

# **Best Practices for Climate Change Adaptation: Spotlight on Michigan Coastal Wetlands**



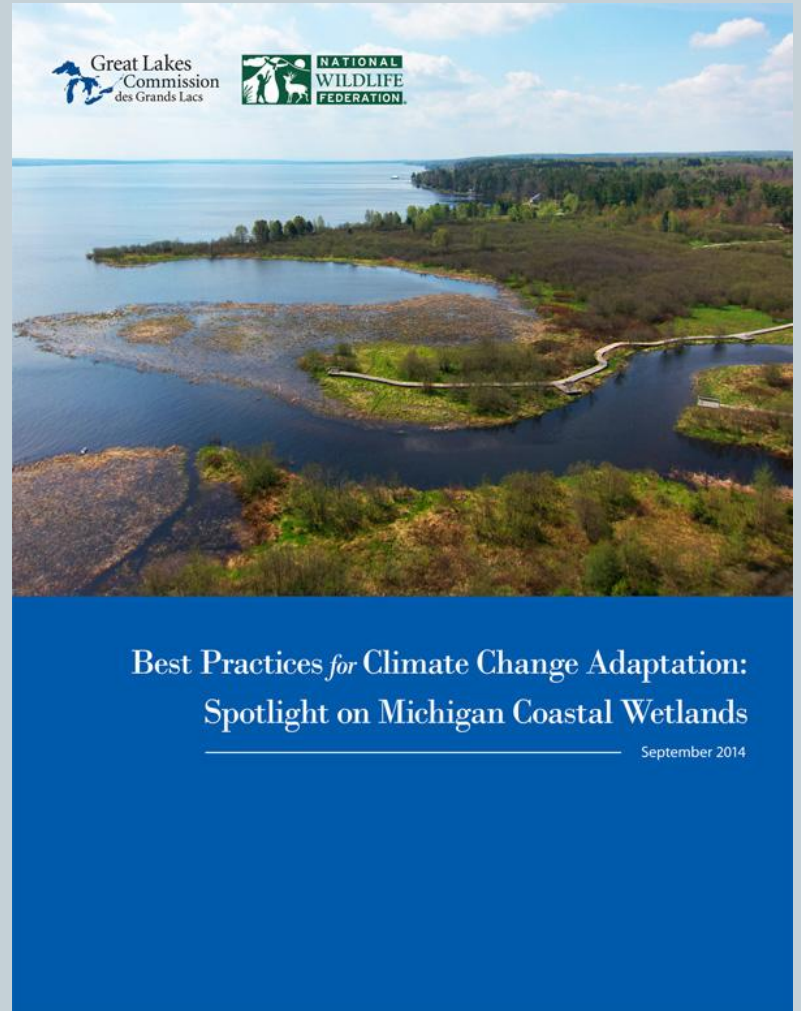
**SEPTEMBER 2014**

**GREAT LAKES COMMISSION &  
NATIONAL WILDLIFE FEDERATION**



# WEBINAR OUTLINE

- **Building the Best Practices Toolkit**
- **Examples of Best Practices**
- **Next steps**



# WHY A BEST PRACTICES TOOLKIT?

**Michigan DEQ  
wanted input  
to improve  
implementation  
of their 2012  
Coastal Wetlands  
Adaptation Plan**

## **Climate Change Adaptation Plan for Coastal and Inland Wetlands in the State of Michigan**

•  
**A White Paper Prepared for the  
Michigan Department of Environmental Quality  
Wetlands Program  
and  
Coastal Management Program**



**Association of State Wetland Managers  
September, 2012**



# WHAT ARE THE MAIN STEPS?



- 1. Create a Project Review Committee (PRC)**
- 2. Develop Best Practice Evaluation Criteria**
- 3. Identify Candidate Best Practices**
- 4. Evaluate, Rank, and Refine Best Practices**
- 5. Design the Toolkit**
- 6. Conduct Outreach**

# PROJECT REVIEW COMMITTEE



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- Kathy Evans, WMSRDC
- Anne Garwood, MI DEQ
- Elizabeth Gibbons, Graham Sustainability Institute – University of Michigan
- Patty Glick, NWF
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- Michael Murray, NWF
- Sarah Opfer, NOAA
- Steve Rice, Cardno JFNew
- Brent Schleck, NOAA
- Heather Stirratt, NOAA
- Lynn Vaccaro, Michigan Sea Grant

# STAGES OF WETLAND MANAGEMENT



# THE APPROACH



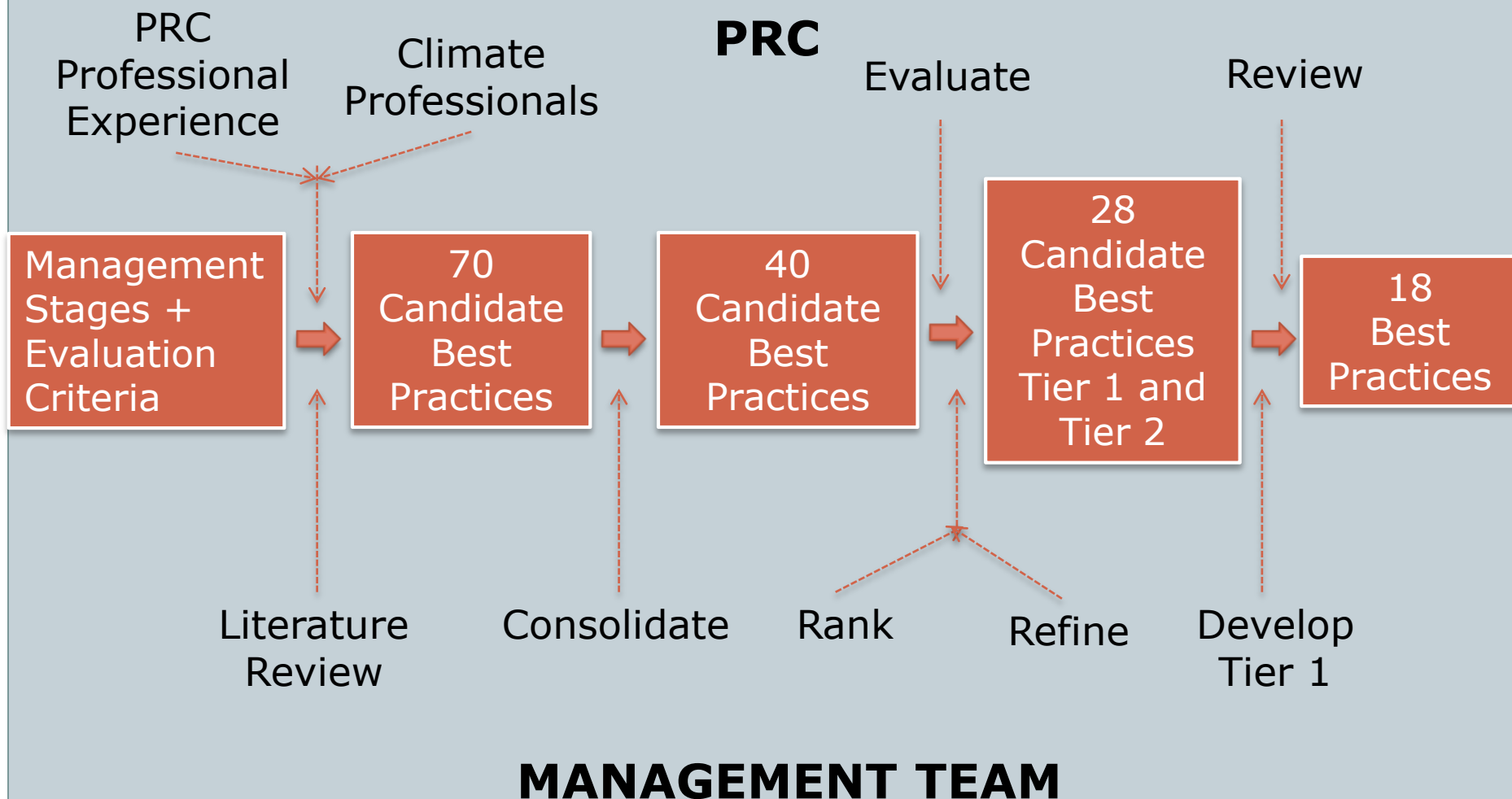
## **2 levels**

Institutional level

Project level

**What is a Best Practice?**

# BUILDING THE TOOLKIT



# BEST PRACTICES TOOLKIT

# I

Best Practices for Climate Change Adaptation: Spotlight on Michigan Wetlands

Institution-level Wetland Adaptation Best Practices | Best Practice #1

## Wetland Adaptation Forums

Conduct periodic public wetland symposiums/forums to advance adaptation knowledge

In rapidly evolving fields like climate change adaptation, regular opportunities for practitioners and key thinkers in the field to come together to exchange experiences and ideas are essential. Small focused invitational workshops are helpful, but there should also be a regional symposium or forum every 1-3 years. This could be open to all interested parties focused either specifically on wetland conservation and restoration in a changing climate or more generally on climate change adaptation. Unrestricted attendance broadens the adaptation network and provides more opportunity for new voices to participate and emerge.

The format can be more directed, for example, built around a set of invited speakers and workshops put together by the organizers, or more participant-driven, with open submission of proposals for presentations, posters or workshops. In either case, the schedule should include ample time for informal interaction and networking, which are an essential component of the empowerment and internalization of climate-smart thinking that are such an important outcome of this sort of forum. Webinars may also be considered to reach more people.

The outcomes of wetland adaptation forums are two-fold. There should be a set of written outputs in the form of proceedings, synthesis reports or overview essays. These may be disseminated via websites and blogs, published reports, or a collection of papers published in a peer-reviewed journal. No less important, however, is the creation of partnerships, project ideas and general inspiration to act; forum organizers and participants should consider ways in which these latter outcomes can be fostered.

### Case Example | Coastal Habitat Conservation in a Changing Climate workshop

In September 2011, the National Wildlife Federation and the National Oceanographic and Atmospheric Administration hosted a two-and-a-half day workshop titled "Coastal Habitat Conservation in a Changing Climate: Strategies and Tools for the Great Lakes Region." The meeting began with a series of presentations giving an overview of regional climatic variability, longer-term changes and impacts. Presenters addressed questions such as how particular climatic changes might affect species, ecosystems, water quality and economies; possibilities for ecological adaptations; and how to integrate climate information into coastal conservation and management despite uncertainties. These presentations provided a common understanding of the state of knowledge for meeting participants.

The second day consisted of breakout sessions built around issues of regional importance, including fish passage, Areas of Concern, invasive species management, agricultural watersheds, and conservation and acquisition. There was also a Tools Café introducing participants to a range of tools supporting regional conservation and restoration work. The breakout format provided an opportunity for extensive interaction and sharing among meeting participants. The second day concluded with field trips to ground participants in the reality of Great Lakes coastal habitat management and restoration work. The third day included another set of breakout sessions as well as an overview of ongoing efforts and next steps.

In evaluations, workshop participants commented on the value of the workshop in providing a diversity of new information and developing new collaborations and partnerships.

### Best Practice #1 | Wetland Adaptation Forums

#### Challenges and Benefits

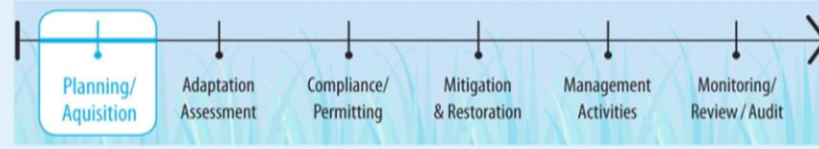
Organizing and implementing regional meetings is not a small task, requiring a host of logistical considerations including venue, catering, registration, and corralling the necessary staff and volunteers to support speakers, posters and workshop faculty. Attendance can also pose a challenge. Agency staff and other natural resource practitioners typically have their plates full meeting their day-to-day responsibilities, and securing the time and funding (if travel is required) to attend meetings not directly linked to project work can be difficult. Webinars are another option that reduce travel expenses. Webinars have the benefit of reaching more dispersed audiences but are limited to those with Internet technology. Also, they don't provide the same level of interaction that in-person meetings do.

The potential benefits of wetland adaptation forums make dealing with these challenges worthwhile. They allow the sharing of experiences and ideas among a broad audience in a short period of time, and provide an opportunity for back-and-forth discussion and brainstorming that webinars or presentations do not. They can also limit the frequency with which people "reinvent the wheel," meaning more resources can go toward on-the-ground action than toward searching for solutions that already exist.

#### Who should implement the practice?

Symposia or forums should be organized by teams made up of a diversity of players, including federal, state, local or tribal government agencies, intergovernmental groups, non-profits, academic institutions, and businesses engaged in wetland conservation and restoration. Groups charged with supporting regional adaptation outreach and capacity-building, such as Landscape Conservation Cooperatives or NOAA climate hubs, are particularly well-suited to these sorts of efforts.

#### When should this practice happen?



#### Tools and Resources

**National Adaptation Forum** | Not wetlands-focused, but this biennial forum is one of the largest gatherings of adaptation professionals, and materials from previous NAFs can serve as models for a wetlands-focused forum. | [www.nationaladaptationforum.org](http://www.nationaladaptationforum.org)

**The Climate Adaptation Knowledge Exchange** | CAKE's calendar of adaptation events can help you see when and where related events are happening, and you can use its georeferenced search capability to find potential partners. | [www.cakex.org](http://www.cakex.org)

**Michigan Wetlands Association** | The annual meetings are not all adaptation-focused, but typically there are opportunities through one or more sessions to address adaptation issues. | [www.miwetlands.org](http://www.miwetlands.org)



# INSTITUTIONAL LEVEL BEST PRACTICES



1. Wetland Adaptation Forums
2. Adaptation-Informed Funding
3. Update State Planning Documents
4. Continuing Education of Practitioners
5. Climate Screening of Wetland-Related Policies
6. Climate-informed Buffer Ordinance Language
7. Processes for Information Access
8. Climate in Wetland Permitting

# PROJECT LEVEL BEST PRACTICES



9. Partner with Experts
10. Engage Stakeholders
11. Data Use and Trend Analysis to Inform Planning
12. Incorporate Climate Change in Land Protection Decisions
13. Lessons Learned Reports
14. Climate Vulnerability Assessments
15. Consider Multiple Climate Scenarios
16. Adaptation Performance Indicators
17. On-going Coastal Wetland Monitoring
18. Consider Climate in Wetland & Shoreline Restoration

# Recommendations from Climate Change Adaptation Plan for Coastal and Inland Wetlands (2012) Compared with Best Practices



Category	Recommendation	Best Practice	Category	Recommendation	Best Practice
Advanced Strategic Planning	Host a workshop or series of workshops with experts to evaluate the feasibility of possible responses to climate change under different management scenarios	1, 15	Voluntary Restoration, Conservation and Management	Develop a state GIS database that provides the ability to do multiple analyses for leveraging wetland restoration, management and protection to provide ecosystem services and mitigate the impacts of climate change	7, 11
	Continue to address issues of GL coastal management in light of uncertain future conditions	15		Identify opportunities for land management and conservation programs to promote protection of coastal wetlands as lake levels change	10
	Develop new model approaches to management of shoreline during a period of change and uncertainty	8, 12, 15, 18		Incorporate appropriate preservation, restoration and similar climate change adaptation measures for coastal wetlands into state's plans	3
	Revise Michigan's AIS Management Plan to anticipate climate change related migration of species from southern biomes	3		Give continuing education credit to local governments for getting training in climate change adaptation	4
Monitoring and Assessment	Identify sources of continually updated information about climate and related status and trends that can be used to measure changes in climate in the state of Michigan	7, 11	Regulation	Revision of current regulatory process to integrate climate change adaptations into the wetland dredge and fill permitting, enforcement and mitigation decision making process	6, 8
	Establish long-term desired outcomes and metrics to identify progress, to measure progress adapting to climate change	16		Consider changes to 404 Program to integrate climate change concerns	5, 8
	Conduct literature review and interview wetland managers and scientists to establish a list of the wetland types as well as individual flora and fauna most threatened by climate change	14		Train staff, wetland consultants and other professionals on how to incorporate climate change measures into wetland regulatory processes including permitting, enforcement and mitigation	2, 6, 8
	Adapt existing wetland monitoring programs to document changes in wetland communities over time	9, 17		Integrate wetland protection and restoration into state flood hazard and climate change initiative	3
	Incorporate the most up-to-date climate change information into Michigan's plans to guide State agencies in program and policy decisions	3, 5		Identify climate change adaptation measures for coastal wetlands and encourage coastal communities to incorporate these measures into local plans and ordinances	6, 8
	Document and communicate success or failures of implementation of wetland protection, restoration and management actions to adapt to climate change in an annual report	13	Integration with Other Water Programs	Provide greater incentives for adopting strategies that provide multiple benefits over single purpose projects	2
	Consider the use of data collected through ongoing coastal wetland monitoring to establish a clear baseline for coastal wetland condition	11		Identify adaptation actions that will maintain or expand overall biodiversity, increase connectivity of coastal wetland areas, and improve water management to address multiple natural resource goals and priorities	18

# BEST PRACTICES FEATURED TODAY



- 
- The background of the slide features a faded, light-colored image of a wetland landscape. It shows a body of water in the foreground, with a path or shoreline leading into a dense area of trees and vegetation in the background. The overall tone is soft and naturalistic.
- 7. Processes for Information Access
  - 8. Climate in Wetland Permitting
  - 11. Data Use and Trend Analysis to Inform Planning
  - 12. Incorporate Climate Change in Land Protection Decisions
  - 13. Lessons Learned Reports
  - 14. Climate Vulnerability Assessments
  - 15. Consider Multiple Climate Scenarios
  - 16. Adaptation Performance Indicators
  - 18. Consider Climate in Wetland and Shoreline Restoration

## 7. PROCESSES FOR INFORMATION ACCESS

### Create a process to enable managers to evaluate regional climate models, reports and relevant websites

- Climate information can be difficult to interpret and apply
- Encourage sustained collaboration between scientists and practitioners

#### Sources

- Professional Collaboratives
- Adaptation web hubs



# 7. PROCESSES FOR INFORMATION ACCESS

## Challenges

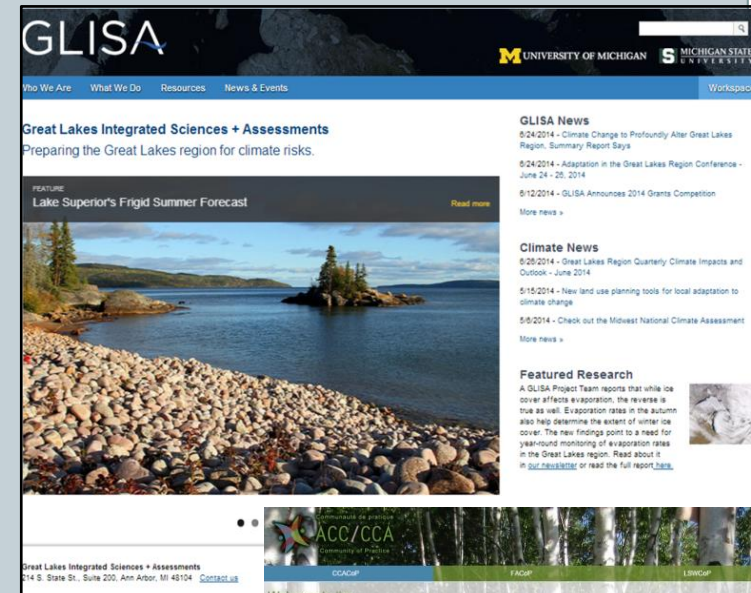
- Requires sustained funding
- Time commitment

## Benefits

- Climate considerations more likely to be applied
- Restoration success long-term

## Implementer

- Collaboration between scientists, managers and practitioners, “boundary organization”



# 7. PROCESSES FOR INFORMATION ACCESS

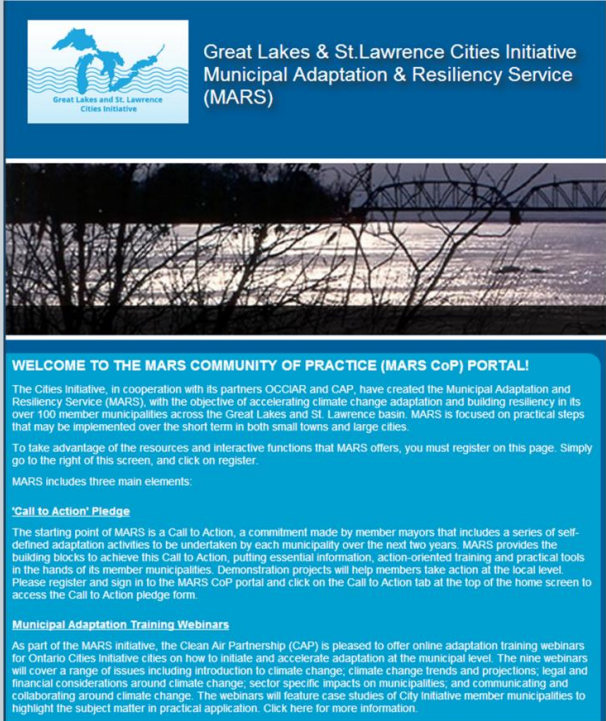


## Case study

### Great Lakes & St. Lawrence Cities Initiative Municipal Adaptation & Resiliency Service (MARS)

## Tools / Resources

- <http://www.glslcities.org/mars.cfm>
- Climate Change Adaptation Community of Practice
- The Georgetown Climate Center's Adaptation Clearinghouse



**Great Lakes & St. Lawrence Cities Initiative Municipal Adaptation & Resiliency Service (MARS)**

**WELCOME TO THE MARS COMMUNITY OF PRACTICE (MARS CoP) PORTAL!**

The Cities Initiative, in cooperation with its partners OCCAR and CAP, have created the Municipal Adaptation and Resiliency Service (MARS), with the objective of accelerating climate change adaptation and building resiliency in its over 100 member municipalities across the Great Lakes and St. Lawrence basin. MARS is focused on practical steps that may be implemented over the short term in both small towns and large cities.

To take advantage of the resources and interactive functions that MARS offers, you must register on this page. Simply go to the right of this screen, and click on register.

MARS includes three main elements:

**'Call to Action' Pledge**

The starting point of MARS is a Call to Action, a commitment made by member mayors that includes a series of self-defined adaptation activities to be undertaken by each municipality over the next two years. MARS provides the building blocks to achieve this Call to Action, putting essential information, action-oriented training and practical tools in the hands of its member municipalities. Demonstration projects will help members take action at the local level. Please register and sign in to the MARS CoP portal and click on the Call to Action tab at the top of the home screen to access the Call to Action pledge form.

**Municipal Adaptation Training Webinars**

As part of the MARS initiative, the Clean Air Partnership (CAP) is pleased to offer online adaptation training webinars for Ontario Cities Initiative cities on how to initiate and accelerate adaptation at the municipal level. The nine webinars will cover a range of issues including introduction to climate change, climate change trends and projections, legal and financial considerations around climate change, sector specific impacts on municipalities, and communicating and collaborating around climate change. The webinars will feature case studies of City Initiative member municipalities to highlight the subject matter in practical application. Click here for more information.

## 8. CLIMATE IN WETLAND PERMITTING



### **Evaluate wetland permit requirements and modify if necessary to incorporate climate adaptation considerations**

- Permit review facilitates project evaluation
- Minimize unintended consequences

#### **Approaches**

- Permit applications should require consideration of climate adaptation
- Applicants should be evaluated based on climate adaptation considerations
- Modify DEQ Project Review Reports

# 8. CLIMATE IN WETLAND PERMITTING



## Challenges

- Requires revisions to statute or rules for permit applications
- ❖ Requires applicants to understand adaptation elements

## Benefits

- Promotes long-term success of coastal wetland restoration

## Implementer

- Permit issuing agencies



# 8. CLIMATE IN WETLAND PERMITTING



## Case Study

San Francisco Bay Plan Implementation:  
San Francisco Bay Conservation and  
Development Commission



## Tools/Resources

- Michigan Natural Resources and Environmental Protection Act (Act 451) of 1994, Section 30311 Project Review Report
- San Francisco Bay Conservation and Development Commission (BCDC)

# 11. DATA USE AND TREND ANALYSIS



## **Use land cover, land-use data and spatiotemporal trend analyses to help inform wetland planning**

- Understanding the patterns underlying past changes can help prepare for the future
- Identify key drivers of wetland extent and condition and potential information sources
- Multiple information sources available

### **Outputs**

- Maps of past change
- Correlative models that generate projections of possible future changes

# 11. DATA USE AND TREND ANALYSIS



## **Challenges**

- Model output as good as data and assumptions
- Expert analysis can be expensive
- The future cannot be predicted

## **Benefits**

- Models highlight need to plan for climate change
- Enable analysis of past events to anticipate and prepare for potential future changes
- Even a qualitative approach can facilitate visualization of future options

## **Implementer**

- Planners and managers

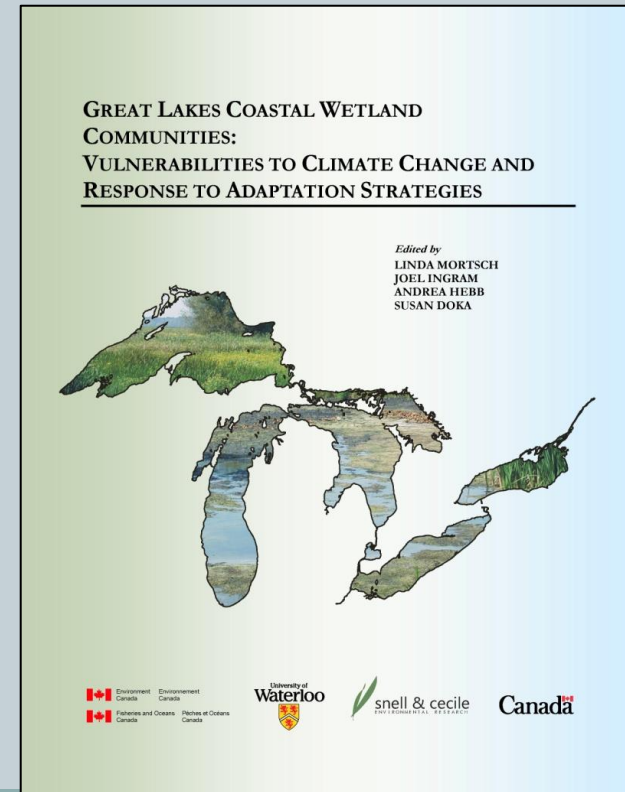
# 11. DATA USE AND TREND ANALYSIS

## Case Study

### Canadian Great Lakes Coastal Wetlands Communities: Vulnerabilities to Climate Change and Response to Adaptation Strategies

## Tools/Resources

- National Oceanic and Atmospheric Administration – Coastal County Snapshots
- Michigan wetlands map viewer
- National Wetlands Status and Trends – U.S. Fish and Wildlife Service



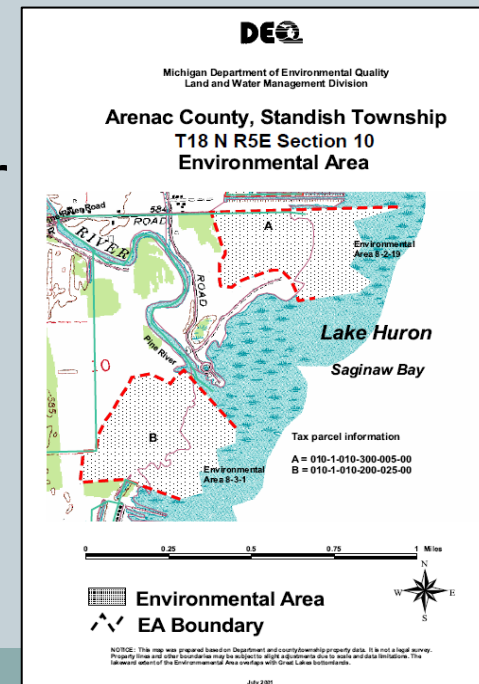
# 12.CLIMATE CHANGE IN LAND PROTECTION

## As lake levels fluctuate, use acquisition, conservation easements and other tools to preserve and conserve

- Land protection can be used to accommodate the effects of lake level fluctuation
- Submerged lands should be considered
- Regulatory framework governing land/water interface can be complex

### Novel Options

- Environmental Areas in Michigan
- Rolling Easements



# 12.CLIMATE CHANGE IN LAND PROTECTION



## **Challenges**

- Land in private ownership may not be for sale
- Acquisition is expensive
- Long-term management is expensive

## **Benefits**

- Coastal wetlands can migrate and adapt
- Easements may be more affordable
- Protection can provide ecological connectivity

## **Implementer**

- Agencies, NGOs

# 12.CLIMATE CHANGE IN LAND PROTECTION



## **Case Study**

Ducks Unlimited Southwest Lake Erie Land Protection Strategy



## **Tools/Resources**

- NOAA– Coastal Change Analysis Program
- U.S. EPA – Rolling Easements
- Michigan Environmental Area Program

# 13. LESSONS LEARNED REPORTS



**Document success or failures of implemented principles for protection, restoration and actions**

- Help inform adaptive management
- Need systematic approach

## **Reports**

- Use template
- Help guide next steps
- Available to others



USFWS

# 13. LESSONS LEARNED REPORTS

## Challenges

- Time commitment
- Ensuring wide readership
- Objective assessments

## Benefits

- Facilitate active learning, adaptive management

## Implementer

- Agency, NGO, academic group



Ducks Unlimited, USFWS

# 13. LESSONS LEARNED REPORTS

## Case Studies

- Great Lakes Restoration Initiative, Great Lakes Accountability System
- Mitigation reports

## Tools/Resources

- U.S. EPA, *Great Lakes Accountability System User Guide*
- Koslow et al., 2014. *Restoring the Great Lakes' Coastal Future*



Great Lakes Restoration Initiative Accountability System  
User Guide

### User Guide Table of Contents

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# 14. CLIMATE VULNERABILITY ASSESSMENTS

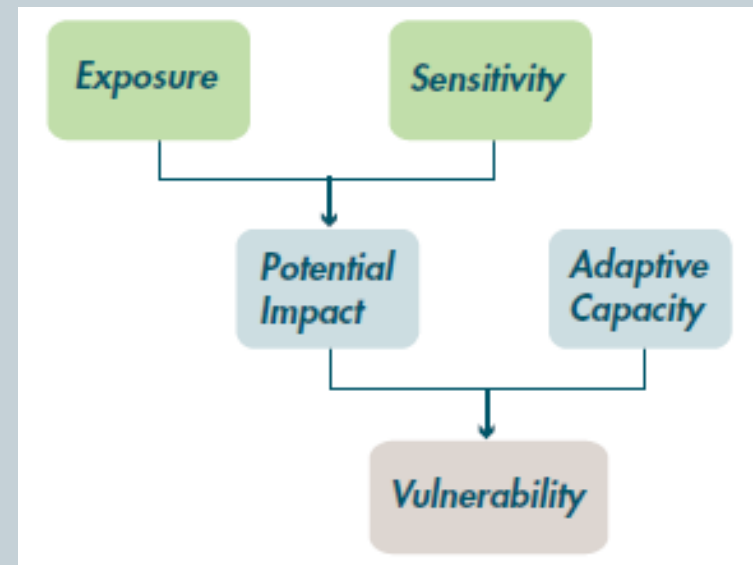
**Conduct climate change vulnerability assessments to inform selection of appropriate response plan(s)**

## **Methods and focus**

➤ Varies widely based on goals and intended use

## **Output types**

- Vulnerability scores
- Vulnerability maps
- Detailed narrative descriptions



# 14. CLIMATE VULNERABILITY ASSESSMENTS



## Challenges

- May lose focus on taking actions to increase resilience
- In spite of time commitment, ID as key component

## Benefits

- Increase efficiency of projects
- Help focus adaptation actions
- Partnerships and collaboration

## Implementer

- Any entity engaged in restoration



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# 14.CLIMATE VULNERABILITY ASSESSMENTS

## Case Studies

- NWF/EcoAdapt Great Lakes guidance document
- Environment Canada coastal wetlands report

## Tools/Resources

- Mortsch et al. 2006. *Great Lakes Coastal Wetland Communities*
- Koslow et al. 2014.
- Hoving et al. 2013 (at right)



MICHIGAN DEPARTMENT OF NATURAL RESOURCES

Wildlife Division Report No. 3564  
April, 2013

Printed by Authority of P. A. 311 of 1994  
Total Number of Copies Printed: 30  
Cost per Copy: \$3.00  
Total Cost: \$90.00  
Michigan Department of Natural Resources

Changing Climate, Changing Wildlife

A Vulnerability Assessment  
of 400 Species of Greatest Conservation Need  
and Game Species  
in Michigan

Christopher L. Hoving<sup>1</sup>, Yu Man Lee<sup>2</sup>, Peter J. Badra<sup>2</sup>, and Brian J. Klatt<sup>2</sup>



<sup>1</sup> Michigan Department of Natural Resources, Wildlife Division

<sup>2</sup> Michigan State University Extension, Michigan Natural Features Inventory

# 15. CONSIDER MULTIPLE SCENARIOS

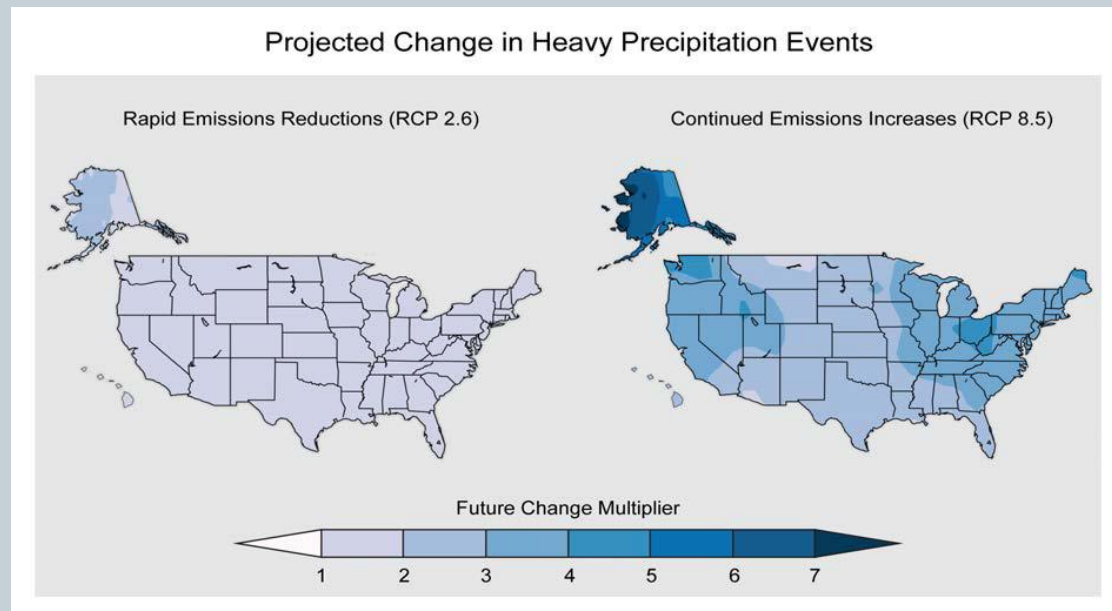


**Evaluate climate scenarios before choosing a technique to help ensure actions take potential future conditions into account**

- Scenarios can be qualitative, quantitative or a mix
- Process may vary according to resources

## Outputs

- Increase capacity for decision making under uncertainty



# 15. CONSIDER MULTIPLE SCENARIOS

## Challenges

- Potential subjectivity; ensure using best science
- Need adequate expertise, resources

## Benefits

- Consider range of future possibilities
- Facilitate adaptive management

## Implementer

- Any entity – may need to bring in outside expertise, facilitator



USFWS, NCTC

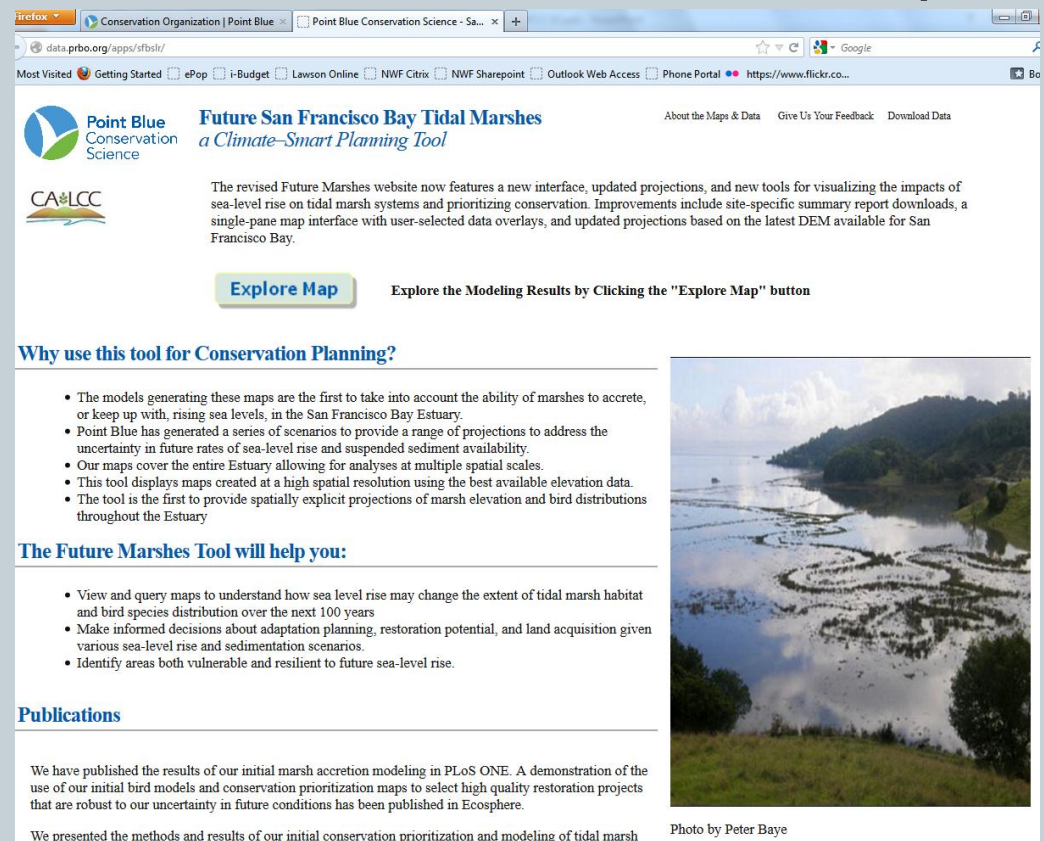
# 15. CONSIDER MULTIPLE SCENARIOS

## Case Study

- Prioritizing wetland restoration in San Francisco Bay

## Tools/Resources

- Veloz et al. 2013.  
*Modeling Climate Change Impacts on Coastal Marsh Birds*
- Moore et al. 2013.  
*Using Scenario Planning for Climate Change Adaptation*



The screenshot displays a web browser window with the URL [data.prbo.org/apps/sfbslr/](http://data.prbo.org/apps/sfbslr/). The page is titled "Future San Francisco Bay Tidal Marshes a Climate-Smart Planning Tool" and features the Point Blue Conservation Science logo and the CA&LCC logo. A navigation bar includes links for "About the Maps & Data", "Give Us Your Feedback", and "Download Data". The main content area describes the tool's capabilities, including updated projections and new tools for visualizing the impacts of sea-level rise on tidal marsh systems. A prominent "Explore Map" button is visible. Below the main text, a section titled "Why use this tool for Conservation Planning?" lists several bullet points: "The models generating these maps are the first to take into account the ability of marshes to accrete, or keep up with, rising sea levels, in the San Francisco Bay Estuary.", "Point Blue has generated a series of scenarios to provide a range of projections to address the uncertainty in future rates of sea-level rise and suspended sediment availability.", "Our maps cover the entire Estuary allowing for analyses at multiple spatial scales.", "This tool displays maps created at a high spatial resolution using the best available elevation data.", and "The tool is the first to provide spatially explicit projections of marsh elevation and bird distributions throughout the Estuary". A section titled "The Future Marshes Tool will help you:" lists three bullet points: "View and query maps to understand how sea level rise may change the extent of tidal marsh habitat and bird species distribution over the next 100 years", "Make informed decisions about adaptation planning, restoration potential, and land acquisition given various sea-level rise and sedimentation scenarios.", and "Identify areas both vulnerable and resilient to future sea-level rise." A "Publications" section mentions that the results of the initial marsh accretion modeling were published in PLoS ONE and that the initial bird models and conservation prioritization maps were published in Ecosphere. A photo of a tidal marsh landscape is shown on the right side of the page, credited to Peter Baye.

Point Blue Conservation Science

CA&LCC

Future San Francisco Bay Tidal Marshes  
a Climate-Smart Planning Tool

About the Maps & Data Give Us Your Feedback Download Data

The revised Future Marshes website now features a new interface, updated projections, and new tools for visualizing the impacts of sea-level rise on tidal marsh systems and prioritizing conservation. Improvements include site-specific summary report downloads, a single-pane map interface with user-selected data overlays, and updated projections based on the latest DEM available for San Francisco Bay.

[Explore Map](#) Explore the Modeling Results by Clicking the "Explore Map" button

**Why use this tool for Conservation Planning?**

- The models generating these maps are the first to take into account the ability of marshes to accrete, or keep up with, rising sea levels, in the San Francisco Bay Estuary.
- Point Blue has generated a series of scenarios to provide a range of projections to address the uncertainty in future rates of sea-level rise and suspended sediment availability.
- Our maps cover the entire Estuary allowing for analyses at multiple spatial scales.
- This tool displays maps created at a high spatial resolution using the best available elevation data.
- The tool is the first to provide spatially explicit projections of marsh elevation and bird distributions throughout the Estuary

**The Future Marshes Tool will help you:**

- View and query maps to understand how sea level rise may change the extent of tidal marsh habitat and bird species distribution over the next 100 years
- Make informed decisions about adaptation planning, restoration potential, and land acquisition given various sea-level rise and sedimentation scenarios.
- Identify areas both vulnerable and resilient to future sea-level rise.

**Publications**

We have published the results of our initial marsh accretion modeling in PLoS ONE. A demonstration of the use of our initial bird models and conservation prioritization maps to select high quality restoration projects that are robust to our uncertainty in future conditions has been published in Ecosphere.

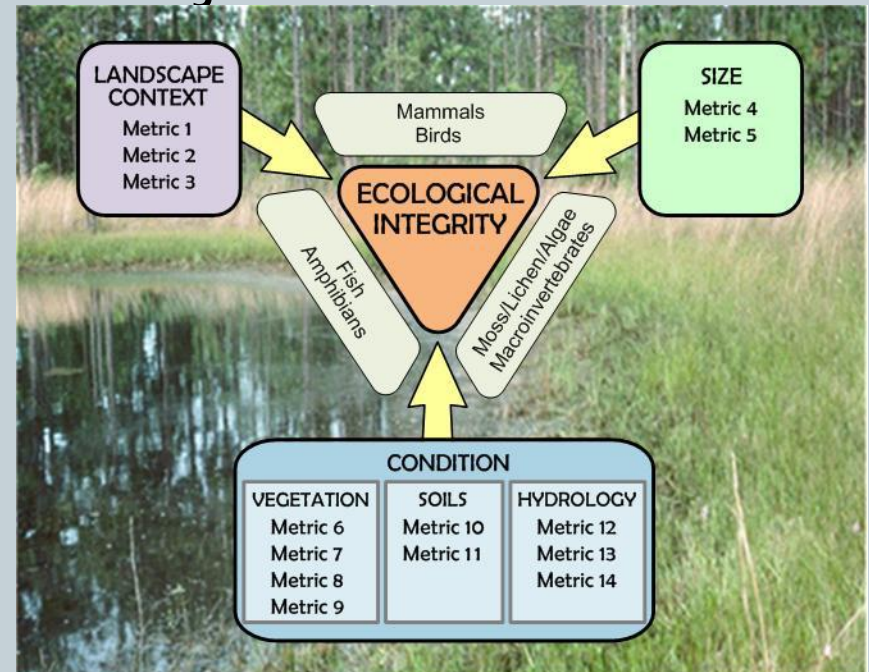
We presented the methods and results of our initial conservation prioritization and modeling of tidal marsh

Photo by Peter Baye

# 16.ADAPTATION PERFORMANCE INDICATORS

## Establish indicators for climate change adaptation to measure performance

- Challenge w/ long-term responses to climatic changes
- Need short and medium-term objectives
- Include regular reporting
- Indicators: ecological, socioeconomic, institutional



# 16.ADAPTATION PERFORMANCE INDICATORS



## Challenges

- Develop practicable but informative indicators
- Ensure monitoring plans are adequate for long term

## Benefits

- Support adaptive management (& evidence-based adaptation)

## Implementer

- Agencies, others involved in restoration



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# 16.ADAPTATION PERFORMANCE INDICATORS



## Case Study

- No good examples available in region
- Draw on SOLEC, IJC indicator efforts
- GL Coastal Wetlands Consortium work can inform

## Tools/Resources

- Janetos et al. 2012. *National Climate Assessment Indicators*.
- International Joint Commission, *Indicators Assessment of Progress*
- UK Climate Impacts Program/Sea Change effort



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# 18. CONSIDER CLIMATE IN RESTORATION



## **Consider water quantity management needs when designing coastal wetland and shoreline restorations**

- Coastal wetlands have been heavily impacted
- Water management infrastructure can be used to emulate natural wetland conditions
- Controversial

### **Design Approaches**

- Evaluate alternatives based on ability to maintain desired conditions
- Infrastructure may go unused until necessary



# 18. CONSIDER CLIMATE IN RESTORATION



## Challenges

- High installation and maintenance costs
- Regulatory challenges
- Requires active management

## Benefits

- Can emulate natural wetland conditions to achieve ecological objectives
- Prepares for water level uncertainty

## Implementer

- Agency and NGO wetland managers



Leonetti

# 18. CONSIDER CLIMATE IN RESTORATION

## Case study

### Erie Marsh Wetland Restoration

## Tools/Resources

- Permits for Voluntary Wetland Restoration: Association of State Wetland Managers (2013)
- The Nature Conservancy, Erie Marsh Preserve: Major Restoration Project Brings Back Fish and Birds to Healthier Habitats



# NEXT STEPS



**RELEASE DATE: SEPTEMBER 29!**

- **Best Practices toolkit will be published online**



[www.glc.org](http://www.glc.org)



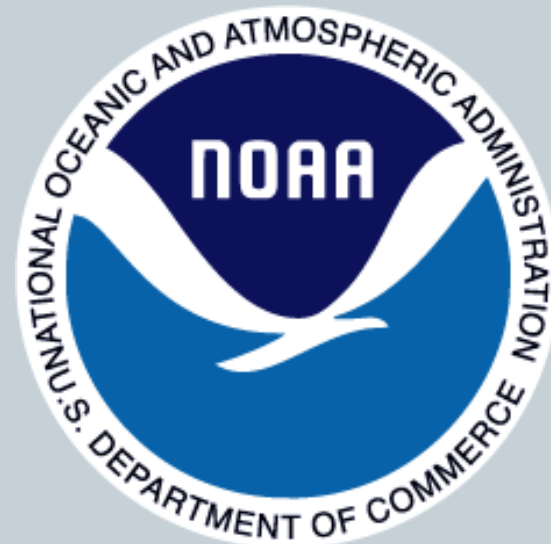
[www.nwf.org](http://www.nwf.org)

- **Webinars**

MI DEQ: September 12

Public webinar: September 24

# ACKNOWLEDGEMENTS



# QUESTIONS?

