IAGLR
LAKES Letter

CONTENTS

This issue explores the linkage between science and policy. It includes stories showing how this boundary has been bridged, where work still remains, and advice to consider in bridging that gap.

Restoring Great Lakes Areas of Concern highlights value of research

By John H. Hartig, IAGLR Great Lakes Science-Policy Advisor; Visiting Scholar, Great Lakes Institute for Environmental Research, University of Windsor

IAGLR, WITH FUNDING from the Fred A. and Barbara M. Erb Family Foundation, has been working on a 3-year project with the Aquatic Ecosystem Health and Management Society and others to evaluate what has been achieved and learned through more than 30 years of developing and implementing remedial action plans (RAPs) to restore Great Lakes Areas of Concern (AOCs) (see project timeline on page 2).

All involved are keenly aware that cleanup of AOCs has been difficult and time consuming. These communities overcame challenges in defining the scope, size, and nature of the problem and in how to even begin the work of unburdening the waters from years of abuse and neglect. They faced costly and confounding choices in tackling the legacy of toxics buried in sediments: whether and how to proceed, at what cost, and where to find the resources. In different ways and through varied approaches, they came to appreciate the importance of engaging and empowering the community in driving the cleanup. In so doing, they animated impactful processes that empowered local residents as partners.

Pollution prevention and control of contaminants at their source were priorities for all AOCs. These communities also came to incorporate in their work the restoration of habitat for fish and wildlife, resulting in a powerful and satisfying restoration of the life in and around the lakes that was such an integral part of their historic beauty and gift to human denizens. By cleaning, reclaiming, and reconnecting local communities to the waters, these communities have also catalyzed local economic development and community rebirth to the tune of hundreds of millions, even billions, of dollars of economic benefits and countless new jobs for local residents. They have also rebuilt the emotional connection—the "love of the lakes"—that is such a defining attribute for those lucky enough to live in their vicinity.

This project clearly shows the value and benefit of Great Lakes research that was the foundation of these cleanup efforts and the importance of strengthening science-policy-management linkages as part of efforts to accelerate the sustainability transition. Four examples of scientific advancements in AOCs are presented below.

Prior to the onset of RAPs in 1985, there were no comprehensive programs in Canada and the United States to assess biological impacts of contaminated sediment, estimate risk, and apply evidence-based decision making. Governments, research scientists, and RAP groups had to figure out how to make decisions on the severity and geographic extent of sediment contamination, on whether or not to remediate, on what techniques to use, and how to get the money for contaminated sediment remediation, if necessary. In many

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respects, both the Canadian and U.S. contaminated sediment assessment and remediation programs came out of the RAP program.

A second example of a scientific achievement in AOCs is quantifying habitat loss and degradation and establishing priorities for habitat rehabilitation and enhancement. Prior to the onset of RAPs, it was often said that "habitat had no home." Responsibility for habitat was fragmented among many stakeholders. RAPs made habitat a priority and challenged management agencies to address it explicitly. Restoration of fish and wildlife habitat had to be addressed in a systematic and comprehensive fashion, which was particularly challenging in urban AOCs. In many cases, RAPs helped make sure that habitat was an integral part of community master plans. Early involvement of habitat scientists in project planning and partnerships was essential to habitat project success.

A third example is quantifying the relative contribution of toxic substances from all sources in order to set management priorities. Mass balance frameworks were successfully used to quantify loadings of priority contaminants, establish baseline conditions to gauge future progress, predict benefits associated with loading reductions, and better understand ecosystem dynamics.

The final example is establishing clean up guidelines that are specific, relevant, measurable, feasible, and achievable. RAPs were a pioneer in quantifying "how clean is clean," identifying ecosystem recovery targets, and working in and through RAP institutional structures to ensure relevancy, feasibility, and achievability.

For more information about this project visit iaglr.org/aoc/.

This project is an example of how members can engage with IAGLR to expand our impact. John Hartig secured funding and led the initiative, with IAGLR acting as the fiduciary and providing oversight and communications support. This opportunity may be of special interest to members interested in science transfer and strengthening the science-policy linkage. If you're interested in leading a similar initiative, contact IAGLR President Paul Sibley, president@iaglr.org.

Project Timeline

May '17 *Restoring Great Lakes Areas of Concern* **symposium at IAGLR's Conference on Great Lakes Research**

2018 **Selected papers from symposium published in special issue of** Aquatic Ecosystem Health and Management

Aug '19 ***Great Lakes Revival*** **published featuring 10 case studies that highlight the value and benefits of science-based cleanup of polluted areas of the Great Lakes**

2020 **Monograph to be published as part of the Ecovision World Monograph Series**

2020 **Review article in** Journal of Great Lakes Research **planned**

Photo at left courtesy of Buffalo Niagara Waterkeeper; photo at right courtesy of Joe Cascio.

Buffalo River restoration has been a catalyst for creating waterfront public spaces in Buffalo, New York. These before and after photos capture the community's success story, one of 10 case studies researched during this project. Cleaning up the Buffalo River spurred improved public access to the river, which in turn contributed to waterfront economic revitalization, including more than $428 million of waterfront development between 2012 and 2018. Without the cleanup of this and other AOCs, such waterfront revitalization throughout the Great Lakes would not have been possible.

KUDOS

We extend our congratulations to the following members and award winners!

JAMES LAST KEYOMBE ATALITSA (Kenya Marine and Fisheries Research Institute)for successfully completing a short course on Inland Water Monitoring and Integrated Ecosystem Management in Africa.

ERIC ANDERSON (NOAA Great Lakes Environmental Research Laboratory) for receiving the Presidential Early Career Award for Scientists and Engineers from the U.S. government, given his contributions in advancing hydrodynamic (moving water) modeling of the Great Lakes in response to natural forces. His most recent (July 2019) research achievement is the transition of GLERL's experimental Lake Michigan-Huron Coastal Forecasting System to operations at NOAA's National Ocean Service. The transition of "research to operations" is the pathway by which fundamental research is developed into a useful tool or product and implemented into an automated or operational environment, providing routine real time and forecast guidance for application and use by the public.

TOM EDGE (McMaster University) for his appointment to the International Joint Commission's Health Professionals Advisory Board.

CATHERINE FEBRIA and **TREVOR PITCHER** (Great Lakes Institute for Environmental Research, University of Windsor) on the successful launch of a Traditional Ecological Knowledge field course in partnership with members of the Walpole Island First Nation.

CHRISTOPHER FRAZIER (Western Michigan University) for successfully defending his master's thesis on patterns of taxonomic and functional structure in interdunal wetlands of Ludington State Park.

RYAN GRAYDON (Ohio Sea Grant Fellow, International Joint Commission) for publishing his graduate research on perceptions of bottled water and tap water in the International Journal of Sustainability in Higher Education.

BRICE GRUNERT (Michigan Technological University) for receiving the Elsevier Student Author Award for the most notable paper in the 2018 Journal of Great Lakes Research.

DANIEL HEATH (GLIER-U Windsor) and his team (including **TREVOR PITCHER** and **HUGH MACISSAC**) for leading a successful multi-institution Genome Canada Large-Scale Applied Research Project proposal worth Can$9.3 million focused on ensuring sustainability of Canada's freshwater fish resources through innovative environmental DNA approaches.

Congratulations to our **Chandler-Misener Award** winners, **LORI IVAN**, **BENJAMIN SCHMITT**, **KENNETH ROSE**, **STEPHEN RILEY**, **JOAN ROSE**, and **CHERYL MURPHY**. Their paper "Evaluation of the thiamine dose-response relationship for lake trout (*Salvelinus namaycush*) fry using an individual based model," was judged the "most notable" paper published in last year's Journal of Great Lakes Research. The research team's results show that low thiamine levels, in addition to predation, can drastically reduce lake trout in a given area, suggesting sublethal effects of low thiamine levels are having a larger effect than previously thought.

KATIE KNAPP (Grand Valley State University) for successfully defending her master's thesis on carbon cycling in a Great Lakes estuary using time-series data from the Muskegon Lake Observatory.

GAIL KRANTZBERG (McMaster University) for her appointment to the International Joint Commission's Great Lakes Science Advisory Board.

JIYING LI (Large Lakes Observatory, University of Minnesota Duluth) for receiving the Elsevier Early Career Scientist Award for the most notable paper in the 2018 Journal of Great Lakes Research for the paper "Sediment geochemistry and contributions to carbon and nutrient cycling in a deep meromictic tropical lake: Lake Malawi (East Africa)," co-authored with Erik Brown, Sean Crowe, and Sergei Katsev.

NICHOLAS MANDRAK (University of Toronto Scarborough) for being promoted to full professor in the Department of Biological Sciences.

ELLEN MARSDEN (University of Vermont) for receiving the 2019 Jack Christie/Ken Loftus Award from the Great Lakes Fishery Commission. The award recognizes distinguished scientific contributions toward understanding healthy Great Lakes ecosystems and honors Marsden's extensive research related to the ecology and management of Great Lakes fisheries.

KUDOS *continued*

JÉRÔME MARTY (Council of Canadian Academies) for his appointment to the International Joint Commission's Great Lakes Science Advisory Board.

TREVOR PITCHER, **AARON FISK**, and Katelyn Johnson (GLIER-U Windsor) for community engagement with the Town of LaSalle, Ontario, through deployment of instrumentation in the Detroit River to provide early alert of flooding to the community, with support from the Cooperative Institute for Great Lakes Research.

PAUL SIBLEY (University of Guelph) for becoming president of the International Association for Great Lakes Research.

MAREK STASTNA (University of Waterloo) for becoming vice president of the Canadian Meteorological and Oceanographic Society.

ED VERHAMME (LimnoTech) for becoming vice president of the International Association for Great Lakes Research.

CHRIS WEISENER, **SCOTT MUNDLE, KEN DROUILLARD**, and **DANIEL HEATH** (GLIER-U Windsor) on leading a successful NSERC Strategic Partnership Grant to develop technology to detect microbial activity related to nutrient retention in sediment.

Submit kudos to lakesletter@iaglr.org

Welcome New Members

The following members joined the association between May and July 2019.

Olivia Anderson
Zoe Armstrong
James Last Keyomb Atalitsa
Sumeep Bath
Sonya Bayba
Sarah Beech
Erin Bergen
Sarah Bickman
Jennifer Bontje
Linden Brinks
Ben Burke
Victoria Campbell-Arvai
Shelby Clark
Ryland Corchis-Scott
Yufeng Dai
Lucinda Darrah
Jason Deglint
Elizabeth DiCesare
Kristen Dieterle
Feifei Dong
Bailey Duxbury
Eric Ellis
Jillian Estrada
Thomas Evans
Rachel Eveleth
Erika Fernandez
James Fischer
Kimberly Fitzpatrick
Kavishka Gallage
Sandra George
Ramin Ghamkhar
Satyaki Ghosh
Robert Gibson
Claire Gilbert
Adrian Gonzalez Ortiz
Amy Greene
Kyla Greenham
David Hampson
Robert Hartnett
Katie Hastings
Aletha Hefko
Liv Herdman
Stephanie Hickel
Donna Hill
Robert Hirsch
Hilmar Hofmann
Nathan Holliday
Brenda Hoppe
Jeffrey Houser
Justin Hubbard
John Hume
Vadym Ianaiev
Terri Jicha
Tong Jin
Zachary Jorgenson
Jeff Kart
Shaffina Kassam
Tae-Woo Kim
Andrew Kowalczk
Rebecca Kreiling
Zi Xun Kua
Anya Leach
Alexandra Leclair
Courtney Leermakers
Chia-An Lin
Yi Liu
Paul Matson
Lewis McCaffrey
Megan McCusker
Katherine Moir
Andrew Monks
Hilary Mosher
Janet Nestlerode
Carly Norris
Daniel O'Donnell
Paul Parete
Erin Parker
Susan Peters
Michael Pisaric
Nkusi Placide
Cuicui Qi
Shelly Ray
Hannah Reish
Kate Sanders
Uwe Schneidewind
Kim Scribner
Lisa Sealock
Shivarudrappa Shivakumar
Ella Shively
Benard Mucholwa Simiyu
Lewis Sitok
Seth Smith
Emma Somers
Scott Steinschneider
Katlyn Sutcliffe
Callia Tellez
Rhiannon Ulatowski
Joshua Unghire
David Ure
Anna Urso
Emily Varga
Brenten Vercruysse
Clara Voorhees
Brianne Walsh
John Wernly
Mary Williams
Lieserl Woods
Cindy Yang
T.Q. Zhang
Xin Zhao
James Zollweg

The IJC's science and policy partnership

By David Burden, Director, International Joint Commission Great Lakes Regional Office

SCIENCE AND POLICY are challenging partners. Policy makers make decisions within deadlines that reflect legislative and political timelines. Scientific research on those issues often takes years or even decades to reach conclusions, or at least reduce uncertainty. In the absence of solid science, policy decisions should reflect the precautionary approach, but they often don't because even that can be hard to define within time demands without adequate research.

Both partners have the best of intentions, particularly when it comes to accomplishing the goals and objectives of the Great Lakes Water Quality Agreement. But by nature, the two federal governments act bilaterally rather than binationally. In many locations, binational direction through the agreement with community action has proven successful; for broader basinwide issues, progress is only as good as the collective political will and lowest common approach.

Scientists also have a deep commitment to and best intentions for their research, but their work is often driven by the issue of the moment in agencies or by what will result in funding in the university setting. Thus scientists tend to work in their own silos, resulting in duplication and repetition of work and databases that are confusing to interpret for policy makers and the public.

Opportunities to anticipate policy and research needs at a decadal scale are limited, but they are essential to tackle new pressures affecting the Great Lakes region such as climate change, novel chemical pollutants, urbanization and water needs, rapidly evolving agricultural practices, habitat loss, and invasive species.

For more than a century, the International Joint Commission (IJC) has demonstrated that the challenge of science-informed policy making and policy-informed science making is possible to surmount with cooperation, collaboration, and coordination. In 1913, epidemic proportions of Great Lakes basin residents were stricken with cholera. The newly created IJC conducted one of the largest ever transboundary bacteriological contamination studies to understand ties between sewage pollution and the waterborne pathogens killing residents. Scientists from across the international border contributed to the study, which led to development of the region's wastewater treatment. Fast forwarding a century, the IJC's Health Professionals Advisory Board is now developing a framework proposing a repeat of this groundbreaking study in a modern context to see where we've made progress and where we need new policies to attack longstanding pollution problems affecting our waters.

In 1972 after Lake Erie was declared "dead," Canada and the United States signed the Great Lakes Water Quality Agreement that, among other things, empowered the IJC to advise governments on their priorities for research and management through the creation of the Water Quality Board and the Science Advisory Board. The boards' studies and the IJC's resulting recommendations helped both countries to restore Lake Erie. When faced with the same issue again in 2011, the IJC completed the Lake Erie Ecosystem Priority study, and in 2014 it recommended, among other actions, a 40 percent reduction in the amount of phosphorus entering the lake. Policies and programs with this reduction requirement have been agreed to by state, provincial, and local governments, and coordinated implementation throughout the Lake Erie basin is the last hurdle.

The IJC's boards exemplify the cooperation, collaboration, and coordination needed for science and policy to be mutually reinforcing. Members include scientists, researchers, government representatives from all levels, nongovernment organizations, businesses, and the public. The IJC also meets with other scientists, decision makers, and the public as part of its assessment of progress under the agreement; it did so in June at the IAGLR conference in Brockport, New York, and will continue to do so in communities around the basin this summer and fall.

Strong consensus is developing among Great Lakes researchers that we are doomed to repeat past mistakes, as seen in bacterial contamination in Lake Erie, unless support for investigation and exploration is improved significantly. Our Science Advisory Board is supporting efforts to develop a decade-long binational plan for Great Lakes research that will help to address the challenge of providing effective, conclusive, and timely scientific findings to policy makers. Such a science plan is required to increase the collective ability of scientists and policy makers to forecast change, mitigate impacts, and help the goals of the agreement seem less daunting.

Students engaging in science policy

By Sivani Baskaran, Ph.D. Student in Environmental Chemistry, University of Toronto Scarborough

ONE OF THE FIRST THINGS I LEARNED as a co-founder of the Toronto Science Policy Network (TSPN) is that science policy is a fairly broad term and a far more complex topic than I initially thought. The term *science policy* can refer to either science for policy (the use of evidence and science to inform policy decisions) or policy for science (how institutional and governmental policies affect the way we do science, from research funding to research prioritizations).

A little over a year ago, I met with fellow graduate students Ellen Gute, Vasa Lukich, Farah Qaiser, and Molly Sung to discuss creating a science policy group at the University of Toronto. We felt that there was a distinct lack of training for people in the sciences interested in learning about policy- and decision-making processes. And so we created the TSPN: a student-run platform for the University of Toronto community to learn about and engage in science and policy.

TSPN has run a number of workshops on the different facets of science policy, including science advocacy, policy writing, and science communication. We have also invited research experts at the university to host public panels where the University of Toronto community and the interested public can learn about the science behind key policy topics like climate action and Ontario's sexual education curriculum. TSPN has become a platform for us to learn more about science policy and connect with not only our fellow students and faculty but also members in our local community.

In our inaugural year, TSPN has engaged over 200 people through panels, workshops, and other events, and we are looking forward to engaging many more in the years to come!

If you have a passion for science policy, now is a great time to get involved. With the Canadian federal election just around the corner, TSPN is partnering with science policy groups on a national nonpartisan #VoteScience campaign. We want to encourage citizens, especially scientists, to go out and engage candidates on the importance of science and evidence-based decision making.

If you're interested in learning more about science policy, check out the TSPN website for resources. You'll find a list of international science policy organizations, campus groups, and post-doctoral fellowships relating to science policy, and even tips on how to start your own group.

The TSPN team at the 2018 Canadian Science Policy Conference.

IISD Experimental Lakes Area committed to policy

By Sumeep Bath, Communications Manager, IISD Experimental Lakes Area

WHEN MANAGEMENT of the Experimental Lakes Area, the self-proclaimed *world's freshwater laboratory,* moved in 2014 from the Government of Canada to the International Institute for Sustainable Development (IISD), a nonprofit think tank whose *raison d'etre* is policy research and knowledge sharing, there was a clear opportunity to make that much-cited yet mostly mythical bridge between science and policy a reality.

But first, let's back up a bit.

A group of 58 lakes and their watersheds in northwestern Ontario, Canada, IISD Experimental Lakes Area (IISD-ELA) is the only place in the world where scientists can manipulate whole lakes to build a more accurate and complete picture of the impacts of human activity on freshwater systems. Findings from IISD-ELA's 50-plus years of groundbreaking research have rewritten environmental policy around the world and the organization aims to keep freshwater clean for generations to come.

Researchers at IISD-ELA have added nutrients to lakes to improve our understanding of the relationship between phosphorous and algal blooms, acidified a lake to mimic acid rain, added artificial estrogen to a lake in similar levels to that which is found downstream from sewage treatment plants, and sprayed a small amount of mercury stable isotopes onto a lake and its watershed to understand mercury cycling in the environment. Research conducted at IISD-ELA is applied science with the goal of improving our understanding of human impacts on freshwater systems.

When it comes to applying that science to government and industrial policy and public consciousness, Pauline Gerrard, who heads up IISD-ELA's education and outreach program, has been leading that charge since the organization became an independent entity.

Pauline, however, was no stranger to those famed 58 lakes. Starting as an undergraduate student in 1994 on a project focused on the impact of hydroelectric reservoir creation, she contributed toward research aimed at understanding mercury biogeochemistry in flooded systems. For her master's research at the University of Alberta, she was back at the site examining the uptake of methylmercury in tree swallows living around the experimentally flooded reservoir.

Photo courtesy of IISD Experimental Lakes Area.

Pauline Gerrard has worked at the world's freshwater laboratory in many different roles since 1994.

IISD-ELA is the only place in the world where scientists can manipulate whole lakes to build a more accurate and complete picture of the impacts of human activity on freshwater systems.

She then tore herself away from her beloved lakes, moving away from Canada and spending 10 years working in southeast Asia for the World Wildlife Fund for Nature focusing on wetland management and connections between poverty alleviation and biodiversity conservation. In 2010, Pauline returned to Canada and started, coincidentally, working for IISD to manage an internship program for Canadian students interested in international development.

When IISD took over management of the site, Pauline immediately flagged the potential for IISD-ELA to communicate its unique take on freshwater science to educate students and the public, engage industry, and influence governmental policy in Canada and around the world.

IISD-ELA's outreach to students and the public has slowly blossomed over the past six years to include field courses, public tours, school presentations, and educational resources. Pauline has worked to make sure that thousands of people from across the country have literally and figuratively walked through IISD-ELA's doors to learn, often firsthand, what freshwater research looks like, and why it matters.

Of course, public education is valuable in and of itself, but it is all the more so when it leads to policy change at the governmental level. While the research born from IISD-ELA over the last 50 years has had significant impact on policy in North

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America and around the world, this was often not the result of concerted efforts toward improved policy outcomes.

The challenge for a nonprofit focused on sustainable development and human impacts on the environment is to strengthen these connections and actively direct science toward better public policy. Research has shown that legitimacy, or studies that were designed to incorporate multiple points of view, is the strongest predictor of science that drives policy change (Posner et al., 2016).

Based on those principles, Pauline and IISD-ELA have been working to engage multiple stakeholders in the research and its outcomes. This includes building diverse research partnerships with academic institutions, government regulators, and industry. It also involves conducting community meetings, presenting in schools, and meeting with decision makers at key stages of the research.

They also track the policy landscape in search of opportunities for recommendations related to their research and communicate these recommendations in a variety of public fora, from opinion pieces to policy briefs.

A next step for IISD-ELA is to build policy-needs analysis into experimental design at the onset. This ongoing process will involve mapping the existing policy landscape and determining priorities as part of the development of the research project so the outcomes of the experiment have an immediate relevance for policy makers.

In fact, you can see for yourself exactly how the world's freshwater laboratory bridges science and policy next year when it hosts IAGLR 2020 in Winnipeg. You will be able to take a tour of the site, meet the scientists in person, and try your hand at some of the science for yourselves.

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Photo courtesy of IISD Experimental Lakes Area.

Researchers assess the health of a fish as part of their experiment to determine the impact of atmospheric mercury deposition on lake ecosystems.

Photo courtesy of IISD Experimental Lakes Area.

The very evident result of the site's first experiment that revealed phosphorus to be the key culprit in algal blooms.

The Microbead-Free Waters Act of 2015: connecting science and policy

By David A. Strifling, Director, Water Law and Policy Initiative, Marquette University Law School

ENVIRONMENTAL LAW scholars have long lamented that it has become unthinkable for Congress to pass noteworthy environmental legislation. This is not uniformly the case, as shown by the Microbead-Free Waters Act of 2015. The act addressed a significant environmental issue—the discharge of certain microplastics to surface waters—and the strategic building blocks underlying the act may provide useful foundations for future policy-making efforts.

Plastics are an increasing threat to our oceans, lakes, and streams. A recent report estimated that each year at least 8 million tons of plastics leak into the oceans—the equivalent of one garbage truck per minute. The oceans are expected to contain more plastics than fish by 2050.

Microbeads represent one aspect of this problem. They are microspheres commonly used as exfoliants in consumer toiletry products such as facial and body cleansers and toothpastes. Most are nonbiodegradable. Microbeads form a high concentration of some products; one study found that a typical exfoliating shower gel contains as much microplastic in the cosmetic as is used to make the plastic packaging it comes in. Prior to the act, no illicit or illegal activity was necessary for microbeads to enter surface waters. On the contrary, washing them down the drain is an expected result of cosmetics and toothpaste disposal after use.

Plastic pollution is also an increasing concern for the Great Lakes. Early scientific research shows that concentrations of plastic microbeads are higher in some parts of the Great Lakes than corresponding concentrations in oceans—as many as 1.1 million bits of microplastics per square mile in some areas of the Lakes.

The confluence of growing scientific understanding of the threat to public health certainly contributed to the genesis of the act. The result, essentially a ban on manufacturing cosmetics containing microbeads, sailed through both houses of Congress without opposition. Three factors help explain the easy passage.

First, the act makes no effort to address our plastics problem in its entirety. Instead, it targets one clearly delineated aspect of the problem: cosmetics that contain microbeads. Had the act included broader provisions to, for example, limit the usage of plastic bags, one can surmise that it would never have passed both houses of Congress.

Second, its congressional sponsors rooted the act in the scientific evidence collected to date, allowing them to position the act as a public health bill first and an environmental protection bill second. This was appropriate. Microbeads pose perhaps an even greater concern for human health than do ordinary plastics. Like other plastics, microbeads bioconcentrate pathogens and other hazardous chemicals. However, unlike macroscale plastics, microbeads are easily ingestible by aquatic organisms and therefore have a greater potential to be concentrated up the food chain to humans. The scientific identification of these public health aspects of the issue may have eliminated—or at least rendered surmountable—the ordinary partisan blockade.

Third, the act enjoyed broad stakeholder support both from grassroots groups and (perhaps surprisingly) from industry. The American

Chemistry Council supported what it called a "sensible" effort to phase out microbeads. Other industry groups expressed comfort with the emplacement of a uniform national policy to avoid concerns over compliance with a patchwork of state regulations. In part, this support may also have been due to a belief that some companies would obtain a competitive advantage from continuing to use the inexpensive microbeads while other, more socially responsible, companies phased them out.

The act shows that Congress can indeed pass smart environmental legislation. But it doesn't come easily, as decades of failure have shown. Proponents of future environmental legislation can benefit from the act's example by setting a reasonable scope and focus, crafting a broad stakeholder coalition, and rooting environmental policy in sound science framed through a public health lens.

For a more complete discussion, see Strifling's article The Microbead-Free Waters Act of 2015: Model for Future Environmental Legislation, or Black Swan? in the Journal of Land Use & Environmental Law, vol. 32.

Cladophora body of knowledge built; still awaiting policy

By Martin T. Auer, Professor Emeritus, Department of Civil & Environmental Engineering, Research Scientist, Great Lakes Research Center, Michigan Technological University

I BECAME A LIMNOLOGIST for a purely personal reason: I love to explore lakes. My training included exposure to the grassroots environmental movement of the 1970s, which nurtured an interest in lake research as a means of serving society's needs. I learned that lake restoration and protection were accomplished in stepwise fashion: science → policy → regulation. I came to see the process as one where scientists would build a body of knowledge from which policy and regulation could evolve. *If scientists build it, policy will come*.

Since 1978, I have been part of a community of Great Lakes scientists focusing their research on the filamentous, benthic macroalga *Cladophora*. Where stimulated by increased phosphorus availability, the alga grows to nuisance proportions fouling beaches, clogging water intakes, and resulting in lost beneficial use. Abundant growth was observed in Lake Erie in the 19th century. Complaints of beach fouling were reported in lakes Erie and Ontario in the 1930s, and extended to lakes Huron and Michigan in a few decades. In 1975, the International Join Commission (IJC) hosted a research needs workshop to foster efforts in support of *Cladophora* management—a clear call to *build* the body of knowledge.

The call has been well received. Studies on Lake Huron in the 1970s and 1980s saw several firsts: application of remote sensing for monitoring *Cladophora* distribution, development of the Great Lakes *Cladophora* Model (GLCM v1), and demonstration of the efficacy of nuisance growth management through point source phosphorus control. The first decade of the 21st century saw teams of scientists publishing on *Cladophora* in lakes Erie and Ontario, with applications to invasive mussels, climate change, and development of the *Cladophora* Growth Model (CGM). The next decade featured a collaborative examination of the response of *Cladophora* to invasive mussels and development of an upgraded model (GLCM v2). More recently, agency scientists in Canada have published the results of *Cladophora* surveys in Lake Ontario, and monitoring and modeling are underway for Lake Michigan. The results of a 5-year study of *Cladophora* at a site on Lake Ontario that describes the role of invasive mussels in mediating the resurgence, the introduction of an advanced model (GLCM v3), and an analysis of the efficacy of point source control on nuisance growth are being rolled out. The bibliography on *Cladophora* in the Great Lakes compiled in the 1980s has grown by more than 100 references. The body of knowledge has been *built*.

Metroland file photo by Ryan Pfeiffer

Cladophora has plagued the Great Lakes nearshore for over a century. Yet, the problem described in 1975 by the IJC as "deserted bathing beaches covered with layers of rotting *Cladophora*; bulldozers pushing *Cladophora* into mountains; and the accompanying flies and pig-pen odor which go hand in hand with rotting protein" remains, having received little policy and regulatory attention. Annex 4 of the Great Lakes Water Quality Agreement (2012 Protocol) has adopted a Lake Ecosystem Objective to maintain levels of algal biomass below those constituting a nuisance condition. But, as of this writing, the level of algal biomass constituting a nuisance condition has not been defined. The agreement further calls for establishment of Substance Objectives for nearshore phosphorus concentrations that would achieve the Lake Ecosystem Objective. Again as of this writing, there is no Substance Objective in place.

Science and policy. *We built it; nobody came.* Why? Certainly policy makers are exposed to significant pushback from those who will carry the economic responsibility for maintaining sustainable water quality. However, work needs to be done at the interface between science and policy. Scientists need access to policy discussions and assistance in communicating the essence of their findings within the context of policy development. We cannot expect policy makers to comb through 100 technical manuscripts to inform decisions. We also cannot expect scientists to intuit the needs of the policy community. This exchange needs to happen in real time with both domain experts present at the table and assisted by communicators who operate at the boundary between science and policy. I believe that IAGLR is well positioned to mediate this partnering of people with complementary strengths. *If you build it well, they will come.*

Restoring lake sturgeon

A story of curiosity, passion, and serendipity leading to hope for this ancient species

By Nancy A. Auer, Research Professor Emeritus, Michigan Technological University

I BELIEVE that engaging the science-policy nexus can only spring out of diligent research. It results from addressing a scientific question and then going on the quest for answers. Some answers can impact policy decisions, but my research was driven by a passion to understand and hopefully impact the future of a fish. It was also based on serendipity.

When I helped develop and publish the *Atlas for Identification of Larval Fishes of the Great Lakes* in 1982, I had visited a hatchery full of baby lake sturgeon (*Acipenser fulvescens*) reared at the University of Wisconsin, Milwaukee. Viewing those tiny fish marked me for life. When I moved to upper Michigan, I inquired at the Baraga Michigan Department of Natural Resources office if there were sturgeon in the river named Sturgeon that hundreds of people cross daily on their way to Houghton. I was told there were lake sturgeon in that river, but nobody had investigated them; I was given permission to try. I wrote a Nongame Wildlife Grant, received funding, and the rest is history.

In the 1980s few people worked on lake sturgeon populations as most were believed to be remnant or lost, but I started tagging and tracking them in 1987. Unbeknownst to me, a hydropower facility operating in a peaking mode and impacting flow regimes was due to be relicensed in 1990. My early research was on basic population biology. We found spawning fish stranded for long

periods, spawned eggs left high and dry when water levels fell, and few females were to be seen. The data collected were used in FERC relicensing, and the facility changed to Near-Run-of-River (ROR) operation after 1990. Dramatic differences were noted in the sturgeon population after that as the same amount of water coming into the reservoir had to be released 24/7 and a minimum flow was imposed to make sure fewer spawned eggs were exposed. The ROR flows brought larger fish (often females) into the spawning area, fish spawned and left quickly, and eggs had more stable flow and temperature conditions.

During my early years of sturgeon work, I often wondered about effects of sea lamprey treatments as they were being done at the same time newly hatched lake sturgeon drifted downstream after hatching. I inquired of the U.S. Fish and Wildlife Service, but they had no data on possible impacts to sturgeon. So one year they set up a trailer onsite and used Sturgeon River water and hatchery-raised sturgeon in tanks to test the possible effect of typical treatment. Much to the dismay of all, it became clear that lake sturgeon youngsters were sensitive and there was enough mortality to change treatment protocols for later in the year when drift would be over. They now treat in late summer or fall in rivers known to have both sturgeon populations and water chemistry conditions that require attention.

Research scientists in other systems also began to see successes. But I am proud to say some of my work was used to reshape policy that improved conditions for and helped increase a population of lake sturgeon that range widely across all of southern Lake Superior after 30 years of effort for the species.

Photos courtesy of MTU

MEMBER PROFILE

G. DOUGLAS HAFFNER

Professor Emeritus, Great Lakes Institute for Environmental Research, University of Windsor

Describe your research.

My research is primarily focused on the transfer of energy, nutrients, and contaminants through Great Lakes food webs. Specific studies include primary production, factors regulating the relative abundance and composition in phytoplankton and zooplankton populations, harmful algal blooms, bioaccumulation of persistent chemicals, and identifying sources and energy transfer efficiencies required to support Great Lake's fisheries. Research is based on open lake systems as well as within areas with ongoing remedial action plans.

Describe how you engage with policy making.

Although my research has strongly been related to policy development, such as the use of primary production to identify the original phosphorus target loads in the Great Lakes, direct linkage to policy formulation is, at best, tenuous. I have served on committees such as the Science Advisory Board and Council of Great Lakes Research Managers, attended meetings of the Cooperative Science and Monitoring Initiative, and participated in the Detroit River Remedial Action Plan since implementation in 1986; however, these do not provide a strong linkage to forming or modifying environmental policies regarding the management of the Great Lakes ecosystem.

Research needs to inform policy

Research outcomes tend to come in small, discrete packets that make great, informative readings in the Journal of Great Lakes Research but are of limited use to policy makers who require much broader, integrated perspectives. The current systems of funding research in Canada and the United States tend to be project based and focused on specific issues or problems. Although this approach produces good science, it does not provide a framework for the research community to take a more integrative approach for the management of the Great Lakes. When attending meetings regarding major research challenges in the Great Lakes, the consistent message is the need for integration. The lack of integration has definitely limited the success of the ecosystem approach as recommended in the Great Lakes Water Quality Agreement.

During the 1970s, there was better communication between science and policy-making processes when dealing with a single issue, such as eutrophication. It was much easier then for the science community to deliver a clear, consistent message. Researchers today must consider the effect of multiple stressors and the many uncertainties associated with predicting lake responses in a highly variable environment. Instead of integrating research knowledge, our current funding systems set up a competition for resources within the science community to address priority research questions.

Challenges connecting research and policy

We need a new approach that integrates research knowledge and information in a timely and meaningful way for policy makers. To form a better connection between research and policy, we should consider the development of an International Integrated Ecosystem Management Program jointly funded by the United States and Canada. The goal of the framework would be to allow government agencies and universities to work together to provide accurate and timely advice to all levels of government. Basically the framework would result in the development of "boundary organizations" that link scientists and communicators to effectively synthesize knowledge and information to meet the needs of policy makers. These boundary organizations will require formal partnerships among agencies and universities that bring together the expertise required for knowledge integration and communication, and they will result in unique international training opportunities for future researchers. These organizations will not just provide a link between research and policy, but will also provide a corporate memory as to how and why specific environmental policies were derived.

MEMBER PROFILE

GAIL KRANTZBERG

Professor, McMaster University, Engineering and Public Policy Program

Describe your work.

I apply known and emerging scientific findings to the development or refinement of programs and policies directed at Great Lakes excellence. I am also aiming to get a better understanding of good governance and how truly meaningful multi-sectoral engagement can enrich collaborative decision making and change the future for the better.

Describe how you engage with policy making.

I was Great Lakes Senior Policy Advisor in the province of Ontario, and I helped decision makers understand how science can inform better policy directions in the face of competing government priorities, economic constraints, equity, inclusion, and societal change. Presently, all my research is focused on addressing ongoing environmental and governance challenges faced by Great Lakes managers and program practitioners.

What advice do you have for other researchers to engage at the science-policy nexus?

To do this well, you must first speak science without jargon. Use simple language as if you were describing your scientific information to your neighbors or family members. You need to understand the nature of the policy maker's request for information. Complex scientific discourse does not help, it only serves to confuse. Overly emphasizing scientific uncertainty and failing to make your best efforts to provide the information in an understandable format will make you irrelevant.

What has been the biggest success story (yours or others) of large lakes research informing policy for good?

One interesting undertaking was the Great Lakes Futures Project, a collaboration among Canadian and U.S. universities and government personnel, within which we explored drivers of change in the Great Lakes regime. Using scenario analysis, we imagined four possible futures and the policy regimes necessary to enable those futures. This allowed students, faculty, the private sector, and the public sector to understand the policy directions necessary to achieve the desired future state of a resilient Great Lakes basin economy, social well-being, and environmental excellence.

Another excellent application of research informing policy was my time as the coordinator of the Collingwood Harbour Remedial Action Plan. Science enabled an understanding of the causes for environmental degradation. Science and engineering enabled a response through active, targeted interventions. Policy determined what to do, when, how, and with whom, and then, ultimately, the decision to delist Collingwood Harbour as an Area of Concern.

What are some of the biggest research needs to inform policy?

Still outstanding is a framework to assess future emerging threats to the integrity of the Great Lakes. We need a systematic method for predicting new threats and prioritizing them for policy responses. Presently the International Joint Commission's Great Lakes Early Warning System working group, on which I am privileged to serve, is grappling with this very matter. I hope we are successful; it is not yet clear that we will be. In the end, we will do our best to make the lakes great.

MEMBER PROFILE

DON SCAVIA

Professor Emeritus, University of Michigan

Describe your work.

I've had a pretty diverse career. At NOAA/GLERL (1975–1990), I developed ecological models of Lake Ontario and carried out lab and field studies on Lake Michigan plankton and nutrient dynamics. At NOAA headquarters (1990–2004), I ran competitive coastal ocean and Great Lakes grant programs, and led several interagency environmental science and policy assessments. On the University of Michigan faculty (2004–2018), I directed Michigan Sea Grant, the NOAA Cooperative Institute, and the Graham Sustainability Institute, and I worked with students and postdocs to develop and apply models of the Gulf of Mexico, Chesapeake Bay, and Lake Erie plus its watersheds.

Describe how you engage with policy making.

While at NOAA headquarters, I had the opportunity to testify in front of various congressional committees, help draft legislation, and lead integrated assessments that assembled and evaluated scientific information to guide environmental policy related primarily to hypoxia and harmful algal blooms. As an academic, I continued all three of these engagements, but I also worked with environmental NGOs to help develop and support their policy initiatives and advocacy.

What advice do you have for other researchers to engage at the science-policy nexus?

To be effective, you need to be a trusted source of information related to your area of expertise, and there is no short cut to that. Research, publish, and establish your credentials. While it is important to understand uncertainty and alternative explanations, when communicating with policy makers and the public, avoid being the "two-handed scientist." Saying "on the one hand, X; but on the other hand, Y" is not helpful. Similarly, knowing that a certain property could change by a factor of 2.4 or 2.6 is likely a nuance when all that is needed for policy making is that it will increase. In other words, understand the context of the policy decision, the precision and certainty realm in which they work, and the nature of the information they already have. You are providing a piece of their more complicated puzzle.

What has been the biggest success story (yours or others) of large lakes research informing policy for good?

Within my area of study, I think the research and modeling support for the original and revised phosphorus loading targets under the Great Lakes Water Quality Agreement are big success stories with some important commonalities and differences. Both agreements were based on the integration of multiple models and expert opinion, and the policy benefited from the consensus across the diversity of models. A key difference between the two eras is that for the original agreement models and associated research were deeply supported, which led to new models and insights that benefited not only the agreement and the Great Lakes, but the field in general. In contrast, the revised agreement had to rely on existing models and the efforts of volunteer modeling teams. While useful for the agreement, it was a lost opportunity for the field.

What are some of the biggest research needs to inform policy?

This may seem a bit strange coming from a natural scientist/engineer, but I think one of the most important research needs for informing policy comes from the social sciences. Increasing the understanding of how new information is used in policy development, identifying the impediments to its use, and exploring methods to overcome those impediments are critical. Equally important is that social scientists need to communicate their findings to natural scientists and engineers, rather than just among themselves in their journals.

MEMBER PROFILE

EMILY TYNER

Ph.D. candidate, School of Freshwater Sciences, University of Wisconsin-Milwaukee

Describe your work.

My dissertation research is interdisciplinary, and I am being advised by a committee with diverse membership comprised of a limnologist, aquatic ecologist, economist, rhetorician of science, and geographer.

I am using a mixed methods approach to explore the following: 1) what are the public preferences for restoration and conservation at areas targeted for restoration by the Great Lakes Restoration Initiative (GLRI), specifically Great Lakes Areas of Concern (AOCs) and National Park Service (NPS) sites; 2) what are the conversations about AOCs and NPS sites on Twitter; 3) how do these conversations connect to things we measure (e.g. visitation, preferences for restoration, political happenings); and 4) how might Twitter be a useful research tool for groups like Great Lakes planners, the International Joint Commission, and even the IAGLR board.

Describe how you engage with policy making.

I see my work as policy adjacent in that it can help inform policy decisions. For example, for my dissertation I did a survey of 1,200 Great Lakes residents to understand their preferences for restoration and conservation. My findings should be useful for regional planners or EPA officials wishing to purse management and policy actions that have the support of local communities.

I have also done research on water quality in Lake Malawi. In that work, conducted collaboratively with researchers from the Malawi Department of Fisheries, we found that *E. coli*, an indicator for fecal contamination, had persistently high levels at sites along the shoreline but dropped off at 15 meters off shore. For beach managers and public health officials along Lake Malawi, this finding should be helpful in setting suggested guidance for shoreline usage of the lake.

As a student I have twice participated in Great Lakes Day in Washington, D.C. Both visits were invaluable learning experiences. After training in crafting and delivering a message to congressional staffers short on time, we visited congressional offices to advocate for the Great Lakes region and the work accomplished through GLRI. In the Great Lakes, we often bemoan federal funding decisions, and it was helpful to hear firsthand what politicians are balancing as they consider support for the Great Lakes. My team had a memorable visit with the late John Dingell from Michigan's 12th Congressional District. He was unhurried in welcoming us into his office, was familiar with Great Lakes-related happenings in his district, and was keen to talk about the health of waterbirds in Michigan. It was clear his interest in the Great Lakes was both political and personal.

What are some of the biggest research needs to inform policy?

As a student interested in learning about the black box of policy and management decision making, I would like to see more research

and articles about the steps from environmental concern to policy decision. One of the best examples of this that I have read is an article in the Journal of Land Use & Environmental Law about the Microbead-Free Waters Act of 2015 (Strifling, 2016). It would be interesting to see the Journal of Great Lakes Research take up similar case studies exploring the detailed steps of taking an ecological issue and the research informing its topic to its policy or management outcomes. Perhaps this is a contribution I can make after finishing my dissertation.

See page 9 for more on Strifling's perspective on the Microbead-Free Waters Act of 2015.

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Edited by Paula McIntyre
Communications Director

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From the field

Grad student Ryland Corchis-Scott training undergraduate research assistants Rina Guxholli and Madison Dugdale on how to conduct environmental DNA sampling for at-risk fish species (with a focus on redside dace) in tributaries off of Lake Ontario. *Submitted by Trevor Pitcher, Great Lakes Institute for Environmental Research, University of Windsor.*

Jasmine Mancuso, Anthony Weinke, and Ian Stone ready to get wet while sampling the experimental bioassay mesocosms moored in Muskegon Lake (Michigan) to find out what drives cyanoHABs. *Submitted by Bopi Biddanda, Annis Water Resources Institute, Grand Valley State University.*

Volunteers prepare for a beach seine haul at Antrim Creek Natural Area on Grand Traverse Bay of Lake Michigan as part of Great Lakes Naturalist sampling led by Steve Hensler of the Cerulean Center (second from right). *Photo courtesy Rick Kane.*

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