Climate Change in the Great Lakes: Advancing the Regional Discussion

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Lake Superior shoreline in Duluth. *Photo by Kari Lydersen.*

Authors: **Julie Hinderer**, **Celia Haven** and **Melinda Koslow**
Editors: **Victoria Pebbles**, **Heather Stricker**, **George Kuper** and **Evelyn Strader**

CGLI Council of GREAT LAKES INDUSTRIES
Great Lakes Commission des Grands Lacs
NATIONAL WILDLIFE FEDERATION

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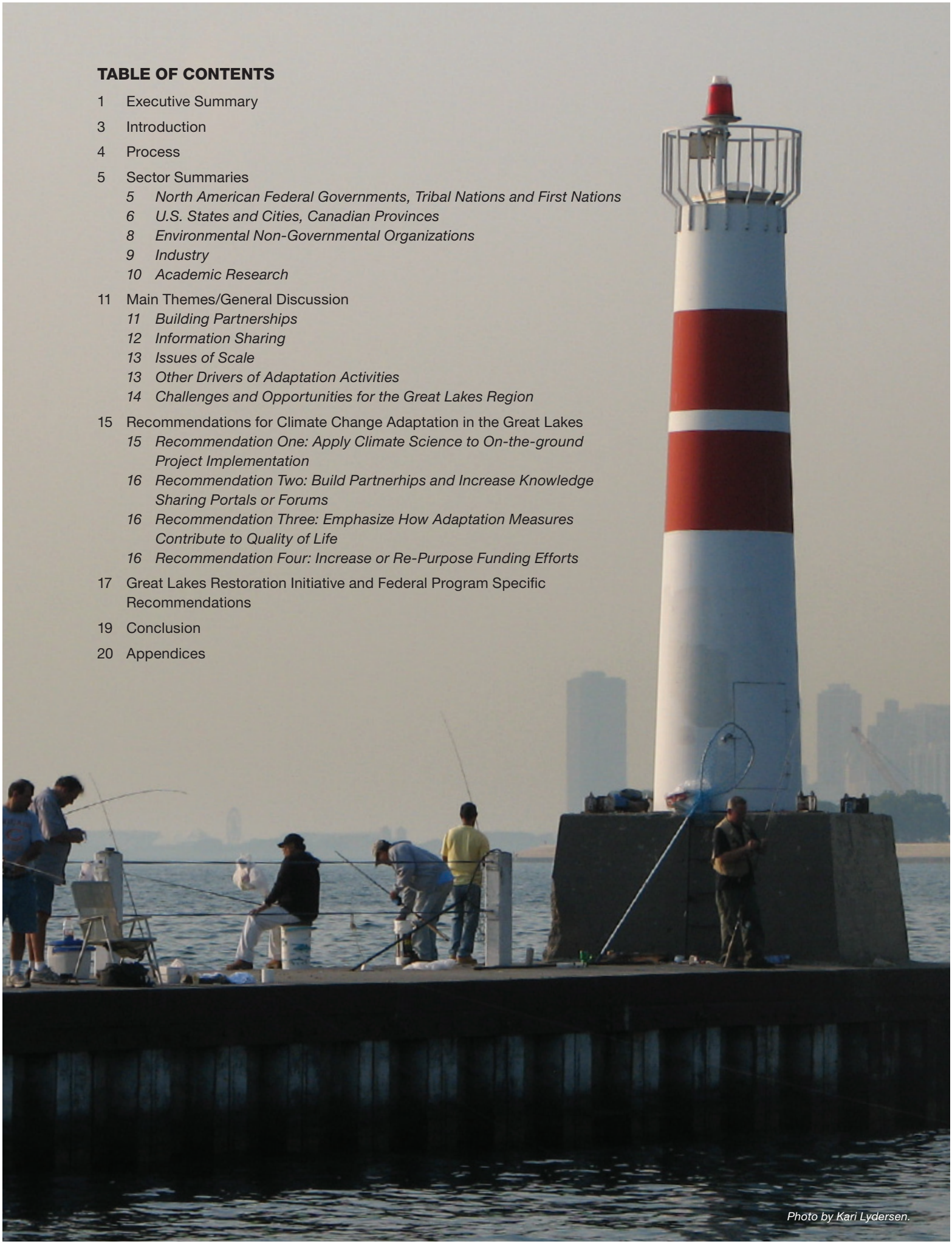

Photo by Kari Lydersen.

Executive Summary

The Great Lakes region is currently experiencing warmer air and water temperatures, decreases of lake ice, longer onset of lake stratification, changes to migration patterns of wildlife, more variable water levels, decreases in soil quality, longer growing seasons and extreme precipitation. Scientists associate these trends with climate change and predict that the trends and their associated impacts may intensify over time. Climate change adaptation provides an opportunity to build resiliency in anticipation of new and accelerated trends and impacts as a result of mounting greenhouse gases in the Earth's atmosphere. Stakeholders throughout the Great Lakes are beginning to plan for and implement adaptation measures that will help prepare for and diminish these impacts.

Photo courtesy of NOAA.

On September 22, 2010 over sixty stakeholders from throughout the Great Lakes region came together in Buffalo, New York to discuss ways to advance the human response to anticipated climate change impacts through climate change adaptation. The workshop was titled *Climate Change in the Great Lakes: Advancing the Regional Discussion*. Stakeholders in attendance represented states and cities, federal agencies, Canada, the International Joint Commission, industry, environmental non-governmental organizations, First Nations, tribal nations and academic institutions. Workshop organizers included National Wildlife Federation, Great Lakes Commission and the Council of Great Lakes Industries. The U.S. National Oceanic and Atmospheric Administration and the U.S. Environmental Protection Agency also helped to shape the day-long program.

The goals of the workshop were to provide guidance from various Great Lakes sectors on how to integrate climate change adaptation into actions of United States federal agencies, share information about climate change adaptation efforts, and enhance collaboration among participating sectors. Some workshop findings aim to inform Great Lakes Restoration Initiative and other federal funding decisions, region-wide practices and strategies and on-the-ground projects.

Workshop discussions were built on the following themes:

- General ways that various sectors have or will be adapting to climate change.
- Climate change adaptation actions that have and have not worked.
- Climate change adaptation actions specific to the Great Lakes region.
- Needs for effective climate change adaptation in the Great Lakes region.
- Ways that ecological restoration efforts as part of the Great Lakes Restoration Initiative or other federal funding programs can be improved to integrate current and future climate change impacts.

The majority of the workshop consisted of small group breakout discussions which were used to help participants focusing on adaptation efforts and needs in individual sectors. This report examines sector-by-sector summaries on adaptation, main themes of discussion, regional multi-stakeholder recommendations and recommendations to federal programs such as the Great

Lakes Restoration Initiative in light of climate change impacts. Full proceedings are available upon request.

Although some recommendations were sector-specific, several overarching, multi-sector recommendations for the Great Lakes region emerged from the discussions. These include:

- Apply climate science to on-the-ground actions such as wildlife management, coastal or habitat restoration, industrial actions, resource management, climate mitigation plans, infrastructure, urban planning and others.
  - *For example, update management decisions using the most recent scientific findings. A partnership between academic researchers and resource managers is one measure that will aid this activity.*
- Build cross-sector partnerships and increase knowledge-sharing portals and forums.
  - *For example, utilize handheld technology when doing on-the-ground work such as, but not limited to: online chat systems, smart phone or laptop applications and data portals.*
- Emphasize quality of life benefits of climate change adaptation.
  - *For example, support and share studies that attempt to quantify economic, social or related quality of life benefits from adaptation efforts.*
- Provide economic incentives and information, increase or re-purpose funding efforts to include climate change.
  - *For example, implement economic incentives such as tax incentives or funding support for adaptation in industries and private sectors.*

Overarching recommendations specific to federal programs such as the Great Lakes Restoration Initiative include:

- Integrate climate variability and change into upcoming requests for proposals.
  - *For example, require grant recipients to demonstrate how a restorations project will also aid in climate change adaptation.*
- Streamline collaboration and knowledge sharing throughout the entire life-cycle of the grant.
  - *For example, encourage partnerships by allowing the submission of joint proposals.*
- Emphasize cross-cutting efforts and goals across focus areas.
  - *For example, prioritize projects that will result in multiple benefits over multiple focus areas, e.g. combats invasive species and restores coastal habitat.*
- Include climate change adaptation for cities to enhance sustainable development.
  - *For example, fund green infrastructure urban restoration projects in the form of rain gardens, green alleys or green roofs to help urban areas adapt.*
- Act both short-term and long-term.
  - *For example, fund projects aimed directly at near term ecosystem improvements, but include funding for long-term monitoring to ensure a baseline of information about actual ecosystem improvements or other trends.*

The Great Lakes region shares an important freshwater resource over national boundaries and varied interests. It has a long history of regional coordination and collaboration among diverse sectors and stakeholder interests. In the face of climate change, however, we will need to strengthen the way we work together. We must also work to integrate applicable science findings into our everyday decision-making. Climate change adaptation is an opportunity not only to reduce the impacts of a threat, but also to capitalize on more efficient ways to protect and sustain this valued resource.

Introduction

On September 22, 2010 over sixty stakeholders from throughout the Great Lakes region came together in Buffalo, New York to discuss ways for the region to put climate change adaptation into action. The workshop was titled *Climate Change in the Great Lakes: Advancing the Regional Discussion*. Stakeholders in attendance represented states and cities, federal agencies, Canada, the International Joint Commission, industry, environmental non-governmental organizations, First Nations, tribal nations and academic institutions. All of the participants consider climate change adaptation an important step toward protecting the Great Lakes and its resources.

Climate change adaptation is defined as efforts to prepare for or cope with the impacts of climate change. Impacts in the Great Lakes region include, but are not limited to, decreased lake ice, increased evaporation, warmer water and air temperatures, variable water levels, extreme precipitation/storms (snow and rain), northerly migration of some wildlife species, longer growing season, and earlier onset of lake stratification.

The goals of the workshop were to provide guidance from various Great Lakes sectors on how to integrate climate change adaptation into actions of United States federal agencies and other entities while learning from each other, building collaborations essential for adaptation. Findings will also inform Great Lakes Restoration Initiative funding decisions, region-wide practices, strategies and on-the-ground projects.

Opening remarks were moderated by Tim Eder, Director of the Great Lakes Commission. Speakers and titles of remarks were as follows:

- John Haugland of the U.S. Environmental Protection Agency: *Adaptation and the Great Lakes Restoration Initiative: Why it's Important*
- Doug Kluck of the U.S. National Oceanic and Atmospheric Administration: *The NOAA Climate Service and Great Lakes Regional Engagement*
- Andy Buchsbaum of the Great Lakes Regional Center, National Wildlife Federation: *Climate Change Adaptation: Roles of Non-Federal Entities*
- Mayor George Heartwell of Grand Rapids, Michigan: *Climate Adaptation of Great Lakes Cities: A Look at Grand Rapids, Michigan*

Buffalo, New York. *Photo by Paul Drajem.*

Process

Workshop organizers employed a breakout group format with rotating facilitators to maximize group discussion. Through this method each of the mixed participant workgroups stayed together throughout the day, beginning with a small group briefing and then followed by discussion. Each hour had a different sectoral focus. Unlike traditional breakouts where the participants move, the participants remained as a group throughout the day, while the sector leaders and facilitators rotated among each group. Importantly, this format fostered knowledge building — because the group stayed together, they could build on discussions and observations made during previous breakouts and carry those into subsequent breakout discussions.

The breakout sessions were designed to prompt discussions that identify new approaches, share ways to overcome challenges and otherwise facilitate climate change adaptation strategies within and among the following sectors:

- United States & Canadian Federal/Tribal
- State/Municipal/Provincial
- Industry
- Environmental Non-Governmental Organization
- Academic Research

Participants were organized into five work groups labeled A, B, C, D, and E. The workgroups were a mix of backgrounds and types of organizations. Sector representatives spent the round with each work group briefing on the sector's adaptation approaches and challenges, including examples. A discussion leader formed a team with the sector representatives and facilitated each work group discussion. Work group leaders helped the group process flow smoothly. At the end of the round, the sector representatives and discussion leader rotated to the next work group and presented the sector's climate adaptation experience (as with the previous workgroup) and then launched into the round's identified discussion questions.

DEFINITIONS OF GROUP ROLES

SECTOR REPRESENTATIVES – Acts as a resource, presenting to each work group sector-specific adaptation actions. These representatives move hourly from group to group with a dedicated discussion leader.

DISCUSSION LEADER – Acts as a facilitator to ensure a smooth, productive and collaborative discussion. Discussion leader moves hourly from group to group alongside dedicated sector representative(s).

GROUP LEADER – Acts as a moderator for the group and summarizes the questions from the group. Group leaders stay with the same work group for the entire day.

The workshop participants and discussion leaders were provided questions upon which to focus for each round. Guidance questions for workshop discussions were built from these themes:

- General ways that various sectors have been or will be adapting to climate change.
- Climate change adaptation actions that have or have not worked.
- Climate change adaptation actions specific to the Great Lakes region.
- Needs for effective climate change adaptation in the Great Lakes region.
- Ways that ecological restoration efforts as part of the Great Lakes Restoration Initiative can be improved to integrate current and future climate change impacts.

A summary session towards the end of the workshop allowed participants to learn what others had said, recurring themes and general recommendations. This session was moderated by Melinda Koslow, Regional Campaign Manager for Great Lakes Climate Change Adaptation of National Wildlife Federation.

The summary panel included:

- Andy Buchsbaum – Director, Great Lakes Regional Center of National Wildlife Federation
- John Nordgren – Program Director, Kresge Foundation
- George Kuper – President and CEO, Council of Great Lakes Industries
- Victoria Pebbles – Program Director, Great Lakes Commission

Sector Summaries

Joe Hoagland, left, pushes a canoe through a wild rice bed in White Earth, Minn., on Aug. 30, 2006, as 14-year-old Chris Salazar learns how to harvest the rice by knocking the grain off the stalks with two sticks. The rice harvest was part of a week-long camp to re-connect young people with their American Indian culture. *AP Photo/Jim Mone.*

NORTH AMERICAN FEDERAL GOVERNMENTS, TRIBAL NATIONS AND FIRST NATIONS

While tribal and First Nations peoples have adapted to changes in their environment for millennia, the rapid changes caused by climate change combined with the inability to move across the landscape as they did historically threaten their way of life. Tribes have traditionally been very "place-based", with their culture and way of life dependant on the resources they are able to collect and use across the landscape. The current reservation system, however, limits the land area upon which tribal people can move to adapt. When species disappear from their land, whether due to habitat loss or shifting ranges caused by climate shifts, tribal nations and First Nations find it increasingly difficult to hunt and fish. Warming temperatures also contribute to reductions of other staples such as wild rice crop in areas of the northern Great Lakes.

The need to adapt to climate change is increasingly evident, and some tribal nations and First Nations governments may take action sooner rather than later. It is important to mention that the manner in which these governments decide to adapt to climate change will vary as they are sovereign nations with their own priorities and decision-making steps. Some tribal or First Nation governments may look to United States or Canadian governments for assistance, while others may try to adapt in a more traditional sense. Some may try a combination of both governmental assistance and traditional knowledge.

Some tribes feel, however, that the amount of U.S. federal grant money that is allotted for tribal conservation work is too small. Often times the tribes with the largest land holdings are first to receive these funds which put smaller tribes with less land at a greater risk. This is very troublesome for many native peoples, as these resources are the very basis for their sustenance, traditional stories, totem animals, culture, religion, and identity.

> ***"Future collaborations and discussions regarding climate change adaptation should strive to provide a 'seat at the table' for Tribes to share their experiences and challenges in facing climate change. This should also be true of forums regarding policy decisions, funding, and multi-agency partnerships, and efforts should be made to ensure that tribal interests and sovereign rights be taken into account." – Heather Stricker, Forest County Potawatomi Community***

United States and Canadian federal governments face their own challenges in adapting to climate change and climate variability[1]. For instance, no specific United States department or agency has a clear leading role on climate adaptation, and oftentimes the result is fragmented policies and actions. In addition, climate change is a politically charged issue, and, unlike other environmental issues where the cause and effect is more straightforward, complexities of climate change science make it difficult to grasp. Some lawmakers may feel climate change is important but do not deem it an immediate threat. While some lawmakers challenge the validity of or misinterpret climate science. One result of political misinterpretation of climate science is that large winter snowstorms or cold air temperatures are often presented to the public as 'scientific' reason against longer-term warming temperatures, or climate change. The result is that it can prove quite difficult to garner public and political support for policies related to climate change.

Policies on climate change adaptation have the potential to be less politically charged since they help protect the public. Adaptation policies can be a bridge over partisanship barriers since they help reduce future costs, protect health and update outdated infrastructure. There are two main political issues related to adaptation policy itself that we should be aware of: (1) Some believe we can simply "adapt our way out of climate change" and therefore do away with any policy to reduce greenhouse gas emissions and (2) Some believe adaptation policy is important but still consider it less urgent or low on the priority list for funding or support.

Deficiencies of information and uncertainty surrounding climate models may also hinder adaptation actions at the government level. Federal agencies recognize this issue and work with scientists and planners to reduce uncertainty and aid decision-making. For example, the National Oceanographic and Atmospheric Administration (NOAA) has a technical role in informing decision-making and hopes to work with local and regional partners on building climate awareness, creating effective climate action plans, and identifying tools readily available to decision makers. A National Climate Service hosted by NOAA intends to synthesize and make available climate information for the general public.

"NOAA is committed to helping governments, businesses, and communities manage climate risks, adapt to changing conditions, and reduce the threat of climate change in the Great Lakes." – Heather Stirratt, NOAA

For Canadian adaptation, Environment Canada has a dedicated climate change adaptation and impact research group. This group researches impacts to improve understanding of the sensitivities of sectors, regions, people and property to a changing climate in order to help develop appropriate adaptation actions. The Canadian government releases adaptation plans or recommendations related to these findings.

More detailed information such as downscaled climate models, ecosystem and infrastructural function assessments will guide plans and actions at the landscape and regional scales. In cases where detailed prediction information is not available, it is still possible to plan and act for climate change by employing a risk assessment and/or adaptive management strategies.

To develop effective adaptation solutions, workshop participants emphasized the importance of North American federal and tribal governments working collaboratively. It is particularly critical that federal agencies increase coordination with tribal nations and First Nations for a few reasons;

- Tribal nations and First Nations have a wealth of natural resource knowledge and have a deep understanding of historical climatology.
- Coordination between governments and nations will aid knowledge sharing on what's worked and what has not — a key piece of effective climate adaptation.
- Collaboration will help make needs of tribal and First nations transparent so federal and provincial governments can properly assist them with obtaining funding and other support for adaptation work.

U.S. STATES AND CITIES, CANADIAN PROVINCES

Much climate adaptation work is taking place at the state, provincial and local levels of government. Climate Action Plans (CAPs) recommend policies in diverse areas such as water conservation, ecosystem research and monitoring, and community health, and are the most common mechanisms in the region for addressing climate adaptation at the state, provincial, and municipal levels. As of this report, eight of the 10 Great Lakes states and provinces have or are developing a CAP, but only four of those CAPs include specific sections or elements related to climate change adaptation. For those that do include adaptation, there is variability in goals and mechanisms with which to deal with climate change. For example, adaptation elements in the CAPs produced by Michigan and Minnesota relate primarily to water conservation, while those developed by Québec

[1] Climate variability is the inherent characteristic of climate which manifests itself in changes of climate with time. Climate variability occurs with or without anthropogenic emissions of greenhouse gases. (From the National Snow and Ice Center glossary)

and Ontario contain detailed adaptation strategies related to public health, including cooling centers and heat wave and pandemic response plans. CAP implementation efforts are usually housed in existing state or provincial programs. Workshop participants stressed the importance of including concrete goals, measurable targets, and adaptive management processes in CAPs.

> ***"Climate Action Plans are the most common state-level mechanism in the region to address adaptation, but we will need collaboration among all levels of government to make sure these plans are implemented." – Tim Eder, Great Lakes Commission***

As with any plan, workshop participants agree that identifying specific strategies, costs and responsibilities will help facilitate and ensure plan implementation. Only a few state/provincial CAPs have that level of detail at this point, but several are planning to develop these details as part of their CAPs in the near future. Cooperation among federal, state, provincial, and municipal governments was discussed as vital to CAP implementation, particularly given the frequently changing political landscapes in the U.S. and Canada.

Municipalities are also taking more specific actions to address climate adaptation. For example, the City of Chicago has its own action plan that outlines a nine-point adaptation strategy, and its Department of Environment has formed an Ecosystem Adaptation Advisory Group. Grand Rapids, Michigan is an inaugural participant in the Climate Resilient Communities Program of Local Governments for Sustainability, or ICLEI, an organization of local governments in the U.S. working towards sustainability. Through this program, the city gets access to the organization's Adaptation Database and Planning Tool, which aids in assessing vulnerabilities, setting resiliency goals, and developing adaptation plans.

WISCONSIN INITIATIVE ON CLIMATE CHANGE IMPACTS (WICCI)

Although Wisconsin's CAP does not have a specific adaptation component, the state is addressing climate change adaptation through its Wisconsin Initiative on Climate Change Impacts (WICCI)—an adaptation consortium between the University of Wisconsin–Madison, the Wisconsin DNR and other state agencies. The WICCI is assessing climate change impacts and will develop and recommend adaptation strategies to focus on impacts and adaptation strategies. Wisconsin and Michigan have a cooperative agreement on mitigation and adaptation strategies that builds on the WICCI structure.

NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY CLIMAID

The New York State Energy Research and Development Authority has taken the first step in recognizing the climate-related threats faced by the state and recently drafted an integrated assessment of climate vulnerabilities and adaptation strategies for New York. Completed in 2010, the assessment draft, entitled *ClimAID: Responding to Climate Change in New York State*, drew from extensive research, models, and experience to synthesize the integrated assessment and outline the adaptation needs throughout the state with a focus on eight sectors: Water Resources, Coastal Zones, Ecosystems, Agriculture, Energy, Transportation, Telecommunications, and Public Health. Each sector report highlights the critical problems faced by the population and applicable adaptation strategies, and includes the costs and benefits associated with both. ClimAID concludes with a set of recommendations for statewide decision-makers, agencies and organizations, and science and research that underline the importance of comprehensive and smart climate adaptation strategies to prepare for the impacts of climate change.

Workshop participants note that cities are uniquely challenged with addressing climate change on the "front line" because they deal most directly with the immediate impacts associated with climate change. An example is exacerbated flooding after an unusual storm event, which also might lead to combined sewer overflows (CSOs) and excessive volumes of urban runoff that bring more pollutants into coastal and in inland waterways. This "front line" challenge presents a unique adaptation opportunity for municipalities to expand and incentivize green practices in private industry and construction via city standards, zoning, and building codes.

> ***"In cities, we have to be building a bicycle while we're riding it. We have to plan and implement as we move forward. It's what I'm hearing from the 72 mayors in the U.S. and Canada that I work with." – Dave Ullrich, Great Lakes Cities Initiative***

Workshop participants recognize that cities face enormous challenges in building the capacity necessary to address climate change. Most local governments struggle with a lack of knowledge, technical capacity and adequate funding. These needs must be met if municipalities are going to be able to adapt effectively. It is necessary to obtain funding to hire or maintain critical staff and to provide training for all staff to build knowledge and technical capability. Cities can help meet this need by leveraging capacity of federal agencies or environmental non-governmental organizations (ENGOs). Enhanced collaboration at the local citizen level is key to success. Due to the complex and often controversial nature of climate change, it is important to educate and thoroughly engage citizens to garner support for adaptation plans, and ample time for these activities must be included in project planning. This is also an area where partnerships with local ENGOs can be helpful.

"Urgent action occurs at the city level, as cities need to respond quickly. I urge other sectors to connect with cities." – Mayor George Heartwell, Grand Rapids, Michigan

ENVIRONMENTAL NON-GOVERNMENTAL ORGANIZATIONS (ENGOS)

"Climate change adaptation is quickly emerging as an important step in Great Lakes protection. Issues that cause harm to the health of our lakes — toxic pollution, invasive species, and algal blooms — could all be exacerbated if we don't take steps to protect the lakes from climate change impacts." – Andy Buchsbaum, Great Lakes Regional Center, National Wildlife Federation

Environmental non-governmental organizations are instrumental in publicly exposing potential damage to our environment and economy if climate change adaptation does not take place. ENGOs also aid in collaboration-building and oftentimes house exploration activities needed to find solutions. Some are expanding conventional facilitator and educator roles so the challenge and burden of effective climate change adaptation need not be met by municipalities or other governments alone. Workshop participants highlight the crucial role of non-governmental organizations (NGOs) in facilitating communication between government officials and the public in order to increase support and ensure that climate adaptation plans are efficiently implemented.

CLIMATE ADAPTATION KNOWLEDGE EXCHANGE (CAKE)

EcoAdapt, an organization whose main objective is advancing climate adaptation, has worked with Island Press to create the Climate Adaptation Knowledge Exchange (CAKE). This online resource provides relevant case studies, a library of climate adaptation resources for both individuals and organizations, a directory of those practicing adaptation throughout the country, and other decision-making tools. In addition, CAKE allows individuals and organizations to collaborate and learn from others and join a community of people with similar goals. Environmental NGOs like EcoAdapt have the capacity to focus on projects like CAKE that advance climate adaptation throughout the region and around the world while continuing to pursue other on-the-ground projects.

"CAKE is knowledge sharing in practice. Our ultimate goal is to create a community of practitioners that can develop climate savvy policies, science, and management approaches." – Jennie Hoffman, EcoAdapt

Workshop participants note that public engagement becomes even more difficult when affected citizens come from disadvantaged communities. All public engagement activities must include concerted efforts to inform and engage members of the public who may not otherwise have the capacity to become involved in decisions concerning their environment, and ENGOs often have the networks available to make these efforts.

Many environmental NGOs are uniquely poised to address adaptation issues because their large geographic membership base enables them to look at the "big picture" while their grassroots structure ensures they understand local ecological and political contexts. This gives many ENGOs a unique ability to work with communities, industries, and governments to facilitate the inclusion of climate adaptation elements into programs and projects.

Environmental NGOs are also well-positioned to provide technical skills and capabilities to organizations doing on-the-ground projects. The area of land and conservation easement acquisition is a good example of where the ENGO community has played and can continue to

play an important role in supporting local conservation and climate change adaptation efforts. Several environmental NGOs have specific real estate skills and experience required to handle real estate transactions associated with land protection, including purchase of lands or acquisition of land easements for conservation or related purposes (e.g., agricultural conservation easements). Land and easement acquisition can also serve conservation goals as well as climate change adaptation goals.

Because of their extensive community involvement, ENGOs can hold government officials and industries accountable by pushing both to respond to climate change adaptation needs, either as part of existing programs or as new initiatives. ENGOs tend to be more nimble and can respond more quickly to issues and problems whereas government agencies may get tangled in bureaucracy. The role of public watchdog played by environmental groups affords them unique abilities to influence investors, governments and constituents, and drive change across multiple sectors.

"In any successful adaptation program you need to build adequate time for stakeholder involvement." – Mark Lowery, State of New York Department of Environmental Conservation

FRESHWATER FUTURE CLIMATE-READY GRANT PROGRAM

Freshwater Future, a Michigan-based ENGO that supports restoration work throughout the Great Lakes basin, has a climate adaptation-centered granting program that provides funding to grassroots initiatives. Priority funding areas include watchdogging and participation in the policy and regulation process, and promoting citizen action.

Finally, ENGOs have the ability to forge equal, standing relationships with tribal nations because they are not part of the legacy of conflict that restrains governmental agencies and groups. This potential for facilitating relationships is an opportunity to foster important collaboration and information sharing.

INDUSTRY

Diverse arrays of industries exist in the Great Lakes region and each has its own climate change adaptation issues and solutions. Companies dependent upon shipping may have a great interest in protecting lake levels from decline whereas companies that are dependent on farm staples may have an interest in dealing with extreme drought or floods. Some companies may even have a financial interest in making items or protective services for use in climate change adaptation.

SUSTAINABILITY EFFORTS AT LAFARGE NORTH AMERICA

Lafarge North America (NA) is an international construction materials company with representation at this workshop. Lafarge NA recognizes the fact that cement manufacture accounts for 4-5% of global greenhouse gas emissions. As cement is the company's main line of business, Lafarge NA has taken steps to find mineral substitutes for cement that require less energy to manufacture. The company is a large landowner and has implemented biodiversity programs on their properties, as well as worked with local community groups to coordinate small scale projects. The construction of buildings and infrastructure is important to adaptation actions because the buildings of today will need to withstand extreme temperatures, precipitation and winds. Companies like Lafarge NA are working towards sustainable construction practices and the development and use of environmentally-conscious building materials such as permeable pavement.

"Industry in the Great Lakes Region is making changes in its operations, its products and its facilities as it pursues climate change adaptation strategies. Market based incentives are important to industry actions. In some cases, adaptation strategies can provide new opportunities for industry. Finding solutions that allow industry to continue to operate profitably are critical. Industry is an important part of adaptation and is pleased to be part of the dialogue with governments and other stakeholders who participated in this workshop." - George Kuper, Council of Great Lakes Industries

While many Great Lakes corporations have been forward-thinking in climate mitigation and adaptation, the current state of the economy severely restricts

[2] Price signals are price increases in order to signal either to consumers to decrease demand or suppliers to increase supply.

investment in self-preserving actions. Furthermore, in most cases, voluntary actions are difficult to undertake unless they are the most economically viable choices. Despite the desire of many industries and companies to work towards sustainability, they are appropriately focused on market demands. As a result of national policy emphasis their climate change agendas are usually dominated by consideration of mitigation strategies. Adaptation is, therefore, a more recent agenda for most companies. This perhaps indicates a need for other drivers toward adaptation, such as market demand, reduction of supply, price signals[2], financing mechanisms and other adaptation oriented policies.

ACADEMIC RESEARCH

Climate adaptation work in the academic sector is often divided between the internal operations of the academic institutions themselves and the work of the researchers, whose work aims to influence much broader audiences. Many academic institutions are invested in climate change mitigation efforts such as recycling and reducing energy consumption. Reduction of energy use is an example of a climate change mitigation strategy utilized by more and more universities each year that could potentially be an adaptation measure. Since a majority of Great Lakes energy comes from carbon-emitting fossil fuel sources, reductions in energy use results in reduction in carbon emissions, which mitigates climate change impacts. At the same time energy reduction can be an adaptation measure in so far as people get used to using less energy, which can reduce future energy demand, thereby reducing future pressure to develop energy sources that could be less available, or more difficult or expensive to extract or process under climate change scenarios. However, academic institutions themselves still lack the inertia to create more detailed adaptation plans and implement actions.

"Climate adaptation research is underway in almost every field — economics, ecology, engineering —you name it. The institutions themselves, however, are not yet planning for adaptation of the campus community."
– Lucinda Johnson, University of Minnesota, Duluth

The primary role of academic researchers in advancing climate adaptation is in modeling future climate scenarios that can identify specific regional or local impacts and the appropriate short, medium, and long-term objectives and strategies to address them. Furthermore, researchers typically have longer funding horizons and related project/research timeframes to carry out work over extended time scales and with greater spatial resolution than those in other sectors. One challenge to developing and using climate models is the lack of available and/or consistent data and data management (e.g., protocols for data collection and classification). Many jurisdictions, agencies, and organizations are carrying out monitoring without standardized methods, making it more difficult for researchers to synthesize information. Increased collaboration and transparency could facilitate model development and more efficiently fill gaps.

The academic sector can assist the Great Lakes region by engaging in research beyond the ecological impacts of climate change to examine broader socio-economic impacts, such as those on ports and other infrastructure, to determine how industries and municipalities and related government programs will need to adapt in the coming years. There may be a need for the academic community to address the policies in relation to climate change research results where the two may differ. This is another area where the non-profit community can assist, by disseminating this information to the public.

GREAT LAKES REGIONAL INTEGRATED SCIENTIFIC ASSESSMENT

The Regional Integrated Scientific Assessment (RISA) program is funded by the National Oceanic and Atmospheric Administration (NOAA) Climate Program Office. RISAs support the scientists who address complex climate-related issues that are of particular concern to regional resource managers and policy planners. While there are several nation-wide, there was no RISA team in the Great Lakes region until this year. The Great Lakes RISA is innovative in that it is designed around a flexible research program that includes the input and deliberation from both scientists and regional stakeholders. The goal is stakeholder-driven rather than researcher-driven research. An archive of climate projections and best practices for the Great Lakes region will aid in their planning and evaluation processes.

Main Themes/General Discussion

Due to the specific nature of many of the discussion questions posed to workshop participants and as a result of the unique mix of expertise in the groups, breakout session conversations were often quite specific and varied widely from group to group. Throughout the course of the day in all breakout groups, five general themes emerged as important to climate adaptation activities within and among the sectors. These themes included the importance of partnerships, the role of information and information sharing, issues of scale, the many drivers of adaptation activities, and the uniqueness of climate adaptation issues in the Great Lakes region.

BUILDING PARTNERSHIPS

As discussed in the sector summaries, each sector experiences unique opportunities and challenges related to climate adaptation. In order to face these challenges, make the best of opportunities, and share information, workshop participants stress that collaboration among sectors is of utmost importance.

Partnerships between tribal nations and U.S. federal and/or state agencies, for example, require consistent, long-term relationships with agency contacts. Tribal representatives shared experiences of shovel-ready restoration projects that were unable to take flight when funding became available in part due to a lack of communication and collaboration with funding agencies, and in part due to the low-level of capacity that continually plagues tribal environmental programs. This lack of capacity limits their ability to track various funding opportunities and to offer competitive applications even when the proposed work may be directly beneficial to the funders. Perhaps another partnership, say with an ENGO, could help offset a tribe's low level of capacity by assisting in these efforts.

Workshop participants identify multiple benefits of partnerships. Collaboration increases all parties' understanding of the intricacies of the large and complex Great Lakes ecosystem and increases overall effectiveness in carrying out restoration and adaptation projects. Working in partnerships can help to identify priority areas and projects for adaptation work. Collaboration allows for more efficient application of science to management decisions, and it can enhance the sharing of success stories and best practices in order to improve future adaptation work and publicize the benefits of adaptation projects.

CITY OF GRAND RAPIDS AND CONSUMERS ENERGY

Grand Rapids Mayor George Hartwell emphasized the importance of partnerships in working towards sustainable and climate-resilient communities. As part of the city's commitment to acquire 100% of its energy from renewable sources by the end of 2020, the City of Grand Rapids has partnered with Consumers Energy and begun to invest in energy efficiency and reduction programs. This collaboration has led to enrollment in Consumers Energy's *Green Generation* program, which allows customers to support renewable sources of energy as part of their monthly energy bill. The partnership has also yielded projects such as the "StreetSmart" program, which will install electric smart meters in a number of homes and businesses in Grand Rapids. These meters send information wirelessly to customers and enable near real-time monitoring of energy consumption and cost, allowing for efficient energy reduction and increased awareness. While not direct climate adaptation measures, these types of programs are important steps towards community resiliency and sustainability, and the partnership between Consumers Energy and the City of Grand Rapids is a critical part of climate adaptation planning for the city.

NATIONAL WILDLIFE FEDERATION (NWF) AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA)

NWF is partnering with NOAA to help implement habitat restoration projects in the region in a "climate-smart" way, meaning, designed to be viable despite climate change and its impacts. Those who seek NOAA funding for their restoration project through the federal Great Lakes Restoration Initiative or other funding opportunities can learn steps from the National Wildlife Federation to become climate-smart via workshops, webinars, guidance documents and one-on-one communication. This partnership allows both organizations to share resources and information throughout their networks and cut research time significantly.

Workshop participants also shared experiences demonstrating the importance of engaging the public and all relevant stakeholders in any decisions regarding adaptation and restoration projects. Stakeholder support was identified as essential for implementing adaptation plans, and many participants stress the importance of building adequate time for the public engagement process into project planning. Workshop participants discussed several challenges in engaging the public on climate adaptation work. For instance, global climate change is still not a universally accepted phenomenon. Furthermore, the level of acceptance of climate change science varies across different demographics. Thus, adaptation strategies are often best marketed as "no-regrets" policies related to public health, economic viability, hazard and loss prevention, and community sustainability. Another concern is environmental justice: disadvantaged communities may lack the knowledge or capacity to participate in public outreach programs, and so engaging these communities may require additional time and resources.

Whether the discussion is centered on public engagement or on partnerships among governments, ENGOs, and private industries, workshop participants agree that collaboration, relationship-building, and open, honest communication are key to implementing climate adaptation plans and to overcoming obstacles.

INFORMATION SHARING

One benefit of partnerships and collaboration is the facilitation of information sharing, identified by workshop participants as key to climate adaptation efforts. Participants stress that their greatest need in planning restoration and adaptation projects is scientifically-based information on the expected impacts of climate change and variability and case studies of what others have tried. Analyses of climate impacts need to be downscaled or linked to ecosystem response in order to be usable at the smaller, local scale or connected to a conservation goal. Workshop participants recognize that many different climate models exist and that models and information are often tailored to the needs of particular groups or geographic areas. As noted earlier, information must first be generated and be somewhat cohesive before it can be shared. There is still a need for additional downscaled models and specific adaptation strategies that reflect institutional authorities, timing and cost considerations.

In order to be effective and credible, information sharing must be coupled with outreach. For example, the industry sector faces unique challenges in using climate models to inform adaptation activities because of the necessity of making economically viable decisions. Perhaps a risk assessment that includes an examination of return on investment would be more useful to industry, or even government. Meaningful conversations between information producers, such as academic institutions, and industry trade groups can facilitate the application of climate scenarios in making environmentally and financially sound decisions. With extensive information sharing Great Lakes stakeholders will be better equipped to assess that information and make practical and cost-effective decisions regarding investments in climate change adaptation.

Information sharing is not just important between sectors such as academia and private industry, but also to local communities. Many important lessons are learned during on-the-ground adaption work, and this information should be shared with other agencies, organizations, and communities that are carrying out similar projects. This "technology transfer" will also serve to foster relationships and build future collaborations. This information may also help inform policy-makers on important appropriations decisions.

Photo by iStockPhoto.

There is often infrastructure already in place that could facilitate this needed information-sharing. To encourage use, however, these resources may need to be improved, updated, and promoted. For example, the Great Lakes Habitat Initiative, a multi-year, collaborative effort led by the US Army Corps of Engineers as part of the Great Lakes Regional Collaboration Strategy (a precursor to the Great Lakes Restoration Initiative (GLRI)) developed a web-based habitat project portal[3] for this type of information sharing. It includes a regional habitat restoration and protection project database that enables sharing of individual project information, type of restoration, project partners, funding and funding needs, and other information that can assist in developing restoration partnerships, including during the proposal development stage. The GLRI could reinvigorate the web site and database to meet current and future GLRI needs related to information sharing and tracking progress on ecosystem restoration. It could also be a place where some (e.g., nonproprietal, non-sensitive) reporting information is housed to enable tracking progress on restoration. The database could also be gleaned easily to get quantitative data on specific aspects of restoration activities (e.g., number of acres restored/being restored; number of active projects, etc.).

ISSUES OF SCALE

Many challenges to implement climate change adaptation deal with temporal and spatial scales. As mentioned above, one obstacle to information sharing is a mismatch between the regional scale of climate change impact models and the local scale of adaptation projects. Workshop participants also note that missed adaptation opportunities occur due to mismatches between the scale of modeling or planning and the scale of solutions. As discussed in the sector summaries, adaptation planning often occurs at the municipal level. A related issue is one of scale regarding decision-making and funding. While municipal governments may be responsible for planning and implementing projects, funding and support often must come from higher levels of government.

In addition to issues of spatial scale in climate adaptation, workshop participants identified challenges related to temporal scales. Many adaptation projects are essentially habitat restoration projects that occur in the short-term, but participants emphasized the potential value of longer-term adaptation work such as ecosystem monitoring and public perception studies. Short-term projects can aid climate change adaptation by considering longer time scales in the planning process. A project that is completed within two years can plan for predicted conditions 100 years into the future, or plans can contain adaptive management strategies for dealing with different scenarios at different time scales. Learning from our experiences and improving adaptation work in the future requires a balance between short- and long-term actions and recognizing the importance of each.

OTHER DRIVERS OF ADAPTATION ACTIVITIES

All sectors agreed that climate change concerns are not the only driver for adaptation actions. In many cases, a “no-regrets” approach is necessary to gain public support for a project. In all projects, emphasizing socioeconomic benefits is crucial — for example, showing how a project will address social issues by increasing access to resources can make a project more appealing in the public eye. Explaining technical issues and showing how projects can improve human quality of life go a long way in garnering support for adaptation. Framing adaptation actions within other projects can also bring public support to efforts that otherwise may have had a smaller group of advocates.

Strategies that increase ecosystem resiliency, such as actions like reducing nonpoint pollution and combating invasive species, often have the added benefit of being adaptation actions. Increasing overall ecosystem resiliency and using “no-regrets” approaches allow us to balance our hesitancy to take action with limited information and our anxiety of taking no action at all. This is especially important in cases where data is limited or nonexistent, but can also help where current actions must be coupled with long-term research. Furthermore, “no-regrets” approaches allow for relationships and collaborative processes to develop as the complexities of climate change are further analyzed and realized. Prioritizing actions that restore ecosystem resiliency necessarily enhances the ecosystem’s ability to adapt, much like a healthier human being is more resilient to sickness and disease. However, not all participants agreed that building resiliency alone was enough. Many participants felt strongly that activities focused specifically on climate change adaptation were imperative.

The market can sometimes be considered a driver of climate adaptation that encourages innovation and efficiency, which can in turn lead to adaptation actions. For the workshop participants, the discussion focused on which policies or practices could create the right market for incentivizing innovations and efficiencies that can enhance adaptation.

[3] http://www.lrb.usace.army.mil/glhi.html

Finally, the growing trend towards green infrastructure, due to its inherent ability to leverage ecosystem services, can drive climate adaptation actions. Municipalities looking to replace outdated infrastructure are examining solutions that can enhance adaptive needs rather than work against them. The need for better stormwater management is an important driver in the trend toward green infrastructure. In the face of more extreme and more frequent storms, the relatively cost-effective investment in green infrastructure begins to look more attractive.

CHALLENGES AND OPPORTUNITIES FOR THE GREAT LAKES REGION

The Great Lakes region is home to the world's largest freshwater ecosystem. As climate change increasingly becomes an issue, the region will face unique opportunities and challenges related to these vast water resources. Workshop participants note that the Great Lakes region has the potential for a "competitive advantage" if climate change impacts reduce water quantity and quality in other regions of the country driving businesses, industries, and people back to areas with major water resources. In this scenario, the region has the opportunity to turn a massive migration of capital and manpower to our advantage and open up opportunities and partnerships that may not otherwise have been available. Participants recognize that the region already has an exemplary culture of collaboration and multi-stakeholder engagement and emphasized the need to continue to build upon this legacy in order to attract investment.

Workshop participants caution, however, that such a hypothetical influx of industry and population could create new challenges to the very resource that might provide the competitive advantage. As reinforced by the other major workshop themes, Great Lakes natural resources must be managed carefully and effectively in order to ensure they will continue to be protected under future climate scenarios. Some participants suggest that climate adaptation efforts should focus on areas of the region where this unique competitive advantage is likely to exist such as coastal cities like Grand Rapids, Milwaukee or Chicago. These efforts protect the resource now while sustaining the advantage over time. Identifying such areas is necessary for future research or investigation.

Some participants are wary of too much planning and not enough action. Workshop participants stress a need to prioritize activities that restore ecosystems and enable a better quality of life in the present. An effective approach may be to focus on adaptation projects that are needed now and that have clear connections to economic stimulation in local communities. Adapting to a changing climate and maintaining a competitive advantage are not necessarily mutually exclusive actions, so long as projects are planned and implemented with an eye to long-term ecological health.

Construction on Chesaning weirs. *Photo by Gail Krantzberg.*

Recommendations for Climate Change Adaptation in the Great Lakes

The overarching goal of adaptation activities is to increase the resiliency of the entire Great Lakes Basin and its people by reducing vulnerability to climate change-induced stressors. By conserving urban and natural ecosystems with an eye to the future, we are building the foundation for effective climate change adaptation.

APPLYING CLIMATE CHANGE SCIENCE TO A PROGRAM: SOME QUESTIONS TO CONSIDER

- How does the climate/environment (i.e. temperature, precipitation, winds, soil) interact with the given urban/agricultural/natural/tribal/industrial area? How important is the stability of these interactions to its function?
- What changes are we noticing to climate/environmental interactions already? Are they amplifying? Stabilizing? Reducing?
- What are the predicted climate changes for the region/state/local area? What resources are available for information (NOAA, EPA, Environment Canada, local universities, scientific academies, knowledge sharing databases, non-profit organizations)?
- How do we deal with gaps of information? Vulnerability assessments? Scenario planning? Monitor and response?
- What are some of the potential economic impacts of climate change impacts? Are there economic benefits to adaptation such as reduced costs, lower insurance rates, better water or crop quality, attracting or maintaining residents?

RECOMMENDATION 1

Apply Climate Science to On-the-ground Project Implementation

- Be careful not to simply re-label current conservation, urban updates or restoration work as adaptation. Adaptation requires the application of climate change science to these projects.
- Direct resource management work towards this goal of reducing vulnerability to climate change impacts.
- Include adequate time for public outreach and engagement when developing and implementing projects.
- Incorporate adaptive management. For example, include evaluative mechanisms in Climate Action Plans or habitat restoration and periodically review and update to incorporate new knowledge as it becomes available.
- Set targets that include goals, strategies and tactics and timetables.
- Follow and document a project's life-cycle and successes or failures. If your agency or organization does not have the time or staff available to document information, partner with an organization that does, such as an ENGO.
- Examine and update old plans for hazard planning, stormwater, and urban development in light of climate change.
- Update management decisions on the most recent scientific findings. A partnership between academic researchers, state climatologists and resource managers, for example, will aid this activity.

"It is important to set targets and provide the institutional support to achieve those targets." – Mayor George Heartwell, City of Grand Rapids, Michigan

RECOMMENDATION 2

Build Partnerships and Increase Knowledge Sharing Portals or Forums

- Build partnerships within and among sectors. Reach out to someone who you recognize as impacted by climate change first and then utilize these relationships to associate with others in their network.
- Identify partners to fill vital information gaps of data, adaptation knowledge, plans, strategies, etc.
- Participate and follow-up with workshops such as this to foster growing relationships.
- Utilize handheld technology when doing on-the-ground work such as, but not limited to; online chat systems, smart phone or laptop applications and data portals.
- Tap into existing knowledge bases coming from on-the-ground work (e.g. in local communities or tribal nations). Synthesize these bases for ease of use and host at an easily accessible source such as federal or state agencies, and/or tribal nations.
- Promote and utilize existing communication infra-structure (e.g. Climate Adaptation Knowledge Exchange).
- Partner to expand education and public outreach efforts as well as land conservation efforts.
- Establish and fund special bureaus or offices dedicated to climate change that are networked with other offices and programs.

RECOMMENDATION 3

Emphasize How Adaptation Measures Contribute to Quality of Life

- Obtain reliable data and information about the potential for future influxes of industries and people into the region and apply these projections to models and planning scenarios.
- Emphasize that adaptation and mitigation are complementary, not mutually exclusive and demonstrate such by engaging in activities to address adaptation and mitigation simultaneously.

Kayaking on the Shiawassee River. *Photo by Kari Lydersen.*

- Conduct, support and share studies that attempt to quantify economic or outline quality of life benefits from adaptation.
- Host public forums and to engage policymakers to show that restoration and adaptation activities have strong economic and quality of life benefits.

RECOMMENDATION 4

Increase or Re-Purpose Funding Efforts

- Prioritize proposals for federal funding or other programs that include formal partnerships or collaborations.
- Fund projects that meet stated goals (e.g., restoration) and also build capacity for climate adaptation.
- Develop a mechanism to include long-term research and monitoring. Utilize non-traditional ecosystem monitoring tools already in place such as highway cameras for ecosystem and/or storm event monitoring purposes.
- Balance short- and long-term adaptation activities depending on urgency.
- Implement economic incentives such as tax incentives or funding support for adaptation in industries and the private sectors.
- Combine resources across sectors to acquire land or easements for habitat expansion, flood management, or other ecological restoration activities that will build resiliency in light of climate change.
- Support risk assessment, return on investment or other economic studies to help make the economic case for climate change adaptation and give industries and municipalities the proper information.

Great Lakes Restoration Initiative and Federal Program Specific Recommendations

One of the goals from the workshop was to inform federal agency funding decisions, practices and the on-the-ground work of the Great Lakes Restoration Initiative (GLRI) or other applicable programs. U.S. federal agencies can protect their investments by integrating climate change scenarios, both current and future, into present work.

The Great Lakes Restoration Initiative funded $475 million its first year towards projects to clean up toxic areas of concern, undergo ecological restoration, reduce pollution and combat invasive species. U.S. Environmental Protection Agency and its federal partners coordinate state, tribal nation, local, and industry GLRI actions to protect, maintain, and restore the chemical, biological, and physical integrity of the Great Lakes.

Workshop participants were asked to apply these questions as guidance to their discussion on the matter:

- Are there some opportunities for constructive work on adaptation that can be related to these GLRI priorities?
- What is the highest priority for adaptation related to the five focus areas of the GLRI?
- What are the central questions for your sector?
- What information is missing to make these judgments?
- What might federal agencies require of those receiving GLRI funding to help the Great Lakes adapt to climate change?
- Should federal agencies consider climate change adaptation in their GLRI grant request for proposals (RFPs)? Or does it depend upon GLRI priority?

Recommendations of workshop attendees include:

1. INTEGRATE CLIMATE VARIABILITY AND CHANGE INTO UPCOMING REQUESTS FOR PROPOSALS

The Great Lakes Restoration Initiative could serve as a vehicle for ensuring that climate variability and change is taken into account in future funded work/projects. To do so, GLRI funded projects would need to protect financial investments by planning, designing, and restoring to expected future conditions in addition to, or in some cases in place of, the traditional approach of restoring to past conditions.

- Use climate change adaptation in the grant review process, possibly as a secondary screen. For example, adaptation could be applied as a sub-criterion under the "Strategic Approach" criterion. In this way, projects would need to justify their ability to restore aspects of the Great Lakes ecosystem and describe how a project will build resiliency to adapt to climate variability and change.
- Develop adaptation-specific criteria that can be incorporated into grant application forms — to ensure that projects are addressing specific adaptation needs and provide a mechanism for evaluating applications. These criteria could be developed in partnerships like a federal/non-governmental organization partnership. Some examples of these criteria could be, for example:
  - Work alongside a state climatologist.
  - Attend "climate-smart" workshops and/or webinars throughout the life of the grant.
  - Outline sources of climate change impact or model prediction information.
  - Advise agriculture work with the goal to sequester carbon in the soil through less tillage and greater use of cover crops.
- Address the question: does a project increase the overall resiliency of the Great Lakes basin to climate variability and change?
  - If so, "fast-track" the project request into consideration.
- Identify baseline science applied by projects; for example, scientific predictions on river temperatures. Applicants should work with the EPA and/or NOAA to find current applicable science information, and should be encouraged to revise proposals when new science is made available.

2. STREAMLINE COLLABORATION AND KNOWLEDGE SHARING THROUGHOUT ENTIRE LIFE-CYCLE OF GRANT

The Great Lakes Restoration Initiative was born of collaboration. Partnerships and communication are very important, and funding agencies need to understand these professional relationships. Access to knowledge bases (i.e. on-the-ground restoration knowledge) provides advantages that organizations are not currently utilizing.

- Allow the submission of joint proposals to encourage and enhance collaboration. Joint proposals will also streamline the review process.
- Provide a "clearinghouse" or other forum for potential partners to communicate their skills to one another and help identify and build beneficial relationships.

- Capture innovation going on in the field, for example, projects where environmental non-profits and local governments are working on restoration in a changing climate.
  - Bring into reporting — projects could report out on innovative concepts/new ideas that could be captured by federal agencies.
  - Create forums for sharing lessons learned and information/data would be beneficial to communication, technology transfer and in further identifying potential partnerships.
    - The Great Lakes Habitat Initiative, a multi-year, collaborative effort led by the US Army Corps of Engineers as part of the Great Lakes Regional Collaboration Strategy (precursor to GLRI) already exists for this type of information sharing[4]. It includes a regional habitat restoration and protection project database that enables sharing of individual project information, type of restoration, project partners, funding and funding needs, and other information that can assist in developing restoration partnerships, including during the proposal development stage. The GLRI could reinvigorate the web site and database to meet current and future GLRI needs related to information sharing and tracking progress on ecosystem restoration. It could also be a place where some (e.g., non-proprietal, non-sensitive) reporting information is housed to enable tracking progress on restoration. The database could also be gleaned easily to get quantitative data on specific aspects of restoration activities (e.g., number of acres restored/being restored; number of active projects, etc.)

3. EMPHASIZE CROSS-CUTTING EFFORTS AND GOALS ACROSS FOCUS AREAS

Many activities and projects have multiple benefits that cross-cut several of the GLRI focus areas. Trying to choose one focus area reduces transparency and could cause others to "reinvent the wheel."

- Prioritize those projects that have an interdisciplinary focus and/or cross-cutting benefits across habitat goals, i.e. reduce invasive species and restores wetland habitat.
- Require funded projects to report and share resulting co-benefits.

4. INCLUDE CLIMATE CHANGE ADAPTATION FOR CITIES TO ENHANCE SUSTAINABLE DEVELOPMENT

Cities expressed frustration at not being eligible to receive Great Lakes Restoration Initiative money for sustainable development, even though it is a focus area of the original Great Lakes Regional Collaboration Strategy. Combined sewer overflows and urban storm runoff are some of the biggest contributors to poor water quality in the Great Lakes and are predicted to increase in severity under climate change scenarios. Green infrastructure projects such as rain gardens and green roofs have important implications for reducing vulnerability/increasing resiliency to these changes.

- Fund urban restoration projects in the form of rain gardens, green alleys or green roofs to help urban areas adapt.
- Prioritize land cover analysis projects that seek to inform, prioritize, and promote good decisions when funding these types of urban restoration projects.
- Include municipal and state officials into decision-making for GLRI and other federal projects.

5. ACT BOTH SHORT-TERM AND LONG-TERM

Great Lakes Restoration Initiative is focused on funding on-the-ground, shovel-ready projects — however; a need has been identified for funding longer-term work that is vital to adaptation.

- Call for long-perspective, multidisciplinary studies on the impacts of climate change.
- Examine and showcase different future scenarios.
- Fund projects aimed directly at near-term ecosystem improvements, but include funding for long-term monitoring to ensure a baseline of information about actual ecosystem improvements or other trends.
- Augment monitoring efforts to reduce lack of information on ecosystem response to impending changes. Monitoring is an important aspect of restoration projects and will contribute knowledge necessary to planning and adapting across different time horizons.
- Continue to build long-term datasets. Information on a decadal scale is important to have for climate assessment purposes.
- Address public perceptions of climate change in order to influence behavior. Increase public support for restoration projects by collaborating with local communities.
  - Increasing the value placed on the outreach criterion in a request for proposal would encourage projects with potential to influence public perception and behavior.
- Set mid- and long-term goals for the region in the goals of the GLRI.

[4] http://www.lrb.usace.army.mil/glhi.html

Conclusion

We hope that *Climate Change in the Great Lakes: Advancing the Regional Discussion* leads the way for other workshops that build on adaptation knowledge and foster an environment for information sharing. The September 2010 workshop helped build partnerships while expanding knowledge and communications among federal agencies and state and local governments, counterparts and other businesses, conservation organizations and academics who are already engaged in climate change adaptation and plan to do more in the future. Organizers from National Wildlife Federation, Council of Great Lakes Industries and Great Lakes Commission and their partners all felt the workshop was a great success and incredibly timely. A large number of attendees expressed their wish to have a workshop every year. This would provide a meaningful forum for regional stakeholders to share new and emerging information about opportunities for ongoing climate change adaptation especially as our understanding of climate change and its impacts evolve.

Photo courtesy of Healing Our Waters-Great Lakes Coalition.

Appendices

APPENDIX ONE: DISCUSSION QUESTIONS

The workshop participants and discussion leaders were provided questions upon which to focus for each round.

Rounds 1-3 focused on general climate change adaptation strategies, what's worked/what has not, needs and collaborations in the Great Lakes region. Questions were developed by the organizers (National Wildlife Federation, Great Lakes Commission and Council for Great Lakes Industries).

Sample discussion questions for rounds 1-3:

- In what types of adaptation actions or activities are participants involved? (For academic participants – What questions of adaptation research are you examining?) Are there other drivers besides climate change for these actions? How might these actions be applied to other sectors?
- Are there some identifiable best (or not-so-best) practices?
- Are there adaptation measures that institutions have chosen not to pursue?
- What is needed (e.g. scientific predictions, cost/benefit analysis, monitoring, etc.) to make adaptation actions more effective? (For academic: How do you prioritize adaptation-related research questions?)
- How might collaboration increase effectiveness of adaptation actions?
- Are there adaptation measures that we would not want to take if climate change were not as extreme as predicted? Are adaptation measures determined by severity of climate impact prediction?
- What are some emergency measures put in place to meet climate change-related disasters?
- How are adaptation actions different in the Great Lakes region as opposed to other parts of the world/country?
- How might the Great Lakes benefit from various adaptation actions?
- Are there adaptation actions that might cause challenges to Great Lakes' health and sustainability?
- What general Great Lakes protection or restoration actions that are currently low-priority might become higher priority under climate change?

Rounds 4-5 focused on identification of adaptation actions by sector and integrating climate change into the five Great Lakes Restoration Initiative Focus Areas: Toxic Substances and Areas of Concern, Invasive Species, Nearshore Health and Nonpoint Source Pollution, Habitat and Wildlife Protection and Restoration, and Accountability, Education, Monitoring, Evaluation, Communication, and Partnerships.

Sample discussion questions for rounds 4-5:

- Are there some opportunities for constructive work on adaptation that can be related to these GLRI priorities?
- What is the highest priority for adaptation related to the five focus areas of the GLRI?
- What are the central questions for your sector?
- What information is missing to make these judgments?
- What might federal agencies require of those receiving GLRI funding to help the Great Lakes adapt to climate change?
- Should federal agencies consider climate change adaptation in their GLRI grant request for proposals? Or does it depend upon GLRI priority?

APPENDIX TWO: FULL PROCEEDINGS

Full proceedings from breakout session rounds 1-5 available upon request. Contact Celia Haven at 734.887.7123 or havenc@nwf.org

Photo by Kari Lydersen.

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