



# Climate Change Adaptation: Stormwater Management in the Lake Champlain Basin

## *Workshop Summary*

*On March 25-26, 2014, the Lake Champlain Basin Program hosted a climate change adaptation workshop in Burlington, VT focusing on stormwater management and aquatic ecosystem impacts in the Lake Champlain Basin. The goal of the workshops was to gather cutting-edge regional climate change scenarios and hear from researchers working to understand how future change will impact Lake Champlain's water resources.*

*Combined, the workshops had around eighty attendees, mostly from conservation districts, city and regional planning commissions and state-level environmental management, who were active participants in the discussions. The presentations of recently completed projects, new research and roundtable dialogue culminated in an enhanced understanding of how climate change could impact stormwater management and the aquatic ecosystem health of Lake Champlain in years to come. This information will be used in conjunction with ongoing research to inform two LCBP publications expected to be completed in mid-2015.*

**Plenary:** Dr. Lesley-Ann Dupigny-Giroux, Vermont State Climatologist and Professor at UVM: *Understanding local and regional climate change: Implications for water resource management in the Lake Champlain Basin*

Climate change is a non-linear system with human and natural interactions

- 1.) Process (how is it changing)
- 2.) Impacts (changes in ecosystem and human-built environments)
- 3.) Strategies (how do we adapt)

Process of climate change:

- Change over time- comparing the 30 year average vs. year-to-year variations
- Change in means and variability- relevant to use (floods and droughts)

Impacts of climate change:

- Floods, droughts and shifts in temperature and precipitation  
(All of these can occur in the same year (as shown by 2011 in the Champlain Valley))

Strategies to Prepare for climate change:

- Model future change (global or regional)
  - More difficult to model precipitation change than temperature
  - Seasonal differences can be predicted on the local level
  - NOAA/NWS will publish TP-40 in next ~year
- Two adaptation scenarios: top-down (model-based predictions) or bottom-up (identification of vulnerabilities leading to management strategies)

## **Session 1: Findings, Issues and Recommendations from Green Infrastructure**

**GOAL:** *Recommendations for Climate Change*

- Mike Winslow, *Lake Champlain Committee*: Building Community Flood Resilience: Lessons from Irene
- Julie Moore, *Stone Environmental*: Integrating LID and GSI Around the Basin
- Stephanie Hurley, *UVM*: Green Stormwater Infrastructure: Implementation and Monitoring

**Session Summary:** Floods and stormwater are a pollution issue in the Lake Champlain Basin. Stormwater runoff accounts for ~20% of the phosphorus load to Lake Champlain. Some problems facing stormwater managers: rural roads are eroding, bridges and culverts are undersized for predicted storms, zoning requirements are restrictive. But green infrastructure has been shown to work. The regulatory framework in this region needs to be re-built to facilitate the movement of funds to community-level projects, enhanced coordination and a long-term commitment to green infrastructure as a way to manage stormwater in the Lake Champlain Basin.

## **Session 2: Boots on the Ground: Applying Low Impact Design Standards (LIDS) in the Champlain Basin**

**GOAL:** *Management Strategies that Work in the Lake Champlain Basin*

- Padraic Monks, *VT DEC*: Vermont Stormwater Regulations and Low Impact Development
- Emily DeBolt, *Lake George Association*: Low Impact Design in the Lake George Watershed
- Megan Moir, *City of Burlington*: College Street Stormwater Retrofit Project Update
- Tom Baird, *Barton & Logoduce*: Lake George Case Studies: Green Infrastructure, Cold Weather & Transportation Projects

**Session Summary:** Low impact design standards are becoming the standard for stormwater management around the basin. The Vermont stormwater manual is being updated to encourage incentives for green infrastructure and low-impact designs. The design storm is being revised to 1 inch (up from 0.9 inch) to reflect a growing emphasis on climate change predictions. The manual is expected to be completed in 2015 and is being modeled after the manual for the state of Maryland.

In other parts of the basin, green and gray infrastructure are combined for the highest rate of success in managing stormwater runoff. Securing funding has historically been an issue, but after the 2011 floods, more funding is available, especially if plans are constructed to show how the project will improve resilience. The use of native plants and minimum compost is encouraged in the construction of raingardens. New technologies have allowed pervious pavement to be used on high-traffic roads that withstand harsh winter conditions, but all testing of these technologies must be done in-house as there is no governmental or private agency currently held responsible.

### **Session 3: Roundtable Panel- Climate Adaptation and Stormwater Management in the Lake Champlain Basin**

**GOAL:** *Suite of Climate-Ready Stormwater Management Tools*

- Kevin Farrington (*City of Plattsburgh*)
- Tom DiPietro (*City of South Burlington*)
- Amy Macrellis (*Stone Environmental*)

**Session Summary:** The panel, representing Vermont and New York, discussed how cities around Lake Champlain are preparing for climate change. Plattsburgh, not yet a Municipal Separate Sewer System (MS4), is just beginning to confront climate change and update its aging infrastructure. The city of South Burlington, at the forefront of development in the region, is working to improve its green infrastructure side of stormwater management. Many smaller towns contract with private sector consultants to update stormwater management plans.

The discussion revolved around the permitting process, which is required for MS4 communities and requires long-term planning and processing time. Smaller communities may be cash-strapped to implement good management practices, but would do more green infrastructure work if they were required by the state. The New York guidelines were revised in 2008 to encourage a more low-impact approach to stormwater. However, in contrast to Vermont, these standards are not required or regulated on the state level.

In terms of climate change, cities are focusing on long-term efforts with goals of changing the standards of re-development to account for larger and more frequent precipitation events. Some needs that were addressed include the lack of education and awareness to promote climate-ready strategies, more enforcement and local by-laws that are consistent with state-level authority.



# Climate Change Adaptation: Impacts on Lake Champlain's Aquatic Ecosystem

## *Workshop Agenda*

**Plenary:** Dr. Curt Stager, Science Writer and Professor at Paul Smith's College:  
*Climate Change in the Champlain Basin*

Climate change is a reality with regional evidence and implications.

- 1.) Evidence of current climate change
- 2.) Predicting our climate in the future
- 3.) What to expect in the Lake Champlain Basin

Evidence of current climate change:

- Historical written records (S. de Champlain, T. Jefferson)
- Lake Champlain freeze-up/ice out dates, and occurrence of ice-free years
- Weather stations trend: mean daily high temp increasing (particularly in autumn)

Predicting the future climate:

- Climate Wizard- 16 standard global atmospheric models downscaled to the Lake Champlain Basin
- Significant variation in model outputs depending on severity of C emission scenario
- Model results:
  - Temperature- all models predict warming (1 – 11°F), vary in seasonal timing.
  - Precipitation- harder to predict, most likely increase in future (but seasonality, quantity, and *sign* disagreement in models), more vigorous atmospheric circulation expected
- Paleoclimate research- evidence of droughts in both warmer and cooler past climates

What to expect in the Lake Champlain Basin:

- Warmer temperatures- most noticeable in winter, more precipitation as rain
- Lake ice-over: occur later and less frequently, end earlier, with thinner ice
- Stronger, longer summer lake stratification
- Increased precipitation: changes in nutrient inputs, lake clarity, productivity, and lake levels
- Droughts possible
- Threat to biodiversity:
  - Heat stress, less oxygen
  - Reproducing stress (fewer nests, later spawning)
  - Changes in ecosystem timing (earlier plankton blooms, food web migration)
  - Invasive species advantages
  - Ideal cyanobacteria environment

Uncertainty in future climate, so flexibility and preparation for a variety of scenarios is key

#### **Session 4: How Can AIS Management Be Prepared for Climate Change?**

**GOAL:** *Preparation tools for climate change*

Facilitated by: Ellen Marsden *and* Mark Malchoff

##### **Session Summary:**

All components of aquatic invasions (origin, vectors, and the receiving environment) will be affected by climate change. Fish adaptation to climate change can only be habitat change, so we can expect different species distributions. Climate change will mean unpredictability (temperature shifts, frequency/severity of episodic events). We can expect a longer growing/boating season, unexpected invaders, hybridization of species, and changes in *when* management practices are most effective. Current knowledge gaps will be exacerbated. In NY, initiatives to mitigate climate change include collaboration and communication inside a network, introducing new regulations, expanded boat steward programs, inspection and decontamination programs, and educational outreach. Additionally, there are efforts for early detection, advanced AIS mapping and reporting, improving response protocols, and identifying AIS research needs. Discussion included the idea of rethinking what is deemed invasive or habitat expansion, and what the goals are for aquatic ecosystem conservation. Resources are limited and some choices will have to be made about restocking, preservation efforts, etc. One potential way to approach this is to focus more on the health of the ecosystem, and less on specific species.

#### **Session 5: Predicted Impacts on Native Aquatic Species: How to Manage Climate Change in Lake Champlain**

**GOAL:** *How to Apply Management Tools in the Champlain Basin*

- Bill Ardren, *USFWS*: Update on Regional Climate Change Programs
- Tim Mihuc, *SUNY Plattsburgh*: Long-term Patterns in Lake Champlain Plankton: the role of Invasive Species and Climate Change
- Jason Stockwell, *UVM*: Impacts of Cyanobacteria Blooms on Essential Fatty Acid Transfer to Fish
- Dan Isaak, *USFS*: Climate Change, Crowd-Sourcing, and 21<sup>st</sup> Century Conservation of Fish and Aquatic Resources

##### **Session Summary:**

Long-term water quality and biology studies in Lake Champlain capture a decline in rotifers and mysid tied to the increase in Zebra Mussels. Flood events affect the total zooplankton density. There is evidence that the epilimnion of Lake Champlain is not so much getting warmer, as it is getting deeper, which reduces the refugia for native cold-water species. Climate change is likely to produce water quality conditions ideal for cyanobacteria blooms. Cyanobacteria has been found to be nutritionally detrimental to zooplankton *and* fish. This indicates an environmental health problems for humans beyond direct exposure to cyanobacteria blooms.

It is essential to identify realistic goals for ecological preservation, as not everything can be saved. The long-term nature of climate change allows for deliberate strategies, but detracts from a sense of urgency. Precise information is needed to facilitate smart, strategic decisions, and we now have better, cheaper tools for environmental assessment.

Studies in Idaho have demonstrated the importance of collective work groups and crowd-sourcing. The pairing of researchers, managers and the public (with varied resources like: lots of data, manpower, money, territory) can be successful where individual efforts would not be.

Crowd-sourcing has the added benefit of building consensus and social involvement in the difficult decisions. There is a need to collaborate more with the public, both to provide information about likely future conditions, and to describe the multiple important facets of climate change efforts.

### **Session 6: Roundtable Panel- ANS Management Tools: What's Working, What's Not?**

**GOAL:** *Suite of ANS Management Tools*

- Emily DeBolt (*LGA*)
- Eric Holmlund (*Paul Smith's*)
- Matt Probasco (*VT DEC*)

#### **Session Summary:**

The most essential tool of the Lake George Association is a boat launch steward program, for both AIS mitigation and data collection. As determined from the Asian clam problem, ANS clean-up is more expensive than prevention. Other useful tools for the Lake George Association are county AIS transport laws, a mandatory inspection program, and state wide regulations. The most effective AIS vector treatment is hot water and high pressure washing. An important component of preventing ANS is understanding waterway visitation networks (i.e. how the lakes are connected, and which could be AIS hubs). Tablet-based, wireless survey software employed by the stewards was essential for collecting visiting boat data. This data coupled with risk criteria can help prioritize prevention measures. In a report requested by the NY DEC, a multi-agency collaboration summarized published science on AIS prevention, pooled data, and provided AIS prevention recommendations.

In Vermont, funding for ANS measures is lake-specific and not organized state-wide. Vermont does not currently have a program that trains and distributes stewards to individual lake associations. Vermont's earlier AIS transportation law has been revised to make it easier to enforce. Other Vermont statutes that aid ANS control include rapid response permitting to deal with infestations, and the use of public water rule (which allows for the closure of a portion of a lake). Implementation of some regulations is problematic. More data would be required for a better lake network analysis and prioritization. Additional problems are funding distribution, public perception, political will, supporting local efforts, and disseminating information to the public.



# Climate Change Adaptation: Stormwater Management and Aquatic Ecosystem Impacts

## *Speaker Biographies*

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### **Dr. Bill Ardren**, Senior Fish Biologist, U.S. Fish and Wildlife Service

William (Bill) Ardren, Ph.D. is a Senior Fish Biologist with the U.S. Fish and Wildlife Service (USFWS). He provides science expertise related to aquatic resource conservation with an emphasis on fisheries management, reintroduction of species, and conservation of endangered species. Bill has extensive experience in population genetics and molecular systematics focused on conservation of fish populations throughout the USA. He is currently leading a large interdisciplinary team of researchers and managers focused on restoring natural populations of landlocked salmon to Lake Champlain. Bill is a member of the Lake Champlain Fisheries Technical Committee, Lake Champlain Basin Program Technical Committee, and Connecticut River Atlantic Salmon Commission Technical Committee. He is also a Dartmouth College visiting scholar in the Department of Environmental Studies, an adjunct assistant professor in the Department of Biology at the University of Vermont, and an adjunct assistant professor in the Department of Fisheries and Wildlife at Oregon State University.

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### **Thomas C. Baird**, P.E., CPESC, Barton & Loguidice, D.P.C.

Mr. Baird has more than 23 years of experience in transportation and environmental design for various state agencies, municipalities and private industry. His experience includes complex rural and urban projects, roundabouts, intersection design, noise analysis, drainage design and the development of mitigation strategies for a wide range of project types. Mr. Baird's experience also includes the design of green infrastructure and stormwater management systems specializing in porous asphalt and designs for linear transportation projects. He is a Licensed Professional Engineer and Certified Professional in Erosion and Sediment Control (CPESC).

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### **Jenn Callahan**, Operations Stormwater Technician, Vermont Agency of Transportation

Jenn Callahan is the Operations Stormwater Technician for the Vermont Agency of Transportation. Jenn has worked for VTrans since 2012; preceding that she was employed with the Vermont Department of Environmental Conservation and assisted in developing and implementing Vermont's stormwater TMDLs. She has a BS in Geology from the University of Massachusetts and a MS in Geology from the University of Rhode Island.

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**Emily DeBolt**, Outreach Coordinator, Lake George Association

Emily DeBolt is the Outreach Coordinator for the Lake George Association. She has been with the LGA for 7 years working on invasive species, land use, and other water quality issues. She has coordinated their flagship education program the Floating Classroom, their award winning AIS prevention Lake Steward Program, and their Lake-Friendly Living outreach program for homeowners around the lake. She is currently in charge of their communications and outreach, after welcoming her first child this past summer. She has an undergraduate degree from Cornell University and a master's degree from SUNY- ESF (College of Environmental Science and Forestry). She also owns and operates a native plant nursery with her husband called Fiddlehead Creek that specializes in growing native plants for sustainable landscapes.

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**Tom DiPietro**, Deputy Director of Public Works, City of South Burlington

Tom DiPietro is the Deputy Director of Public Works for the City of South Burlington and has managed the South Burlington Stormwater Utility since 2006. Tom is also on the Board of Directors for the Green Mountain Water Environment Association. He has a B.S. in Environmental Management from the Rochester Institute of Technology and a M.S. in Plant and Soil Science from the University of Vermont.

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**Dr. Lesley-Ann Dupigny-Giroux**, Professor, University of Vermont; State Climatologist

An applied climatologist by training, Dr. Dupigny-Giroux's research interests intersect a number of interdisciplinary fields including hydroclimatic natural hazards and climate literacy as well as the use of remote sensing and GIS (Geographic Information Systems) in the fields of spatial climate and land-surface processes. Dr. Dupigny-Giroux is also the State Climatologist for Vermont. Her work takes her across Vermont to assist colleagues in State Agencies (transportation, emergency management, agriculture, forestry and legislators) to help plan for and adapt to climate change. She is an expert in floods, droughts and severe weather and the ways in which these affect Vermont's landscape and people. She also works extensively with K-12 teachers and students, bringing the use of satellites and understanding climate to all levels of the pre-university curriculum. She is the lead editor of Historical climate variability and impacts in North America, the first monograph to deal with the use of documentary and other ancillary records for analyzing climate variability and change. Nationally, she serves on two NOAA Science Advisory Board Committees related to climate research across the US. She is also a contributing author to the Climate Change in the Northeast: A Sourcebook, for the NorthEast Region chapter of the 2013 National Climate Assessment report, US Global Change Research Program. She holds a B.S. in Physical Geography and Development Studies from the University of Toronto (1989), an M.S.(1992) in Climatology and Hydrology and a Ph.D. (1996) in Climatology and Geographic Information Systems from McGill University.

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**Kevin Farrington**, City Engineer, City of Plattsburgh

Kevin Farrington is a licensed Professional Engineer and has been the City Engineer in Plattsburgh since 2002 where he designs, reviews and implements stormwater management plans for compliance with State and Local guidelines. Prior to that he worked in a private consulting firm

where he specialized in design of stormwater management plans for a variety of Federal, State, local and private commercial, industrial and recreational clients. Kevin serves on the LCBP Technical Advisory Committee and is currently the Project Manager on a LCBP funded Stormwater Conveyance System and Green Infrastructure Planning Project for the City of Plattsburgh.

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**Dr. Eric Holmlund**, Professor, Paul Smith's College

Eric Holmlund is the founding director of Paul Smith's College's Watershed Stewardship Program, the spread prevention and education wing of the Adirondack Watershed Institute. He is a Professor of Environmental Studies and Program Director for Liberal Arts, Environmental Studies and Recreation at Paul Smith's College in New York's Adirondack Park. He recently co-authored, with Emily DeBolt, Hilary Smith, Meghan Johnstone, and Kristen Rohne, a report requested by the NYSDEC entitled "Boat Inspection and Decontamination for Aquatic Invasive Species Prevention: Recommendations for the Adirondack Region", which is intended to be a management resource for landscape-level ANS spread prevention.

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**Dr. Stephanie Hurley**, Professor, University of Vermont

Dr. Stephanie Hurley is an Assistant Professor in the Plant and Soil Science (PSS) Department at the University of Vermont. Her background integrates the fields of landscape architecture, land use planning, ecological restoration, and watershed protection. Her current stormwater research projects include the design, construction, and monitoring of the University of Vermont Bioretention Laboratory (funded by Lake Champlain Sea Grant and the Lintilhac Foundation), and a parking lot retrofit with green stormwater infrastructure in Waitsfield, VT (funded by the Vermont Ecosystem Restoration Program). Dr. Hurley is a member of a collaborative research team that is using "crowdsourcing" techniques to engage stakeholders in identifying climate change solutions for our region via the Research on Adaptation to Climate Change (RACC) project. Her research lab also develops landscape visualizations for agricultural best management practices that target climate change resiliency as part of a collaborative effort within the UVM Food Systems research arena. Dr. Hurley teaches courses in Landscape Design Fundamentals and Ecological Landscape Design.

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**Dr. Daniel Isaak**, Research Fisheries Scientist, U.S. Forest Service

Dan Isaak is a Research Fisheries Scientist with the U.S. Forest Service, in Boise, Idaho. He grew up in South Dakota & has a Ph.D. from the University of Wyoming. His research focuses on understanding the effects of climate change and environmental gradients on stream habitats and fish populations, monitoring and modeling of stream temperature and fish populations, development and application of spatial statistical models for stream networks, and use of digital and social media to connect people, information, and landscapes.

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**Justin Kenney**, Green Infrastructure Coordinator, Vermont DEC

Justin Kenney, Green Infrastructure Coordinator at the Vermont Department of Environmental Conservation (VTDEC), is a graduate of the University of Vermont with a Bachelor of Science in Environmental Sciences and a concentration in Ecological Design. Justin has worked in the

environmental field for over 10 years and has worked with a number of organizations on a wide array of projects involving agricultural sustainability, habitat enhancement and restoration, forest stewardship, and stormwater management. Justin joined VTDEC in early 2013 and now works diligently to promote better site design and sustainable stormwater management throughout the Vermont.

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**Amy Macrellis**, Project Water Quality Specialist, Stone Environmental

Amy Macrellis is a Project Water Quality Specialist in the Water Resources Management Group at Stone Environmental. Amy has over a decade of experience providing technical leadership and editorial support for water quality assessments, stormwater treatment system and policy evaluations, wastewater planning and feasibility studies for unsewered communities, and research projects. Her current work interests include the ongoing revisions to Vermont's Stormwater Management Manual, as well as research into how to quantify the stormwater treatment benefits of trees and the potential to incorporate "tree credits" into the Manual or municipal permitting processes. Amy earned her Master's degree in Environmental Geoscience from Michigan State University, and her undergraduate degree in Geological Sciences from Albion College.

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**Mark Malchoff**, Extension Program Leader, and Aquatic Resource Specialist, Lake Champlain Sea Grant

Mark is an adjunct faculty member at SUNY Plattsburgh, where he serves as an Aquatic Resource Specialist with the Lake Champlain Sea Grant. His responsibilities deal primarily with outreach/extension aspects of aquatic invasive species and fisheries issues in the Lake Champlain Basin of New York and Vermont. His recent efforts include co-authorship of *Post tournament release movements of black bass in Lake Champlain*. Other interests/projects include fish passage and invasive species barrier options for the Champlain Canal. He currently serves as co-chair of the Northeast Aquatic Nuisance Species Panel. He holds an M.S. degree in Environmental Studies from Bard College, and a B.S. in Natural Resources from Cornell University. Current organizations/committees include: Lake Champlain Basin Program Technical Advisory Committee, Lake Champlain Fisheries Technical Committee, and the American Fisheries Society.

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**Dr. J. Ellen Marsden**, Professor of Fisheries, University of Vermont

Ellen received her Masters degree and PhD from Cornell University, and was a post-doctoral associate at Cornell for two years before moving to the Illinois Natural History Survey, where she was director of the Lake Michigan Biological Station for six years. In 1996, she moved to the University of Vermont. Her research focuses on early life history of lake trout, population dynamics of lake whitefish, alternative control methods for sea lamprey, ecology of exotic species, and effects of lake habitat fragmentation. She is currently studying the effects of alewife on lake trout reproductive success, and the use of artificial reefs to enhance lake trout spawning.

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**Dr. Tim Mihuc**, Director of the Lake Champlain Research Institute at SUNY Plattsburgh

Timothy (Tim) Mihuc has served as the director of the Lake Champlain Research Institute at SUNY-Plattsburgh since 1999. He holds a Ph.D. in Biology from Idaho State University (1994) and a M.S. degree in Zoology from Oklahoma State University (1989) and a B.S. in Biology from Oral Roberts University. Tim began his career with an undergraduate independent research project on nutrient limitation of algae in a small eutrophic lake in Oklahoma. He continued his education with a Master's thesis on invertebrate life-history ecology in a Colorado alpine wetland and Ph.D. thesis on post-fire food web dynamics in Yellowstone National Park streams. He spent several years at Louisiana State University as a post-doctoral researcher (1994-96) conducting invasive species research in the Atchafalaya River Basin, the largest contiguous hardwood swamp ecosystem in the U.S. From 1996-1999 Tim served as director of the Great Rivers Field Station (Illinois Natural History Survey) where he led a multidisciplinary research team working on the Upper Mississippi River. He has published over 35 research articles including journals such as *Ecology*, *Freshwater Biology*, *Aquatic Sciences*, *Hydrobiologia*, *Journal of Great Lakes Research* and *American Midland Naturalist* and has co-edited the book volume titled "*Lake Champlain: Partnership and research in the new millennium*" published by Kluwer Academic publishers. Tim's professional areas of interest include aquatic food webs, plankton ecology, river ecology, fish population dynamics, ecological integrity and aquatic biodiversity. He enjoys outdoor activities, particularly fly-fishing, skiing, hiking and mountain climbing (preferably combined).

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**Meg Modley**, Aquatic Nuisance Species Management Coordinator, LCBP

M. Modley is the Aquatic Nuisance Species Manager Coordinator at the Lake Champlain Basin Program in Grand Isle, VT where she has worked since 2003. She has a Bachelor of Arts Degree in Environmental Studies and Geology from the University of Vermont and a Masters Degree in Public Administration from the University of Vermont. Her work has focused on invasive species rapid response planning in the states of New York and Vermont and the province of Quebec. She is a member of the National Aquatic Nuisance Species Task Force and is the current Treasurer of the Northeast Aquatic Nuisance Species Panel. Modley supervises the Lake Champlain Boat Launch Steward Program on Lake Champlain, coordinates an invasive species grant program in the basin, and enjoys assisting partners with field management control and rapid response efforts.

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**Megan Moir**, Manager of Stormwater Program, City of Burlington

Ms. Moir has served as the manager of the City of Burlington Stormwater Program and the administrator of the Stormwater and Erosion Control articles of the City's Chapter 26 Wastewater, Stormwater and Pollution Control Ordinance since 2009. She has ten years of technical expertise in stormwater management and erosion prevention and sediment control, including retrofit planning and design, the development and review of post-construction and construction plans, administration of the City's stormwater ordinance and management of the City's MS-4 stormwater permit compliance and stormwater infrastructure. Prior to working with the Department, she worked for the Vermont Agency of Natural Resources Stormwater Section after working for the private sector. Ms. Moir holds an M.S. in Water Resources from the University of Vermont.

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**Padraic Monks**, Program Manager, Stormwater Division, VT DEC

Padraic Monks is the manager of the Vermont DEC Stormwater Program, a 12-person office charged with implementing several state and federal stormwater regulations. Padraic has been with DEC since 1997, where he also worked as an ecologist for several years with the Wetlands Program. Prior to joining DEC he worked in environmental consulting and residential construction. Padraic holds a BS from Northeastern University, and an MS in Natural Resources from the University of Michigan.

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**Julie Moore**, Leader of Water Resources Management Group, Stone Environmental

Julie Moore is the leader of the Water Resources Management Group at Stone Environmental. Julie has led a variety of watershed planning and assessment projects, often culminating in implementation of specific measures to address identified concerns, including projects related to stormwater management, agricultural stewardship, wetland restoration, and riparian corridor protection. She has led the successful implementation of a variety of projects related to stormwater management, including the design and construction of numerous low impact development practices, such as step pool conveyance, bioretention treatment areas and subsurface gravel wetlands. Prior to joining Stone, Julie worked for the Vermont Agency of Natural Resources where she was the director of the Clean & Clear Program and managed the state's efforts to implement the TMDL (total maximum daily load) for phosphorus pollution in Lake Champlain. Julie earned a Bachelor of Science in Civil Engineering from the University at Buffalo, a master's degree in Environmental Engineering from Johns Hopkins University, and is a registered professional engineer in Vermont.

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**Matt Probasco**, Aquatic Nuisance Control, VT DEC

Matthew Probasco is the Aquatic Nuisance Control & Pesticide General Permit Coordinator for Vermont's Department of Environmental Conservation (VT DEC), Lakes & Ponds Program. In '95 he received a Bachelor's Degree in Natural Science from The Ohio State University while working for the Ohio Sea Grant Program and Stone Laboratory on Lake Erie. More recently, he earned a Master's of Public Administration from the University of Vermont in '06, and has worked for VT DEC ever since. When he's not reviewing permit applications to control aquatic nuisance species, he enjoys his lead role in coordinating the Agency of Natural Resources' intra-departmental Aquatic Species Rapid Response General Permit.

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**Dr. Curt Stager**, Professor, Paul Smith's College

Curt Stager is a paleoecologist and science writer with a Ph.D. in biology and geology from Duke University. An authority on the climatic history of Africa and the Adirondack region, he has also investigated El Niño in Peru, human impacts on lakes in Sweden, exploding lakes in Cameroon, and bat pollination in Melanesia. He has published over three dozen papers in journals including *Science* and *Quaternary Research*, served on the Intergovernmental Panel on Climate Change, has written extensively in periodicals such as *National Geographic*, *Fast Company*, and *Adirondack Life*, and co-hosts the science program *Natural Selections* on North Country Public Radio. Curt has taught natural sciences at Paul Smith's College since 1987 and was chosen as 2013 New York State

Professor of the Year by the Carnegie Foundation. And if nobody stops him, he has been known to play a mean banjo.

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**Dr. Jason Stockwell**, Director of Rubenstein Ecosystem Science Lab, University of Vermont

Dr. Stockwell received his doctorate from the University of Toronto in 1996, followed by post-doctoral associate positions at Colorado State University and Michigan State University. More recently, he was the station chief at the USGS Lake Superior Biological Station in Ashland, Wisconsin, and a pelagic ecologist at the Gulf of Maine Research Institute in Portland, Maine. Much of Dr. Stockwell's previous work focused on the Great Lakes where he developed a unified research framework to help identify the mechanisms underlying cisco recruitment, modeled linkages between population dynamics and habitat supply, and transitioned and integrated a long-term monitoring program into a template for examining energy flow through food webs across habitat gradients. He also has extensive experience investigating the role of diel vertical migration in the ecology of pelagic species.

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**Becky Tharp**, Land Use Planning and Water Quality Educator, Lake Champlain Sea Grant

Becky is responsible for managing LCSG's urban non-point source pollution and stormwater education programs. She develops and conducts outreach and trainings that teach the connection between land use and water quality by drawing on relevant scientific research. Becky holds a BA from Harvard University and an MS from the University of Vermont where she investigated the use of *Mentha aquatica* (an emergent mint species) as a living drinking water disinfectant in developing communities.

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**Mike Winslow**, Staff Scientist, Lake Champlain Committee

Mike Winslow has been the staff scientist with the non-profit Lake Champlain Committee since 2001. He is the author of *Lake Champlain: A Natural History*, and the chair of the Lake Champlain Basin Program's Technical Advisory Committee. In Mike's past he taught in a high school classroom in Maryland, a vocational center in Ecuador, and environmental education programs in Vermont and Virginia. He holds a Bachelor's degree from St. Lawrence University in Biology and Environmental Studies, and a Master's in Botany from the University of Vermont.

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