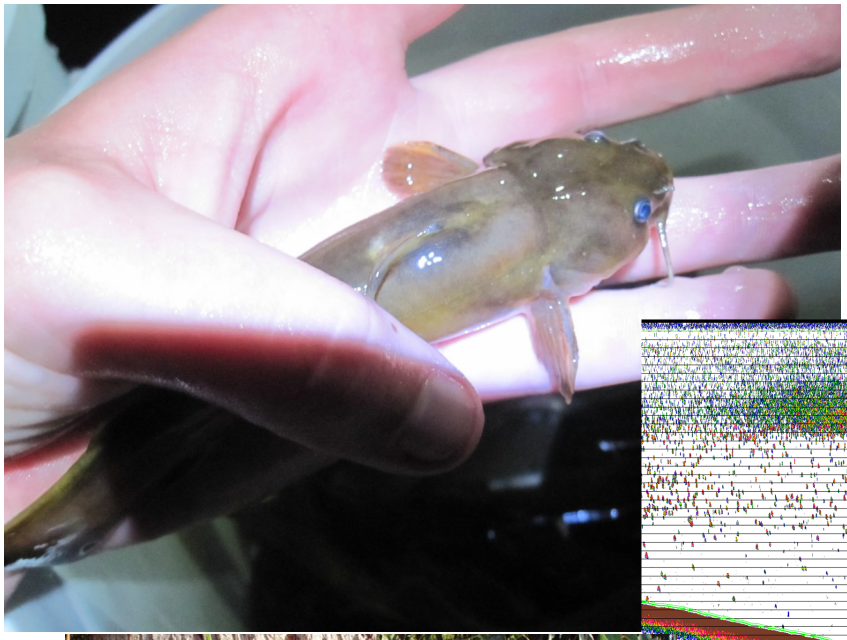
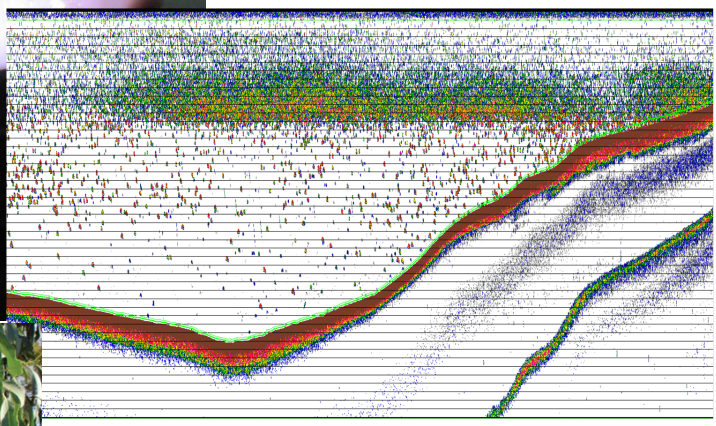
2012-2013 Unit Report

Vermont Cooperative Fish and Wildlife Research Unit





In Cooperation With

- U.S. Geological Survey
- Vermont Department of Fish and Wildlife
- University of Vermont
- Wildlife Management Institute

Vermont Cooperative Fish and Wildlife Research Unit

2012-2013
Report of Activities

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Cover photos clockwise from top: Stonecat captured on the Chazy River; Acoustic transects with YOY rainbow smelt targets highlighted (red box) at thermocline; Wildlife Acoustics recording device for remote monitoring of birds, amphibians, insects and bats.

Table of Contents

Unit Staff and Cooperators

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Program Direction Statement

The Vermont Cooperative Fish and Wildlife Research Unit is located at the University of Vermont (UVM) in Burlington, Vermont, and is housed on campus in The Rubenstein School of Environment and Natural Resources. Overall goals of the Unit are (i) to address technical and research needs of federal fish and wildlife agencies, the Vermont Department of Fish and Wildlife, the University of Vermont, and other federal, state, and private entities; (ii) to participate in the education of graduate students and advanced undergraduate students at the University of Vermont; and (iii) to disseminate findings of research conducted by Unit personnel, graduate students, and cooperators. Unit personnel coordinate Unit activities with federal fish and wildlife agencies, the Vermont Department of Fish and Wildlife, and other agencies and groups involved in the management of natural resources.

Research by current Unit personnel is directed primarily toward aquatic and terrestrial ecosystems within the state of Vermont. Unit research is conducted in the context of a comprehensive, ecosystems approach that recognizes the importance of ecological and human interactions among species and their habitats. Research activities focus on the biology/ecology of fish, mammal, and bird species, and the biological consequences of human impacts on aquatic and terrestrial systems.

Research in these areas is conducted by Unit personnel who possess technical expertise in fish/aquatic ecology, landscape ecology, species/habitat associations, bioenergetics modeling, population viability modeling, and hydroacoustics technology.

To achieve the Unit research goals, Unit personnel aggressively pursue funding sources for projects of scientific merit that advance our knowledge of natural resources and their management. This involves both field and laboratory studies in which integrated research is conducted with colleagues at UVM and elsewhere. Along with these studies, Unit activities include enhancement of methodological and analytic capabilities at UVM in the areas of fish and wildlife biology.

Unit Leader Donna Parrish and Assistant Unit Leader Terri Donovan

Unit educational goals are achieved in several ways, including the teaching of formal courses at the graduate and upper undergraduate level. Courses recently taught by Unit personnel include Ecology of Fishes, Population Dynamics and Modeling, and Occupancy Modeling and Estimation. Several on-line courses have been developed in collaboration with the U.S. Fish and Wildlife Service National Conservation Training Center. Unit staff also participate in the classroom through presentation of guest lectures and seminars. Unit staff act as advisors for graduate students, and are involved as committee members on graduate research committees. To the extent possible, Unit personnel also participate in training and education programs for personnel in the Vermont Department of Fish and Wildlife.

Our vision for this Unit is to provide the best possible science to natural resource management agencies for the restoration of habitats and recovery and sustainability of Vermont's fish and wildlife species. In achieving our vision, we will continue to conduct research that is highly relevant to and valued by managers and policy makers.

November 2011

Research Project Narratives

NON-NATIVE ALEWIFE AND NATIVE RAINBOW SMELT IN LAKE CHAMPLAIN: A MODELING APPROACH TO DESCRIBE INTERACTIONS AND SYSTEM-WIDE CONSEQUENCES

Principal Investigators: Donna L. Parrish, Lars G. Rudstam and Patrick J. Sullivan (Cornell University), and Bernie Pientka (VTFW)

Graduate Student: Paul W. Simonin (M.S. Student, UVM, 2007-2010 and Ph.D. Student, Cornell University, 2009-2014)

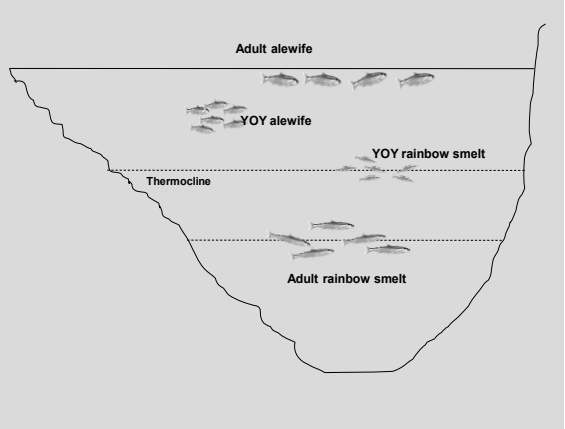
Project Cooperators: Lake Champlain Sea Grant and Vermont Department of Fish and Wildlife

Project Period: 1 February 2009 – 31 January 2014

Objectives: 1) To develop a model of YOY rainbow smelt and alewife survival through their first summer that includes explicit attention to changes in spatial distributions of cannibalistic predators (adult alewife and rainbow smelt) and prey (YOY alewife and rainbow smelt) in Lake Champlain, 2) Using the results of objective (1), develop a coupled, age-structured population dynamics model of alewife and rainbow smelt in Lake Champlain, and 3) Evaluate the likely effects of the expansion of alewife on rainbow smelt and the greater Lake Champlain ecosystem.

Synopsis: Alewife became established over the past ten years, and are now quite abundant, in most basins of Lake Champlain. Previous work on this project studied the distribution of rainbow smelt and alewife in relation to the abiotic environment, and predictive distribution models were created. We are now using these models, and empirical relationships between distribution and cannibalism, to simulate population and community dynamics for rainbow smelt and alewife. This model is being used both to simulate possible future changes in the abiotic environment, and possible management decisions. Our distribution models and data are also being used to aid fish sampling design, and we are comparing trawl and acoustic sampling techniques in addition to developing shallow-water sampling methods. We are also studying how salmonid predators have responded to alewife as new potential prey. Tissue samples were analyzed to determine carbon and nitrogen stable isotope concentrations, and thus trophic positions in the system. Preliminary evidence suggests that adult rainbow smelt are feeding at a higher trophic level than adult alewives, and that Atlantic salmon have begun to consume alewife in addition to rainbow smelt. The basic ecology of mysids (*Mysis diluviana*) in Lake Champlain is also being studied, including trophic relationships, bioenergetics, growth, and abundance. This is the first such study in this lake.

Project Status: Ongoing.



Cartoon illustrating summer distribution of rainbow smelt and alewife at night in Lake Champlain.

Sampling on Lake Champlain at night.

MODELING THE EFFECTS OF CLIMATE CHANGE ON ANADROMOUS FISH POPULATIONS IN THE CONNECTICUT RIVER

Principal Investigators: Donna L. Parrish, Martha E. Mather (USGS-KansasCoop Unit), and Elizabeth A. Marschall (The Ohio State University)

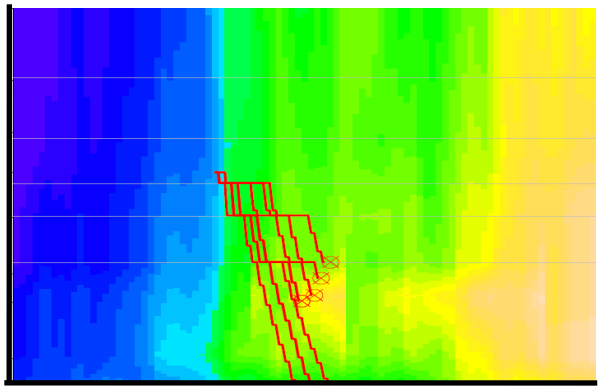
Project Cooperators: National Marine Fisheries Service and Vermont Department of Fish and Wildlife

Project Period: 1 August 2011 – 31 July 2015

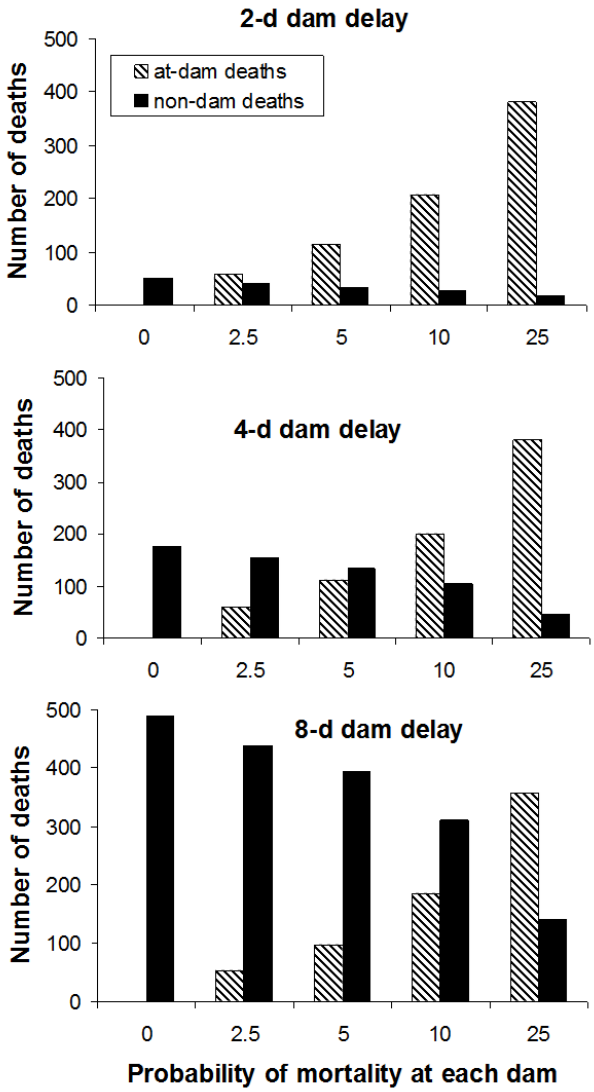
Objective: To model Atlantic salmon or other species to forecast survival of migratory fish in relation to increased temperature and fluctuating discharges.

Synopsis: Previously we explored how temperature, discharge, and the indirect effects of dams (by creating delays in migration) were related to survival of Atlantic salmon smolts. Here we are adding American shad to forecast survival of migratory fish in relation to increased temperature and fluctuating discharges. In switching our focus to a mainstem andromous species, we need to devise a framework for determining if there is an "environmental window of suitability." One possible approach is to investigate the patterns of phenology along the East Coast to guide our understanding in how American shad in the Connecticut River may respond to climate change. Fortunately, American shad range from Nova Scotia to Florida and their life histories move from long-lived, larger bodies in the north to short-lived, smaller bodies in the south. People speculate that temperature is an important driver for anadromous fish life history and movement events, but this has rarely been tested and the data are inconsistent. We hope to address the importance of temperature to migration timing through an analysis of original data in the primary literature along the range of latitudes where American shad occur. Many studies on American shad have been reported in the literature over the last 40 years. However, upon closer scrutiny some critical information, e.g., temperature at time of migration, refer to a single source that does not appear to be backed by original data. Thus, we are taking several steps back to attempt to recover information from papers with data. This process will eventually help us move forward to a better understanding of fish migration.

Project Status: Ongoing.



Simulations of Atlantic salmon smolts migrating (red lines) downstream—left panel without dams and right panel with dams. An X marks where a smolt dies during the migration. Fish most often die when encountering hotspots (yellow) caused by delay at dams not the dams themselves.



Right: Number of deaths (of 500 initial simulated migrants) directly at dams and at times and locations removed from dams for smolts from the Wells River (RK 428) at five levels of direct mortality at dams. From top to bottom, panels represent simulations with 2-d, 4-d, and 8-d delays at each dam.

ASSESSMENT OF STONECAT (*NOTURUS FLAVUS*) POPULATIONS IN THE MISSISQUOI AND LAPLATTE RIVERS OF VERMONT

Principal Investigator: Donna L. Parrish

Graduate Student: Elizabeth A. Puchala (M.S. Student)

Project Cooperator: Vermont Department of Fish and Wildlife

Project Period: 1 June 2011 – 31 December 2014

Objective: To increase our knowledge of the current status of identified stonecat populations in the Missisquoi and LaPlatte rivers including estimates of abundance, age and size structures, population and suitable habitat distributions, survival rates, and other information critical to assessing the likelihood of long-term stonecat population persistence and viability faced with mortality resulting from lampricides and other threats.

Synopsis: Stonecats *Noturus flavus* are known to populate two rivers in Vermont, the Missisquoi and LaPlatte rivers located in the Lake Champlain watershed. The stonecat is a state listed endangered species and species of greatest conservation need. Little is known about stonecat populations in Vermont including their abundance and other population parameters in the Missisquoi and LaPlatte rivers, distribution and habitat availability and use, and population viability and persistence. This project is assessing stonecat populations in both rivers. From June to September 2012, we captured and marked 412 stonecats in the LaPlatte River and 64 in the Missisquoi River below Swanton Dam using backpack electrofishing and minnow traps. In late August 2012, eleven dead stonecats were in a rocky area just below the Swanton Dam where there was low or no flow. None of the dead stonecats had been collected and marked previously. Stonecats were collected (N>400) from the Great Chazy River, NY for the purpose of obtaining length-at-age information that can potentially be applied to the endangered Vermont stonecats. Sampling will resume in spring 2013 to increase the number of marked fish.

Project Status: Ongoing.

Removing minnow traps from the Missisquoi River during low water phase in August 2012.

Juvenile stonecat collected in Missisquoi River.

Using PITpack in LaPlatte River to remotely detect PIT tagged stonecats.

STRUCTURED DECISION MAKING FOR LAND USE PLANNING IN VERMONT: INTEGRATING SOCIAL AND ECOLOGICAL OBJECTIVES

Principal Investigators: Therese M. Donovan, Robert Manning (UVM Rubenstein School), John Austin (VTFW), and Doug Walker (Placeways)

Graduate Student: Charles Bettigole (M.S. Student)

Project Cooperator: Northeastern States Research Cooperative (USDA)

Project Period: 1 January 2010 - 30 June 2012

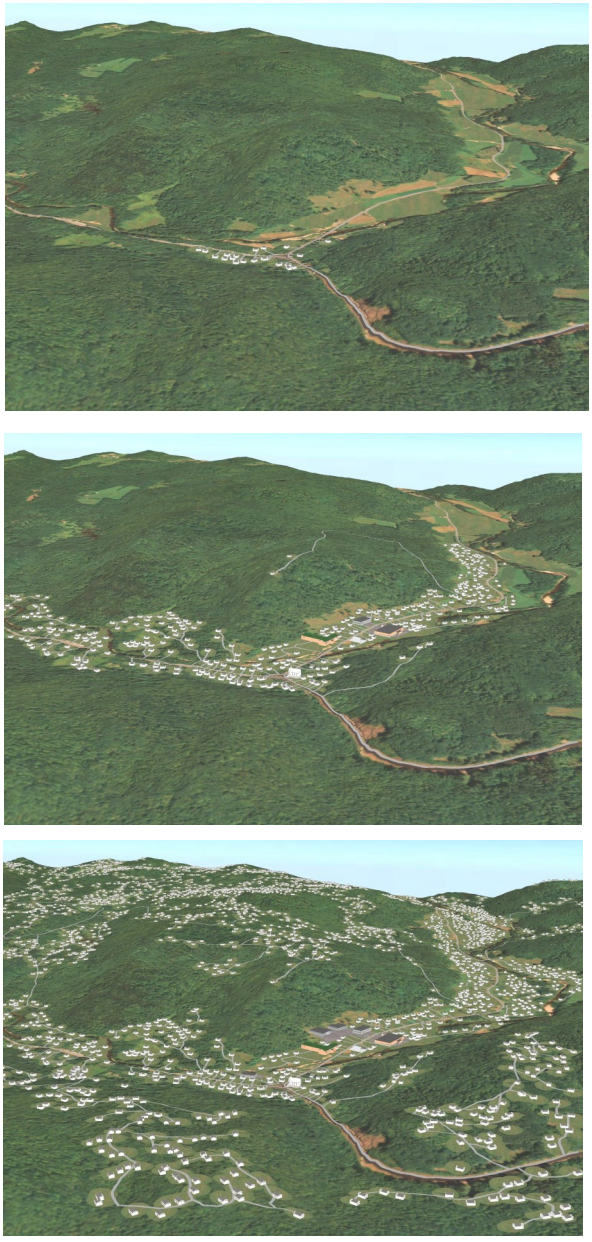
Synopsis: The most serious threat to native wildlife species in the Northern Forest is the conversion of natural lands to development. Many wildlife species that live in the Northern Forest require large areas to carry out their life cycle, suggesting a landscape scale approach is needed to ensure long term biological conservation. However, top-down landscape level planning is challenging in the Northern Forest, where the majority of lands are under private ownership, resulting in landscape patterns that are driven from the bottom-up. That is, individual decisions made by local land owners and towns acting in their own interest collectively determine landscape quality for wildlife species, for better or worse. The issue of how to design a landscape that meets the needs of multiple interests is inherent in the town planning process. Often, however, wildlife is a silent stakeholder in this process.

The goal of this project is to develop a prototype of a Structured Decision Making (SDM) process that will bring wildlife to the table in local town planning efforts. The first phase of the Structured Decision Process is to develop measurable objectives such as "Maintain at least 40% of the town as forest." This example contains both an indicator (level of forest cover in a town) and a standard (40%).

To establish objectives (indicators and standards) for development in towns across Vermont, we developed a visual preference survey that utilized CommunityViz and Google Earth software (see figure to right). Survey respondents were asked to rate the acceptability of visual images of varying levels of development, agriculture and natural lands within their local community. Data were also collected with respect to age, income, sex, and home town. We used a stratified random sample of Vermont residents and mailed the survey to 4000 home owners in the summer of 2011. To date, >1600 responses have been received.

"Norms of acceptability" of development are being estimated for each town in Vermont, based on survey results, which provide the level of development that is deemed "acceptable" by residents. Given these norms, the Vermont Cooperative Fish and Wildlife Research Unit is assessing the likely ecological consequences of these "norms" for a variety of forest-dependent wildlife species. This process will, for the first time, allow state biologists to evaluate how planning objectives for a collection of local towns will likely impact landscape quality for wildlife species.

Project Status: Completed.



Example images depicting different levels of development in a hypothetical town, to which survey respondents rated their "level of accept-

PREDICTING IMPACTS OF FUTURE HUMAN POPULATION GROWTH OF DEVELOPMENT ON FOREST-DEPENDENT WILDLIFE SPECIES

Principal Investigators: Therese M. Donovan and David Theobald (Colorado State)

Graduate Student: Michelle Brown (M.S. Student)

Project Cooperator: U.S.D.A. McIntire-Stennis

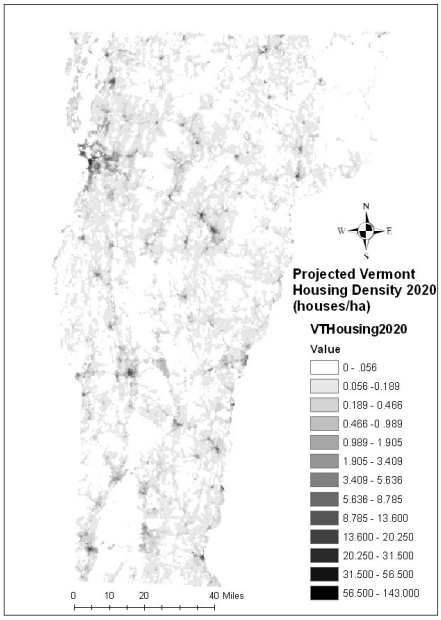
Project Period: 1 January 2009 - 31 December 2011

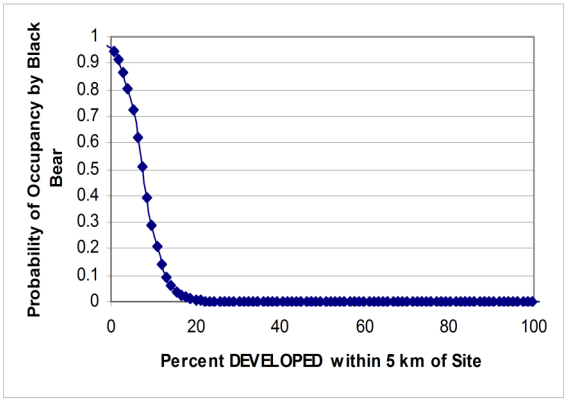
Synopsis: Forest loss is perhaps the most important contemporary issue in the Northeast for wildlife species. Given increasing forest loss and fragmentation, the "problem" of how native fauna will respond to eminent land-use change is widespread, and requires tools and methods for understanding population responses as well as management recommendations for conservation. This study integrates wildlife habitat modeling with GIS models of human population growth to quantify how various forest-dependent wildlife species will respond to projected increases in human population growth (year 2050) for the state of Vermont. The Vermont Cooperative Fish and Wildlife Research Unit is collaborating with Dr. David Theobald (Colorado State University) on this work.

The first analysis involves estimating changes in housing density across Vermont to the year 2050, accomplished through a population growth model called SERGoM (Spatially Explict Regional Growth Model). With projected changes in human housing, researchers can predict the increase in developed land cover classes and road density as a result of human growth. These two factors (% development and road density) are known to affect the abundance and distribution of several different wildlife species in Vermont. Finally, given changes in road density and development, researchers are quantifying the likely impact of human growth on occupancy probability for several forest-dependent species.

The study will advance conservation planning by: 1) providing GIS layers on the contemporary distribution (probability of occurrence) for selected forest-dependent species; and 2) providing GIS layers that quantify risk for these same species given future human population growth and development.

Project Status: Completed.





Projected housing density for Vermont in the year 2050 (top). Bottom: Increases in housing density will increase the percent developed landcover classes in Vermont, which in turn will decrease black bear occurrence.

ACOUSTICAL MONITORING OF BIODIVERSITY AND PHENOLOGY: A PILOT WILDLIFE MONITORING PARTNERSHIP FOR ADAPTIVE MANAGEMENT

Principal Investigators: Therese M. Donovan and Brian Mitchell (NPS)

Graduate Students: Cori Brauer (M.S. Student) and Jon Katz (Ph.D. Student)

Project Cooperators: National Park Service, National Phenology Network, and Vermont Department of Fish and Wildlife

Project Period: 1 February 2010 - 31 December 2013

Synopsis: A primary principle guiding the management of the state and federal lands is to conserve and enhance habitats that support a full range of native flora and fauna. Two serious forces threaten the viability of native flora and fauna today: land use change and global climate change.

Confronting these resource management challenges requires, first and foremost, robust data to accurately predict how biodiversity will respond to land-use and climate change, and a process that links this information to planning efforts and resource management in a continual way (i.e., adaptive management). The first step in this process, gathering and monitoring biodiversity data, is extremely challenging. First, the sampling area is vast. Second, not all wildlife species can be monitored; many are secretive or rare and are not easily counted by humans (e.g., black bears). Third, even if a few, target species were monitored, field-based monitoring by humans across the entire state of Vermont would be cost prohibitive.

One potential solution to these challenges is to establish an acoustical monitoring network, where 1) vocalizations made by indicator wildlife species are recorded continually at sampling stations located throughout the sampling area, 2) recorded sounds are delivered to a central database where computers are used to identify species-specific sounds, and 3) the acoustical data can be accessed and used by natural resource managers in a structured decision making/adaptive management framework.

Our goal in this pilot effort is to field test acoustical techniques, database development, computer-automated animal identification, and programmatic methodologies. Data were collected at 12 sites in the Northeast (Vermont and Maine) in the summers of 2010 and 2011. Through this study, we hope to identify opportunities and constraints for establishing a large-scale acoustic monitoring program in Vermont. This pilot study is a partnership between the National Park Service, the National Phenology Network, the Vermont Department of Fish and Wildlife, and the Vermont Cooperative Fish and Wildlife Research Unit.

Project Status: Ongoing.

Remote acoustic recording devices for monitoring amphibians, birds, bats, and insects. Top photo: Commercially available unit available from Wildlife Acoustics, Inc. Middle photo: Home-made recording device. Bottom: Sample species recordings in both time– and frequency-domain (source: Wildlife Acoustics, Inc.)

USING RELATIONAL DATABASES TO IMPROVE STRUCTURED DECISION MAKING FOR NATURAL RESOURCE MANAGEMENT

Principal Investigator: Therese M. Donovan

Graduate Students: Jonathan Cummings (Ph.D. Student) and Kurt Rinehart (Ph.D. Student)

Project Cooperators: Vermont Department of Fish and Wildlife and U.S. Geological Survey

Project Period: 1 June 2009 – 30 September 2013

Synopsis: A major initiative of the USGS Cooperative Research Unit (CRU) Program is to teach and apply formal structured decision making approaches to the management of natural resources. Structured decision making, or SDM, is "an organized approach to identifying and evaluating creative options and making choices in complex decision situations." In the context of natural resource management, SDM is designed to deliver insight to natural resource decision makers about how well their management objectives may be satisfied by potential alternative courses of action. The SDM process generally involves identifying the natural resource management problem, setting management objectives, identifying potential alternative management actions, estimating the likely consequences of each alternative (often through rigorous quantitative modeling), and then weighing each alternative and identifying trade-offs among alternatives. When the same decision problem is tackled on a recurrent basis, new (updated) information is used to provide fresh perspectives on alternatives, their likely outcomes, and trade-offs. "Adaptive management" is the application of SDM approaches when a decision problem is iterative.

The primary goal of this project is to improve the decision making processes used by both state biologists and land use planners in managing and conserving wildlife and habitat. This project has several interconnected objectives: 1) develop a relational database to support, organize and manage the Department's wildlife data, as well as data collected for wildlife research through the USGS Cooperative Research Unit at the University of Vermont and through other sources; 2) Provide a website that facilitates the exchange of data among different projects; 3) Develop habitat suitability maps for target harvest species (black bear, fisher, bobcat) and predict how these species distributions may change in the face of climate, forest, and land use change in the next 100 years; and 4) Evaluate several, alternative methods for estimating abundance of target harvest species based on harvest records, and develop an adaptive management framework for linking harvest with population trends. This project is a critical first step in achieving the overarching goal of improved, science-based conservation management of wildlife and habitat both through Fish and Wildlife Department programs as well as through technical assistance programs to land use planners and decision-makers.

Project Status: Ongoing.

The Steps of Structured Decision Making. Source: http://www.structureddecisionmaking.org/

The bobcat (Lynx rufus) is one of the focal species for which adaptive management plans are being developed.

EFFECTS OF FOREST BIOMASS ENERGY PRODUCTION ON NORTHERN FOREST WILDLIFE AND FOREST SUSTAINABILITY

Principal Investigator: Therese M. Donovan

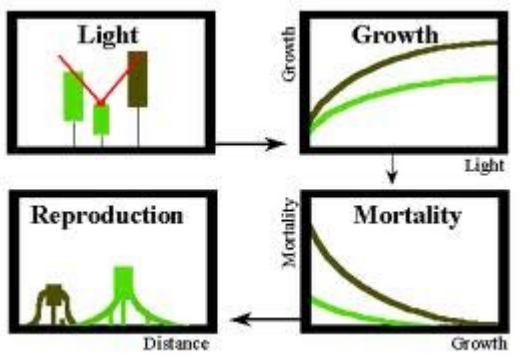
Graduate Students: Michelle Brown (Ph.D. Student)

Project Cooperators: Northeastern States Research Cooperative

Project Period: 1 July2012– 30 June 2015

Synopsis: Federal and state governments in the Northern Forest are actively engaged in assessing the potential role of forest biomass in meeting renewable energy portfolios. While current rates of timber harvest are generally sustainable, there is considerable pressure to increase the contribution of forest biomass for renewable energy. Maximizing the biomass energy supply could compromise (potentially seriously) other uses and values of forests, including a wide range of ecosystem services and the conservation of native species. What has been missing from this debate is a realistic, regional assessment of these trade-offs through time. The goal of this study is to critically evaluate the capacity of the Northern Forest to contribute to the energy needs of the region through forest biomass harvest, and also to evaluate the tradeoffs between biomass energy harvest, carbon storage, biodiversity levels, energy needs met, and CO_2 emissions. We will use a Multi-Criteria Decision Analysis (MCDA) framework to evaluate what different harvest regimes will mean for the Northern Forest in terms carbon storage, biodiversity levels, energy needs met, and CO_2 emissions. The results will provide decision-makers with regional assessments of the benefits and impacts of biomass energy production to meet state and regional renewable energy portfolios on a landscape level that to date have been largely unavailable. We will create a spreadsheet tool that will allow other stakeholders (i.e. conservation NGOs, forest and energy industries) to weight the MCDA decision objectives from their perspectives. A series of maps will be developed that illustrate the potential effect of forest biomass harvest on biodiversity and multiple peer-reviewed scientific publications and presentations will result.

Project Status: New.



Peer-Reviewed Publications

Butryn, R. S., D. L. Parrish, and D. M. Rizzo. 2013. Summer stream temperature metrics for predicting brook trout (*Salvelinus fontinalis*) distribution in streams. Hydrobiologia 703: 47-57.

Donovan, T. M., G. S. Warrington, W. S. Schwenk, and J. H. Dinitz. 2012. Estimating landscape carrying capacity through maximum clique analysis. Ecological Applications 22:2265-2276.

Duerr, A. E., D. E. Capen, and T. M. Donovan. 2012. Energetic considerations for managing double-crested cormorants on Lake Champlain. Journal of Great Lakes Research (Supplement 1) 38:131-140.

Howe, E. A., J. E. Marsden, T. M. Donovan, and R.H. Lamberson. 2012. A life cycle approach to modeling sea lamprey population dynamics in the Lake Champlain basin to evaluate alternative control strategies. Journal of Great Lakes Research (Supplement 1) 38:101-114.

Marschall, E. A., M. E. Mather, D.L. Parrish, G. Allison, and J. McMenemy. 2012. Migration delays caused by anthropogenic barriers: modeling dams, temperature, and success of migrating salmon smolts. Ecological Applications 22: 3014-3031.

Mather, M.E., D.L. Parrish, and J.M. Dettmers. 2012. Now that you have great results, where should you submit your manuscript? Pages 121-133 *in* C. A. Jennings, T. E. Lauer, B. Vondracek, editors. Scientific communications for natural resources professionals. American Fisheries Society, Bethesda, Maryland.

Murdoch, J., H. Davie, M. Galbadrah, T. Donovan, and R. Reading. 2013. Do Siberian marmots influence toad-headed agama occupancy? Examining the influence of marmot colonies and three steppe habitats in Mongolia. Journal of Arid Environments 92:76-80.

Schwenk, W. S., T. M. Donovan, W. S. Keeton, and J. S. Nunery. 2012. Carbon storage, timber production, and biodiversity: comparing ecosystem services with multi-criteria decision analysis. Ecological Applications 22:1612-1627.

Simonin, P. W., D. L. Parrish, L. G. Rudstam, P. J. Sullivan, and B. Pientka. 2012. Native rainbow smelt and nonnative alewife distribution related to temperature and light gradients in Lake Champlain. Journal of Great Lakes Research (Supplement 1): 115-122.

Zale, A. V., D. L. Parrish, and T. M. Sutton, editors. 2012. Fisheries techniques 3rd Edition. American Fisheries Society, Bethesda, Maryland.

Zale, A.V., T. M. Sutton, and D. L. Parrish. 2012. Conducting fisheries investigations. Pages 1-13 *in* A. V. Zale, D. L. Parrish, and T. M. Sutton, editors. Fisheries techniques, 3rd edition. American Fisheries Society, Bethesda, Maryland.

Theses and Educational Materials

THESES:

Bettigole, Charles A. 2012. Normative standards for land use in Vermont: The effects of social norms on wildlife occupancy . MS Thesis, University of Vermont, Burlington, VT. Advisor: Therese Donovan

Brauer, Corinne L. 2012. A comparison of acoustic monitoring methods for common anurans of the northeastern United States. MS Thesis, University of Vermont, Burlington, VT. Advisor: Therese Donovan

Brown, Michelle L. 2012. Predicting impacts of future human population growth and development on forest-dependent birds. MS Thesis, University of Vermont, Burlington, VT. Advisor: Therese Donovan.

EDUCATIONAL MATERIALS:

The VTCFWRU Spreadsheet Project http://www.uvm.edu/envnr/vtcfwru/spreadsheets/ Peer-reviewed spreadsheet, MARK, and PRESENCE exercises that focus on a variety of ecological and parameter estimation problems.

Principles of Modeling On-line Course https://sharepoint.uvm.edu/sites/modeling/default.aspx Co-instructed by Tony Starfield and Terri Donovan. This course was developed in concert with the BLM National Training Center and the National Conservation Training Center. It consists of instructional videos, paired with weekly group modeling challenges. Participants include both graduate students and professionals from USFWS and USGS.

Introduction to Conservation Biology http://vimeo.com/channels/conbio/52460638. Co-instructed by Jed Murdoch and Terri Donovan with support from the BLM National Training Center. This on-line course material pairs lectures, spreadsheet exercises, and homework to provide students a foundation in the principles of conservation biology.

Scholarly Activities

PRESENTATIONS:

Bettigole, C., T. Donovan, B. Manning, and J. Austin. Normative standards for land use in Vermont: The effects of social norms on wildlife occupancy. Northeastern States Research Cooperative webinar. February 2012.

Parrish, D. L. Atlantic salmon in the Connecticut River. 38th Annual Meeting of the Atlantic International Chapter of the American Fisheries Society, Averill, Vermont, 23-25 September 2012. (Plenary Speaker).

Parrish, D. L. Modeling Atlantic salmon migration. Fall Seminar Series, Rubenstein School of Environment and Natural Resources, University of Vermont, 21 September 2012.

Parrish, D. L. Dispersal and migrations. Paul Smith's College, 6 April 2012. (Invited Seminar.)

COURSES OFFERED:

Ecology of Fishes., UVM, Fall 2012.

Graduate Student Seminar-On Becoming a Successful Scientist, UVM, Spring 2012.

Principles of Modeling, UVM, Spring 2012.

Professional Service and Technical Assistance

Therese M. Donovan

Rubenstein School Graduate Program Database. Manage and write scripts for tracking multiple facets of the graduate program.

Vermont Fish and Wildlife Deer Biologist Search Committee, 2012.

Vermont Monitoring Cooperative Technical Review, 2012.

Associate Editor, Conservation Biology, 2001-2013.

UVM Research, Scholarship, and Graduate Education Committee, 2010-2013.

UVM Extension Forest Ecologist Search Committee, Nov 2011-March 2013.

Donna L. Parrish

Ad Hoc Business Advisory Committee, Rubenstein School, UVM, 2011-2012.

Faculty Standards Committee, Rubenstein School, UVM, 2012-2015.

Executive Director Succession Planning Committee Chair, American Fisheries Society, 2012.

Officer in the American Fisheries Society—2nd VP (2012), 1st VP (2013), President-elect (2014), President (2015).

Awards Committee Chair, American Fisheries Society, 2013.

Membership Committee Chair, American Fisheries Society, 2013.

Modeling Workshop: Alewife and rainbow smelt interactions in Lake Champlain. Co-organizer with Mark Malchoff. Sponsored by Lake Champlain Sea Grant, 11 January 2013.

Vermont Cooperative Fish & Wildlife Research Unit