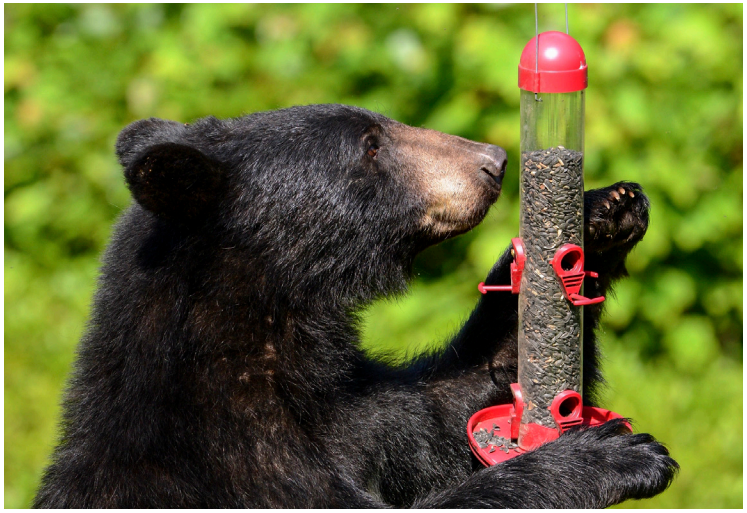
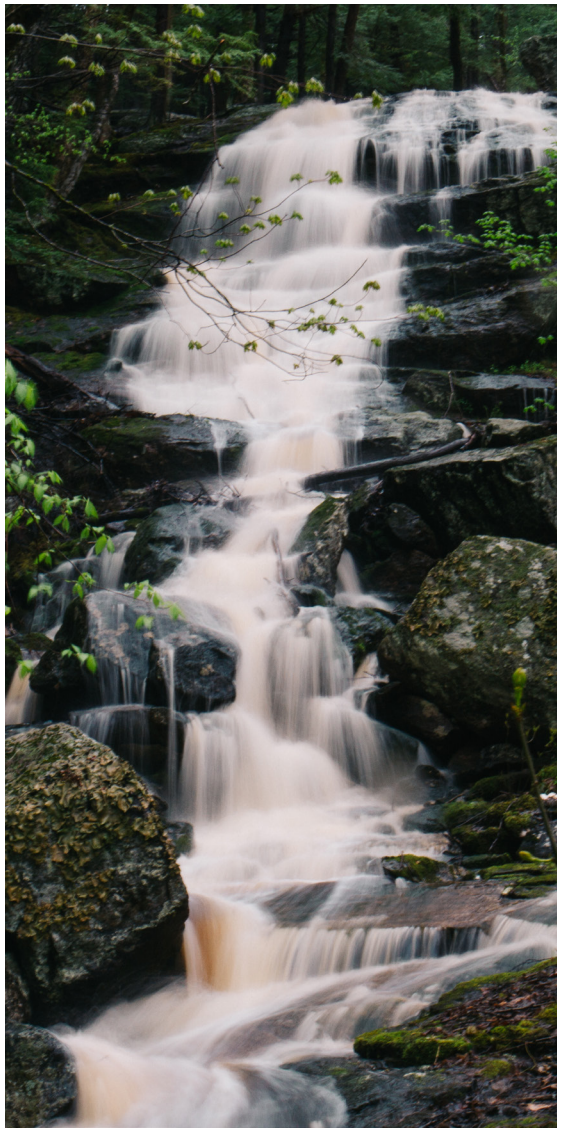
United States Geological Survey

Massachusetts Cooperative Fish and Wildlife Research Unit



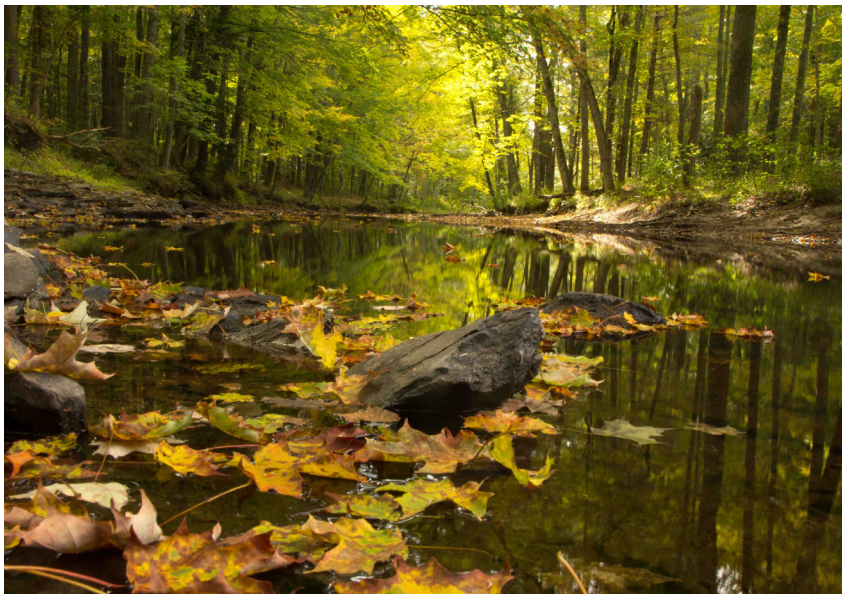


Biennial Report 2016–2017

Amherst, MA
August 2017

Welcome to the latest installment of the Massachusetts Cooperative Fish and Wildlife Research Unit's Biennial Report. This report covers the years 2016-2017, with some overlap in activities and projects that began in 2015. In these pages of the report you will see information on who we are, where we came from, and where we are going. We present brief updates and progress reports on our current graduate research projects in the areas of Fish and Aquatic Resources and Terrestrial Wildlife, completion reports for those projects that were finished in the past 2 years, and a list of presentations and publications coming out of these research efforts.

Our annual Unit Coordination Committee Meetings for 2015 and 2016 took place at the impressive new field headquarters of the Massachusetts Division of Fisheries and Wildlife (MassWildlife). The 45,000-square-foot Richard Cronin building opened at the end of 2014 and is a state-of-the-art energy efficient structure that replaces the original 12,000-square-foot building. It achieves its goal of zero net energy by generating power from an extensive rooftop solar panel array and features a closed-loop geothermal well system, radiant ceilings, and a heat recovery system. Visitors enter a cavernous lobby, which houses lots of displays and information as well as an active trout stream that flows right through the building. Several meeting rooms of various sizes are equipped with the latest in audio-visual equipment. The site overlooks the Westborough Wildlife Management Area – renamed the Wayne MacCallum Wildlife Management Area in honor of Director MacCallum upon his retirement – and overall it is a spectacular venue for meetings and gatherings.



The Nissitissit River in Pepperell, MA (Peter Zaidel)

In 2015, our Unit meeting featured 8-minute "speed talks" and posters presented by Unit graduate students on their research projects. This was followed by an open lunch and discussion period, where students were able to interact with personnel from MassWildlife as well as several other agencies. The Unit business portion of the meeting took place after lunch.

We repeated the same format for our 2016 Unit meeting, but we featured a mix of Unit graduate students and several new faculty members in the Department of Environmental Conservation, our host department at the University of Massachusetts-Amherst. This provided an opportunity for new faculty to present to our Cooperators some of their areas of interest and expertise, and provided time for faculty members to interact with agency personnel.

Our Coordination Committee meeting for 2017 will take place at the UMass-Amherst campus. A major goal for this year's meeting will be to plan for next year's meeting, which will be the 70th anniversary of the Massachusetts Unit, dating back to the year 1948. A lot has happened in those 7 decades, and we hope to represent some of the research, education, and service that the Unit has provided in collaboration with its long-term and very supportive Cooperators.

It has been an active and productive 2 years, and the support of our cooperating agencies and institutions has never been stronger. Those of us with the Cooperative Research Unit Program are continually grateful for the assistance we receive from our State, Federal, University, and private collaborators and colleagues. As always, we welcome your comments and suggestions and we appreciate your continued interest and support.

Otter (Dale Monette)

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Abbreviations

BOEM = Bureau of Ocean Energy Management
CAFE = Center for Agriculture, Food, & the Environment
CHC = Commonwealth Honor's College
CRUP = Cooperative Research Units Program
ECO = Department of Environmental Conservation
HF = Harvard Forest
IBA = International Association for Bear Research and Management
MDOT = Massachusetts Department of Transportation
MDCR = Massachusetts Department of Conservation & Recreation
MDEP = Massachusetts Department of Environmental Protection
MDER = Massachusetts Division of Ecological Restoration
MassWildlife = Massachusetts Division of Fisheries & Wildlife
MDMF = Massachusetts Division of Marine Fisheries
NSF = National Science Foundation
UMass = University of Massachusetts-Amherst
OEB= Organismic and Evolutionary Biology Program
USFWS = U. S. Fish and Wildlife Service
USGS = U. S. Geological Survey

Cover Photos
Top: Black Bear with birdfeeder (Bill Byrne), Bunchberry Flowers in MA (Ayla Skorupa)
Bottom: Female Bluebird, White-tailed Deer (Dale Monette)
Right: Spirit Falls in Royalston, MA (Ayla Skorupa)
Back Cover: Dale Monette

Photo Credits Provided in Parentheses
Report Compiled By: Grace Wright

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Chipmunk (Dale Monette)

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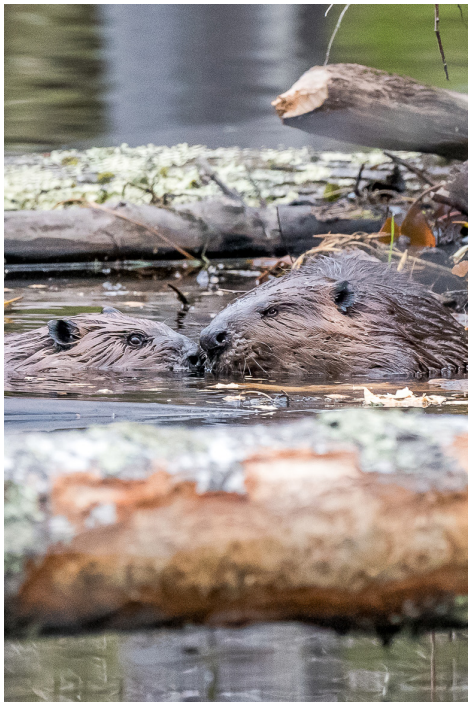


Beavers (Dale Monette)

COLLABORATING FACULTY, ADJUNCTS, COOPERATORS

Antioch College of New England
Lisabeth Willey

Boston University and Harvard Forest
Adrien Finzi, Marc-André Giasson

Connecticut River Conservancy
Andy Fisk

Highstead and Harvard Forest
Ed Faison, David Foster

Maine Department of Inland Fisheries and Wildlife
Jennifer Vashon

Massachusetts Department of Conservation and Recreation
Dan Clark, Kiana Koenen, Ken MacKenzie, Jillian Whitney

Massachusetts Department of Transportation
Tim Dexter

Massachusetts Division of Ecological Restoration
Michelle Craddock, Kris Houle, Beth Lambert

Massachusetts Division of Marine Fisheries
Mike Armstrong, Brad Chase, Ben Gahagan, John Sheppard, Sara Turner

Massachusetts Division of Fisheries and Wildlife
Nate Buckhout, Jack Buckley, Bill Davis, Tom French, Dave Fuller, Peter Hazelton, Andrew Madden, Steven Mattocks, Mike Morelley, Dave Paulson, Rebecca Quinones, Jonathan Regosin, Todd Richards, Jason Stolarski, Ralph Taylor, Mark Tisa, Dave Wattles

New York State Department of Environmental Conservation
Gordon Batcheller (retired)

Responsive Management
Mark Duda

Smithsonian Conservation Biology Institute
Warren Johnson

University of Maryland Baltimore County
Matt Baker

University of Massachusetts Amherst
David Bloniarz, John Finn, Todd Fuller, Curt Griffin, Christine Hatch, Scott Jackson, Adrian Jordaan, Derek Lovley, Ezra Markowitz, Anita Milman, Hank Moylan, Robert Ryan, Paul Sievert

University of Montana
Andrew Whiteley

University of Pittsburgh and Harvard Forest
Walter Carson, Sarah C. Pasquini

U.S.D.A. Forest Service
Dave King, Keith Nislow

U.S. Fish and Wildlife Service
Mike Bailey, Scott Kahan, Rachel Katz, Dave Perkins, Tim Warren

U.S. Geological Survey
Cooperative Research Units Program: John Organ, Mike Tome
S.O. Conte Anadromous Fish Research Center: Evan Grant, Ben Letcher
New England Water Science Center: Dave Armstrong, Sara Levin
Patuxent Wildlife Research Center: Mike Runge

Dale Monette

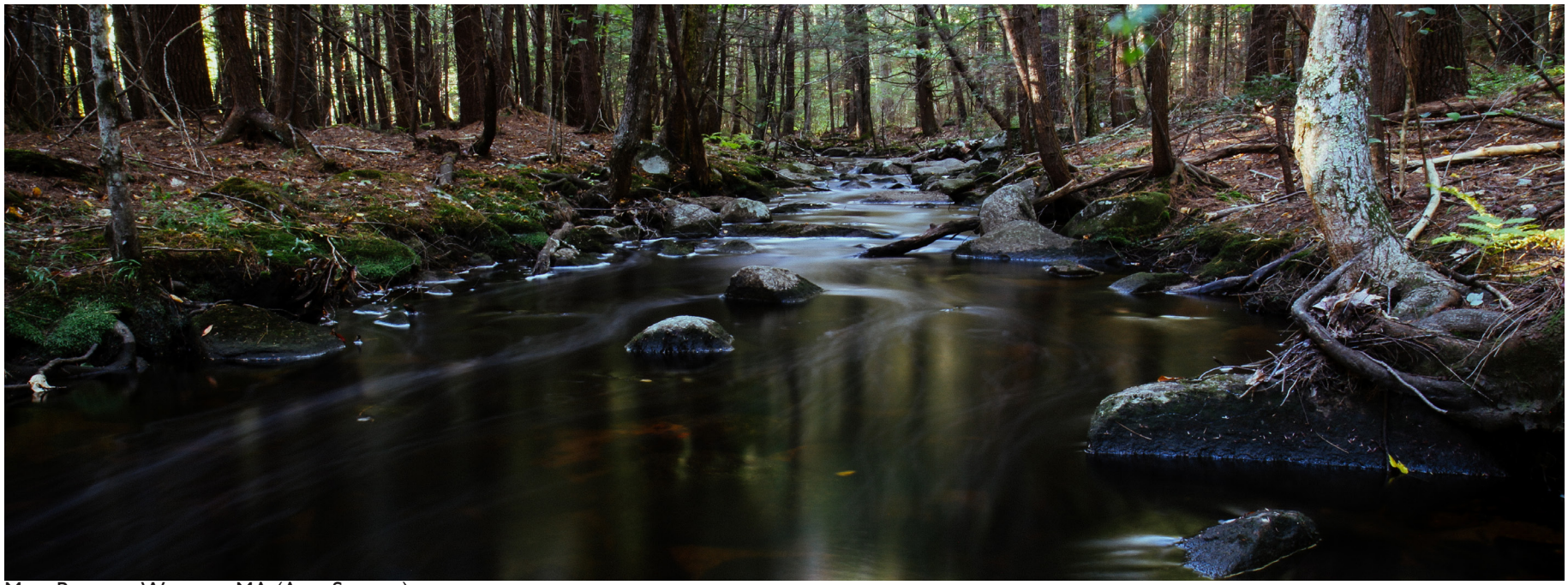
The Cooperative Research Units Program (CRUP) was established in the 1930s to enhance graduate education in fisheries and wildlife sciences and to facilitate research between natural resource agencies and universities on topics of mutual concern. The catalyst for the idea of a cooperative program was the conservationist and political cartoonist, J. N. "Ding" Darling. Darling's innovative thinking and push for conservation reforms in Iowa led to the first Unit, which was established between Iowa State College and the Iowa Fish and Game Commission in 1932. Paul Errington, a student of Aldo Leopold and a notable wildlife biologist, became the Iowa Unit's first leader.

In 1935, Darling and others successfully established a national program for Cooperative Research Units, which involved a federal agency (the Bureau of Biological Survey, a precursor to today's U. S. Fish and Wildlife Service) as well as a land-grant university and a state agency. Nine Units were formed: Oregon, Utah, Texas, Iowa, Maine, Connecticut, Virginia, Alabama, and Ohio. The Connecticut Unit was only in operation from 1935-1937, and the Ohio Unit was closed in 1991.

The Massachusetts Unit was established in 1948 and was one of a second wave of new Units, which included Missouri, Pennsylvania, Colorado, Idaho, Oklahoma, Alaska, Arizona, and Montana. Originally, Cooperative Wildlife Research Units preceded Cooperative Fishery Research Units, and the two types of Units were separate entities. In 1963, the Massachusetts Fishery Unit was formed. In 1990 most Wildlife Units and Fishery Units were combined, and the two Units at the University of Massachusetts became the combined Massachusetts Cooperative Fish and Wildlife Research Unit.

The CRUP was part of the U. S. Fish and Wildlife Service until the 1990s, when CRUP joined the U. S. Geological Survey. Today, there are 40 Cooperative Research Units in 38 states. Each Unit consists of 2-5 federal scientists and 1-2 administrative specialists, and each is a partnership among the U.S. Geological Survey, state natural resource agencies, a host university, the Wildlife Management Institute, and in many cases the U. S. Fish and Wildlife Service. A formal Cooperative Agreement specifies the responsibilities of each cooperator, and a Coordinating Committee meets annually and serves to advise and guide the Unit. Staffed by Federal personnel, Cooperative Research Units conduct research on applied conservation questions, participate in the education of graduate students, provide technical assistance and consultation on natural resource issues, and provide continuing education for natural resource professionals.

Throughout its history, the primary three-fold mission of the CRUP has remained the same: (1) Graduate Education, (2) Research, and (3) Technical Assistance in matters related to fish and wildlife populations and their habitats.



Moss Brook in Warwick, MA (Ayla Skorupa)

Stephen DeStefano
Leader - Wildlife
Research Professor

I have worked on a variety of species and topics related to wildlife population dynamics, habitat relationships, and wildlife-human interactions, particularly within forested ecosystems and urban-suburban environments. I am particularly interested in the influence of anthropogenic factors (development, disturbance) on wildlife, how large animals that require large spatial scales use fragmented and human-dominated landscapes and the implications for land conservation, and the science and management of "overabundant" wildlife – what makes some species successful and how that influences human-wildlife interactions.

Allison H. Roy
Assistant Leader - Fisheries
Research Assistant Professor

My research broadly revolves around characterizing anthropogenic impacts on aquatic ecosystems and identifying conservation strategies for effectively protecting and restoring watersheds. Understanding the mechanisms by which urbanization and its associated stressors result in degraded biotic assemblages is an overarching challenge of my research program. I am interested in examining effects of alterations (e.g., hydrology, temperature, habitat, food resources) on fishes, mussels, and macroinvertebrates; population ecology and conservation of rare and endangered species; and potential for management to restore freshwater ecosystems.

Deb Wright
MA Cooperative Research Unit
Administrative Assistant

I joined the MA Cooperative Research Unit in December 2014 and have thoroughly enjoyed learning about the various research projects. In working with grant tracking and budgeting, I'm always curious as to when the next order of black strap molasses will be for those bears! With a background in education, I have worked at a variety of schools in Idaho, Washington, and Vermont-both in the classroom and on the financial end. After raising a family of four kids in Vermont I continue to love the outdoors, whether it be in the garden, out on a run, or Nordic skiing.

COOPERATOR SERVICE

- Associate Editor, Freshwater Science (Roy)
- Graduate Committee member (DeStefano, Roy)
- Seminar Committee, OEB Graduate Program (Roy)

GRADUATE COURSES TAUGHT

- Research Concepts (ECO 601: DeStefano and Roy, alternate years)
- Aquatic Ecology (ECO 590AE: Roy, alternate years)
- Dam Removal Independent Study (NRC 496Y, ECO 696Y: Roy)
- Conservation in Practice (ECO 697CP: DeStefano and John Organ)

GRADUATE STUDENTS AND POSTDOCS (MAJOR PROFESSOR) 2013-PRESENT

COMPLETED

Mike Jones, Post-doc (Paul Sievert) - Regional coordination for wood turtle conservation in the Northeastern States (December 2017)
Rachel Katz, Post-doc (Roy with Evan Grant, Ben Letcher and Michael Runge) - Making decisions in complex landscapes: headwater stream management across multiple agencies (July 2017)
Bob Smith, Post-doc (Roy) - SEES Fellows: A heads up view of aquatic ecosystem sustainability—understanding the terrestrial, landscape scale impacts of urbanization on aquatic biota (August 2015)
Dave Wattles, Post-doc (DeStefano) - Movements, habitat selection, and diet of black bears in Massachusetts (September 2016)

Pam Loring, Ph.D. (Paul Sievert and Curt Griffin) - Tracking movements of common terns, endangered roseate terns, and threatened piping plovers in the Northwest Atlantic (September 2016)

Emily Argo, M.S. (Roy) - Factors influencing household outdoor residential water use decisions in suburban Boston (USA) (September 2016)
Kate Bentsen, M.S. (Roy) - Accounting for biotic variability in streams with low levels of impervious cover: the role of reach- and watershed-scale factors (May 2017)
Meghna Marjadi, M.S. (Roy and Andrew Whiteley) – River herring conservation in freshwater: investigating fish reproductive success and the educational value of citizen monitoring programs (September 2016)
Julianne Rosset, M.S. (Roy and Adrian Jordaan) - The life history characteristics, growth, and mortality of juvenile alewife, *Alosa pseudoharengus*, in coastal Massachusetts (May 2016)

Andrew Grant, B.S. Honor's (Roy) - Investigating the effects of interannual variation in streamflow and temperature on benthic macroinvertebrate assemblages over a 13 year period (2003-2016) in West Brook (May 2017)
Virginia Martell, B.S. Honor's (Roy) – The effect of calcium supplementation on the growth and survival of a freshwater mussel (May 2017)
Spencer Weinstein, B.S. Honor's (Roy and Andrew Whiteley) – Genetic analysis of slimy sculpin (*Cottus cognatus*) movement before and after dam removal (May 2016)

CURRENT

Sean Sterrett, Post-doc (Roy)
Katherine Zeller, Post-doc (DeStefano)

Jason Carmignani, Ph.D. (Roy)
Laura Conlee, Ph.D. (DeStefano)
Nereyda Falconi Lopez, Ph.D. (John Organ and DeStefano)
Rick Harper, Ph.D. (DeStefano and David Bloniarz)
Tanya Lama, Ph.D. (John Organ and DeStefano)
Todd Richards, Ph.D. (Roy)
Ayla Skorupa, Ph.D. (Roy)

Christopher Cahill, M.S. (DeStefano and John Organ)
Matthew Devine, M.S. (Roy and Adrian Jordaan)
Virginia Martell, M.S. (Roy)
Susan McCarthy, M.S. (DeStefano)
Calvin Ritter, M.S. (Dave King and DeStefano)
Peter Zaidel, M.S. (Roy)

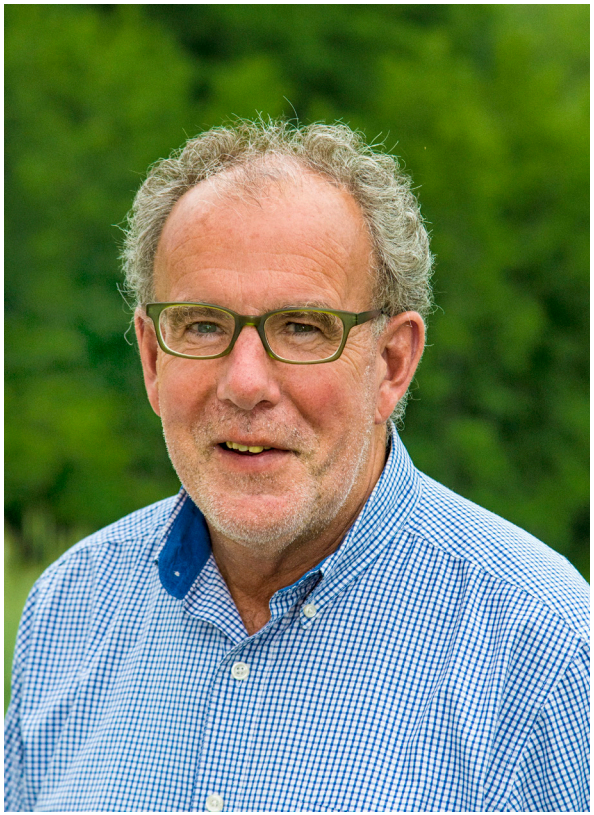
SANDHILL CRANE (DALE MONETTE)

Several key leadership positions in fish and wildlife conservation have been filled in the past 2 years. In 2015, Jack Buckley was appointed Director of the Massachusetts Division of Fisheries and Wildlife (MassWildlife) by the Fisheries and Wildlife Board. Jack has a long history of involvement with natural resources conservation in the Northeast and has been with MassWildlife since 1988 as Deputy Director of Administration until his appointment as the new Director, replacing Wayne MacCallum. Jack is also a product of the Cooperative Research Unit Program and an alumnus of the University of Massachusetts-Amherst, where he got his Bachelor's and Master's degrees in Fisheries Biology.

Also in 2015, David Pierce was named as Director of the Massachusetts Division of Marine Fisheries by the Marine Fisheries Commission. David has been a longtime member of DMF and had been serving as interim director for former Director Paul Diodati, who retired earlier in 2015. David's background includes work as a marine biologist before moving into marine fisheries policy and regulations, and serving as deputy director of DMF. He has B.S. and M.S. degrees from UMass-Dartmouth and a Ph.D. in environmental sciences from UMass-Boston.

In early 2017, Joe Larson, professor emeritus of Environmental Conservation with UMass-Amherst and longtime member of the Massachusetts Fisheries and Wildlife Board, was elected as Chair of the Board, succeeding George Dary of Lenox, Massachusetts, who served on the Board for 38 years. The Fisheries and Wildlife Board is made up of 7 people who oversee MassWildlife in such matters as personnel appointments and regulatory responsibilities for fauna and flora in the Commonwealth. Joe also holds a concurrent appointment with MassWildlife's Natural Heritage and Endangered Species Scientific Advisory Committee. He earned B.S. and M.S. degrees in Wildlife Management from UMass-Amherst and a Ph.D. in Zoology from Virginia Polytechnic Institute.

We extend our congratulations to Jack, David, and Joe, and look forward to working with these dedicated leaders in the years to come.



Jack Buckley (MassWildlife)

David Pierce (MDMF)

Joe Larson (UMass-Amherst)

Workshops and Conferences – Allison Roy helped to organize multiple workshops and conferences over the last two years. She co-organized the 4th Symposium on Urbanization and Stream Ecology in North Carolina in June 2017, which brought together stream ecologists and managers from around the US and world to discuss challenges and approaches to urban stream restoration and management (https://urbanstreams.wordpress.com/). She served on the local organizing committee for Fish Passage 2016: International Conference on River Connectivity, held at the University of Massachusetts Amherst in June 2016. She was also on the Planning Team for a Stream and Wetland Buffer meeting in May 2016 led by the U.S. Environmental Protection Agency.

The River Herring research team, led by Allison Roy, Adrian Jordaan, and Andrew Whiteley (now at the University of Montana) have been presenting exciting research to colleagues around the world. Several students have won presentation awards at regional conferences: Meghna Marjadi (MS student; best oral presentation, Southern New England Chapter (SNEC) of the American Fisheries Society winter 2016 meeting), Matt Devine (MS student; best poster, New England Association of Environmental Biologists 2016 and SNEC winter 2016 meeting; best oral presentation, SNEC winter 2017 meeting), and Kyle Grasso and Anthony Dangora (BS students; 1st and 2nd place poster presentations, SNEC winter 2017 meeting). Congratulations!

Stephen DeStefano participated in a workshop hosted by the Wildlife Conservation Society and U. S. Geological Survey on climate change, the boreal forest, and moose, during which scenario planning was used to inform land and wildlife management agencies on issues related to changes in moose populations and climate change. He also attended Harvard Forest's annual Forest Ecology Symposiums, where he and collaborator Ed Faison presented and discussed their ongoing research on experimental exclosures and ungulate browsing.

Steve, along with colleagues John Organ (USGS CRUP) and David Stainbrook and Susan McCarthy, both of MassWildlife, visited the Cary Institute of Ecosystem Studies research site in Millbrook, NY to discuss suburban deer management. Dave Wattles and Steve began discussions with Andy Finton and Jessica Dyson of The Nature Conservancy, Dave Paulson of MassWildlife, and Tim Dexter of the Massachusetts Department of Transportation regarding large mammal movements, habitat fragmentation, and linking landscapes for conservation. Steve also consulted with Anne Short and John Connors of Boston University on their research on human dimensions, conflicts, and suburban deer populations.

Steve, John Organ, Scott Kahan of the U. S. Fish and Wildlife Service, and Gordon Batcheller of the New York State Department of Environmental Conservation (retired) visited the National Shooting Sports Foundation's main headquarters in Newtown, Connecticut to discuss development of a project to assess hunter attitudes and knowledge of alternative ammunition for hunting deer on National Wildlife Refuges. Graduate student Tanya Lama and Steve, John Organ, and Warren Johnson of the Smithsonian Conservation Biology Institute met with biologists and managers from the Maine Department of Inland of Fisheries and Wildlife in Augusta, Maine to begin research on lynx genetics.

Steve also participated in a U. S. Fish and Wildlife Service-USGS CRUP joint meeting with Reston staff and other Unit Leaders for the Northeast Region to discuss and advance collaborations between the FWS and CRUP. He also participated in hearings and evaluations by MassWildlife to assess the potential for establishing a population of endangered timber rattlesnakes on an island in the Quabbin reservoir.

Richard Cronin Aquatic Resource Center – In spring 2015, the USFWS re-opened the salmon hatchery in Sunderland as a facility for collaborative research and education. Dr. David Perkins, a biologist with the USFWS, was named the Director of the new Richard Cronin Aquatic Resource Center. The MA Coop Unit and University of Massachusetts, among other organizations, entered into a collaborative agreement with USFWS, and the first students started in summer 2015. Since then, several exciting research projects have been initiated at Cronin, the biggest of which is an effort to propagate endangered freshwater mussels for conservation and restoration. This research is led by Perkins, Pete Hazelton of MassWildlife, and Allison Roy, and has resulted in 2 undergraduate Honor's theses (Stephanie Gill and Virginia Martell, see page 24) and new grant funding to support 1 MS (Virginia Martell, page 17), 1 PhD (Ayla Skorupa, page 16), and 1 Postdoc (Sean Sterrett, page 14).

Pete Hazelton (MassWildlife) talks to the Fisheries and Wildlife Board about our mussel propagation program at the Richard Cronin Aquatic Resource Center (Allison Roy).

Graduate Degrees for Working Professionals – The Massachusetts Unit's Working Professional Graduate Program continues to recruit outstanding working professionals to pursue a graduate degree (MS or PhD) while actively employed, as well as to confer graduate degrees on those who have been in the program and now have returned to work, degree in hand. The latter have been successful in securing raises and promotions. The program is producing many benefits: our State and Federal Cooperators can provide opportunities for training and advancement for some of their people, and they get applied, relevant research done; our University host produces additional graduate students who are now alums and form a stronger relationship between the university and regional conservation agencies; and the individuals involved have increased opportunities for career advancement as well as the personal satisfaction of completing a graduate degree. The program is purposely small and focused on a few key variables that we believe improve its success, and it benefits CRUP by advancing our mission and creating and strengthening our connection to the conservation community on both professional and personal levels.

ECO 601: Research Concepts – Since 2002, the Massachusetts Unit has taken the lead in teaching one of two required graduate courses for incoming MS candidates in the Department of Environmental Conservation. *Research Concepts* is focused on introducing new graduate students to the scientific research process, teaching the fundamental components of developing a research project, and providing guidance as students write the first draft of their graduate proposal. The course includes topics such as the scientific method, philosophy and history of science, the importance of literature reviews, approaches to science such as hypothesis testing (development, issues, alternatives), asking and framing good questions, experimental design, important research considerations (sample size, independence, random sampling, etc.), basic statistical concepts, and scientific writing and presentations. The course culminates in a working written draft of the proposal, and a 1-day proposal presentation symposium where students have the opportunity to present their research plans to an audience and receive constructive criticism and encouragement.

Students Inspiring Students – Under the leadership of Matt Devine and with the help of many Unit students, the UMass American Fisheries Society student subunit has organized and led day-long spring field trips for 5th graders at Shutesbury Elementary School (2016 & 2017) and Leverett Elementary School (2017) to participate in "A Day in The Life of a Fisheries Biologist." The kids spend half of the day at UMass dissecting fish, looking at bugs under a microscope, and seeing bones of marine mammals, among other activities. The other half day is spent at Amethyst Brook catching and identifying fishes and macroinvertebrates and learning how to sample aquatic habitats. The 5th graders love the hands-on science learning and so do we! In 2016, Unit students Matt Devine and Peter Zaidel, along with ECo graduate student Mercedes Harris, participated in a career workshop at Westfield State University where they spoke to undergraduate students about graduate school.

Graduate students Mercedes Harris, Peter Zaidel, and Matt Devine during an undergraduate career workshop at Westfield State University (Peter Zaidel).

The Cooperative Research Units Program's close coordination with the agencies and institutions that support us leads to graduate research that is of high value to our Cooperators. This in turns leads to the subsequent hiring of many of our graduates, who are now contributing their training and talents to the conservation and management of natural resources through employment with local, state, and federal agencies in the Northeast. This pattern of cooperation-graduate training-employment is repeated throughout the U.S. with the many Units that are established around the country, and it is particularly evident in Massachusetts, as our Unit has had a long and extremely supportive relationship with our state, federal, and university partners. These two pages display our recent Unit graduates, their new positions, and the agencies or institutions with whom they now work. The Massachusetts Unit has a long history of such successes, with dozens of graduates having held key positions with our Cooperators for the past many decades.

JULIANNE ROSSET
Migratory Fish and Hydropower Biologist
U.S. Fish and Wildlife Service
Concord, NH

PAM LORING
Wildlife Biologist
U.S. Fish and Wildlife Service
Division of Migratory Birds
Hadley, MA

RACHEL KATZ
Biometrician
U.S. Fish and Wildlife Service
Hadley, MA

DEREK YORK
Wildlife Biologist
ME Department of Inland Fisheries and Wildlife
Jonesboro, ME

SARAH SPENCER
Assistant Regional Wildlife Biologist
ME Department of Inland Fisheries and Wildlife
Jonesboro, ME

KATE BENTSEN
Streamflow Restoration Specialist
MA Division of Ecological Restoration
Boston, MA

ED FAISON
Senior Ecologist
Highstead and Harvard Forest
Redding, CT

ALLYSON YARRA
Hydrologist Technician
U.S. Geological Survey
New England Water Science Center
Northborough, MA

DAN CLARK
Director of Natural Resources
MA Department of Conservation
and Recreation
West Bolyston, MA

MIKE JONES
State Herpetologist
MassWildlife
Westborough, MA

DAVE WATTLES
Black Bear and Furbearer Biologist
MassWildlife
Westborough, MA

LUANNE JOHNSON
Director and Wildlife Biologist
BiodiversityWorks
Edgartown, MA

STEVEN MATTOCKS
Fisheries Biologist
MassWildlife
Westborough, MA

TODD RICHARDS
Assistant Director of Fishieries
MassWildlife
Westborough, MA

MICHAEL HUGUENIN
Assistant Director of Operations
MassWildlife
Westborough, MA

Brook Floater Rangewide Conservation and Restoration Initiative

The Brook Floater (*Alasmidonta varicosa)* is a stream-dwelling freshwater mussel native to the Atlantic Slope of the US and Canada that has experienced large population declines over the last 50 years and is at high risk of extinction. This project focuses on strategies for achieving conservation for Brook Floater through multiple objectives: (1) Project partners will build upon findings from a recently completed range-wide status assessment. (2) Partners will develop a conservation working group that will develop standardized surveys that will be conducted throughout partnering states to estimate abundances and predict occupancy of Brook Floater and associated imperiled mussels. (3) We will utilize Structured Decision Making approaches to focus monitoring design and conservation planning objectives at the state and regional scale. (4) We will coordinate the development of propagation methods and approaches for population restoration. (5) We will identify additional site-specific conservation actions to benefit the Brook Floater and associated habitats.

POST DOC Sean Sterrett

ADVISOR Allison Roy

FUNDING USFWS
MassWildlife

COLLABORATORS Peter Hazelton
David Perkins

A Brook Floater captured in eastern Massachusetts (Ayla Skorupa).

Impacts of Annual Wintertime Drawdowns on Littoral Zone Ecology

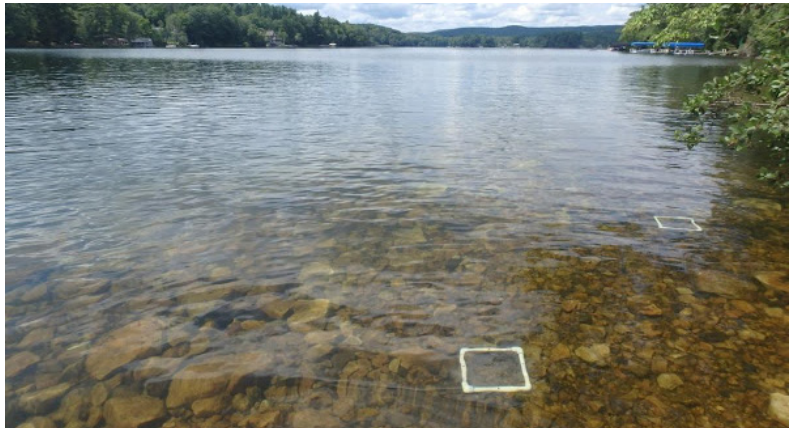
Annual winter water-level drawdowns are a common lake and pond management practice in Massachusetts, but little is known about the effects on non-target biota. This research aims to estimate these effects on physical habitat for invertebrates and fish (e.g., sediment, vegetation, wood), macroinvertebrate assemblage composition, fish reliance on littoral zone carbon, and mussel distributions. We are continuously collecting water-level data (2-hour intervals) in 22 MA lakes to quantify drawdown hydrology. In the 2015 and 2016 summers, we collected 210 macroinvertebrate samples from three habitats in 14 MA lakes covering a drawdown amplitude gradient. Over the same time and gradient, we collected approximately 1400 fish of 4 common species and 700 macroinvertebrates to estimate isotopic-based food web structure. We sampled mussels in 3 drawdown and 3 non-drawdown lakes in fall 2015 before drawdowns commenced. At depths exposed during drawdown, we found surface mussel densities were significantly higher in non-drawdown than drawdown lakes.

STUDENT Jason Carmignani (PhD)

ADVISOR Allison Roy

FUNDING MassWildlife
UMass OEB

COLLABORATOR Jason Stolarksi



Quadrats set to sample cobble-associated macroinvertebrates (Jason Carmignani).

Effects of Dam Removal on Stream Ecosystems

Practitioners are increasingly turning to dam removal as a tool for restoring streams and alleviating the threats posed by aging dams to infrastructure. Despite their prevalence across the landscape, the effects of dams on stream ecosystems, particularly on stream temperature and dissolved oxygen, are not well quantified. This project seeks to quantify the impacts of small dams to these water quality parameters upstream, within the impoundment, and downstream of 12 dam removal sites in Massachusetts. We additionally aim to understand what factors (landscape, dam characteristics, environmental) are driving observed variation in response to these dams. Understanding the factors that are driving this variation can help us better identify dams likely having the most negative impacts to water quality, and therefore help to prioritize sites that will maximize the ecological benefits from dam removal.

STUDENT Peter Zaidel (MS)

ADVISOR Allison Roy

FUNDING MDER
National Fish and Wildlife Foundation

COLLABORATORS Keith Nislow
Beth Lambert
Kristopher Houle

Installing a dissolved oxygen logger (Joe Foster).

Optimizing Sampling Effort and Investigating Productivity for Juvenile Anadromous Alewife

Anadromous alewives have experienced substantial population declines over the past five decades due in part to habitat degradation and overfishing. Current management objectives include restoring alewives to historic spawning habitats, yet data linking adult counts and juvenile production is lacking, and favorable habitats are not well described. The goal of this research is to (1) design a sampling protocol to be used for estimating juvenile densities in freshwater lakes, and (2) investigate biotic and abiotic factors influencing growth and mortality. We used a purse seine to sample juveniles at night in 16 lakes in 2015 using varying levels of effort. Saggital otoliths were extracted from a subsample of fish to estimate age, growth, and mortality, and we observed large variation in these estimates both within and among lakes. Preliminary results suggest density-dependence is the mechanism driving growth rates, and large lakes will require more purse seine hauls than smaller waterbodies.

STUDENT Matt Devine (MS)

ADVISORS Allison Roy
Adrian Jordaan

FUNDING National Fish and Wildlife Foundation
Atlantic States Marine Fisheries Commission
MDMF

COLLABORATORS Ben Gahagan
Michael Bailey

Enumerating juvenile alewife captured at night in a purse seine (Matt Devine).

Hydrological and Biological Impacts of Water Supply Reservoirs on Massachusetts Streams

Massachusetts has more than 150 surface water supply reservoirs that contribute to stream flow alteration in nearly one third of the surface area of the state. The goal of this research is to characterize stream flow alteration downstream of water supply reservoirs and examine impacts to fish communities. I will compare: (1) measured stream flows downstream of 6 water supply reservoirs to modeled estimates of stream flow at those same locations, (2) measured stream flow downstream of at water supply reservoirs to measured stream flows on similar unimpounded streams, and (3) fish communities at all of the same locations. Fish community samples and hundreds of thousands of discharge estimates have been developed to this point. Results will provide valuable information on potential and actual streamflow alterations downstream of water supply reservoirs and the stream processes that determine fish community structure. Managers can use these data to assess cumulative impacts on natural resources and guide water allocation decisions.

STUDENT Todd Richards (PhD)

ADVISOR Allison Roy

FUNDING MassWildlife
USGS CRUP

A stream flows downstream of a dam during spring conditions (Todd Richards).

Brook Floater Habitat Requirements and Propagation

The Brook Floater (*Alasmidonta varicosa*) is a freshwater mussel that is listed as threatened or endangered throughout New England. In Massachusetts, the current distribution of Brook Floater has been reduced from over 20 populations to four extant populations. With the help of volunteers from the Connecticut River Conservancy, we are surveying mussel and habitat in rivers with Brook Floater and where historical populations have been documented. This survey data will be used to assess habitat and water quality predictors for Brook Floater and identify potential locations for reintroduction. Propagation efforts are already underway at the USFWS Richard Cronin Aquatic Resource Center. We are conducting experiments to determine the best host fish for Brook Floater development. Juvenile mussels are collected once they drop off the fish and then reared in special systems until they are large enough to be reintroduced.

STUDENT Ayla Skorupa (PhD)

ADVISOR Allison Roy

FUNDING Massachusetts Environmental Trust
USFWS
MassWildlife

COLLABORATORS Pete Hazelton
Andrew Fisk
David Perkins

Ayla checks the growth of freshwater mussels kept in a submerged basket at USFWS Richard Cronin Aquatic Resource Center in Sunderland, MA (Jadziah Moonstone).

Yellow Lampmussel Restoration Initiative

The Yellow Lampmussel (*Lampsilis cariosa*) is protected as Endangered under the Massachusetts Endangered Species Act (MESA), and prior to 2006, was thought to be extirpated from the Commonwealth. In 2016, two projects were determined under MESA environmental review to alter *L. cariosa* habitat within the Connecticut River, which triggered a Conservation Management Permit to provide net benefit for the species, resulting in this new research initiative. Laboratory propagation of freshwater mussels has been identified in the Massachusetts State Wildlife Action Plan as a potential conservation measure to reintroduce mussels to historically occupied sites or to augment populations that are currently present. The objectives of the restoration initiative are to investigate host fish preference, metamorphic success, and methods to increase growth and survival of *L. cariosa* in captivity. Research will be conducted at the USFWS Richard Cronin Aquatic Resource Center in Sunderland, MA with potential rearing testing across other Massachusetts fisheries.

STUDENT Virginia Martell (MS)

ADVISORS Allison Roy

FUNDING Columbia Gas of Massachusetts
Springfield Water and Sewer Commission
USFWS

COLLABORATORS David Perkins
Pete Hazelton

Yellow lampmussel displaying its lure (Jeffrey Cole).

Impacts of Tidal Road-Stream Crossings on Aquatic Organism Passage

The North Atlantic Aquatic Connectivity Cooperative has developed a unified protocol to rapidly assess aquatic road-stream crossings for aquatic connectivity. This protocol is not applicable to tidal crossings as it does not address two-directional flow, daily depth fluctuations, or many of the species likely present in coastal habitats. The goal of this project is to create a new rapid protocol for assessing aquatic organism passage at tidal crossings based on information about species and habitats that are likely to be impacted by road crossings. We conducted a literature-based synthesis to identify species that move within in tidal streams, the unique traits that put them at risk, and passage threats unique to tidal crossings that are not addressed by non-tidal system protocols. Life history traits, environmental sensitivities, and movement patterns for each species have been compiled in a database that can be queried to identify species with common risk factors for impeded passage at tidal crossings. This information will be used to create guidelines and rapid assessment tools for assessing the degree risk to aquatic organism passage posed at tidal road-stream crossings.

RESEARCH ASSOCIATE Sarah Becker

FUNDING USFWS

COLLABORATORS Scott Jackson
Adrian Jordaan
Allison Roy

Tidal crossing in Fox Creek in Ipswich, MA (Great Marsh Coastal Wetlands Restoration Plan 2016).

The Life History Characteristics, Growth, and Mortality of Juvenile Alewife in Coastal Massachusetts

Over the past two centuries, anadromous alewife populations have drastically declined due to damming, inadequate fish passage, overfishing in the ocean and freshwater, climate change, and reduction in habitat quality. Alewife populations are currently assessed by counting adult fish as they migrate upstream, but little is known about resulting juvenile production within lakes. Lack of knowledge of freshwater life history characteristics of juvenile alewife limits our understanding of overall productivity.

For this project, we filled existing information gaps by (1) characterizing the timing of adult alewife migrations and subsequent spawning and (2) assessing juvenile alewife density, size, growth, and mortality within lakes, and abiotic factors influencing these estimates across lakes. Twenty lakes across coastal Massachusetts were sampled for juvenile alewife (Fig. 1) and water quality in summer 2014. Each lake was sampled three times: Round 1 (29 May to 15 June), Round 2 (26 June to 16 July), and Round 3 (27 July to 15 August).

Analyses of instream adult counts and otolith-based estimates of spawning date from captured juveniles showed a distinct delay (7-28 d) between the beginning of the adult migration run and spawning, and spawning continued 13-48 days after adults stopped migrating. These findings further corroborate recent discoveries that suggest alewife exhibit asynchronous spawning and has large implications for freshwater food webs. Lakes, overall, did not produce the same sized fish and there appear to be substantial variations of length-at-age with some lakes exhibiting large differences (Fig. 2). No change in length-at-age occurred in August, thus differences were achieved earlier in the growing season.

All 20 lakes exhibited variable growth, density, and mortality rates that yielded generally weak relationships with abiotic and biotic factors. Juvenile alewife density was positively related to juvenile density in the previous sampling Round, suggesting that a single sampling date may be sufficient to estimate relative lake density across the landscape. Factors affecting growth were not consistent; overall growth was positively correlated with dissolved organic carbon (DOC), while the last 20 days of growth was negatively correlated with secchi depth. While different, these responses are likely the result of the same mechanisms, both intrinsically linked with zooplankton abundance, prey availability, and feeding behavior within lakes. No significant correlate was found for mortality. In the future, the data in this project can be incorporated into models to improve stock assessments and support timely adaptive management strategies.

STUDENT Julianne Rosset (MS)
ADVISORS Allison Roy
Adrian Jordaan

FUNDING MDMF
UMass ECO

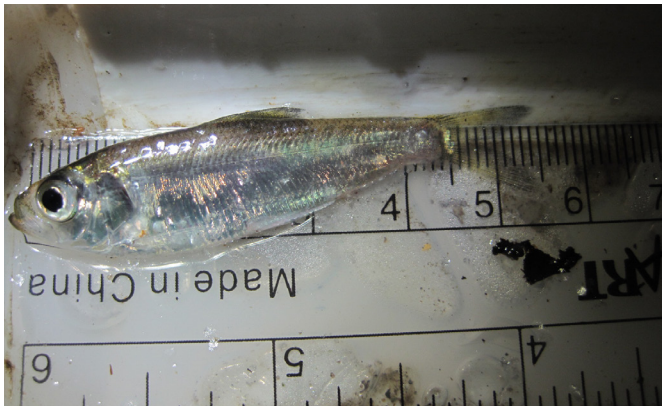


Figure 1. A juvenile alewife caught at night using a pelagic purse seine (Julianne Rosset).

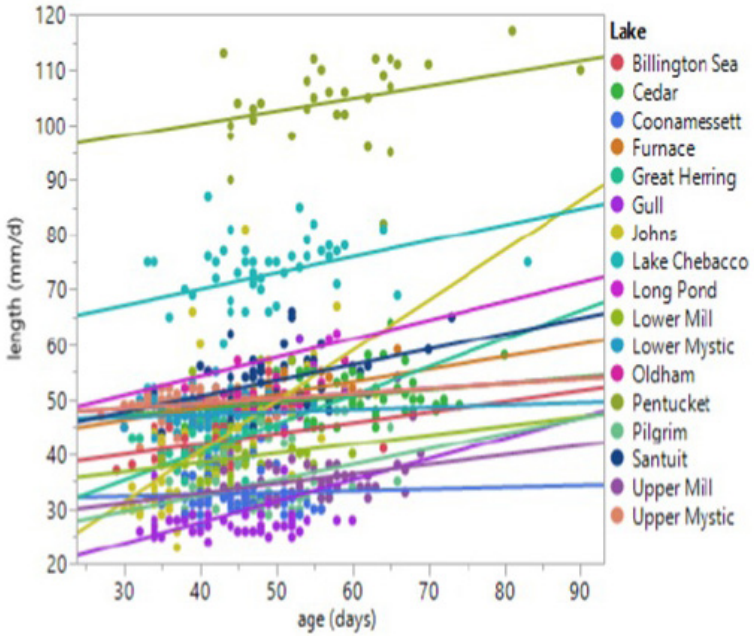


Figure 2. Regression of the lengths of juvenile alewife and their ages. Lakes are color coded and the slope of each is plotted.

Factors Influencing Household Outdoor Residential Water Use Decisions in Suburban Boston (USA)

Water withdrawals for human use can reduce water in lakes and streams, with significant consequences for aquatic biota. Outdoor water use accounts for the largest proportion of residential water use during the summer months, which corresponds to the lowest water levels in freshwater ecosystems. Prior studies have identified property features associated with the highest water use; however, these studies do not consider other types of water use nor do they capture the decisions by residents that result in outdoor water use. Understanding these decisions is critical for developing policies and education tools that reduce outdoor water use by addressing people's water use behavior. Focusing on the Ipswich River Watershed, which has been impacted by extreme low flows due to water withdrawals, a mixed-methods approach was used to evaluate residents' outdoor water use and factors influencing the amount and timing of water use. Water meters were placed on outdoor spigots to quantify use and written surveys and in-person interviews were conducted to understand the factors influencing this water use (Fig. 3). Irrigation systems used the most water; however, garden watering occurred as frequently as lawn irrigation and many participants indicated that their garden was a primary factor in water use decisions. Water use decisions fell into categories from habitual (i.e., watering at the same time of day) to purely cognitive (i.e., watering based on weather and plant needs). Participants' willingness to implement landscape-level conservation practices, such as rain barrels, did not differ based on their belief in need for water conservation. To have the greatest impact on overall water use, efforts should focus on residents' running irrigation systems on a schedule. Outreach should emphasize individualized approaches to water conservation, regardless of water source (public or private), and include information and conservation options specific to the water needs of the individual property.

Figure 1. Water meter at participant residence (Emily Argo).

STUDENT Emily Argo (MS)

ADVISORS Allison Roy
Robert Ryan
Anita Milman

FUNDING UMass CAFE
UMass OEB

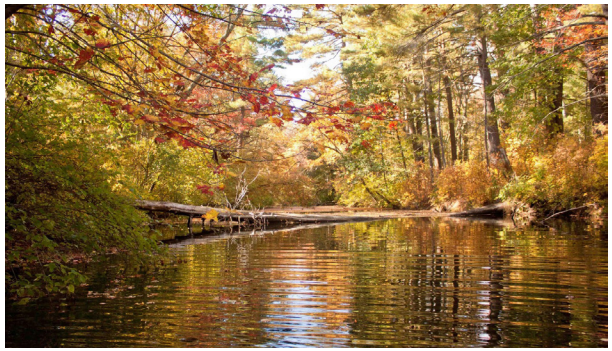


Figure 2. Ipswich River (Peter Zaidel).

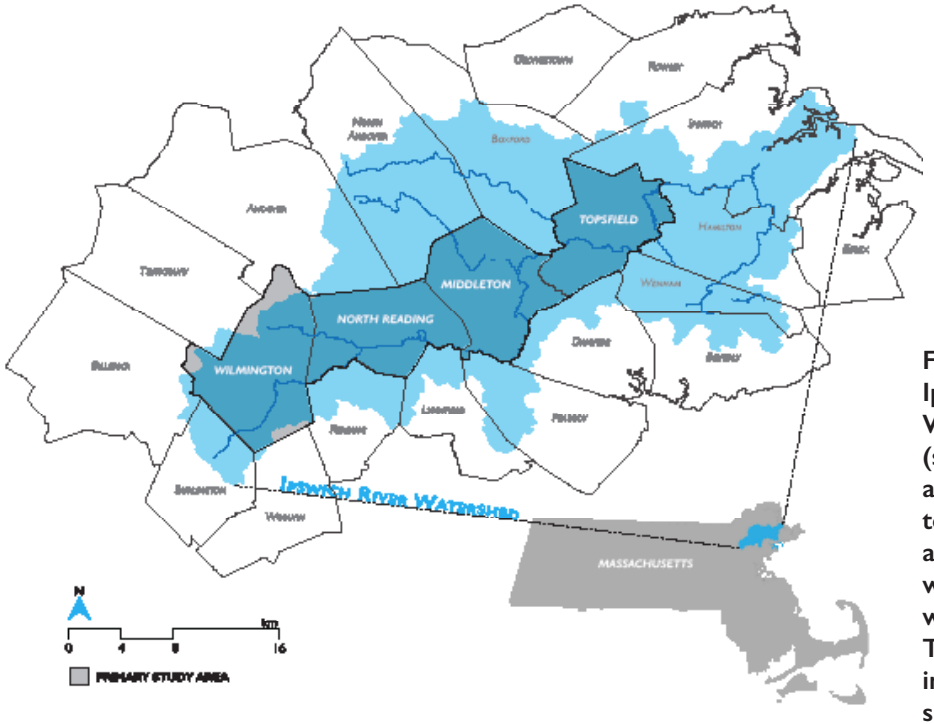


Figure 3. The Ipswich River Watershed (shaded blue) and the 21 towns that are all or partially within the watershed. Towns included in study are shaded gray.

Making Decisions in Complex Landscapes: Headwater Stream Management Across Multiple Agencies

Headwater stream ecosystems are especially vulnerable to changing climate and land use, but their conservation is challenged by the need to address landscape scale threats through coordination of multiple management organizations and landowners. We used a structured decision-making framework to identify barriers and impediments to collaborative landscape conservation of stream salamanders and brook trout. We held stakeholder workshops in three watersheds (Deerfield Watershed, Merrimack River Basin, and Potomac River Basin) that represented over 20 organizations involved in headwater stream management (Fig. 1). We used existing brook trout models to predict brook trout presence under various climate scenarios (stream temperature) and conducted expert elicitation to build predictive salamander models, which included uncertainty among experts (n = 18; Fig. 2). Results from both modeling efforts suggested that stream temperature and upland and riparian forest cover were major drivers of occupancy, with streamflow and interspecies interactions having smaller effects. We also found that successful collaborative management requires a substantial information sharing phase and shared understanding of the problem as it relates to allocating resources across large spatial scales. Focusing on a narrower geographic area (subwatershed or tributary) can improve the ability of stakeholders to reach a shared vision for collaborative management, which then that could be replicated in other subwatersheds or at larger scales. If there is no shared vision for pooling resources at larger scales, landscape collaborative management may not result in beneficial strategies to all stakeholders and multi-party negotiations may be preferred.

Figure 1. Representatives from 17 organizations participate in a workshop to explore collaborative management in the Deerfield watershed (Sean Sterrett).

POST-DOC Rachel Katz

ADVISORS Allison Roy
Evan Grant
Ben Letcher
Michael Runge

FUNDING USGS Northeast Climate Science Center

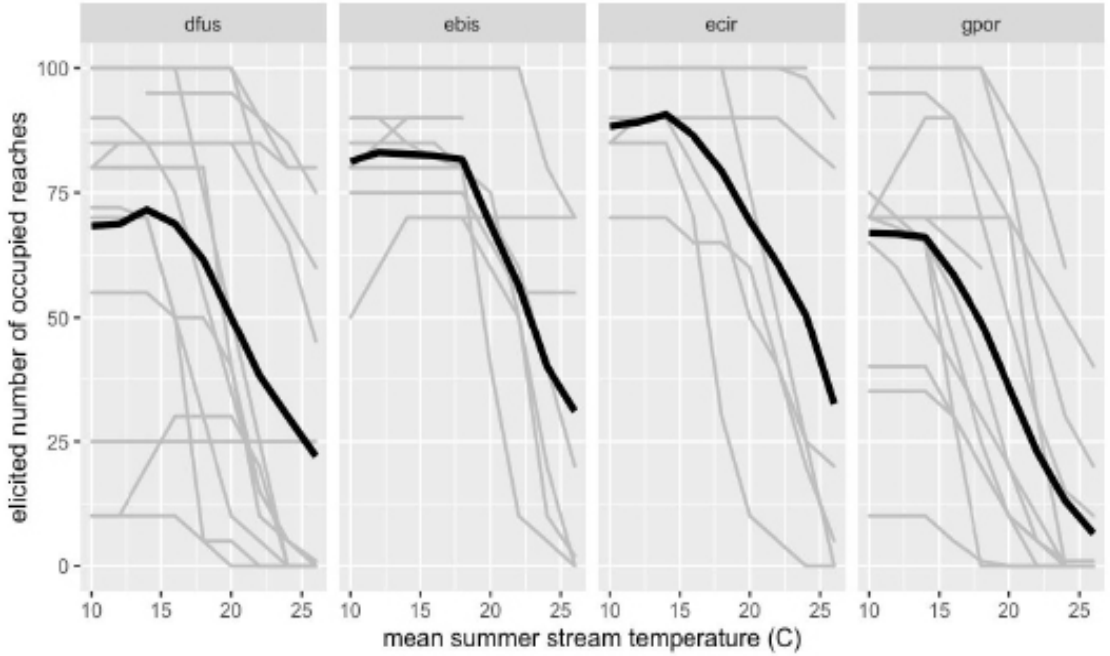


Figure 2. Number of occupied reaches for four headwater stream salamander species (Desmognathus fuscus = dfus, Eurycea bislineata = ebis, Eurycea cirrigera = ecir, Gyrinophilus porphyriticus =gpor) in relation to mean summer temperature across 18 salamander experts (thick line = mean across experts), reflecting various hypotheses related to temperature and salamander demography.

Investigating Alewife Reproductive Patterns and the Educational Impacts of a River Herring Citizen Science Program

Part 1: Reproductive success in alewives

Alewife, which are anadromous, iteroparous clupeids, have experienced drastic population declines throughout their range (Newfoundland (Canada) to North Carolina (USA)), declines in mean body size of migrating adults, and altered migration timing over the last five decades. A 2011 petition to include alewife in the Endangered Species Act was rejected, partly due to inadequate information towards identifying coast-wide population status and identification of gaps in knowledge of basic alewife life-history characteristics, including species reproductive strategies. Over three years (2013-2015), we introduced adult alewives into Pentucket Pond in Massachusetts (421, 266, and 410 individuals in 2013, 2014, and 2015, respectively) to understand their mating systems and assess how body size and introduction timing influence reproductive success (Fig. 1). We used 15 microsatellites to reconstruct pedigrees based on genotypes from all possible parents and samples of offspring within four months of hatching (Fig. 2). Across study years, spawning adults had small families (mean = 1.2) and spawned multiple times with multiple mates between May and June. Females were assigned more offspring than males. Generalized linear models suggest that earlier arrival and larger adult body size corresponded to elevated reproductive success. These results provide critical alewife life history information which contributes to interpretation of the implications of predicted changes in migration timing and size and at maturity, which will inform management of this at-risk species.

Part 2: Educational value of citizen science counts

Presently, most river herring populations are monitored using data from citizen counts of spawning adults entering freshwater. Involving citizen watershed groups in data collection and may provide ancillary benefits beyond collection of population-level count data. We used pre-and post-surveys to assess how involvement in one citizen monitoring program influenced participants' environmental knowledge, attitudes, and behaviors. Participants began the program with high scores for broader scientific and pro-environmental attitudes and pro-environmental behaviors. After the program, participants reported increased connection to nature, additional citizen science involvement, river herring knowledge, and engagement in outdoor recreation. For participants, engagement with nature was the most important program benefit. These results provide an additional case study to the citizen science literature and demonstrate that citizen science programs can help participants connect with the environment.

STUDENT Meghna Marjadi (MS)

ADVISORS Allison Roy
Andrew Whiteley

FUNDING MassWildlife
UMass OEB

COLLABORATORS Adrian Jordaan
Ben Gahagan
Ezra Markowitz

Figure 1. Processing alewives to be stocked, including measurements and taking fin clips (Kate Bentsen).

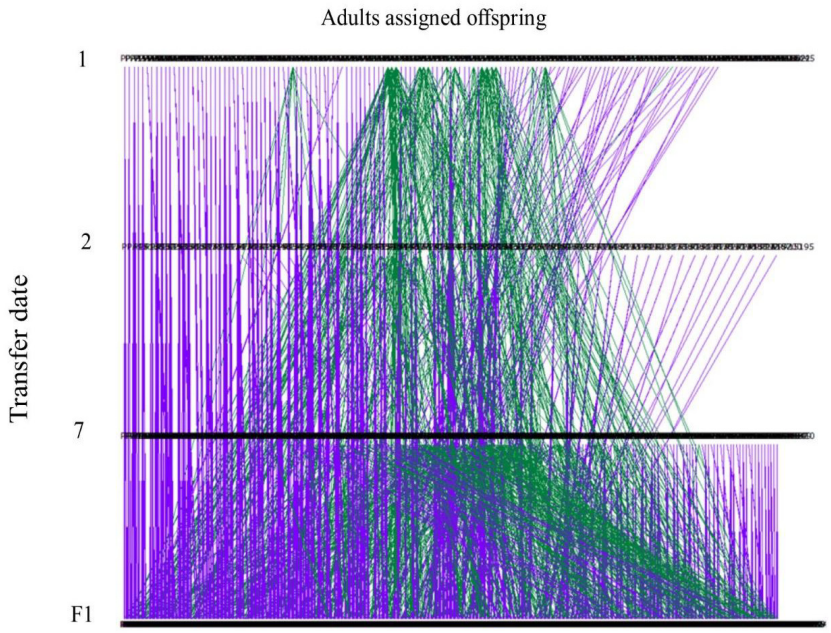


Figure 2. Pedigree results from 2015 demonstrate mating between multiple fish at multiple times. Purple lines indicate females and green lines indicate males. Offspring are connected to parent pairs through intersection of these lines. Each horizontal tier indicates a different transfer day (1, 2, and 7), with the lowest line showing the offspring (F1).

Investigating the Effects of Interannual Variation in Streamflow and Temperature on Benthic Macroinvertebrates in West Brook

Climate change has the potential to alter patterns of precipitation and temperature, which in turn could have effects on benthic macroinvertebrates. Many studies have compared macroinvertebrate assemblages among sites with different flow and thermal regimes, but few studies have examined changes in macroinvertebrate assemblages over long periods of time to address the impacts of climate change. We quantified the effects of stream temperature and flow on benthic macroinvertebrates over a 13-year period at West Brook in Whately, MA (Fig. 1). Specifically, we asked whether interannual variation in benthic macroinvertebrate assemblages could be explained by temperature or flow. Macroinvertebrates have been collected annually in late June since 2003 from three sections (approximately 300-400 m apart) using a Surber sampler. Stream temperature was recorded every 2 h with a Hobo data logger (Onset Corp., Bourne, MA, USA) placed at the downstream end of the reach. Depth was recorded every 2 hours with a pressure transducer (Onset Corp.) and converted to discharge (m^3/s) using a stage discharge relationship. We calculated several streamflow and temperature metrics related to frequency, duration, magnitude, timing, and variation of events. Macroinvertebrates were identified to genus (except Chironimidae), where possible, and used to calculate metrics, including total richness, EPT (Ephemeroptera, Plecoptera, Trichoptera) richness, Shannon diversity index, abundance, % abundance of EPT taxa, and Chironomidae. Macroinvertebrate richness and diversity was highly variable across years (Fig. 2). Percent EPT decreased and % Chironomidae increased over time, but there changes were not related to variation in streamflow and temperature. Spring minimum, mean, and maximum temperatures increased significantly over the study period (Fig. 3). However, macroinvertebrate metrics were unaffected by increasing spring temperatures. Density of Trichoptera increased significantly over time and may have been related to summer temperatures. Density of Ephemeroptera increased with higher baseflows and decreased with higher 90 day minimum discharge. This study provides insight into long term changes in macroinvertebrate assemblages in a single stream; however, more long term monitoring across larger geographic regions is necessary to assess the effects of climate change on macroinvertebrate assemblages.

STUDENT Andrew Grant (BS)
ADVISORS Allison Roy
FUNDING UMass CHC
COLLABORATORS Keith Nislow
Ben Letcher

Figure 1. West Brook taken during normal flow conditions (Andrew Grant).

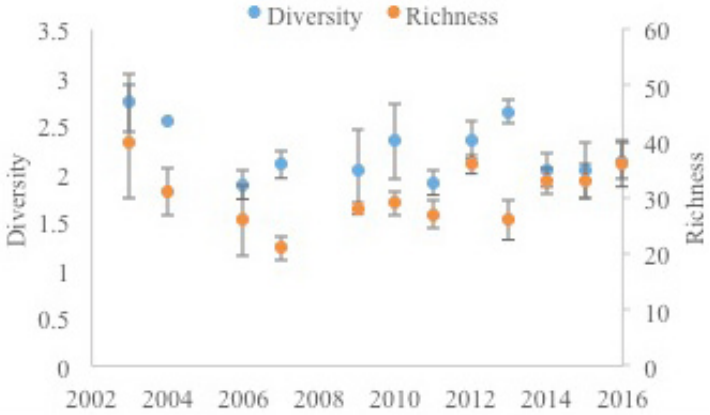


Figure 2. Mean (± SE) Shannon Diversity Index and taxa richness over time.

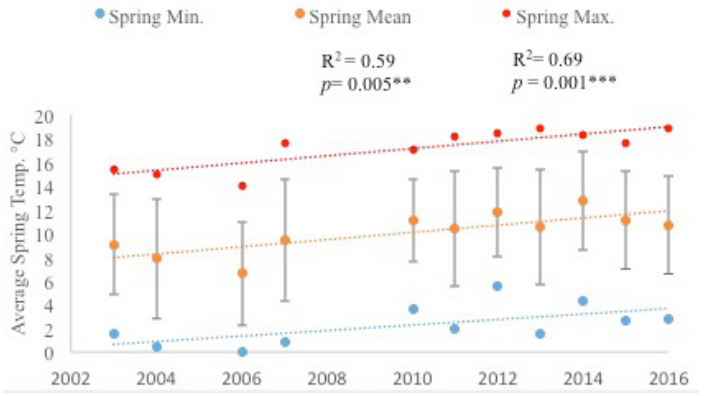


Figure 3. Linear regression of spring minimum (min.) mean (± SE), and spring maximum (max.) over time.

Accounting for Biotic Variability in Streams With Low Levels of Impervious Cover: The Role of Reach- and Watershed-Scale Factors

As landscapes become increasingly urbanized, there is an associated increase in impervious cover. Biotic assemblages consistently degrade with increased watershed impervious cover; however, at low levels of impervious cover, these assemblages exhibit wide variability in biotic integrity. This study investigated which reach- and watershed-scale factors explained biotic condition (i.e., richness, flow traits, thermal traits, and tolerance for macroinvertebrates and fishes) at similar levels of low imperviousness. The primary objective was to identify factors that confer resistance for biota, such that they retain high biotic integrity at low levels of impervious cover, and, conversely, to determine which factors make biota more vulnerable to urban disturbance, such that they have low biotic integrity despite low levels of impervious cover.

Forty sites were selected across Massachusetts within two narrow bands of impervious cover: 1–4% (n = 20) and 7–10% (n = 20). Models with reach-scale variables (reflecting habitat heterogeneity, flow, temperature, or water quality) or watershed-scale variables (representing natural characteristics, land use, flow alterations, and other measures of urbanization or impervious) explained additional variance compared to models with impervious cover alone (Fig. 2). Reach-scale factors tended to explain more variance than watershed-scale factors for all biotic responses except fluvial fishes, with overall more variance explained for fish than macroinvertebrate assemblages. At the reach scale, colder water temperatures, higher dissolved oxygen, and more large wood were related to higher proportions of fluvial, coldwater, and intolerant fishes. For macroinvertebrates, warmer water temperature, smaller sediment size, and higher nitrate were related to higher macroinvertebrate richness and tolerance. At the watershed scale, air temperature emerged as an important predictor for both taxonomic groups and across response metrics; air temperature was highly correlated with high-elevation watersheds. Other important watershed-scale predictors were open water and dams, flow alteration, and other urban measures such as housing density, impervious in a 120-m buffer, and road crossings.

Restoration should focus on strategies to reduce impacts that would degrade in-stream conditions that allow for higher biotic integrity, such as habitat heterogeneity, more large wood, and colder water temperatures. Similarly, watersheds should be prioritized for protection with those characteristics potentially more resistant to urban disturbance, such as high-elevation regions that retained high biotic integrity despite higher dam density, more road crossings, and more flow alteration.

STUDENT Kate Bentsen (MS)

ADVISOR Allison Roy

FUNDING MDEP

Figure 1. Geomorphic surveys using an electronic total station during summer 2015 (Kate Bentsen).

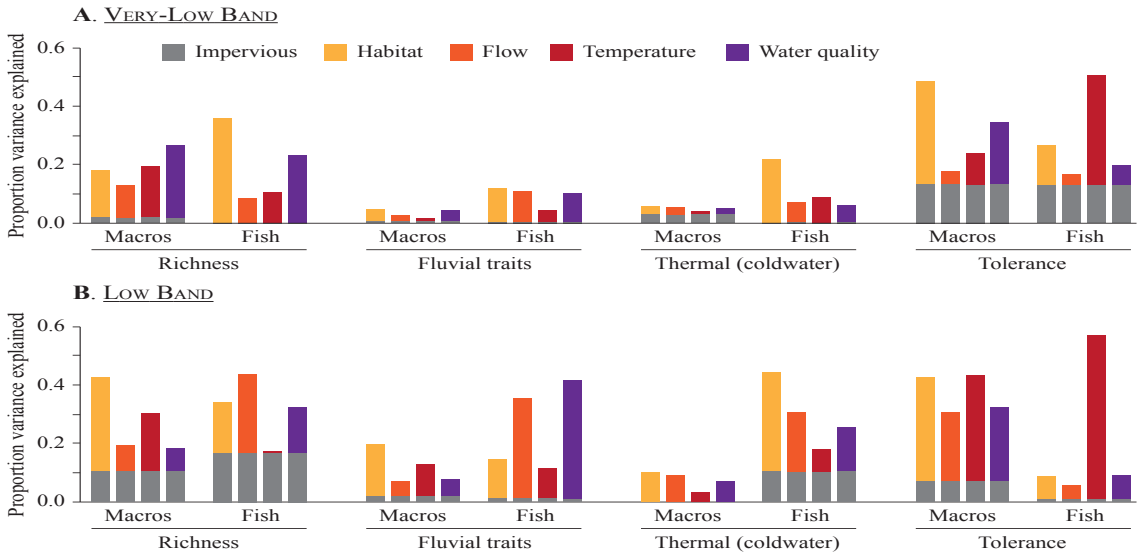


Figure 2. Additional variance explained by reach-scale predictors within predictor categories of habitat, flow, temperature, and water quality, for (A) very-low (1–4%, n = 20) and (B) low (7–10%, n = 20) impervious bands.

Growth and Survival of Freshwater Mussel *Lampsilis radiata* Under Different Rearing Conditions

As of 2013, over 65% of freshwater mussel species were considered endangered, threatened, or vulnerable. Where dispersal limits freshwater mussel populations, reintroduction and augmentation using propagated mussels has been considered an ideal conservation strategy. Mussel propagation has been successful at multiple culturing facilities; however, methods are still being refined to develop best practices.

The first two studies conducted at the Richard Cronin Aquatic Resource Center focused on growth of a common freshwater mussel under different rearing conditions. The goal of the first study (led by Stephanie Gill) was to determine whether bacteria found in the gut content of mussels would increase growth and survival if added to traditional mussel feed. Freshwater mussels can selectively digest food, preferring smaller organisms, not too spherical or spiny, that have a negative electrostatic charge. Genetic sequencing of gut bacteria from wild mussels using the 16S Diversity tool in Geneious© 2005 revealed an array of genera of bacteria, with *Geobacter* in most mussels. A comparison of the size, shape, and electrostatic charge of various *Geobacter* species resulted in selection of *Geobacter sulfurreducens* as an experimental food source. Thus, we supplemented juvenile mussel diets with *Geobacter sulfurreducens* and found that mussels grew fastest with a mixture of *Geobacter* and the normal algae feed, as compared to either feed type alone (Fig.2). The results indicate that there may be potential for use of bacteria as a main food source for juvenile *Lampsilis radiata*.

The goal of the second study (led by Virginia Martell) was to determine whether calcium supplementation would lead to increased growth and survival on juvenile mussels. Although lab studies have linked decreased calcium availability to impaired growth and survival of numerous freshwater fauna such as crustaceans, amphipods, and gastropods, to date only one study has experimentally examined the role of calcium carbonate in mussel development. We had 5 treatments: 2 levels of calcium created using a coral media calcium reactor ($CaCO_3$), 2 similar levels of calcium chloride ($CaCl_2$), and a control treatment with natural levels of calcium. The control was significantly higher in both growth and survival. The $CaCl_2$ High had the lowest average survival; and the $CaCO_3$ Low had the lowest average growth. The results of this study indicate that calcium is not beneficial to early juvenile development of *L. radiata*; and in fact may be detrimental to growth and survival.

STUDENTS Virginia Martell (BS)
Stephanie Gill (BS)

ADVISORS Allison Roy
Derek Lovely

FUNDING USFWS
UMass ECO
UMass CHC

COLLABORATORS David Perkins
Peter Hazelton
Timothy Warren

Figure 1. Juvenile mussel measurements (µm) processed in Image Pro (Virginia Martell).

Figure 2. Recirculating feed system (Stephanie Gill).

Dispersal by Stream Biota Across Natural and Human Dominated Landscapes

Local habitat characteristics and dispersal determine the species composition of communities. The remaining patches of natural habitat in urban landscapes are typically less suitable and more fragmented than in undeveloped landscapes. Managing human impacts on stream ecosystems usually focuses on catchment land use and in-stream habitat conditions while largely ignoring broader landscape characteristics affecting dispersal. Using a multi-model inference approach, we examined the ability of catchment land use (percent forested) and characteristics of the landscape affecting dispersal to predict the richness of fish (935 sites) and insect assemblages (393 sites) in streams along an urbanization gradient. We hypothesized that catchment land use has a greater effect on assemblage richness than network configuration or dispersal barriers and that the effects of dispersal variables would differ between fish and insect assemblages. A regression approach was used to empirically determine the appropriate spatial extent to measure landscape characteristics affecting dispersal in a radius around the sample site (Fig. 1) and along stream network (Fig. 2). The results of the model selection procedure supported our hypothesis. Catchment land use was found in the top models and was the only significant coefficient for the top model (beta=-0.481, p<0.001) for the insect assemblage. Catchment land use variable was also found in the top models for the fish assemblage, but both catchment land use (beta=-0.100, p=0.002) and the variable representing stream network configuration (beta=0.073, p=0.025) were significant coefficients. Catchment land use had the greatest effect on insect and fish assemblages, but network configuration had a secondary effect on fish assemblage richness. The linear models used to empirically determine the spatial extent for the dispersal variables had universally poor fit and inconsistent relationships with landscape variables (Fig. 3). Species belonging to a single assemblage likely have different dispersal abilities, explaining why whole-assemblage metrics are not sensitive to dispersal barriers measured in a single spatial extent.

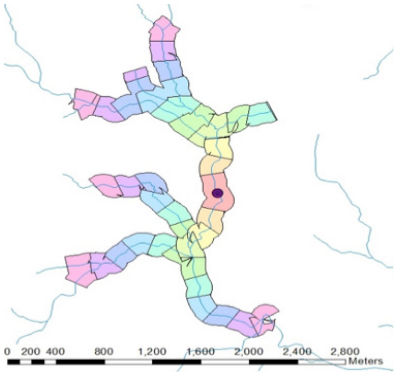


Figure 2. Landscape variables were calculated within 100 m buffer (200 m total width) along the stream in distance intervals of 200 m from the sampling site in all directions along the stream network to determine the spatial scale best at predicting fish and insect assemblage richness.

POST-DOC Bob Smith

ADVISOR Allison Roy

FUNDING NSF

COLLLABORATORS Robert Ryan
Todd Richards
Bob Nuzzo

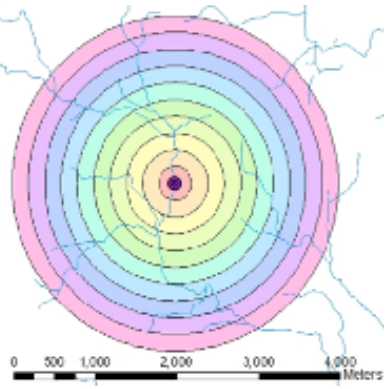


Figure 1. Landscape variables were calculated in circles around the sampling sites at 10 intervals of 200 m (radius) to determine the best distance for predicting insect richness.

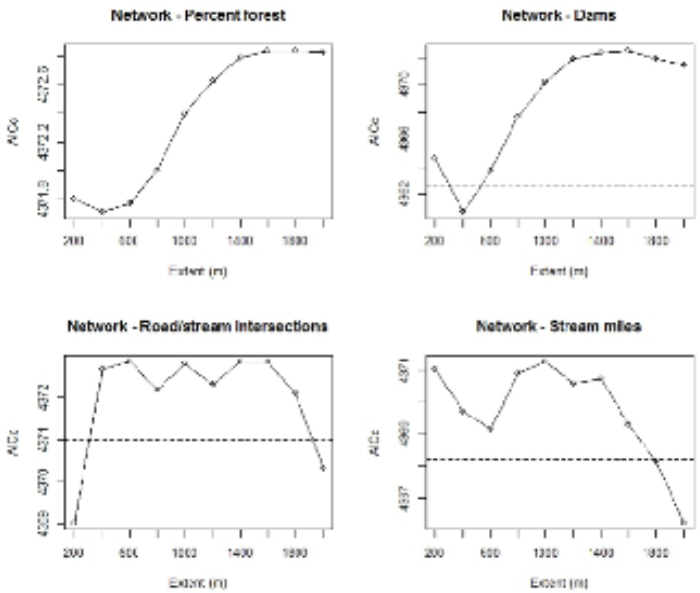


Figure 3. Similar to all radial and network landscape dispersal variables for fish & insect assemblages, linear regressions of network dispersal variables vs fish richness demonstrated poor fit overall. In each plot, the dashed line represents Δ=2 (i.e., any points below the line represent models that are equivalent based on AICc values). A single best-fit extent was rarely indicated with this modelling approach. The best fit extent was 400 m for dams, 200 m & 2000 m for road-stream crossings, & 2000 m for stream miles. All models for network percent forest in the riparian zone had essentially the same fit.

Assessing Hunter Values, Expectations, and Satisfaction Regarding Controlled White-tailed Deer Hunts in Suburban Eastern Massachusetts

White-tailed deer (*Odocoileus virginianus*) are abundant throughout Massachusetts, particularly in eastern portions of the state where suburban landscapes provide high quality habitat. Ecological degradation from over-browsing and increased human-deer conflicts result in a need to address overabundant deer populations. Regulated hunting is a widely accepted deer management strategy used to effectively reduce and maintain deer densities, although its use in suburban areas presents challenges. Of particular concern is the long-term participation of devoted hunters. Presumably, continued hunter participation is driven largely by participants' satisfaction with the hunting experience. Highly controlled hunts may restrict participants in ways that minimize satisfaction. Without a dependable suburban hunting constituency, successful reduction of deer populations may be impeded. A better understanding of suburban hunters' expectations, preferences, and limitations is of great importance if effective deer management programs are to be implemented.

STUDENT Susan McCarthy (MS)

ADVISOR Stephen DeStefano

FUNDING MassWildlife

Suburban deer (Bill Byrne).

Large Mammal Habitat Use, Movement, and Dispersal in Highly Developed Landscapes

Massachusetts is the third most densely populated state in the U.S. and contains a vast road network. Massachusetts is unique in that it also has expanding populations of moose (*Alces americanus*) and black bears (*Ursus americanus*). We are using GPS collar data from over 20 moose and 30 black bears to explore habitat use across the wildland-urban gradient. For both species we will (1) develop multi-level, multi-scale habitat selection models, (2) model movement and behavioral response to roads, and (3) map resistance to movement surfaces and dispersal corridors. Results from the research will be used to improve our understanding of large mammal habitat use in heavily developed areas, help implement mitigation measures for roads, and develop statewide management plans.

POST DOC Katherine Zeller

ADVISOR Stephen DeStefano

FUNDING MassWildlife
MDOT

Moose sighting in central Massachusetts (Dale Monette).

Massachusetts Residents' Attitudes Toward Black Bear and Black Bear Management.

A human dimensions survey of Massachusetts residents' attitudes of black bears and black bear management has not been conducted in recent years. The black bear population is growing and expanding into eastern areas of the state where residents are largely inexperienced with living with bears. We will assess Massachusetts resident's attitudes and beliefs related to black bears and the growing and expanding black bear population, residents' experience with bears and bear-related damage, and residents' perception of bear management scenarios and options. We will also assess residents' wildlife feeding habits, as they may relate to human-bear conflicts and opinions on personal and agency responsibilities related to feeding and opinions on feeding laws and regulations.

STUDENT Laura Conlee (PhD)

ADVISOR Stephen DeStefano

FUNDING MassWildlife

A black bear cub in an apple tree (Bill Byrne).

Natural-Ecological and Socio-Political Factors Influencing Urban Forest Management in Massachusetts

From wildlife habitat to carbon sequestration, urban forests supply an array of ecosystem benefits to over 90% of Massachusetts' residents, who live and work in an urban setting. Urban trees, however, face a multitude of challenges, from limited growing space to invasive pests. To gain further understanding into emergent urban forest management issues, we conducted 50 qualitative research interviews with municipal tree wardens from 2014-2016. Forest health emerged as an important theme, as interviewees (n=49) indicated that they routinely monitor for pests of urban trees. We will explore the potential for planting low-maintenance conifers, like Chinese hemlock, as part of an overarching urban forest health management and diversification strategy that incorporates host plant resistant species.

STUDENT Rick Harper (PhD)

ADVISORS David Bloniarz
Stephen DeStefano

FUNDING UMass ECO
UMass CAFE
MDCR

Measuring the diameter of an urban tree in Northampton, MA.

Andean Bear Distribution and Land Use Change: Implications for Populations in Peru

The Andean bear (*Tremarctos ornatus*) is an iconic species in the tropical Andes. Recent studies indicate that the majority of its range (~70%) is in Peru and Bolivia, but these studies also identify geographic areas where information on Andean bears is lacking. Land use changes threaten Andean bear habitats, and since habitat loss is increasing it is imperative to establish measures to reduce and mitigate these effects, particularly given the Andean bear's declining conservation status. This research approach entails compiling existing Andean bear records, field data collection on locations and habitat variables, and habitat and population modeling. Compilation of existing data has been initiated and the first stage of data analysis will begin soon, which will lead to study area identification. The study areas will be located within the Andean bear's potential distribution indicated by our analyses. I will confirm presence in these areas and apply spatial and landscape ecology methods to build information about the relationship between Andean bear presence and environmental, anthropogenic, and ecological characteristics.

STUDENT Nereyda Falconi Lopez (PhD)

ADVISORS John Organ
Stephen DeStefano
Todd Fuller
John Finn

FUNDING IBA
USGS CRUP

Cloud forest in Andean bear habitat, Weyqecha, Peru (John Organ).

Assessing Attitudes and Impacts to Society Associated with Use of Alternative Ammunition for Hunting on National Wildlife Refuges

In collaboration with U.S. Fish and Wildlife Service and the U.S. Geological Survey Cooperative Research Units, this study will assess a voluntary approach to converting to non-lead based ammunition for hunting white-tailed deer (*Odocoileus virginianus*) on targeted National Wildlife Refuges in the northeast. The goal of this research is to assess the human dimensions associated with transferring to non-lead ammunition by surveying hunter attitudes regarding a switch to non-lead based ammunition. Facilitating hunter involvement will allow managers to incorporate stakeholder interests in the management decision process. This will benefit managers by increasing the potential for a successful transition to alternative ammunition use by cultivating stakeholder ownership and increasing resilience of management decisions.

STUDENT Christopher Cahill (MS)

ADVISORS Stephen DeStefano
John Organ

FUNDING USGS CRUP
U.S. Fish and Wildlife Service

Hunter training in Vermont (Christopher Cahill).

Impact of Deer and Moose on Soil Carbon, Soil Respiration, and Root Biomass

Over the past decade, several exclosures have been built in southern New England to study the effect of ungulate browsing on tree regeneration, species diversity, and composition. The main objective of this proposed research is to build on the existing infrastructure to study the impacts of browsing on soil carbon stocks (soil C, root biomass) and soil respiration in regenerating forests. We propose to establish 3 plots in some of the exclosure sites on Harvard Forest and, time permitting, DCR lands. Each plot will use the "Conant" design (Fig. 1). The Conant plots are 2 x 3m. Along the perimeter of the plots we will extract 6 soil samples. At the surface, we will collect a 10 x 10 cm organic horizon sample [assuming it is there] and then sample the underlying mineral soil to a depth of 30 cm in 10 cm increments. The soil core is 5 cm diameter. This aspect of the soil sampling is minimally invasive. Space permitting we will also dig one 1 x 1m soil pit in each exclosure to quantify coarse root biomass. One small soil respiration collar will be added to one edge of each Conant plot and the rate of soil respiration will be measured monthly using a soil respiration chamber attachment to a LiCor6400. Samples will be processed at Boston University to quantify live and dead root biomass, and root and soil C and N content. A second set of samples will be collected in a few years to study the change in these C pools with time.

COLLABORATORS
Adrien Finzi
Marc-André Giasson
Ed Faison
Stephen DeStefano

FUNDING
Boston University
Harvard Forest
MDCR
USGS CRUP

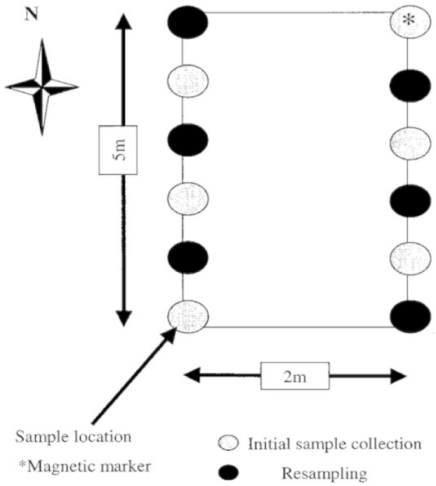


Figure 1. Diagram illustrating design and orientation of all microplots used for collection of soil samples. Initial (gray) and resampling (black) cores are distinguished.

Disturbance by Moose and Deer: An Examination of Their No Trophic Indirect Effects

We will examine the degree to which the presence of moose (*Alces americanus*) and deer (*Odocoileus virginianus*) cause non-trophic indirect impacts on forest structure, soil and litter disturbance, and plant architecture. We will test the hypothesis that moose, as opposed to deer, are ecosystem engineers and alter forest function in a manner similar to elephants (*Loxodonta africana*) in Afrotropical Forests. We argue that this impact will likely not scale with body size. We will carry out our research by examining moose and deer exclosures that are distributed across the region during the summer of 2017 and quantifying stem damage and breakage among a broad range of saplings size classes.

COLLABORATORS
Walter Carson
Sarah Pasquini
Ed Faison
Stephen DeStefano

FUNDING
Harvard Forest
MDCR
USGS CRUP

Prescott Peninsula bull moose (Dale Monette).

Using Genomic Data and Novel Analytical Tools to Understand Metapopulation Dynamics and Enhance Management of Extant Canada Lynx Populations

The Canada lynx (*Lynx canadensis*) is a wide-ranging felid listed as threatened under the U.S. Endangered Species Act. The listing pertained to the lower 48 States, and identified lynx as part of a single, biologically and genetically similar population. However, known populations of lynx are separated geographically, with no known population between the Northern Appalachian/Acadian Ecoregion and the western Great Lakes. This project aims to use genomic data to explore the population dynamics of geographically non-contiguous populations in the U.S. and Canada. A reference genome is currently under construction using high quality, whole genome sequence data from a 27 lb adult male from Aroostook County, Maine. We also plan on using genomic data to construct a custom capture array of single nucleotide polymorphisms. Analyses using these genetic markers will provide more precise estimates of effective population size, demographic history, inbreeding, gene flow, and genetic differentiation among lynx metapopulations.

STUDENT Tanya Lama (PhD)

ADVISORS John Organ
Stephen DeStefano

FUNDING Maine Department of Inland Fisheries & Wildlife

Male Canada lynx captured in Maine, 2016 (Tanya Lama).

Ecological Value of Spruce Plantations in Massachusetts

Remnant patches of exotic Norway spruce (*Picea abies*), planted in the early 1900s, are scattered across Massachusetts. Although monocultures of this type are thought to represent inferior habitat for local wildlife, these plantations are small and are situated within large mosaics of native forest. Given these conditions, there exists the possibility that they can provide habitat niches that are otherwise absent, leading to an increase in regional biodiversity. Our project will examine this relationship. In addition, we hope to understand their potential to play a larger role in the face of climate related changes. Native eastern hemlock (*Tsuga canadensis*) are declining because of the invasive hemlock wooly adelgid (*Adelges tsugae*). The negative impacts of wooly adelgid will likely become more severe as climate change leads to warmer winters. This could result in massive losses of coniferous habitat. Even if spruce plantations contribute minimally to local biodiversity, their significance may increase as hemlock forests disappear, especially if they can provide unique structure or thermal refugia. We will examine biodiversity within Norway spruce plantations, eastern hemlock stands, and other native forest stands using avian point counts and detailed vegetation surveys to assess these relationships.

STUDENT Calvin Ritter (MS)

ADVISORS Dave King
Stephen DeStefano

FUNDING MDCR
USFS
USGS CRUP

A Norway spruce plantation in central Massachusetts (Calvin Ritter).

Tracking Movements of Common Terns, Endangered Roseate Terns, and Threatened Piping Plovers in the Northwest Atlantic

Since 2013, we have worked in partnership with the U.S. Fish and Wildlife Service, Division of Migratory Birds to track the offshore movements of high-priority species using light-weight digital VHF transmitters (nanotags) and an array of automated radio telemetry stations (Figs. 1,2). Since the study began in 2013, we have tagged 230 common terns (*Sterna hirundo*), 90 Federally-endangered roseate terns (*S. dougallii*), and 100 Federally-threatened piping plovers (*Charadrius melodus*) from nesting populations in Southern New England and New York (Fig. 3). We tracked their movements using an array of 35 automated radio telemetry stations at coastal and offshore sites from Cape Cod, Massachusetts to Diamond Shoals, North Carolina, in cooperation with the Motus Wildlife Tracking System (www.motus-wts.org). We have collected extensive new information on the movements of terns during nesting and staging, including regular chick provisioning trips to sites located over 50 km away from the nesting colony.

This study has also revealed new information about nocturnal offshore migratory flights of piping plovers across the mid-Atlantic Bight. Our research was funded by the Bureau of Ocean Energy Management (BOEM) and informs siting and monitoring of offshore wind energy areas along the U.S. Atlantic Outer Continental Shelf.

STUDENT Pamela Loring (PhD)

ADVISORS Paul Sievert
Curt Griffin

FUNDING BOEM

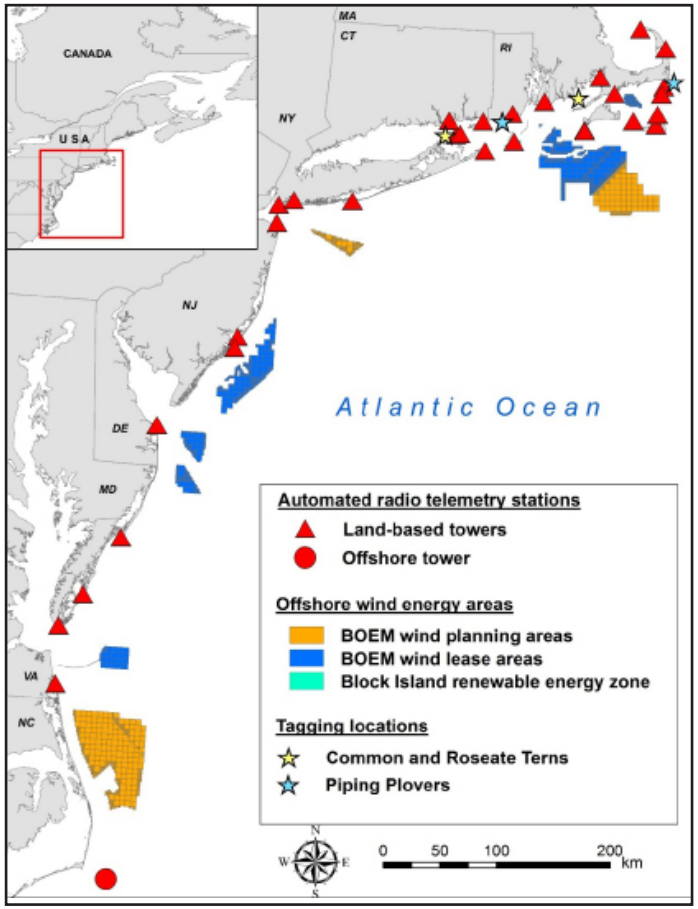


Figure 1. Map of the 2016 automated radio telemetry array across the U.S. mid-Atlantic Bight, showing locations of automated radio telemetry stations (red triangles), and tagging locations of common and roseate terns (yellow stars) and piping plovers (blue stars). Also shown are the Submerged Lands Act boundary (dashed blue line), BOEM renewable energy lease areas (green polygons) and planning areas (orange polygons), and the Rhode Island Renewable Energy Zone (light blue polygon).

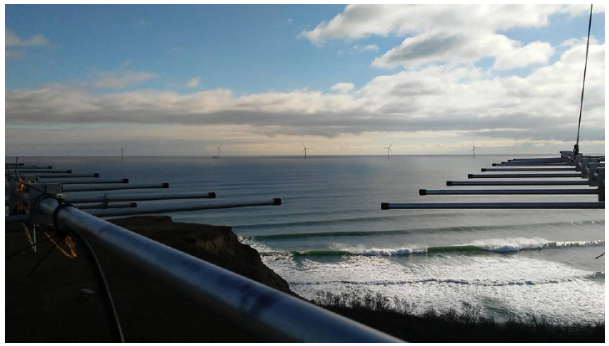


Figure 2. View of offshore wind turbines in the Rhode Island Renewable Energy Zone from the top of radio telemetry station on Block Island, RI (Brett Still).

Figure 3. Roseate tern with nanotag transmitter (Peter Paton).

Movements, Habitat Selection, and Diet of Black Bears in Massachusetts

Research on the population ecology, habitat relationships, landscape ecology, and conservation and management of black bears (*Ursus americanus*) has a long history in the Commonwealth of Massachusetts. Until recently, conventional VHF telemetry collars were used to locate female bears and their denning sites. This project began the use of GPS collars to provide near-continuous monitoring of bears throughout the year (Fig. 1). To date we have place nearly 40 GPS collars on bears throughout western and central Massachusetts and have amassed thousands of locations and resulting movement patterns. In addition, we established protocols and completed data collection for stable isotope analysis of black bear diet (Fig. 2). The next phase of bear research will involve management of large spatial data sets and advanced modeling and data analyses of movements, habitat and landscape use, and demographic performance (causes of mortality, survival, and reproduction). In addition, we will be coordinating efforts to conduct an extensive human dimensions survey of residents to determine their knowledge of, attitudes toward, and experiences with bears. This extensive data collection will lead to the development of a revised statewide management plan for black bears in Massachusetts.

POST DOC Dave Wattles

ADVISOR Stephen DeStefano

FUNDING MassWildlife

Figure 1. Dave placing a GPS-collar on a female black bear in Hatfield, MA (Stephen DeStefano).

Figure 2. We collected samples of potential black bear food items, both natural and human associated, along with hair samples from research bears and bears taken during the regulated hunting season to assess bear diet in the state (Bill Byrne).

Regional Coordination for Wood Turtle Conservation in the Northeastern States

The Northeast Wood Turtle Working Group first convened within Northeast Partners for Amphibian and Reptile Conservation (NEPARC) in 2009 and is now in its 8th active year (Figs. 1,2). The group meets annually at NEPARC and in smaller groups throughout the region for trainings and coordinating meetings. Thirteen northeastern states coordinated from 2012 to 2015 to develop a comprehensive status assessment funded by the Regional Conservation Needs State Wildlife Grant program, which found evidence of widespread decline and a lack of effective regulation to protect habitat and curtail poaching. This effort was led by theMassachusetts Cooperative Fish and Wildlife Research Unit. A subset of eight NE states and partners from adjacent states are in the final year of a Competitive State Wildlife Grant-funded effort to develop a Conservation Plan; the Plan should be complete by December 2017. The Wood Turtle Working Group hosted a rangewide conservation symposium in October 2016 in Massachusetts. As part of the effort, a regional genetics study is underway, led by UMass and the University of Montana. Partners are also coordinating on the development of a Conservation Area Network (CAN) to prioritize basins for conservation action to ensure representative persistence of functional wood turtle (*Glyptemys insculpta*) populations from Maine to Virginia/West Virginia. The CAN is based on a hydrologic unit code-based stratification, habitat suitability models, empirical results and population estimates and evidence of population structure from standardized surveys across the range. With the completion of the Conservation Plan, the working group will focus on the multi-scale implementation of the Plan including outreach materials to hinder illegal poaching, inform habitat management, and reduce roadkill, and formalize its implementation and governing body.

POST-DOC Mike Jones

ADVISOR Paul Sievert

FUNDING Competative State Wildlife Grant

COLLABORATORS Andrew Whiteley
Lisabeth Willey
Tom Akre

Figure 1. Wood turtle (Mike Jones).

Figure 2. Wood and Blanding's turtle (*Emydoidea blandingii*) conservation partners meet in Massachusetts for the first joint conservation symposium for these two federally-petitioned species.

Experimental Ungulate Exclosures: Current Results and Long-Term Plans

Since 2007, we have been studying the effects of deer (*Odocoileus virginianus*) and moose (*Alces americanus*) browsing on forest recruitment and herbaceous and shrub layer composition in logged and unlogged forests of southern New England. Fifteen sets of 20 x 20 m exclosures have been built in a randomized block design with 3 treatment levels: (1) no-ungulates (full exclosure), (2) deer only (partial exclosure), and (3) deer + moose (control, i.e., no fence) (Fig.1).

In logged forests, moose and deer used the cuts at roughly the same frequency despite moose densities being much lower than deer densities. Given the much larger body size of moose, we concluded that moose were the dominant browser in terms of animal biomass in these cuts. After 6–7 years of browsing, deer + moose reduced stem densities and basal area by 2-3-fold, *Prunus pensylvanica* and *Quercus* spp. recruitment by 3–6 fold, and species richness by 1.7 species (19%). In contrast, deer had non-significant effects on stem density, basal area, and species composition, but significantly reduced species richness by 2.5 species on average (28%) (Fig. 2).

In the herbaceous layer in logged stands, plant assemblages characteristic of closed canopy forests were less abundant while assemblages characteristic of open/disturbed habitats were more abundant in the deer + moose plots (controls) compared with the ungulate excluded areas (exclosures). Browsing by deer + moose resulted in greater herbaceous species richness at the plot scale (169 m^2) and greater woody species richness at the subplot scale (1 m^2) than ungulate exclusion and deer alone.

In the coming years, we will resample the woody plants in the exclosures located in previously logged areas, as the stands surpass the 10-year mark. This sampling will begin to document the long-term legacy effects of browsing during stand initiation – when ungulates exert their strongest effects – in stands entering the stem exclusion stage. To what extent stands exposed to different initial browsing – and whose structure, composition, and successional rate were initially altered – will develop along differential pathways as they age, or will converge over time (as stems grow above the reach of the animals), will be our focus (Fig. 3).

COLLABORATORS
Ed Faison
Stephen DeStefano
David Foster

FUNDING
Harvard Forest
MDCR
MassWildlife
USFS

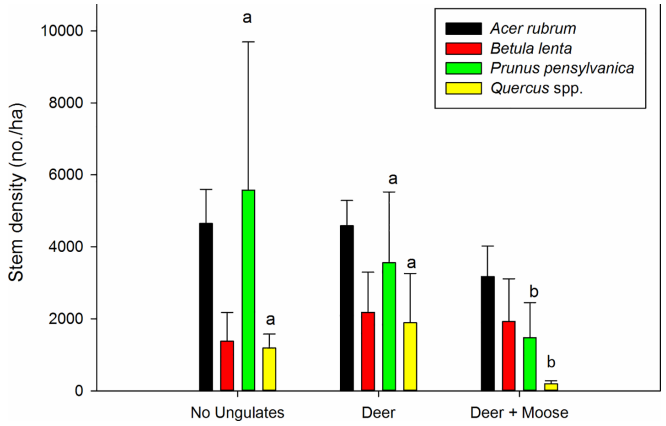


Figure 2. After 6-7 years, overall stem densities were higher in the exclosures, but woody species showed variable responses, likely due to differences in browsing preference and competition.

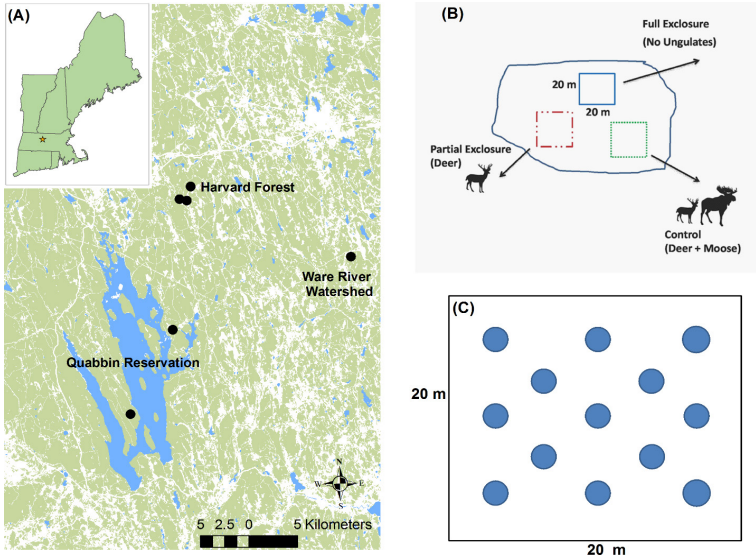


Figure 1. Experimental exclosures are located at 15 sites in southern New England (A). Each site consists of 3 treatments: a full fence that excludes both moose and deer, a partial fence that excludes only moose, and a control (no fence) (B). Vegetation and browsing activity were measured within a set of circular subplots (C).

Figure 3. A female moose and her calf just outside one of the exclosures (Stephen DeStefano).

Black Bear Research and Management

Research on black bears (*Ursus americanus*) has a long history in Massachusetts. Led by MassWildlife and in collaboration with the Massachusetts Unit and UMass-Amherst, a variety of topics related to bear ecology and natural history have been examined, including demography, habitat use, movements, and diet (Fig.1).

For years a main research tool was conventional VHF telemetry collars, placed mainly on female bears during various phases of their reproductive cycle (with new-born cubs, yearling cubs, or no cubs). In 2009, the first GPS collar was placed on a female bear in Massachusetts. Since then, close to 40 individual bears have been fitted with this new technology, which can yield thousands of location points in a year compared to several dozens to a few hundred with conventional collars.

The study has been designed to examine bear ecology along urban-rural gradients, especially in light of the increase in both bear numbers and bear distribution in the state (Fig.2). In addition, we have launched new aspects of the research, including the use of stable isotopes to examine diet, genetic information to further understand relationships among bears, modeling movements especially as related to conservation area linkages and interactions with roads and other infrastructure, and public surveys to address the attitudes, beliefs, and knowledge of the state's residents regarding bears and bear management, including interactions in urban and suburban areas, potential damage and mitigation of agricultural products, and the role of hunting in bear management.

It has been said that wildlife management involves animal populations and their habitats, while wildlife conservation involves animals and people . . . the human dimensions aspects of wildlife ecology. The Massachusetts bear study involves all of these aspects of bear biology and ecology, conservation and management. These new multi-disciplinary approaches have opened up a whole new realm of bear research that continues in – and adds to – the long tradition of bear research in the Commonwealth (Fig. 3). These efforts will culminate in a revision of the state's bear management plan.

COLLABORATORS

MassWildlife: Dave Wattles, Laura Conlee (MO DOC), Ralph Taylor, Dave Fuller, Bill Davis, Mike Morelley, Andrew Madden, Nate Buckhout, Dave Paulson
Unit: Kathy Zeller, Stephen DeStefano
UMass: Todd Fuller, Hank Moylan
MDCR: Kiana Koenen, Dan Clark, Ken MacKenzie, Jillian Whitney
Mass DOT: Tim Dexter
Responsive Management: Mark Duda

FUNDING

MassWildlife
USGS CRUP

Figure 1. One of the female bears in the state's long-term project (Dave Wattles).

Figure 2. Bear numbers and distribution have been growing in the state (Stephen DeStefano).

Figure 3. Dave Fuller and Laura Conlee place a GPS collar on a female black bear. (Stephen DeStefano).

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Bentsen, C.N., **A.H. Roy**, and D.A. Armstrong. 2016. Investigating the role of channel geomorphology on biotic responses to urbanization. New England Association of Environmental Biologists, 23-25 March 2016, Rockland, ME. (Poster)

Bentsen, C.N., **A.H. Roy**, and D.S. Armstrong. 2016. Accounting for biotic variability in urbanizing streams: the role of reach- and watershed-scale factors. Ecological Society of America Mid-Atlantic Chapter Meeting, 8-10 April 2016, Kutztown, PA.

Bentsen, C.N., **A.H. Roy**, and D.S. Armstrong. 2016. Accounting for biotic variability in urbanizing streams: the role of local and landscape factors. Annual Meeting of the Society for Freshwater Science, 21-25 May 2016, Sacramento, CA.

Bentsen, C.N., **A.H. Roy**, D.S. Armstrong, and M.E. Baker. 2017. Context matters: Variable responses of fish and macroinvertebrate assemblages to urbanization based on stream habitat, water quality, and watershed characteristics. Annual Meeting of the New England Association of Environmental Biologists, 14-16 March 2017, Hartford, CT.

Bittner, S.M., **A.H. Roy**, M.T. Devine, S. Mattocks, H. Mohammadi, and A. Jordaan. 2016. Alewife alter zooplankton biomass and morphology in freshwater lakes. Annual Meeting of the New England Association of Environmental Biologists, 23-25 March 2016, Rockport, ME. (Poster)

Bittner, S. **A.H. Roy**, M.T. Devine, H. Mohammadi, and A. Jordaan. 2017. Dietary preferences among juvenile and adult river herring in freshwater lakes. Joint Meeting of the Southern New England Chapter and Northeast Division of the American Fisheries Society, 26-27 February 2017, Mystic, CT. (Poster)

Carmignani, J., **A.H. Roy**, and K. Stankiewicz. 2016. Freshwater mussel distribution in shallow depths of winter drawdown lakes. New England Association of Environmental Biologists, 23-25 March 2016, Rockland, ME.

Carmignani, J. and **A.H. Roy**. 2016. Impact of winter drawdowns on mussel distributions in Massachusetts (USA) lakes. Annual Meeting of the Society for Freshwater Science, 21-25 May 2016, Sacramento, CA.

Clark, D., and **S. DeStefano**. 2015. Roosting, site fidelity, and food sources of urban gulls: implications for protecting public water supplies. USGS MCFWRU Annual Review, Westboro, MA.

Conlee, L., and **S. DeStefano**. 2015. Black bear status, habitat use, and management in Massachusetts. USGS MCFWRU Annual Review, Westboro, MA.

Dangora, A., M.T. Devine, **A.H. Roy**, J. Zydlewski, and A. Jordaan. 2017. Evaluating DIDSON as a tool to monitor juvenile river herring in coastal freshwater lakes. Joint Meeting of the Southern New England Chapter and Northeast Division of the American Fisheries Society, 26-27 February 2017, Mystic, CT. (Poster)

Roberts Meadow Brook in Northampton, MA. (Peter Zaidel)

DeStefano, S., and D. Wattles. 2015. Update on the status of moose in southern New England. Northfield Environmental Center, Northfield, MA.

Devine, M.T, A. Jordaan, A.P., **A.H. Roy**, and A.R. Whiteley. 2016. Optimal sampling effort for estimating juvenile alewife densities in freshwater lakes using a pelagic purse seine. Winter Science Meeting, Southern New England Chapter of the American Fisheries Society, 14 Jan 2015, Groton, Connecticut. (Poster)

Devine, M.T., A. Jordaan, **A.H. Roy**, and A.R. Whiteley. 2016. Optimal sampling effort for estimating juvenile alewife densities in freshwater lakes using a pelagic purse seine. New England Association of Environmental Biologists, 23-25 March 2016, Rockport, ME. (Poster)

Devine, M.T., **A.H. Roy**, A.R. Whiteley, and A. Jordaan. 2016. Quantifying optimal sampling effort for estimating recruit abundance for juvenile anadromous alewife. International Council for the Exploration of the Sea (ICES) Conference, 19-23 September 2016, Riga, Latvia.

Devine, M.T., **A.H. Roy,** A.J. Whiteley, B.I. Gahagan, M.P. Armstrong, M.M. Bailey, and A. Jordaan. 2017. The lake effect: identifying optimal growth conditions for juvenile anadromous alewife. Joint Meeting of the Southern New England Chapter and Northeast Division of the American Fisheries Society, 26-27 February 2017, Mystic, CT.

Devine, M.T., **A.H. Roy**, A.J. Whiteley, B.I. Gahagan, M.P. Armstrong, M.M. Bailey, and A. Jordaan. 2017. The lake effect: identifying optimal growth conditions for juvenile anadromous alewife. Annual Meeting of the New England Association of Environmental Biologists, 14-16 March 2017, Hartford, CT.

A GPS-Collared Female Black Bear (Dale Monette)

Doubleday, A.J., P.D. Hazelton, **A.H. Roy,** A. Fisk, and D. Perkins. 2017. Local habitat effects on the abundance and distribution of Brook Floater (*Alasmidonta varicosa*) in Massachusetts. Meeting of the Freshwater Mollusk Conservation Society, 26-30 March 2017, Cleveland, OH. (Poster)

Faison, E., and **S. DeStefano**. 2016. Ungulates, tree recruitment, and herbaceous layers: results from the DCR and Harvard Forest deer and moose exclosures. USGS MCFWRU Annual Review, Westboro, MA.

Grasso, K., M.T. Devine, **A.H. Roy**, A.R. Whiteley, J. Rosset, M. Marjadi, and A. Jordaan. 2017. Testing for differences in juvenile growth rates of anadromous alewife and blueback herring. Joint Meeting of the Southern New England Chapter and Northeast Division of the American Fisheries Society, 26-27 February 2017, Mystic, CT. (Poster)

Grant, A., **A.H. Roy**, K.H. Nislow, and B.H. Letcher. 2017. Investigating the effects of interannual differences in streamflow and temperature on macroinvertebrate assemblages. Annual Meeting of the New England Association of Environmental Biologists, 14-16 March 2017, Hartford, CT. (Poster)

Huguenin, M., and **S. DeStefano**. 2015. Trends in human-wildlife interactions in Massachusetts. USGS MCFWRU Annual Review, Westboro, MA.

Johnson, L., **S. DeStefano**, S. Melvin, and D. Wattles. 2016. Movements and resource use of striped skunks inhabiting piping plover nesting beaches on Martha's Vineyard, Massachusetts. USGS MCFWRU Annual Review, Westboro, Mass.

Marjadi, M. A. Jordaan, **A.H. Roy**, B.I. Gahagan, and A.R. Whiteley. 2016. Evaluating reproductive strategies in alewife (*Alosa pseudoharengus*) using pedigree reconstruction. Winter Science Meeting, Southern New England Chapter of the American Fisheries Society, 14 Jan 2016, Groton, Connecticut.

Marjadi, M., J. Rosset, A. Jordaan, **A.H. Roy**, B.I. Gahagan, and A.R. Whiteley. 2016. Earlier arrival and larger body size increase reproductive success in alewife. Annual Meeting of the Society for Freshwater Science, 21-25 May 2016, Sacramento, CA.

Marjadi, M., **A.H. Roy**, A. Jordaan, A.R. Whiteley, and E.M. Markowitz. 2017. "Counting fish is my yoga": Evaluating the social and educational impacts of a river herring citizen monitoring program. Citizen Science Association 2017, St. Paul, Minnesota.

Marjadi, M., A. Jordaan, **A.H. Roy**, B.I. Gahagan, and A.R. Whiteley. 2017. Reproductive success in coastal pond breeding river herring: effects of migration timing and body size. Annual Meeting of the American Fisheries Society, 20-24 August 2017, Tampa, FL.

Martell, V., **A.H. Roy**, D. Perkins, P. Hazelton, and T. Warren. 2017. The effect of calcium supplementation on the growth and survival of a freshwater mussel. Annual Meeting of the New England Association of Environmental Biologists, 14-16 March 2017, Hartford, CT. (Poster)

McCarthy, S., **S. DeStefano**, and J. F. Organ. 2015. Assessing stakeholder values and management expectations regarding white-tailed deer in suburban communities. USGS MCFWRU Annual Review, Westboro, MA.

Mohammadi, H., M. Devine, S. Bittner, **A.H. Roy**, and A. Jordaan. 2016. Study of feeding habits of alewife (Alosa pseudoharengus) in northeastern United States. Southern New England Chapter of the American Fisheries Society, 14 January 2016, Groton, Connecticut. (Poster)

Perkins, D., P. Hazelton, and **A. Roy**. 2017. A new freshwater mussel collaboration in the northeast. Northeast Freshwater Mussel Meeting, 7 March 2017, Hadley, MA.

Roy, A.H. and J. Carmignani. 2015. Investigating impacts of winter lake drawdowns on lake ecosystems, Massachusetts Division of Fisheries and Wildlife Board Meeting, 23 November 2015, Westborough, MA. (Invited)

Roy, A.H. 2015. What's happening in the lakes? Spawn timing and juvenile density, growth, and mortality across 20 Massachusetts lakes, River Herring Network, 15 October 2015, Pembroke, MA. (Invited)

Roy, A.H., J. Rosset, M. Marjadi, A. Whiteley, B. Gahagan, A. Jordaan. 2016. Insights in reproduction, growth, and survival of anadromous alewife in freshwater lakes. New England Association of Environmental Biologists, 23-25 March 2016, Rockland, ME.

Roy, A.H. 2016. Effectiveness of stream buffers: A watershed perspective, Stream and Wetland Buffer Workshop, 4 May 2016, Westborough, MA. (Invited)

Roy, A.H. 2016. Urbanization: Using resistance to this homogenizing force to inform management. Annual Meeting of the Society for Freshwater Science, 21-25 May 2016, Sacramento, CA. (Invited).

Roy, A.H. and J. Carmignani. 2016. Impacts of winter drawdowns on lake ecosystems. Lake and Pond Association—West Conference, 22 October 2016, Pittsfield, MA. (Invited)

Roy, A.H. and P.A. Zaidel. 2017. Assessing impacts and restoration potential: Variation in temperature and dissolved oxygen alteration from small dams across streams in Massachusetts. Massachusetts Division of Ecological Restoration, 23 February 2017, Boston, MA. (Invited)

Roy, A.H., P.D. Hazelton, S. Sterrett, A. Doubleday, A. Fisk, L. Holst, M. Marchand, D. Perkins, M.D. Staudinger, B. Swartz, and B. Watson. 2017. What's next? Brook Floater rangewide conservation and restoration initiative. Northeast Freshwater Mussel Meeting, 7 March 2017, Hadley, MA.

Roy, A.H. 2017. Headwater stream restoration and protection prioritization, Massachusetts Department of Environmental Protection Watershed Planning Workshop, 8 March 2017, Worcester, MA. (Invited)

Roy, A.H., C.N. Bentsen, D.S. Armstrong, and M.E. Baker. 2017. Prioritizing stream restoration and protection to maximize ecological benefits: stream habitat, temperature, and watershed considerations. Annual Meeting of the Society for Freshwater Science, 4-9 June 2017, Raleigh, NC.

Small, D., and **S. DeStefano**. 2015. Bats of New England. Mount Grace Land Conservation Trust, Petersham, MA.

Westfield Reservoir in Montgomery, MA (Peter Zaidel)

Smith, R.F. and **A.H. Roy**. 2017. Exploring the importance of catchment land use and dispersal barriers for fish and insect assemblage composition in human-dominated landscapes. Meeting of the US Regional Association of the International Association for Landscape Ecology (US-IALE), 9-13 April 2017, Baltimore, MD.

Smith, R.F., J. Blaszczak, B. Bledsoe, T. Parr, **A.H. Roy**, M. Scoggins, R. Utz, and S. Wenger. 2017. A summary of SUSE4: making urban stream rehabilitation a co-evolutionary process. Annual Meeting of the Society for Freshwater Science, 4-9 June 2017, Raleigh, NC. (Invited)

Stankiewicz, K., J. Carmignani, and **A.H. Roy**. 2016. Hydrologic characteristics of annual winter water-level drawdowns in Massachusetts lakes. New England Association of Environmental Biologists. 23-25 March 2016, Rockland, ME. (Poster)

Sterrett, S., P.D. Hazelton, A. Doubleday, D. Perkins, **A.H. Roy**, and M.D. Staudinger. 2017. Brook Floater rangewide conservation and restoration initiative. Meeting of the Freshwater Mollusk Conservation Society, 26-30 March 2017, Cleveland, OH. (Poster)

Tiernan, R., T. K. Fuller, D. Wattles, and **S. DeStefano**. 2016. Use of camera traps to assess relative abundance, activity, and distribution of mega-mammals (and other wildlife) in the forests of Massachusetts. USGS MCFWRU Annual Review, Westboro, Mass. (Poster)

Weinstein, S., A.R. Whiteley, and **A. Roy.** 2016. Slimy sculpin movement before and after dam removal. Northeast Natural History Conference, 22-24 April 2016, Springfield, MA.

Zaidel, P.A., **A.H. Roy**, K.H. Nislow, C.R. Smith, and B.H. Letcher. 2016. Impacts of small, surface-release dams on stream temperature. New England Association of Environmental Biologists, 23-25 March 2016, Rockland, ME. (Poster)

Zaidel, P.A., **A.H. Roy**, K.H. Nislow, B.H. Letcher, and C.R. Smith. 2016. Small dam impacts to stream temperature and potential consequences for aquatic biota. Northeast Natural History Conference, 22-24 April 2016, Springfield, MA.

Zaidel, P.A., **A.H. Roy**, K.H. Nislow, C.R. Smith, and B.H. Letcher. 2016. Impacts of small, surface-release dams on stream temperature. Annual Meeting of the Society for Freshwater Science, 21-25 May 2016, Sacramento, CA. (Poster)

Zaidel, P., **A. Roy**, K. Nislow, B. Letcher, B. Lambert, K. Houle, and C. Smith. 2016. Assessing the potential for dam removal to restore natural thermal and dissolved oxygen regimes. Life Sciences Graduate Research Symposium, University of Massachusetts, Amherst, MA.

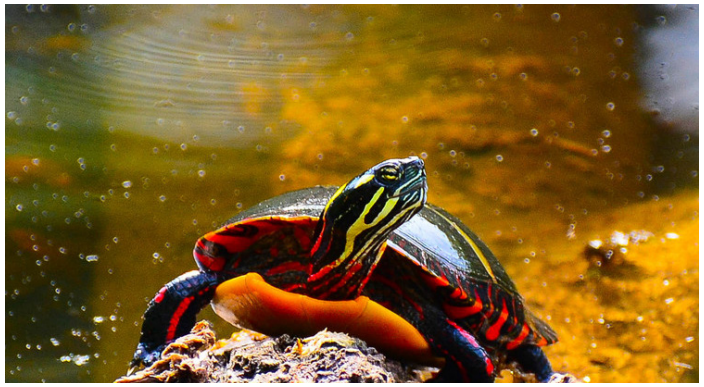
Zaidel, P., **A. Roy**, K. Nislow, B. Letcher, B. Lambert, K. Houle, and C. Smith. 2016. Assessing the potential for dam removal to restore natural thermal and dissolved oxygen regimes. Society for Ecological Restoration New England Chapter Annual Conference, 14-15 October 2016, Durham, NH.

Zaidel, P.A., **A.H. Roy**, K.H. Nislow, B.H. Letcher, B. Lambert, K. Houle, and C.R. Smith. 2017. Factors explaining observed variation in dam-induced temperature and dissolved oxygen changes in Massachusetts streams. Annual Meeting of the New England Association of Environmental Biologists, 14-16 March 2017, Hartford, CT.

Zaidel, P.A., **A.H. Roy**, K.H. Nislow, B.H. Letcher, K. Houle, B. Lambert, and C.R. Smith. 2017. Tackling the worst first: Variable impacts of dams on stream temperature and dissolved oxygen. 4th Symposium on Urbanization and Stream Ecology, 31 May-3 June 2017, Browns Summit, NC. (Poster)

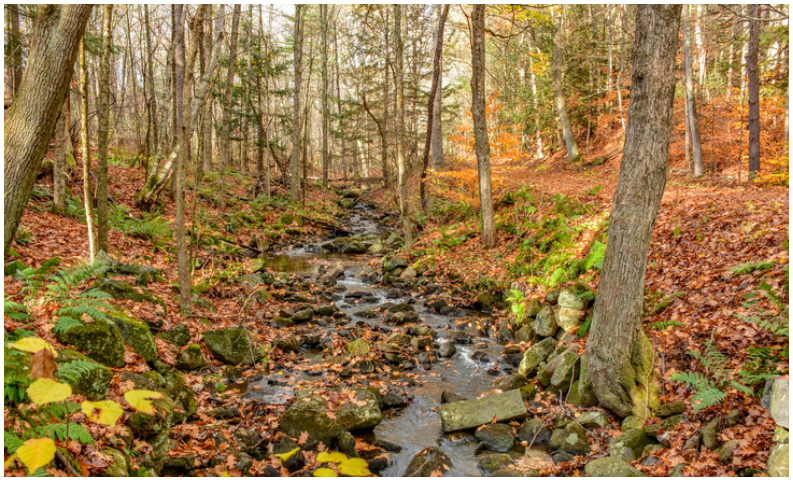
Zaidel, P.A., **A.H. Roy**, K.H. Nislow, B.H. Letcher, B. Lambert, K. Houle, and C.R. Smith. 2017. Understanding variation in stream temperature and dissolved oxygen responses to small dams. Annual Meeting of the Society for Freshwater Science, 4-9 June 2017, Raleigh, NC.

Damselfly (Peter Zaidel)



Dale Monette

North Quabbin Photography



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