Helping Marina and Harbor Operators Respond to Climate Change

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Project Context and Objectives

Many Great Lakes coastal communities include small recreational harbors or private marinas that provide numerous social and economic benefits (Great Lakes Commission 2007) and a sense of place for the community. Michigan is home to more than 800 marinas and harbors. These facilities experience a variety of climate change impacts, including shorter winters (Kling and Wuebbles 2005); warmer temperatures (U.S. Global Change Research Program 2009); more intense storms (Mortsch et al. 2003); reduction in ice cover (Wang et al. 2011); and fluctuating lake levels (Holman et al. 2012). Concurrently, the infrastructure of many of these facilities is aging and deteriorating while funding needed improvements is a struggle in an uncertain economy and declining state and federal funding. To increase capacity for climate change resilience, these enterprises need access to resources and tools that improve understanding of potential climate-related impacts and provide a suite of management practices, infrastructure improvements and funding options.

A variety of climate adaptation tools are currently available, but may be overwhelming without a structured introduction to information and available tools. A sense of information overload paired with uncertainty in environmental conditions may result in an overall lack of confidence in assessing or adopting potential responses. Such factors complicate – and sometimes deter – responsive actions in the face of environmental change and necessitate a structured and accessible approach to delivering information to stakeholders.

Our project aimed to assist marina and harbor operators in sector-specific problem identification, decision-making and planning related to climate change adaptation. As an outcome of this project, marina and harbor operators increased knowledge of climate change impacts; were equipped to identify and implement sector-specific responses to variable conditions; gained familiarity with available tools and technology; participated in development of best management practices; and developed insight on messaging to local planners and decision makers.

Project Approach

Michigan Sea Grant led a team of industry, legal, science, extension, education, and tourism professionals that developed training materials about climate change for marina and harbor operators. This project team met monthly by conference call and regularly communicated through email updates. The team provided technical input and overall direction for the project, including approval of the work plan. Great Lakes Integrated Sciences and Assessments (GLISA) staff assisted by offering guidance and support throughout the project period, facilitating outreach efforts (e.g., Michigan Municipal League contacts, invitation to Adaptation in the Great Lakes Conference), providing staff support for a climate trend presentation at three outreach events, and facilitating quarterly progress updates with peer knowledge exchange among the 2013 cohort of funded projects.

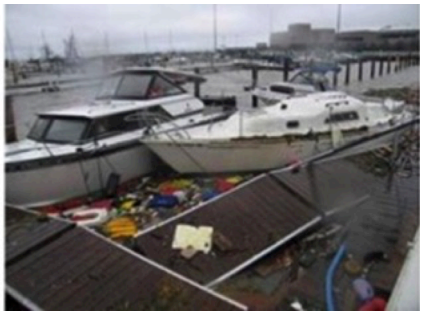
The overall project goal was to develop training content for marina and harbor operators in increasing resilience to climate change. A new unit for an existing training tool was created to efficiently reach marina and harbor operators. Companion print and web-based materials are publicly available and used by extension educators who work with marinas and shoreline businesses in relaying information on coastal resilience.

Training Content Development

Based on previous investment in establishing the Clean Marina Classroom (www.cleanmarinaclassroom.org) as an online training tool for operators, the new climate-related training material was modeled after and incorporated as part of the existing Classroom. The first section includes an overview of relevant environmental risks and potential impacts, plus a summary of topically organized resources and tools. The remaining three sections (Sections 2-4) provide best practices for marina and harbor operators in adapting to environmental variability and building resilience to climate change (Table 1).

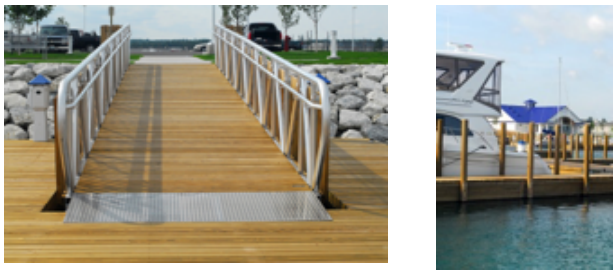
Framing

To cater our messaging to our target audience, we framed climate-related risks as threats to the facility or operations of harbors and marinas. For example, since marina and harbor patronage is vulnerable to impacts that influence infrastructure, aesthetics, and navigability, we framed these



Left: Storm damage from Hurricane Sandy at a Lake Erie marina. (Source: Ohio Department of Natural Resources)
Right: Wind-generated waves breach the harbor structure in Canal Park in Duluth, Minnesota. (Source: Gene Clark, Wisconsin Sea Grant)

as operational risks. We used images of marina damage from Hurricane Sandy to illustrate how increased storm intensity can impact a waterfront facility. Such images provide visual context and create a sense of immediacy and personal connection to what may otherwise seem a remote possibility of risk. Tools and adaptation approaches were provided with an introduction and interpretation specifically crafted for marina and harbor operators.



Floating dock and gangway at Straits State Harbor; Mackinaw City, Michigan

Table 1: Summary of Increasing Resilience Unit Training Content

Section Title	Best Management Practices/Topic
Section 1: Potential Risks and Impacts Background	An overview impacts and tools to learn more about the three major environmental and climate-related changes most relevant to ports, harbors, and marinas: • Fluctuating Water Levels • Increased Storm Frequency and Intensity • Precipitation and Temperature Changes
Section 2: Infrastructure	Best practices related to potential risks and adaptations for stormwater management, buildings, wood infrastructure, floating docks, shoreline protection, and pilings: • Evaluate Risks to Infrastructure and Grounds • Invest in Permanent Adaptations
Section 3: Dredging	Best practices related to the complexity of jurisdictional considerations and permit and funding requirements: • Identify Jurisdiction for Dredging • Collect Required Information • Explore Funding Options
Section 4: Planning and Financing	Best practices for community adaptation planning, creating facility-specific plans, and exploring financing options for applying adaptations: • Represent Your Facility in Community Planning • Create Facility-specific Plans • Estimate Costs of Adaptation • Explore Financing Options

Featured Resources

Content was derived from known resources, expert knowledge, operator input, and a literature review of climate adaptation resources specific to waterfronts. The roster of featured resources grew as the project progressed, including:

- Interactive Tools:
  - Great Lakes Water Level Dashboard (glerl.noaa.gov/data/wldb)
  - Great Lakes Lake Level Viewer (www.coast.noaa.gov/digitalcoast/tools/llv)
  - Great Lakes Infrastructure Matrix and Dredging Cost Estimate Tool (climategreatlakes.com/great-lakes-port-harbor-infrastructure-matrix)
  - Climate Wizard (www.climatewizard.org)
  - Cities Impacts & Adaptation Tool (graham-maps.miserver.it.umich.edu/ciat)
- Data Collections:
  - USACE Water Level Bulletins and Forecasts (www.lre.usace.army.mil/Missions/GreatLakesInformation/GreatLakesWaterLevels.asp
  - CoastWatch: Great Lakes (coastwatch.glerl.noaa.gov)
  - FEMA Flood Map Service Center (msc.fema.gov/portal)
- Guidance Resources:
  - NOAA Great Lakes Coastal Resilience Planning Guide (www.greatlakesresilience.org)
  - Adapting to Climate Change: A Planning Guide for State Coastal Managers (coastalmanagement.noaa.gov/climate/docs/adaptationguide.pdf) and Great Lakes Supplement (coastalmanagement.noaa.gov/climate/docs/adaptationgreatlakes.pdf)

Content was also informed by the Great Lakes Integrated Sciences and Assessments Center, 2014 National Climate Assessment, International Upper Great Lakes Study, NOAA Great Lakes Environmental Research Laboratory, NOAA Office for Coastal Management, University of Wisconsin Sea Grant Institute, Michigan Clean Marina Program, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, National Working Waterfronts Network, The Nature Conservancy, and others.

Beta Testing

Beta testing was conducted from October 22 to November 5, 2014. Twenty-seven individuals were invited to participate, including the project team, GLISA staff, and representative facility operators and climate outreach specialists. Eleven people formally participated, and several others contributed feedback outside of the formal Qualtrics-based survey. Beta testers included representatives from the National Sea Grant Law Center, Ohio Sea Grant, Illinois-Indiana Sea Grant, Wisconsin Sea Grant, Illinois Coastal Management Program, Purdue University, City of South Haven, City of Alpena, a private marina, and a consulting firm.

Overall, beta testing indicates a positive review of the unit. The unit was scored 4.73 of 5 with eight "excellent" ratings, defined as providing information that was "easy to understand, applicable and well presented." When asked to rate the unit's contribution toward the goals and outcomes for the project, the unit was rated 4.6 of 5. Comments on this rating include:

- Good contribution to issue in good location (Clean Marinas).
- The amount of information given is great, and the links to external resources is an amazingly useful feature.
- I thought this unit was very comprehensive. It was full of information, but not overwhelming. I definitely think users will learn a lot taking this Unit.
- Text describes via both text and photos the major issues they should be aware of in a clear and easily understandable format.
- There is a lot of good information here! I think it's well organized and should help people that it's all in one place.

Information from *Section 1: Potential Risks and Impacts Background* scored highly (easy to understand, applicable, and well presented), suggesting the identification of sector-specific risks and related tools was valuable. This feedback supports the premise of this project by confirming perceived value in customizing climate training information and also indicates potential for replicating this effort for other stakeholder groups.

In consideration of our effort to relay climate adaptation information to the target marina and harbor operator audience, challenges perceived by beta testers include:

- Communicating effectively, in an easy-to-understand way, without overwhelming the user with too much information.
- Overcoming preoccupation of marina operators (mostly small businesses and small communities) with more immediate concerns, like cash flow.
- [Clarifying the] many unknowns; there is some opposition to climate change discussion.
- Convincing them the data is relevant to their particular harbor. Many operators are retired, part-time individuals that may be lacking in the understanding of that [which] you are trying to tell them.

The team addressed these and other challenges as described in the *Challenges and Lessons Learned* section, below.

Stakeholder Engagement

A core component of our project was Michigan Sea Grant's capacity to serve as a bridge between researchers and stakeholders. Building on a prior needs assessment, the team maintained an open dialogue with stakeholders to ensure project outcomes would be useful to the target audience of marina and harbor operators. Early in the project, the team acknowledged that local decision makers are also key players in determining the efficacy of waterfront climate adaptation efforts. Consequently, the team expanded outreach goals to include municipal planners and local communities. Additionally, conference and community presentations, a printed project summary, fact sheets, and public webpages successfully extended our project outreach effort beyond initial goals.

Stakeholder Poll

To clarify stakeholder needs, we conducted outreach to marina and harbor operators for input on recognized environmental changes and associated impacts. Input was collected at the 2013 Michigan Harbor Masters Association meeting and through an online Qualtrics-based survey circulated by Michigan Boating Industries Association.

Operators reported lake level changes and storm-related structural repairs as having the most impact on facilities. They also expressed interest in grant funding assistance for adaptation projects and collaborative development of best practices. Training content was developed based on this input, existing adaptation guidance, advice from the project team, and feedback from workshops where operators provided insight on best practices.

Workshops

The project included a workshop series to explore and promote proposed best practices for climate adaptation at marinas and harbors. The project was introduced in workshops in Petoskey (April 2014) and Harrison Township (July 2014) and fully presented in Grand Haven (August 2014), Michigan Harbor Masters Association Meeting (December 2014) and Michigan Boating Industries Association's Recreational Boating Educational Conference (December 2014). The final two workshops represent a full circle effort, in reporting back one year after the initial stakeholder poll was distributed to harbor masters and MBIA membership.

Webinar

On November 17, 2014 Michigan Sea Grant hosted a webinar titled "Increasing Resilience for Marinas and Harbors Webinar: Facing an Uncertain Future." The hour-and-fifteen-minute online seminar included an overview of climate trends (by Dan Brown of GLISA), Great Lakes levels update, and best practices to increase resilience to changing environmental conditions. The event was publicized through Michigan Sea Grant's email distribution lists, calendar of events, social media, and GLIN-announcements and by partners including the Wisconsin Marine Association.

Forty-four individuals registered for the event, including representatives from U.S. Army Corps of Engineers, U.S. Environmental Protection Agency – Region 5, Great Lakes Commission, Council of Great Lakes Industries, Marina Dock Age magazine, Delta Institute, Bay-Lake Regional Planning Commission (WI), Florida Department of Environmental Protection, Indiana Department of Environmental Management, Michigan Department of Environmental Quality (including Coastal Zone Management Program), New York State Department of Environmental Conservation, Wisconsin Department of Natural Resources, Ohio Sea Grant, Wisconsin Sea Grant, several consulting and law firms (IL, IN, MI, NY) and private marinas from Michigan, Minnesota and Wisconsin.

Conference Presentations

The project and best practices for increasing resilience were presented at several conferences: Michigan Municipal League – Green Communities Conference (February 2014), Adaptation in the Great Lakes Conference (June 2014) and the Ohio Climate Preparedness and Resiliency Roundtable (July 2014). GLISA assisted our team by facilitating participation in two of these conferences, enabling us to further disseminate our project findings.

Publications

Michigan Sea Grant seized several opportunities to engage media and other outreach outlets, resulting in publications that furthered the scope of our outreach effort:

- The Review – Michigan Municipal League magazine. "Marinas and Harbors: Standing the Test of Time." May-June issue; pg 11. Available: http://www.mml.org/RESOURCES/PUBLICATIONS/MMR/issue/may-june2014/review-mayjune2014-online.pdf
- Great Lakes Boating Magazine. "Climate Change Affects Boating." July-August issue; pg 26. Available: http://issuu.com/glbm/docs/julyaugust_issue_web
- July 2014 Network Update (National Working Waterfronts Network). "Marinas and Harbors Addressing Impacts of Weather Changes." Available: http://campaign.r20.constantcontact.com/render?ca=69f0d5c5-f152-4238-b580-415d0cda8c9c&c=38637440-b9e8-11e3-8c1c-d4ae529a8250&ch=388490d0-b9e8-11e3-8c29-d4ae529a8250
- Michigan Journal of Sustainability – Special Edition on Climate Adaptation in the United States. "Engaging Marina and Harbor Operators in Climate Adaptation." In review.

Featured Resources and Outputs

Project outputs will support the objective to increase knowledge and adaptive capacity for marina and harbor operators long after the project period concludes. As outputs from this project, Michigan Sea Grant has developed:

- *Clean Marina Classroom: Unit 10 – Increasing Resilience* (www.cleanmarinaclassroom.org)
- *Reinforcing our Waterfronts: Increased Resilience at Marinas and Harbors* (Project Summary)
- Webpages
  - *Climate Adaptation* (http://www.miseagrant.umich.edu/explore/climate-weather-and-the-great-lakes/climate-adaptation/)
  - *Policy and Planning for Coastal Communities* (http://www.miseagrant.umich.edu/explore/coastal-communities/policy-planning-coastal-communities/)
- Fact Sheet Series: Climate Adaptation Tip Sheets (http://www.miseagrant.umich.edu/great-lakes-clean-marina/publications-and-resources/tip-sheets/)

Clean Marina Classroom Unit

The "Increasing Resilience" training module was developed as a new unit of the Clean Marina Classroom (www.cleanmarinaclassroom.org), an online training tool for marina and harbor operators. The Classroom provides

an established platform for training content and is used by several Clean Marina programs in the Great Lakes basin.

Project Summary

The *Reinforcing our Waterfronts: Increased Resilience at Marinas and Harbors* project summary was developed to provide a publicly available version of the content developed for *Unit 10: Increasing Resilience*. The eight-page, full-color publication was printed and mailed to 783 marina and harbor operators in Michigan. Additionally, through the Great Lakes Clean Marina Network, we identified interest from other Great Lakes programs and arranged to ship a supply of booklets to partner programs in Illinois, Indiana, Minnesota, Ohio, and Wisconsin.

Webpages

Two webpages were developed to further establish a presence for educational content outside of the password-protected Clean Marina Classroom. The *Policy and Planning for Coastal Communities* webpage provides an introduction to planning terminology and practices. Climate adaptation and working waterfront protections often evolve from existing planning practices, including use of zoning ordinance and harbor management plans. This page provides a brief introduction to these concepts. The *Climate Adaptation* webpage provides a summary of climate adaptation planning efforts and resources. Content on these two pages is supplemental to the Classroom content.

Fact Sheet Series

We issued three fact sheets that address infrastructure, dredging, and planning and financing sections of the Classroom to make the content developed for the Classroom available to a broad audience. These additional supporting materials are publicly available on the Great Lakes Clean Marina Network webpage and may be especially useful to extension educators and marina and harbor operators who have not enrolled in the Clean Marina program.

Challenges and Lessons Learned

We confronted several challenges that will inform development of the next generation of climate resilience tools. One challenge in customizing outreach efforts was establishing access and trust with stakeholders. We overcame this challenge by incorporating the Michigan Boating Industries Association, Michigan State Harbor Masters Association, Great Lakes Clean Marina Network, and the National Working Waterfront Network as collaborators. We found word of mouth and advice from industry peers was a significant factor in how operators attain and apply information. Working within existing, trusted peer networks first established access and then increased the efficacy of our outreach effort. If replicating this work, a key element for success will be to identify analogous partners.

A second challenge was focusing the attention of an audience typically dedicated to day-to-day operations on longer-term issues and solutions. This tendency to focus on short-term needs may be amplified when working with stakeholders who work on a seasonal basis, such as marina and harbor staff. One stakeholder group declined our invitation to formally collaborate, stating their need to focus on "immediate needs." For future efforts, we recommend framing climate adaptation as an immediate need, overcoming temptations to delay or decline action. For example, as operators replace aging or deteriorating infrastructure, our training materials encourage investment in replacement structures that accommodate predicted future environmental extremes.

A third challenge was accounting for uncertainty and personal bias against climate science. Our climate is changing – often in unpredictable ways – and it is difficult to convey inherent uncertainties of climate science predictions. For example, though we know existing science predicts a wide range of lake level changes (Lofgren et al. 2011, Holman et al. 2012), extraordinarily low lake levels in 2013 garnered much public attention; these perceptions were confounded by a rapid rebound in lake levels in 2014. To address potential roadblocks of climate change bias or mistrust of science, we focused our message on building resilience to a range of conditions.

Next Steps

Findings from this research suggest that customized training materials are more accessible and useful if framed in a stakeholder's familiar context and language, adapted to the constraints (e.g., seasonal appointment) and priorities of the user and ideally collaboratively developed and refined. Also, by recognizing both impacts and potential adaptations, users will be better informed in recognizing risks and identifying and implementing efforts to increase their facility's resilience to climate change.

Members of the project team have noted that in addition to the resources made available through this project, there is potential for added value in repackaging and expanding distribution of training content. For example, additional magazine articles, newsletters, or blogs could expand our audience and provide a quick reference on a waterfront adaptation topic.

Beta testing indicated interest in exploring additional best management practices, including how to build soft shorelines that adapt to changing water levels, how to reduce sediment in rivers, sedimentation traps, anti-erosion measures, green buffers on shoreline, storm drain improvements, and tillage restrictions. Additionally, Ohio Sea Grant is developing coastal storm preparedness materials specific to the Great Lakes which should be incorporated in the Clean Marina Classroom.

Finally, increasing general climate awareness is an ongoing need. To further engage full-time planners, as opposed to seasonal harbor operators, it would be beneficial to provide additional outreach to local planning agencies, city managers, village presidents, and councils who have year-round responsibility for managing public harbors. As one beta tester stated, our training content "will likely be the best resource available to operators that deal with long-range sustainability – to the extent that operators have that objective, the unit will be a valuable tool." Michigan Sea Grant and GLISA will continue to share the goal for waterfront communities, including marina and harbor operators, to indeed set the objective to attain long-term sustainability.

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