important qualitative as well as quantitative data associated with community health within a given wastewater catchment area. This method is non-invasive because individuals are never directly targeted, and privacy is always protected. In addition, the population normalization of data allows direct comparisons to be made between catchments of different population size bins [29].

With regard to the COVID-19 pandemic, scientists around the world have started to give serious consideration to wastewater tracking and monitoring. Many jurisdictions are turning to their countries' sewage systems to understand spread of COVID-19 in their communities, e.g., researchers detected a rise and fall in coronavirus from samples taken across greater Paris for more than one month [32]. Researchers in Paris confirmed, through the testing of wastewater from several wastewater plants in Paris, that the increase in SARS-CoV-2 genome units in raw wastewater "accurately followed the increase in human COVID-19 cases observed at the regional level" [33] (p. 2). Similarly, in Finland, the Finnish Institute for Health and Welfare (THL) has detected the coronavirus in wastewater samples collected in Helsinki, Espoo, Turku, Tampere, Rauma and Vaasa [30]. According to Senior Researcher at the Finnish Insitute for Health and Welfare, Tarja Pitkänen, "wastewater research shows

that coronavirus can be detected in the same locations where coronavirus infections have also been diagnosed through individual testing" [34].

In essence, wastewater provides a vast matrix of information on biological and chemical signatures reflective of population health. With a better understanding of the wastewater biomarkers, such monitoring can serve as a cost effective and efficient method of tracking COVID-19 disease progression at a community scale in the Baltic Sea Region. For the Great Lakes areas of concern, monitoring temporal trends in the recovery of beneficial uses is complicated, as is establishing endpoints to identify a return to "normal" conditions. For COVID-19, by monitoring temporal trends and spatial analysis, alerts against baseline data could provide valuable insights to identify emerging pathogenic status in a community. This would enable decision-makers, health care professionals, and policy makers to use real-time COVID-19 data from wastewater surveillance and tracking program to enact dynamic municipal/regional intervention action plans when an outbreak is detected within a community in a particular municipal district.

3.7. Using the Precautionary Principle

The old adage that prevention is better than cure can certainly been applied to the response to combat COVID-19, in the absence of complete information. Health officials and other experts have advised that it is better to flatten the curve to prevent overwhelming hospital resources. Physical distancing and lockdowns were advised in the absence of complete information on how the virus spreads, how long it remains on surfaces and the modes of transmission. Generally, it was recognized that preventing large numbers of persons from catching the virus was safer and more cost effective than treating a large number of cases at the same time.

Similarly, it would be safer and more cost effective to adopt measures in the Great Lakes Water Quality Protocol and the Baltic Sea Action Plan to counteract stressors, such as persistent toxic chemicals, than to deal with the projected consequences of these stressors. This would not be hard to do, as we have good examples of the use of the precautionary principle in North America. One example is the Calgary Mayor Nasheed Nenshi [35], whose words captivated social media:

"When we look back, let's hope the narrative is that we overreacted. These are tough decisions. For me personally, it was heartbreaking to close rec centres and libraries. However ultimately, these good habits keep us collectively safe . . . remember we are intentionally overreacting."

Good proactive actions in the face of uncertainty can keep the lakes and the sea safe and prevent more rapid deterioration of the ecosystem and make a big difference. As Moon [36] concludes, COVID-19 requires that scholars and practitioners re-examine the capacity of government, science and policy, leadership and citizen engagement, to handle wicked problems. Doing this uncovers failures in policy and organizational learning, central to inform decisions that are agile and effective in the face of uncertainty. All are susceptible to environmental injury and pervasive pollution in the face of incomplete information, just as all are susceptible to COVID-19. Just as we need to track the development of COVID-19, so we need to track the restoration of beneficial uses in the Great Lakes and the progress of the Baltic Sea and conduct comparative studies of approaches being tested in other regimes to comparable health threats. Governments and civil society need to find alternative approaches to ways of managing uncertainties and complexities through evidence-based science that includes citizen science as well as adaptive governance capacities to respond to present and future complex threats to ecosystems and human health.

3.8. Institutional Accountability

Institutions are widely understood as rules that shape societal behavior and can be both formal and informal. Formal institutions are vested with authority through some written or legal means whereas informal ones operate outside of formal legal guidelines. These institutions operate at all levels, local, regional, national and global. The World Health Organization (WHO) is the key institution that is coordinating global response to the COVID-19 pandemic. It has been lauded and attacked for

its response and, after much debate, the WHO assembly approved a COVID-19 response audit [37]. This resolution was brought forward to the Assembly by the European Union in collaboration with more than 100 countries including Australia, China and Japan. This comprehensive evaluation is intended to be a transparent evaluation of this global institution's response in order to evaluate the lessons learnt from its coordination of the virus outbreak.

Similarly, evaluations of key Great Lakes institutions, such as the International Joint Commission, the Great Lakes Commission, the Great Lakes St. Lawrence Cities Initiative, the Great Lakes Fishery Commission, and the Binational Executive Committee, can provide valuable insights for adaptive governance of the Great Lakes. In the Baltic Sea Region, institutional accountability can help in decreasing governance gaps, such as stakeholder participation, funding deficits and governance tradeoffs [6].

3.9. Everyone Is Susceptible to an Existential Threat and Responsible

The spread of the virus, to the old, young, noble, rich, and poor has decimated all standards of hierarchy in society to a level playing field. Prominent examples of high-profile persons susceptible to the disease include actor Tom Hanks and Prince Charles. What the virus has shown is that changes in individual action to protect oneself goes hand in hand with government stipulations and corporate action. In other words, global challenges, such as restoration of the Great lakes and the Baltic Sea require all hands on deck! Community-based management is a form of participatory governance often applied to natural resource management problems to better govern in the face of uncertainty [38]. It involves the people living closest to the resource in the design, implementation, and monitoring of management measures. The approach is seen in integrated coastal and ocean management, as is it seen in the RAP process. Those connected to the resource are those invested in its regeneration and protection, as seen in Baltic Sea nongovernmental organizations commitment to clean up work [6]. Various scholars of social science point to the interdependency of people living in a community in developing their identity, sense of meaning, values, and economic well-being [39].

Such governance connects individuals, governments and associations at multiple organizational levels. Central to success are those who provide leadership, generate trust, and foster a learning environment. Adaptive governance requires participants to draw on a broad array of experiences to achieve a common understanding through collaboration and conflict resolution for the adaptive co-management of threats, pressures and opportunities. It is accepted that COVID-19 can infect anyone, and similarly, water pollution impacts everyone. Good governances enable the transformation of a crisis into an opportunity to innovate for achieving a desired state and allows solutions to be implemented in the face of scientific certainty.

4. Conclusions

This natural event of the COVID-19 pandemic has caused catastrophic loss of lives and disruption of life as we know it. However, the overarching lesson is the benefits to humans of protecting the natural world. Moreover, this must be kept at the forefront of governing the restoration of the Great Lakes and the Baltic Sea. All solutions to the pandemic need to be solutions that are sustainable. The lessons from the pandemic are ones that we can heed for Great Lakes and Baltic Sea restoration. It is now scientifically acknowledged that tackling the pandemic earlier would have had a big impact on slowing its spread. According to Sir Ian Boyd, of the Sage scientific advisory group:

"Acting very early was really important and I would have loved to have seen us acting a week or two weeks earlier and it would have made quite a big difference to the steepness of the curve of infection and therefore the death rate." [24].

This was highlighted in the high numbers that correlated with the failure of some countries to act earlier on the knowledge of the known threats and to plan adaptively with measures such as lockdowns and social distancing and in the lower numbers of countries that acted proactively. Adaptability needs to be fostered in both severe and less challenging situations, as it adds both to the strength of the

current and future ecosystems, fostering resilience as the continuous capacity to resolve issues [40]. The lesson for Great Lakes and Baltic Sea governance could not be clearer; waiting for total certainty in science to make decisions can have fatal consequences. We cannot let societal changes that are inevitable in the face of COVID-19 stymie our collective priority that restoring the functions of these jewels is a must and cannot be abandoned. We are, as we hear minute by minute, in this together, in making our communities shine together.

There is the potential for much future research on the impacts of COVID-19 for the Great Lakes, Baltic Sea and global governance. COVID-19 has impacted world trade and agricultural supply chains which will impact the Great Lakes, Baltic Sea and global governance. Future research needs include interdisciplinary research on the impacts of disruption of supply chains on global water governance, trade and taxation policy, the impact of possible trading restrictions on nutrient trading schemes, risk management, and measures that can be taken to protect vulnerable groups, such as small-scale farmers and fishers. More research is needed on future food systems and the resilience of social and environmental systems amidst the COVID-19 pandemic.

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