Fish Passage Breakout Sessions

Purpose of Session

This breakout examined ways to plan for fish passage restoration in a changing climate. Utilizing *Restoring the Great Lakes Coastal Future: Technical Guidance for the Design and Implementation of Climate-Smart Restoration Projects* as a guide, participants examined how to develop the scope and objectives for restoration efforts, assess the components of vulnerability of both restoration targets and project approaches to known and projected climate change impacts, and identify potential adaptation responses and strategies.

Specifically, participants were asked to apply the following Climate Smart Planning Framework:

1. ***Identify restoration goals and targets*** (these are the "why" and "what" of restoration efforts, and are assumed to be pre-determined, at least initially, under existing restoration programs):
    a. Great Lakes Restoration Initiative (GLRI) Principal Actions:
        - Improve aquatic ecosystem resiliency;
        - Maintain, improve, enhance populations of native species;
        - Enhance wetlands, wetland associated uplands, high priority coastal, upland, and inland habitat;
        - Restore habitat functioning in Areas of Concern (AOC).
2. ***Identify restoration project approaches*** (these are the "how" of restoration efforts – the important issue here is that, while these approaches are themselves not necessarily different from all restoration efforts, applying them through a climate change lens requires understanding what impacts it will have on priorities and potential effectiveness of approaches):
    a. Improve terrestrial/aquatic connectivity;
    b. Protect key ecosystem features;
    c. Maintain and improve diversity;
    d. Reduce existing stressors.
3. ***Assess vulnerability to climate change***:
    a. Set the stage (i.e., establish reasons restoration efforts are warranted in the first place);
    b. Assess sensitivity of targets and project approaches to climate change (i.e., the extent to which they are likely to be affected);
    c. Assess exposure (including climate change scenarios as well as associated impacts);
    d. Assess adaptive capacity (i.e., the ability for the target system as well as one's institutional ability/management flexibility, etc., to cope with changes);
    e. Determine overall vulnerability (including "what" is vulnerable, as well as "why").
4. ***Identify climate-smart management options***:

a. Strategies to reduce sensitivity;
b. Strategies to reduce exposure;
c. Strategies to enhance adaptive capacity.

5. ***Select and implement management options*** (a number of criteria may be used when choosing which strategies to undertake):
    a. Importance/urgency;
    b. Cost/feasibility;
    c. Likely benefits/performance.
6. ***Monitor, review, and revise***:
    a. Incorporate new science;
    b. Evaluate effectiveness of management efforts;
    c. Revisit one or more of previous steps.

Discussion Highlights

Participants were given the opportunity to choose a case project based on their particular interests. Participants in both sessions chose to focus on projects to restore fish passage to Great Lakes coastal wetlands: Group 1 identified Erie Marsh as its target, while Group 2 chose the Middle Harbor wetland. The groups were then led through the above framework. The following table provides a comparison of some of the similarities and differences among the two groups' responses:

Climate-Smart Restoration Planning for Great Lakes Fish Passage: Two Cases		
	Group 1: Erie Marsh	Group 2: Middle Harbor
1. Restoration goals and targets	Goal: Enhance fish passage for native species, but prevent passage of invasives/non-natives. Target: Native fish, native sportfish (e.g., northern pike).	Goal: Restore hydrology, restore aquatic vegetation, restore fish access. Target: Habitat function for wetland in given area (not species-specific).
2. Restoration project approaches	Use wetland management infrastructure (pumps, water distribution canal, water control structures, levies) to improve wetland function and allow fish passage.	Increase habitat connectivity, dewater currently-impounded area. Include water control structure (but mindful of need to prevent invasive species such as carp. Consider two growing seasons, timing: spring.
3. Components of vulnerability	Set the stage: Erie Marsh preserve is on western Lake Erie, 990 acres is contained within huge levy system. Currently no opportunity for fish access. Habitat inside highly	Set the stage: This is a wetland impounded by misplaced or crushed pipes. Depth generally 3 feet of water. Surrounded by Lake Erie beach on one side, access roads on the other. No

	degraded due to agriculture, etc. Sensitivity: Sensitivity of target habitat and species likely to be sensitive to lake level changes in the future (some impacts may be positive, some negative); potential sensitivity to non-native species invasions. Sensitivity of project approach – lake level changes may affect effectiveness of structures, ability of fish to access habitat. Exposure: Mid-term (20-40 years) expect drop in average lake levels. Adaptive capacity: Project design is fairly flexible, the managers have the capacity to modify design given their level of ownership/control (some projects may not have this capacity). The project is likely to be less flexible once project has been implemented. Overall vulnerability: High.	vegetation – 250 acres of open water. Sensitivity: Target habitat and project design both likely to be sensitive to changes in lake levels, which will affect water flow and vegetation, ability for fish passage, nutrients, other factors. Exposure: The region is likely to see lake level change, as well as increased storm frequency and magnitude (which may contribute to waves/erosion). Already seeing some changes, timing is a concern. Adaptive capacity: Project management capacity is relatively limited. Area owned by Ohio Department of Parks, but minimal staff and funding. Different divisions with different responsibilities means limited adaptive capacity, although this could improve. Overall vulnerability: High.
4. Potential climate-smart management options	Given that there is considerable uncertainty, it is desirable to identify a suite of potential management tools to be able to change/adapt the project later on (e.g., hedge bets). Identify multiple ways to enhance fish passage under multiple scenarios.	Alter water control structures; design for a range of scenarios, making designs/infrastructure highly flexible. Design for the historic range of levels, with climate change in mind, and then examine for extreme highs and lows. Modify design if necessary and possible. Also consider impact of using grasses/other species that might actually exacerbate problems (e.g., cottonwoods, phragmites). It will be necessary to monitor for invasive species, including Asian carp. Refugia options may be needed, such as deep pools for fish during

		manufactured water level changes or winterkill. Timing and permitting considerations will be necessary.
5. Selection of management options	Important criteria for choosing management options will be cost versus benefits from retrofitting versus original design to accommodate broader range of impacts. Also, consider managing for habitat function rather than focus on specific target species.	Important criteria for choosing management options will be cost versus benefits from retrofitting versus original design. Invasive species are a current priority and will remain so – be particularly mindful of climate change impacts on invasives (both positive and negative). Issues with longevity of structures.
6. Monitoring, review	Keep an eye on the science, increase understanding, recognize that uncertainty may actually increase.	Water level gauges will be important to help monitor for water level variation. Also must be mindful of when one might need to go back to beginning and revisit overarching goals. Keep track of thresholds as well – at a certain point, some plans will not work. When might one need to consider letting "nature take its course"?
Additional thoughts/concerns	• The reality is that there are a number of different impacts/aspects/issues that interact and will affect project/targets. There is a need to think about overarching principles. • What about thresholds? It will be important to keep this in mind throughout the project. Is there a point where efforts will be moot? • With this project, TNC (the project lead) is	• Should managers be "open to" areas that might change habitat composition? • When is it OK to facilitate transitions? Some species will migrate north – which do we allow, which do we not? • Generational issues: the way we think about things will change over time. • What if we drain the wetland and don't have an appropriate seed

	prepared to adjust its goals if the situation changes. Right now, they are looking at all parts of ecosystem services. • Ultimately, it may be necessary/prudent to reevaluate one's overarching goal in the face of climate change.	bank?

General Themes

Overall, there were many similarities in how both groups applied the framework. For example, since each group identified coastal wetland habitats with primarily lake-based water connection (as opposed to riverine input), Great Lake water levels were identified as the overarching climate change impact of concern. In addition, both projects intended to use engineering/infrastructure to provide fish passage and habitat connectivity, and they recognized the importance of including scenarios for variations in lake levels in project design. Both groups identified the importance of understanding trade-offs in terms of project costs for having to retrofit project design versus designing for more variable climate change in the first place. Finally, both acknowledged that at some point it may be necessary to revisit overarching restoration goals, particularly those that are focused more specifically on species composition than on overall habitat function. This ended up being a particular "ah ha" moment in each group discussion. In terms of differences, one factor likely to be more of a problem for Group 2 is the relative lack of adaptive capacity for the managers in terms of decision-making flexibility.