**Environmental Flows in the Northeast –**

**Summary and Opportunities for Future LCC / NECSC Involvement**

Summary and Recommendation

“Environmental flows” refer to the quantity, quality, and timing of water flows necessary to sustain freshwater and estuarine ecosystems and the associated resources that people depend on. Building on recently initiated regional projects and prior discussions of the NALCC Technical Committee, NALCC staff and colleagues recommend that a Technical subgroup be convened to more fully define current science needs and next steps for consideration by the North Atlantic LCC and the Northeast Climate Science Center (NECSC). This effort should consider how to integrate the results of ongoing projects and the appropriate role of the NALCC among the broader community of partners with a role in environmental flows (including adjacent LCCs). Steering Committee guidance on scope and potential participants in this effort is requested.

Related Projects Funded by NALCC, Appalachian LCC, NECSC, or State RCN Program

NALCC

* Forecasting changes in aquatic systems and resilience of aquatic populations in the NALCC: decision-support tools for conservation. Ben Letcher, USGS / U. Mass. (2010 – in progress)

AppLCC

* Development of a hydrologic foundation and flow-ecology relationships for monitoring riverine resources in the Marcellus Shale region. Dr. Fisher, NY Coop Fish and Wildlife Research Unit (2012 – in progress)

NECSC

* Bringing people, data, and models together – addressing impacts of climate change on stream temperature. Dr. Polebitski, U. Mass. (2012 – in progress)
* A Stream Temperature Inventory Network and Decision Support Metadata Mapper - Evaluating the Resources to Understanding Climate Change Effects on Streams in New England and the Great Lakes States. Jana Stewart, USGS Wisconsin Water Science Center (2012 – in progress)

RCN

* GIS based Application to Estimate Stream Flow, Connecticut River basin. USGS (2007 – complete)
* MacroHABSIM: Creation of a Regional Simulation Model of Fish Community Instream Habitat. Rushing Rivers Insitute (2008 – complete)
* Instream Flow for Great Lakes Basin of NY and PA. The Nature Conservancy (2010 – in progress)

Background

Better understanding environmental flows and their use in decision making represents a key science need for the North Atlantic Landscape Conservation Cooperative and the Northeast Climate Science Center. In 2012, the Highest Priority Science Needs were recommended by the LCC Technical Committee for the North Atlantic Landscape Conservation Cooperative. One of those recommendations is “Understand and develop models to quantify and describe ecological flow in the North Atlantic.” The Northeast Climate Science Center also funded projects related to this topic in 2012.

In 2010 leading river scientists and ecologists published a new framework for developing regional environmental flow standards known as the Ecological Limits of Hydrologic Alteration (ELOHA)[[1]](#footnote-1). This approach builds on the “Natural Flow Paradigm’ and presents a framework that emphasizes the synthesis of existing hydrologic and ecological data from multiple river systems to develop scientifically defensible relations between flow alteration and ecological response. One of the first ELOHA style frameworks was developed as part of Michigan’s water withdrawal assessment process. An ELOHA approach was used by the USGS and MA DF&W to categorize aquatic habitat and develop proposed streamflow criteria in Massachusetts. The Massachusetts work involved a rigorous examination of the effects of flow, impervious cover and dams on fish assemblages. Integral to Massachusetts work was the Sustainable Yield Estimator (SYE), a flow duration transference tool developed by the USGS[[2]](#footnote-2). It allowed simulation of daily streamflow hydrographs representing altered and unaltered flows for each fish sampling site. The Massachusetts approach combined a quantitative analysis of extensive biological data with a hydrologic foundation to develop flow-ecology response models that incorporated water use accounting.

ELOHA work has been completed or is underway in a number of other places in the Northeast Region. These efforts, in some cases, do not have the detailed biological and hydrologic analyses that has been completed in Massachusetts, however, they lay the groundwork for more detailed work, if desired. They all include expert-driven processes. For example, during 2009-2010, researchers in Ohio utilized elements of the ELOHA framework.  A Statewide ELOHA effort was completed in Virginia in 2012. Work is complete for the Susquehanna basin (NY/PA) and is nearing completion in the upper Ohio and middle Potomac drainages. Additionally, work is in progress in the Delaware basin by the USGS National Water Census which incorporates most elements of the ELOHA processes including the development of: a hydrologic watershed model, a streamflow estimation tool, a decision support system, and relations between streamflow processes and aquatic ecosystem response

Potential areas for involvement with Environmental Flow processes in Northeast

A number of ideas for future work on environmental flows in the Northeast have been raised. The majority of the Northeastern states have given serious attention to ecoflows over the last several years. Some have used extensive biological data and sophisticated hydrological modeling techniques to understand the ecological effect of altered streamflow. However, a number have not been able to use these more sophisticated approaches. Opportunities exist for the North Atlantic LCC to partner in such efforts. However, it is not yet clear which areas should be of highest priority for the North Atlantic LCC as a whole, which are best deferred to other organizations and partnerships, and how to most effectively integrate existing work sponsored by the LCC and others. Examples of potential environmental flow science needs and next steps include the following:

**Ecological flows**

* Support the synthesis of ecohydrologic processes in the Northeast as a priority science need. Develop a comprehensive synthesis of the state of the science regarding the use of the various existing rainfall-runoff and statistical hydrologic models to support investigations of the effects of climate and land cover change on stream ecology and hydrology in the Northeast.
* Undertake or enhance ELOHA process in Rhode Island, Maine, West Virginia, Maryland and Delaware.
* Expand Sustainable Yield Estimator (SYE) for portions of CT, NH and VT outside CT River Project. Properly designed it could help enable statewide ELOHA efforts for NH, VT and CT. Possibly in PA for the DE Water Gap project
* Participate in follow up to statewide ELOHA processes such as developing basin-specific recommendations both for protection and restoration of environmental flows. Results can be evaluated within the context of local water-supply models, with inferences to the scalability of the ELOHA outcomes.
* Support work to better understand the linkages between impervious cover and ecosystem response. This is particularly important in the more urbanized portion of the region and would provide an important foundation for the NECSC science focus area dealing with Urban Natural Resources.
* Identify locations with altered and unaltered flow regimes where ecological flow thresholds have been developed, and prioritize collection of long-term biological datasets toward the validation of ecological flow thresholds.

**Temperature monitoring, modeling and relationship to streamflow**

* Assess how changes in streamflow and stream temperature may affect future ecological flows.
* Develop a regional stream temperature model and monitoring network for Northeastern Streams.- Implement key recommendations from May 2012 EPA/FWS NALCC/USGS May 2012 temperature meeting.(<http://www.northatlanticlcc.org/streamtemp_050312.html>)
  + Develop a spatially-nested, year-round temperature monitoring network
  + Develop a paired water temperature data, air temperature and aquatic biota data where and when possible
  + Develop a regional temperature model that could estimate and forecast temperature for gaged and ungaged sites
* Develop a centralized temperature database, similar to the one developed by the USFS in the Northwest (Work currently underway through USGS Northeast Climate Science Center).
* Incorporate regional stream-temperature information into existing models of anthropogenic impacts on cold-water aquatic species.
* Identify thermally limiting stream sections and the source/cause of the thermal loads. Restoration of coldwater habitat could be then initiated that would address those factors limiting thermal conditions (dams, groundwater depletion etc). Conservation efforts could be focused on habitat areas with the most risk, while sections with ‘thermal protection’ from spring or groundwater discharge may be targeted second.
* Support collaborative efforts to coordinate and evaluate temperature modeling throughout the Northeast in large and small streams.

1. Poff, N.L.,Richter, B.D., Arthington, A.H., Bunn, S.E., Naiman, R.J., Kendy, E., Acreman, M., Apse, C., Bledsoe, B.P., Freeman,M, Henriksen, J., Jacobson, R.B., Kennen, J., Merritt, D.M., O’Keefe, J., Olden, J.D., Rogers, K., Tharme, R.E., and Warner, A.,2010, The ecological limits of hydrologic alteration (ELOHA) – A new framework for developing regional environmental flow standards: Freshwater Biology, v.55, p194-205. [↑](#footnote-ref-1)
2. Archfield,S.A.,Vogel,R.M.,Steeves,P.A.,Brandt,S.L.,Weiskel,P.K.,and Garabedian,S.P.,2010, The Massachusetts Sustainable-Yield Estimator – A decision support tool to assess water availability at ungaged stream locations in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2009-5227, 41p. [↑](#footnote-ref-2)