



Great Lakes One Health

A CONVENING AT SHEDD AQUARIUM — MAY 20, 2011





EXECUTIVE SUMMARY

The Great Lakes region is far more than the sum of its five majestic bodies of water. More than 42 million people—and 1,000 animal species—depend on the Great Lakes for clean drinking water, home or habitat, and overall well-being. The good health of Great Lakes aquatic environments is critical to the health of the region's human population, wildlife and livestock, and terrestrial ecosystems. Therefore, the time is right to apply the One Health framework to conservation efforts for the Great Lakes ecosystem.

One Health links human, animal and environmental health through interdisciplinary collaborations among physicians, veterinarians, other health practitioners, and professionals in all fields of the environmental sciences. It has enormous potential to bring together a multitude of separate, and often siloed, programs and projects as well as identify gaps in research and data.

From a long roster of problems affecting the Great Lakes, convening participants targeted five areas for action necessary to launch One Health in the Great Lakes: communications; education; database integration; and attention to the two issues of stormwater runoff and biodiversity. They then developed regional collaborative solutions for each, taking into consideration potential solutions to the issue, barriers to addressing the issue, who is—or needs to be—involved, and potential next steps to take.

The relatively new concept of One Health needs to be clearly defined—to all stakeholders, but especially beginning with those working within it—so that it can be communicated through consistent key messages. Target audiences need to be identified and researched. People are bombarded with information, so the One Health message has to stand out and resonate with their concerns. Government agencies, nongovernmental organizations and academic institutions working on One Health must collaborate. Professional communicators should develop the PR/media campaign. Aquariums, zoos, museums and other educational and outreach institutions were identified as the “storytellers” that can connect with the public.

Educating the educators is the most effective way to introduce the upcoming generation to One Health. Packaged curricula developed for K through 12 that meet state standards and integrate with existing programs could be distributed to teachers. For higher education, in addition to launching a paradigm shift in the health and environmental sciences, One Health could also be integrated into liberal arts curricula. Informal programs, on site at museums, zoos and aquariums and in outreach programs, would bring One Health to a wider general audience. A variety of educational and conservation organizations are involved with this already.

EXECUTIVE SUMMARY CONTINUED

A vast store of information exists on the Internet, as well as in the private electronic and paper files of many organizations and agencies. We are data rich, but knowledge poor. Complicating the situation, many of the agencies, organizations and universities that operate these databases do not want to share their information. To advance the One Health approach, partners need to make their information available so that it can be identified, vetted, coordinated and, to be usable throughout the Great Lakes conservation and health communities, linked.

A quick review also reveals a lack of consensus on what the key indicators of Great Lakes health are. It will take leadership, coordination and a lot of human and financial resources to integrate the databases dealing with issues pertinent to One Health.

One of the first on-the-ground (or in-the-water) issues to tackle is stormwater runoff, which is exacerbated by outdated, deteriorating infrastructure, the predominance of impermeable surfaces and development practices that alter local hydrology. Runoff carries chemical fertilizers (from both residential and agricultural sources), animal wastes, petroleum pollutants associated with transportation and recently identified pharmaceutical and personal-care-product compounds, which are not removed in the wastewater-treatment process. Abuses of water resources continue because the current low price of water does not reflect the cost of keeping it clean or its future value in a water-deprived world. One Health must raise public awareness about these water-quality issues. And the agricultural, pharmaceutical, medical, chemical and construction industries need to be at the table, contributing preventive and sustainable strategies for their products and practices.

A biologically diverse ecosystem is a healthy one, and the greatest challenge in the Great Lakes is dealing with what has been lost, on land and in the water. At this point, what constitutes “good” biodiversity, and how is it conserved, restored and sustained? What ecosystem components must remain intact for species to adapt and survive in the face of further habitat degradation and emerging climate change? What is the break-even point, to consumers and commerce, of preserving biodiversity, and is a native animal or plant more valuable than a non-native species that performs the same ecosystem function? More research and analysis—on natural variation, ecosystem function, species composition, environmental and manmade risks, and mitigation opportunities—is needed.

Given the interdisciplinary nature of One Health, it became apparent that many of the solutions and next steps identified can serve to begin to solve several of these issues simultaneously.

GREAT LAKES ONE HEALTH

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Shedd Aquarium’s commitment to conservation begins in its own backyard, where Lake Michigan alternately rolls and roils. Michigan and her sister lakes—Erie, Huron, Ontario and Superior—give their name to and define the Great Lakes region, a vast watershed that contains major population centers. The lakes themselves hold nearly 20 percent of the world’s liquid fresh water, making them the Earth’s largest freshwater ecosystem. More than 42 million people—and 1,000 animal species—depend on the Great Lakes for drinking water, home or habitat, and overall well-being. The health of humans, wildlife and livestock, and the region’s terrestrial ecosystems are one with the health of the Great Lakes.

The time is right to apply the One Health framework to conservation efforts for the Great Lakes ecosystem. One Health links human, animal and environmental health through interdisciplinary collaborations among physicians, veterinarians, other health practitioners, and professionals in all fields of the environmental sciences. The breadth of interest and expertise represented at the May 20 convening mirrors the multidisciplinary nature of One Health. The 42 participants included researchers, academics, field scientists, aquarium and zoo professionals, conservation leaders, federal, state and local fisheries and wildlife officials, water district officials, veterinarians and medical doctors.

The goals for the daylong session were twofold: Identify the most urgent One Health issues pertinent to the Great Lakes, and brainstorm regional collaborative solutions. Participants enthusiastically tackled both tasks, and their contributions produced a set of next steps that are both comprehensive and creative.

The Great Lakes One Health convening was made possible by funding from the National Oceanic and Atmospheric Administration.

ON ONE HEALTH

Two keynote speakers provided information and inspiration about One Health, its origins, current applications and vast potential.

Roger K. Mahr, DVM

While serving as president of the American Veterinary Medical Association (AVMA), Dr. Mahr, a small-animal practitioner, took action to establish the One Health Initiative Task Force. The One Health Commission was officially established as a nonprofit corporation in 2009. Dr. Mahr currently serves as the CEO of the commission, which is based in the Nutrition and Wellness Research Center at Iowa State University. The goals of the One Health Commission are to inform all audiences about the importance of the One Health approach and to transform the way human, animal, plant and ecosystem health-related disciplines work together.



Citing the oath he took as a newly minted veterinarian “to use my scientific knowledge and skills for the benefit of society,” Dr. Mahr emphasized the need for accredited colleges and schools of health sciences to prepare the next generation of health sciences professionals with interdisciplinary training that bridges human medicine, veterinary medicine, public health and ecosystem health. An interdisciplinary, international collaborative approach will be needed to meet the challenges of a changing environment in the 21st century.

In an ever-more-crowded environment, people and animals are interconnected, in positive and negative ways. Currently 6 billion people depend on 24 billion animals for food and fiber each year. By 2020, the demand for food, especially nourishment derived from fresh water and the ocean, will increase 50 percent over what it was in 2000. Meanwhile, 75 percent of all emerging diseases are zoonotic—infectious diseases that can be transmitted between or are shared by animals and humans. In addition, every human disease can be caused by, modified, or altered by an environmental agent; tuberculosis, West Nile virus and algal blooms are examples. This convergence of animal, human and ecosystem health issues dictates that the One Health concept must be embraced.

The scope of One Health extends to conservation; safe and secure food and water supplies; disease prevention, surveillance and response; clinical medicine; education and training; research; disaster preparedness and response; ethics; public policy; regulation; global trade and commerce; and public awareness and communication.

The One Health approach will engender more interdisciplinary programs, more information sharing, more prevention of diseases and new therapeutic treatments.



Sonia Joseph-Joshi

Sonia Joseph-Joshi, outreach coordinator for the NOAA Center of Excellence for Great Lakes and Human Health, detailed how the National Oceanic and Atmospheric Administration, the U.S. government’s agency for ocean and coastal environmental research, has expanded its scope to include an oceans and human health initiative.

The goal of the initiative is to develop early warning systems to forecast threats and predict long-term risks to human health throughout U.S. coastal and Great Lakes waters. The three research priority issues for the Great Lakes are beach closures, harmful algal blooms and drinking water quality.

As an example, beach closures resonate with the public. A report on water quality at a favorite Chicago beach can make or break a planned family outing. The number of days beaches are closed due to contaminants in the water are increasing. More monitoring is detecting more frequent occurrences of *E. coli* and other bacteria, but the current sampling technology does not provide real-time water-

quality assessments. The water is sampled one day, and the results are posted—and used by beach managers—the next. Seventy percent of the time, the day-old data no longer reflect current shoreline conditions, so that beaches are closed when water quality has recovered, and they are open when incoming contaminants are present. New forecasting methods will increase the accuracy of beach management. Tracking tools under development can identify sources and causes of contamination, leading to remediation. Meteorological and water circulation models are helping to predict where that contamination is headed to allow advanced notices for beach closures.

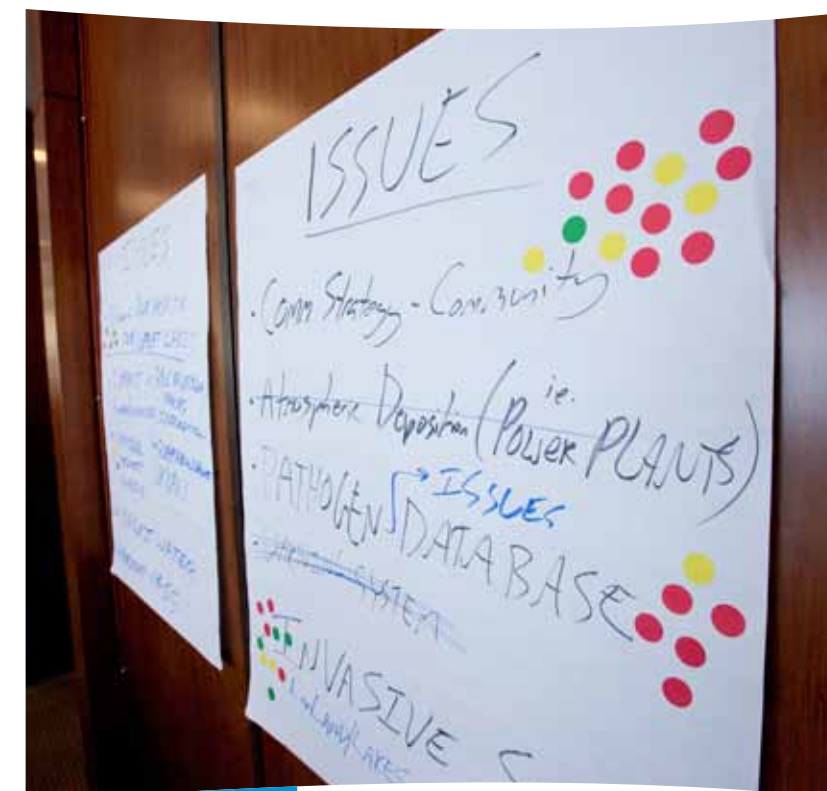
The effects of climate change on the Great Lakes will also affect human health, as water temperature rises, lake levels rise or fall, and extreme hydrological events—floods and droughts—increase. Increased and new vector-borne and water-borne diseases as well as disruptions in clean drinking water and our food supply are tied directly to climate change. NOAA is a resource for long-term climate data. It also has the framework to share its oceans and human health research with other federal agencies to integrate data on animal health, ecosystem health and human health. The pieces are there; they just need to be connected to bring One Health to the Great Lakes.

KEY GREAT LAKES ISSUES

Facilitator Jill Allread of Public Communications Inc. (PCI) led a brainstorming session with attendees to create a list of any and all issues that could relate to One Health for the Great Lakes. Thirty-four topics were identified. (See the appendix at the end of this report for a complete list.) Participants then voted on the issues to narrow the field to five broad topics for further discussion. The clear leaders were:

Communications	20 votes
Education and ecological literacy	19 votes
Stormwater runoff	17 votes
Integration of Great Lakes One Health network and resource databases	15 votes
Biodiversity and adaptability	15 votes

Participants were assigned to one of five breakout groups. Rotating through discussion areas set up around the room, each breakout group took part in a 40-minute facilitated brainstorming session on each key issue. By the end of the afternoon, everyone had contributed on all five topics. Discussions focused on potential solutions (action steps) to address the issue; barriers to addressing the issue; who is working on this issue now and who should be recruited; and what are the next steps to taking action on this issue.



BREAKOUT SESSIONS

COMMUNICATIONS

The intuitive first action step identified by each group was to “know/identify your audience.” Defining and understanding the target audience(s) will drive the communications strategy. “One Health”—a new concept to most people—also must be clearly defined and understood internally so that all communicators are consistent in their message development and delivery. From there, the key messages developed should be specific—not too overarching or abstract—so that audiences can identify with them. Messages should also be limited in number so audiences are not overwhelmed by more environmental “bad news.” Use memorable catch phrases, staying specific and avoiding platitudes. Relate it to human health first, which will resonate with the public.

The two standout barriers to a successful communications campaign are lack of funds and competition for the public’s attention. Allocation of resources for communicating a targeted concept like Great Lakes One Health is a challenge in the current economy, in which funders are looking for the biggest, broadest bang for the buck. At the same time, it is hard to get the attention of audiences living in an information-saturated world. The challenge is that they won’t hear the message, won’t care about it, or won’t believe it.

In addition, the “One Health” concept might be too broad or too complex for some audiences to grasp and relate to in their lives. Without some understanding of basic ecological relationships—“ecological literacy”—people will not appreciate the value of One Health and its benefits to them, their families and their communities, including both human and wildlife habitats. One Health practices need to be relevant to what’s happening in John and Jane Q. Public’s backyard. The concept could also be misrepresented as a politically partisan issue despite its multidisciplinary nature and universal benefits. The fact that One Health does involve so many partners—governmental, nongovernmental, public health, environmental, academic, scientific, etc.—carries the drawback that participating individuals or organizations may not be willing to share information or credit with other partners, due to everything from a sense of ownership of information to egos.

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The group discussed who potentially needs to be involved in the communications process rather than who is already working on it. Participants weighed a top-down approach, which is the most direct and immediate way to issue messages, with a bottom-up approach that involves local communities and is more apt to build buy-in at the grassroots level. Spokespeople, from community leaders to celebrities, can attract attention and imbue credibility. The communications coalition should include the Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Agriculture (USDA),

state natural resources departments, and state and local permitting bodies, along with nongovernmental agencies, universities, veterinarians and such popular and trusted “storytellers” as zoos, aquariums, museums and other educational or outreach institutions. Just as consistent messaging is critical, so too is collaboration among the communicators.

“One Health” is totally different from the ingrained way of thinking about Great Lakes conservation. It is not business as usual.

For One Health communicators, collaboration is also key in planning the next steps, with regional meetings of agencies, conferences and stakeholder meetings to get people into the same room to build on the existing foundation and advancements accomplished at this convening. “One Health” is totally different from the ingrained way of thinking about Great Lakes conservation. It is not business as usual. Everyone involved should support and promote this paradigm shift. Professional communicators (and not scientists alone) should interpret the science content for the public relations/media campaign (one example cited is the successful multigenerational campaign for the U.S. Forest Service’s “Smokey Bear.”) In the process, groom a new generation of communicators who are experts in science *and* communication. And begin to let those already-trusted voices of the museum community tell the story of One Health within the Great Lakes. For the public, One Health must be spelled out using examples of current recognizable problems (for example, beach closings) and how One Health can alleviate or solve them, it must be user-friendly, and it must offer solutions through actions everyone can take.

EDUCATION/ECOLOGICAL LITERACY

Solutions begin with educating the educators. Work One Health into teaching certification or standards. One Health should be integrated into K–12 standards and teaching curricula, possibly spearheaded by the One Health Commission. In higher education, One Health science should be bridged to other disciplines, including the arts, journalism, culinary arts, business, etc. (Business leaders constitute an important subset of the population to educate. Bring them in as stakeholders and, through economic analysis, put a dollar value on One Health.) One Health should be integrated into veterinary, public health and medical schools’ curricula in the first year. Use informal programs, presented by aquariums, zoos, museums and other popular cultural venues, to reach more people. Experiential learning and direct contact with the Great Lakes leads to awareness, then action. It would also be helpful to secure federal grant money to create curricula.

The uphill elements to bringing the new and unfamiliar concepts of One Health to students, teachers and a general public begin with addressing ecological illiteracy. Nature can be an alien subject removed from everyday experience. For many urbanites, it takes time, money and transportation to commune with, or just visit, the great outdoors. An alarming number of Chicago schoolchildren have never seen Lake Michigan. Can anyone be ecologically engaged without the inclination or ability to go outdoors?





The education system also presents barriers because of rigid school standards, an overloaded and under-resourced workforce of teachers and a lack of continuity in science concepts and curriculum between grades (for example, students learn biology in freshman year, physics during junior year, without any bridges between the disciplines). In higher education outside the health professions, One Health may be too specialized, with a lack of job opportunities. And different people need and want different information. One Health must be made relevant and realistic to diverse audiences, which first have to be identified. And, of course, there is the ubiquitous barrier of lack of resources for nature interpretation.

Currently groups supporting One Health include aquariums and zoos (whose informal programs are a direct conduit to the public); Alliance for the Great Lakes; AQUAVET, a program in aquatic veterinary medicine; Centers for Ocean Science Education Excellence (COSEE), which offers experiential learning and website lesson plans; Chicago Wilderness; Envirovet, a One Health leadership training program for veterinarians; Geolibary.org, the global environmental and occupational health online library of training materials; the Lake

Michigan Lakewide Management Plan (LaMP); the Leopold Leadership Program to train scientists to be communicators as well; state Master Naturalist programs; National Science Foundation's biology program; the No Child Left Inside programs; Sea Grant; Shedd Aquarium's Right Bite sustainable seafood initiative; the University of Illinois through its environmental public health program; Waldorf and Montessori schools (potential models for One Health curricula in public schools); and some journalism programs.

Immediate actions and next steps include evaluating the existing science education in schools (are they teaching One Health already?); adding new curriculum to existing programs, which will expedite buy-in; producing tool kits for formal and informal education, distributed by the One Health Commission; working with teaching associations to market the concept but also to better understand their needs; develop a One Health packaged curriculum that is user-friendly and relevant and can be distributed by regional representatives; and create a "living document" in the form of a wiki, or website that can be edited and continually added to by stakeholders. Also educate the decision makers (board of health, politicians, business leaders, and, in schools, the PTA) on the economic and health benefits of One Health. Work with teachers associations to get buy-in on the concept. Finally, One Health representatives should attend graduate and professional school fairs.

STORM-WATER RUNOFF

This issue is complicated by multiple facets. As the discussions progressed, it became apparent that stormwater runoff is part of the broader problem of wasteful water usage. Stormwater runoff is exacerbated by the predominance of impermeable surfaces and by development practices, both of which can alter local hydrology and, actively or by oversight, often channel large volumes of water into sewer systems or cause flooding. Runoff is loaded

with toxic contaminants, including lawn and garden chemicals, animal waste (from pets as well as livestock), personal-care products and medications.

The barriers to addressing this issue are daunting. Outdated zoning laws often prohibit "green" solutions, from residential rain gardens to "smart growth" urban planning that reins in sprawl. Much of the region's existing infrastructure—sewer systems—is approaching or has passed the century mark. In addition to deteriorating, it is overwhelmed by the 21st-century volume of wastewater plus stormwater that it carries.* This is a serious barrier because of the immense costs associated with replacing these massive sewer systems—which is why so many cash-strapped

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cities are limping along with them now. And while the U.S. EPA administers stormwater rules for urban systems, there are minimal regulations, and little administrative capacity, to control agricultural and other rural runoff, which generally falls under the category of nonpoint-source pollution.

Lack of public awareness about the runoff issue is another serious barrier. For the most part, people have no concept of the effect of their daily water use on the supply of their local resource, nor do they know where the water goes once it drains or is flushed. The cumulative effect of a community's "normal" water use during heavy rainstorms—for example, doing laundry—adds to the burden on combined sewer systems and can contribute to flooding or to the need to channel raw sewage out

*Shedd Aquarium's first Great Lakes convening addressed the issue of identifying a comprehensive public alert system for combined sewer overflows. Read the report at www.sheddaquarium.org/pdf/CSO_convening_report.pdf.

of the system and into the environment. The latter happens from time to time in Chicago, when an overload of combined storm- and wastewater must be redirected into Lake Michigan, the metropolitan region's source of drinking water. Many people are also unaware of the unhealthy ingredients in their personal-care and household cleaning products, which are not removed in the water treatment process and contaminate the environment, especially aquatic ecosystems. They would also be surprised to know that pharmaceuticals also are not removed during water treatment but continue downstream, exposing wildlife to antibiotics, estrogen and more. Artificially low water rates promote a disconnect between the cost of clean drinking water and its actual value, which does nothing to curb waste and pollution.

The widespread and often intensive use of petrochemical fertilizers and toxic pesticides and herbicides, in a variety of settings from city backyards to suburban golf courses to megafarms, poses barriers on many levels, beginning with entrenched practices. Similarly, continued installation of conventional hardscapes, including roads, parking lots and other impermeable paved surfaces, creates sluiceways for contaminant-laden runoff and floodwater. The commercial sector—agricultural, pharmaceutical, medical, industrial and the building trades—will continue to pose barriers until they become more accountable for what they produce, how it is handled, how it is used and where it winds up. Some of these barriers are coming down as both communities and companies recognize the practical value of "green" business practices. But the trend is just gaining momentum.

Potential solutions start with product accountability from manufacture to disposal ("cradle to grave") or recycling ("cradle to cradle"). Conversation included a desire for advances in ecologically sound options as well as increased and uniform enforcement of existing regulations on the agricultural, pharmaceutical, medical and chemical communities.

Fertilizers must be phosphorus-free. Another tactic is creating incentives to reduce runoff through the use of rain barrels, semipermeable pavement, large-scale plantings and other water-retaining or absorbing methods. Other solutions included wetland restoration or re-creation to absorb runoff and filter water. As aging infrastructure is replaced, create green water-management systems that incorporate or mimic elements of natural water flow. Low-impact development and an overall move toward smart growth, which concentrates residential and commercial districts into walkable urban centers, will reduce sprawl and the need to drive everywhere. Again, the impetus for change must come from an informed and invested public. Part of the One Health paradigm shift must include creating a mindset of stormwater as a resource. Runoff retained is water that's still available to use.

The current lack of consensus on key indicators of Great Lakes ecosystem health is a headache for database building.

Headway is already being made by federal agencies, including the Army Corps of Engineers, EPA, the Federal Emergency Management Agency, NOAA and USDA; municipal sanitary/water reclamation districts; and conservation organizations such as the Northeast Wisconsin Stormwater Coalition and H2O Hero. Partners to be recruited include the U.S. Department of Transportation, the Food and Drug Administration, the construction industry, realtors, municipalities (to enact stormwater regulation) and facilities such as parks and golf courses. The collaboration of the agricultural industry is especially important; it needs to be proactive.

Next steps to take include: revamp the funding structure of water districts so that it is based on actual usage and not some percentage of property taxes; raise public awareness about where water

goes, then provide everyday opportunities to conserve water on the household level; address zoning; promote rain gardens, native plantings and xeriscaping for homes, corporate campuses, parks and green spaces around government buildings to conserve water and recycle runoff; stabilize streambanks; provide incentives for rainwater management and initiate legislation to allow rainwater harvesting.

INTEGRATION OF GREAT LAKES ONE HEALTH NETWORK AND RESOURCE DATABASES

All five groups agreed that this is one of the most challenging issues, given the plethora of databases but the lack of clear, consistent metadata. Identifying barriers seemed to be the place to start the discussion on this daunting, time-consuming, strategically challenging and costly undertaking. In addition to the sheer volume of data, much of it "siloes" or managed by agencies outside of One Health, there is resistance among many agencies and academic institutions to share data. Funding is another obstacle: Most grants are for specific fields, so it would be difficult to get funding for something as holistic, not to mention interdisciplinary, as One Health. The current lack of consensus on key indicators of Great Lakes ecosystem health is a headache for database building. Other questions and concerns included who would be in charge of efforts, strategic planning, etc.; what database resources are already out there and who is working on them; the possibility that privacy regulations would prevent sharing human health data; nonexistent higher education connections; the possibility of having to manage others' databases; and compatibility of computer systems.

The first solution is to recruit leadership on a higher level, such as NOAA or one of the Great Lakes agencies, to provide organization, resources and experience. This could also be done by a Great Lakes chapter set up by the One Health Commission. From

there, form a working group to create conferences leading to an annual conference on One Health issues. A natural tie-in would be with the EPA/Great Lakes and Environment Canada's SOLEC (State of the Lakes Ecosystem Conferences) program, which views the Great Lakes ecosystem in terms of the state or "health" of the living system and its physical, chemical and biological components, including people. The human and animal health professions should be integrated into the SOLEC process. Develop electronic publications, always including the key words "One Health." Develop a One Health clearinghouse website that links to who is working on what. Or, the One Health Commission website could serve as the web-based communication platform. Create an electronic mailing list with a weekly or monthly digest by region. Develop a peer-reviewed One Health journal. In addition, encourage journals in a variety of fields to have One Health-themed special issues. Raw data needs to be synthesized. Data should be vetted by both scientific and information technology staffs. Local human health agencies are a source for disease reports that could be overlaid with data on wildlife pathogens and disease outbreaks. Other information to include would be toxic waste releases and storage in coastal areas as well as reports on fish kills. A project for a graduate student, with grant support, would be to sort through historical data; specifically, this would be a multiyear project, with three years allotted for each topic and 100 hours a year to maintain. Retirees and volunteers could also be excellent assistants in database projects. Geographic references must be included in databases to allow the development of maps.

All regional One Health organizations need to be involved, with incentives for working together. Existing or potential partners with important databases include the Association of Poison Control Centers (algae data); Birdlife International (avian diseases); Centers for Disease Control (morbidity and mortality data, state-by-state environment-

borne diseases); Environmental Defense Fund; EPA (watershed data), fishhabitat.org (the only fish habitat database on a national scale); Great Lakes Beach Association; Great Lakes Commission; Great Lakes Environmental Indicators Project; Great Lakes Fishery Commission (diseases); Great Lakes Observing System (GLOS) (real-time and historic data on the hydrology, biology, chemistry, geology and cultural resources of the Great Lakes); Great Lakes Regional Research Information Network (inventories GL research); International Joint Commission; International Union for the Conservation of Nature (IUCN); Lake Michigan Monitoring and Coordinating Council; National Health and Nutrition Survey (toxin monitoring); National Water Quality Council; National Wildlife Health Center (incomplete data, but a good tool with good procedures); NOAA; Sea Grants using geographic information systems (GIS); SOLEC; University of California/Berkeley (demographic database can query data); USDA; USFWS (economic data on recreational fisheries); U.S. Geological Survey; state databases and university-based centers of excellence. The need also exists to find nonpublic databases, obtain appropriate metadata and create metamodels for software systems that mine data not in public databases.



Next steps: Conduct a database gap analysis to see what databases are missing. Enlist a coordinating organization, perhaps from one of the state coastal programs or other Great Lakes organizations with substantial database experience, to lead integration efforts. (Chicago Wilderness was cited as an example of an organization that can network and create personal relationships). An appropriate list of Great Lakes health indicators needs to be determined and standardized state by state so groups can work together. Tie grant applications to these indicators. Look at data from SOLEC. Look at recommendations of the Great Lakes Regional Collaboration's 2005 Strategy to Restore and Protect the Great Lakes. Look at the Great Lakes Restoration Initiative's funding aggregation efforts. Develop opportunities for multidisciplinary grants that address One Health needs.

BIODIVERSITY AND ADAPTABILITY

Biodiversity is a broad and, to many people, ambiguous term. Within the groups, people associated biodiversity with competition between native and non-native or invasive species and how that affects the health of an ecosystem. But each group emphasized the need to clearly define both biodiversity and adaptability to ensure that everyone within the One Health initiative starts out with an understanding of how healthy ecosystems function so that they can better understand, and to a greater or lesser degree correct, what happens in compromised ecosystems.



Also crucial is the need to establish goals among stakeholders: What constitutes “good” biodiversity, in the lakes and throughout the watershed? Participants grappled with that question from three angles: research-based, value-based and system-based. Research-based solutions called for collecting data to understand historical biodiversity, what has been lost, what is currently present and, by understanding ecosystem variation, predict what can happen to biodiversity in the future.

Value-based solutions were fewer, but some group members acknowledged that trade-offs would be inevitable, as the hefty costs of some projects would have to be weighed against the benefits. This is where it is necessary to bring business and industry to the table. Of major consideration, although they are not always apparent or understood, are the “ecosystem services” a healthy, diverse environment provides to the surrounding human community. For example, much-maligned wetlands provide the valuable service of flood control and water filtration; preserving a diverse, functioning wetland can save millions of dollars in property damage.

System-based solutions raised thorny questions. Suggestions included looking at species in terms of their function, not just their origin. A non-native species might be just as desirable as a native species if it plays the same ecological role, or it might be even more desirable if it has the added benefit of being more appealing to anglers (which many non-native game fishes are). The introduction of a non-native species is often a Pandora's box: The initial benefits, in this case to outdoor recreation, could be subverted by widespread ecological damage. Whatever the goal, the criteria should be sustainability with minimal human input and functionality in regard to human-valued features.

The final question was about resiliency. What is it, at the species level and ecosystem level? What impacts resiliency, what levels of stressors are too

great, and what adaptations are needed for a species or habitat to be resilient?

Once One Health stakeholders are on the same page on what level of biodiversity they are going to work/live with, they can address habitat restoration, which also requires goals for each habitat type. Impaired ecosystems need to be analyzed and good restoration models developed. Restoration projects need to be prioritized: Urban habitats need more examination, and migratory corridors, including both flyway habitats for birds and significant tracts of contiguous habitat for terrestrial animals, are disappearing fast. Invasives need to be controlled and minimized, through regulation and carefully considered biotic methods.

By nature, ecosystems are not static, and we should not be surprised when they change, either for better or for worse as we perceive it. We have, however, lost critical components, and the challenge is to decide how to move forward. It's impractical, even impossible, to restore significant portions of the Great Lakes region's original prairies, savannas, woodlands, wetlands, dunes and waters to a loosely defined presettlement condition. The Great Lakes themselves have been irreversibly altered by overfishing and the intentional or accidental introduction of non-native species. The question is, what level of loss is tolerable?

Lack of knowledge among the public may be the next biggest hurdle: Many people don't know—or care—what factors made the historical condition better than the current condition. Meanwhile, our native ecosystems continue to face onslaughts from invasive species, both established and incoming, which outcompete natives and degrade habitat, effectively preventing reintroductions. Negative human impacts, from nonpoint-source pollution to stocking non-native sport fisheries, have yet to abate. Maintaining or restoring healthy biodiversity goes back to what is going to be included and excluded in that picture of ecosystem health.

Even moderate restorations can become contentious when opinions differ on what is the “right” historical state to have as a goal. Conflicting interests, scientific complexity, unpredictable conditions and, not least of all, strongly stated public preference will influence the biological decisions. So will funding. Participants noted that both restoration to reverse ecosystem damage and regulations to mitigate future damage through tighter controls would involve large investment, necessitating grants and public monies. And identifying compelling funding opportunities is somewhat more challenging because the Great Lakes region is not associated in the public mind with any charismatic fauna on a par with pandas and sea turtles, despite it still being home to many intriguing taxa. But it was acknowledged that finding funding will always be challenging in times of limited resources.

The biggest barrier is dealing with what has already been lost... The question is, what level of loss is tolerable?

Currently working on Great Lakes biodiversity issues are the Army Corps of Engineers, EPA, Great Lakes Restoration Initiative, NOAA, U.S. Department of Agriculture and its Animal and Plant Health Inspection Service, U.S. Geological Survey, state natural resource agencies, NGOs including existing One Health agencies, the Brookings Institute, Chicago Wilderness, Ducks Unlimited, Great Lakes Fisheries Commission, Health Care Without Harm, National Wildlife Federation, the Nature Conservancy, Practice Green Health, Union of Concerned Scientists, USFWS, the U.S. Green Building Council and World Wildlife Fund, as well as academia from kindergarten through college and citizen-science groups such as those conducting “BioBlitzes” (which could inform the selection of an iconic Great Lakes charismatic species.)

New partners should include the medical and veterinary communities, municipal public works departments, public health agencies including the Center for Disease Control, urban and land-use planners, business interests, agriculture representatives and the public, especially targeting recreational fishermen, boaters and beachgoers, who could become the grassroots front line for ecosystem health. Reiterating what was called for in the communications focus group, there's a need to put a friendly face on Great Lakes resources issues.

Next steps include expanding baseline data on how ecosystems function; understanding natural variation; developing species composition goals for the watershed; identifying risks (invasive species; chemical contaminants; emerging pathogens; genetically modified organisms [GMOs]) and mitigation opportunities; and publicizing results, good or bad, as they happen. Develop targeted public education programs, and ensure and increase resources for public outreach. An economic analysis of Great Lakes resources is also needed.

CONCLUSIONS

The convening was set in Shedd Aquarium's President's Conference Room, which boasts two walls of windows that provide panoramic vistas of the Chicago skyline and Lake Michigan. Halfway through the day, a dense fog settled on the lakefront, obscuring all views. Facilitator Jill Allread observed, "Lake Michigan has disappeared, which we hope won't really happen."

"Great Lakes" means more than the five beautiful connected bodies of water; it's also the surrounding region that relies on what is the world's largest freshwater system. That region doesn't stop at the shoreline. It includes Chicago, Cleveland, Detroit, Toronto and other coastal population centers, and it reaches inland to the origins of the watersheds that feed into the lakes. "Great Lakes" is the sum of its waters, wildlife, people, ecosystems, farms and municipalities large and small. As the keynote speakers illustrated, many of the problems of each component—as well as the solutions—extend to and interconnect with the other components so penetratingly that it is not only strategic but imperative to consider them in the context of the interdisciplinary One Health initiative.

One Health, in concept and practice, poses an across-the-board paradigm shift in the way we think about our relationship with our environment, our water supply, and the plant and animal communities living around us—and how our well-being and that of all those other components is interdependent. One Health expands the concept of holistic wellness to encompass the health of wildlife and the wholeness of the ecosystems we live in, and it draws on the creative collaboration of doctors, veterinarians, biologists, conservationists, educators and practitioners in myriad other disciplines. To effect widespread change, other partners should include policymakers, economists, businesspeople and politicians.

The goals of this convening—to identify the most urgent issues pertinent to the systemwide health of the Great Lakes and to brainstorm regional collaborative solutions—were enthusiastically tackled by the participants, who represented a broad swath of environmental professions as well as human and animal medicine.

Of the many next steps identified, finding leaders, coordinators and communicators is at the top of the list. At future workshops and conferences, the goals of Great Lakes One Health and the language that is used to talk about One Health need to be defined. Members of the growing One Health network must be equipped with consistent language and messages that can be communicated to and grasped by various targeted audiences. Two key issues, communication and education, work hand in hand, and a third, integrating One Health and other databases, supports those functions. By locating, surveying, organizing and linking what resources are already available, researchers can determine what additional data are needed and even partner with appropriate facilities to move forward without redundancy and within limited budgets. Certainly more research is needed in the areas of biodiversity, one of the unarguable indicators of One Health, and stormwater runoff, an issue that impacts public health and safety, wildlife and both terrestrial and aquatic environments in rural and urban areas. While much still has to be defined, one thing is certain: One Health is a big table, with room for many disciplines, specialties, skills and talents. Those participating in the convening are the nucleus of a Great Lakes One Health coalition, and they are invited to stay engaged and involved.



PARTICIPATING ORGANIZATIONS

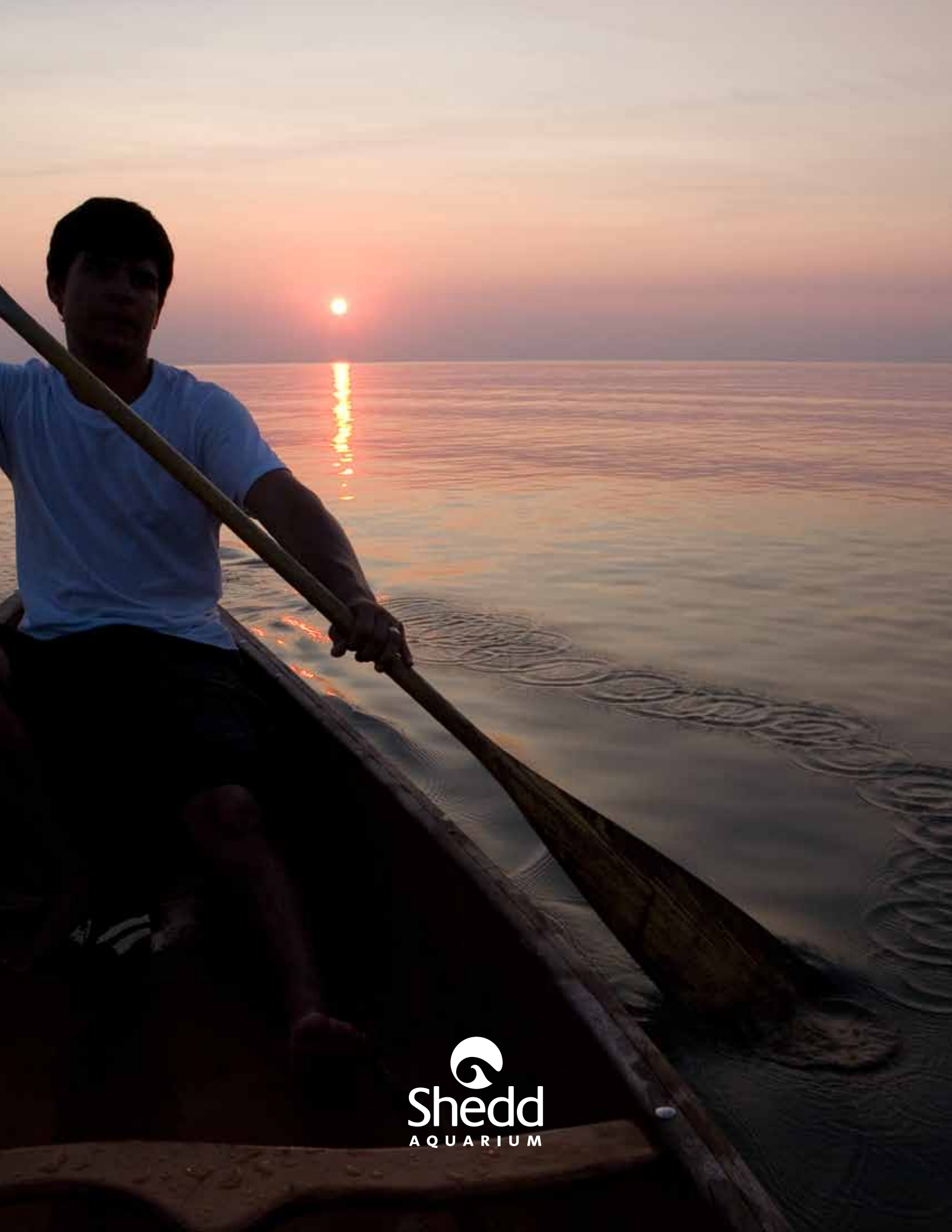
- > American Veterinary Medical Association, Schaumburg, IL
- > Brookfield Zoo, Brookfield, IL
- > Chicago Botanic Garden, Glencoe, IL
- > Chicago Metropolitan Agency for Planning, Chicago, IL
- > Environmental Consulting & Technology, Inc., Chicago, IL
- > Great Lakes and St. Lawrence Cities Initiative, Chicago, IL
- > Great Lakes Commission, Ann Arbor, MI
- > Illinois Department of Natural Resources, Chicago, IL
- > Illinois-Indiana Sea Grant, Great Lakes National Program Office, Chicago, IL
- > Lincoln Park Zoo, Chicago, IL
- > Maryland Department of Natural Resources, Oxford, MD
- > Metropolitan Water Reclamation District of Greater Chicago
- > Michigan Department of Natural Resources, Fisheries Division, Lansing, MI
- > Michigan State University, Lansing, MI
- > Museum of Science and Industry, Center for the Advancement of Science Education, Chicago, IL
- > National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Southeast Region, Key West, FL
- > National Wildlife Federation, Ann Arbor, MI
- > Northwestern University, Evanston, IL
- > One Health Commission, Iowa State University, Ames, IA
- > Public Communications, Inc., Chicago, IL
- > Rhode Island School of Design, Providence, RI
- > Sea Grant Michigan Center of Excellence for Great Lakes and Human Health, Ann Arbor, MI
- > Seneca Park Zoo, Rochester, NY
- > Shedd Aquarium, Chicago, IL
- > University of Florida, Ruskin, FL
- > University of Illinois at Chicago
- > University of Illinois at Chicago Great Lakes Centers for Occupational and Environmental Safety and Health
- > University of Illinois at Urbana-Champaign College of Veterinary Medicine
- > University of Minnesota, Duluth
- > University of Notre Dame, Center for Aquatic Conservation, Notre Dame, IN
- > University of Rochester Medical Center, Rochester, NY
- > University of Wisconsin Sea Grant Institute, Green Bay, WI
- > U.S. Department of the Interior, U.S. Geological Survey, Madison, WI
- > Westlake Hospital, Melrose Park, IL
- > Wisconsin Department of Agriculture, Trade and Consumer Protection, Madison, WI

APPENDIX

URGENT HEALTH ISSUES PERTAINING TO THE GREAT LAKES

This is a complete list of health issues identified by participants during the whole-group brainstorming session.

- > Building on the priorities of the One Health Commission, develop communication strategies to target lay and health-sciences community
- > Stormwater runoff control; agricultural runoff (chemicals, nutrients, herbicides); urban runoff (pharmaceuticals and personal-care products in wastewater)
- > Lack of an organized, valid surveillance system to collect data on fish and wildlife pathogens
- > Lack of an early warning system to identify new pathogens
- > The role of climate change in affecting the synergy of elevated aquatic temperatures on microbes in polluted water; also the role of elevated aquatic temperatures on increasing secondary diseases in aquatic life
- > A comprehensive definition of One Health that encompasses all species—human, wildlife, livestock—and the environment
- > Communication and reaching all One Health stakeholders
- > Invasive species, on land and in the lakes, positioning humans as one of the most invasive
- > Algal blooms increasing due to invasives, but urbanization and climate change also carry additional nutrient and sediment loading to lakes; more coordinating among groups in developing protocols on how to deal with harmful algal blooms
- > What is the expected outcome, a list of issues that will overwhelm us or a vision for the Great Lakes using the One Health approach?
- > Impact of human-wildlife interactions and the degree to which these ecosystems support both high human populations and overconcentration of adaptive wildlife populations
- > Lack of suitable habitat for more diverse species
- > Strategic priority analysis
- > Ballast water
- > Pathogens, toxins introduced by invasive species
- > Persistent organic pollutants
- > Wildlife disease; threatening endangered species
- > Education: Teach kids about the Great Lakes; industry, consumers also need to be educated; overall problem of ecological illiteracy
- > Water quality
- > Funding priorities
- > Disconnect between cheap price of water, high cost of providing safe drinking water; cost vs. value
- > Sustainable development
- > Integrate Great Lakes One Health network and existing resources, databases
- > Funding priorities
- > Air quality and atmospheric deposition of metals and other contaminants by power plants and other emission sources
- > Make science understandable
- > Mystery die-offs in the Great Lakes
- > Freshwater fish food safety
- > Future Great Lakes water extraction and transport to other areas of the country: water quantity as important as water quality
- > Political pressure all around on Great Lakes issues
- > Effect on economics
- > Social and environmental justice; account for the diversity that is society in Great Lakes
- > Make healthcare greener; physician buy-in
- > Biodiversity and adaptability: How does the ecosystem natural readjust to stress?




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