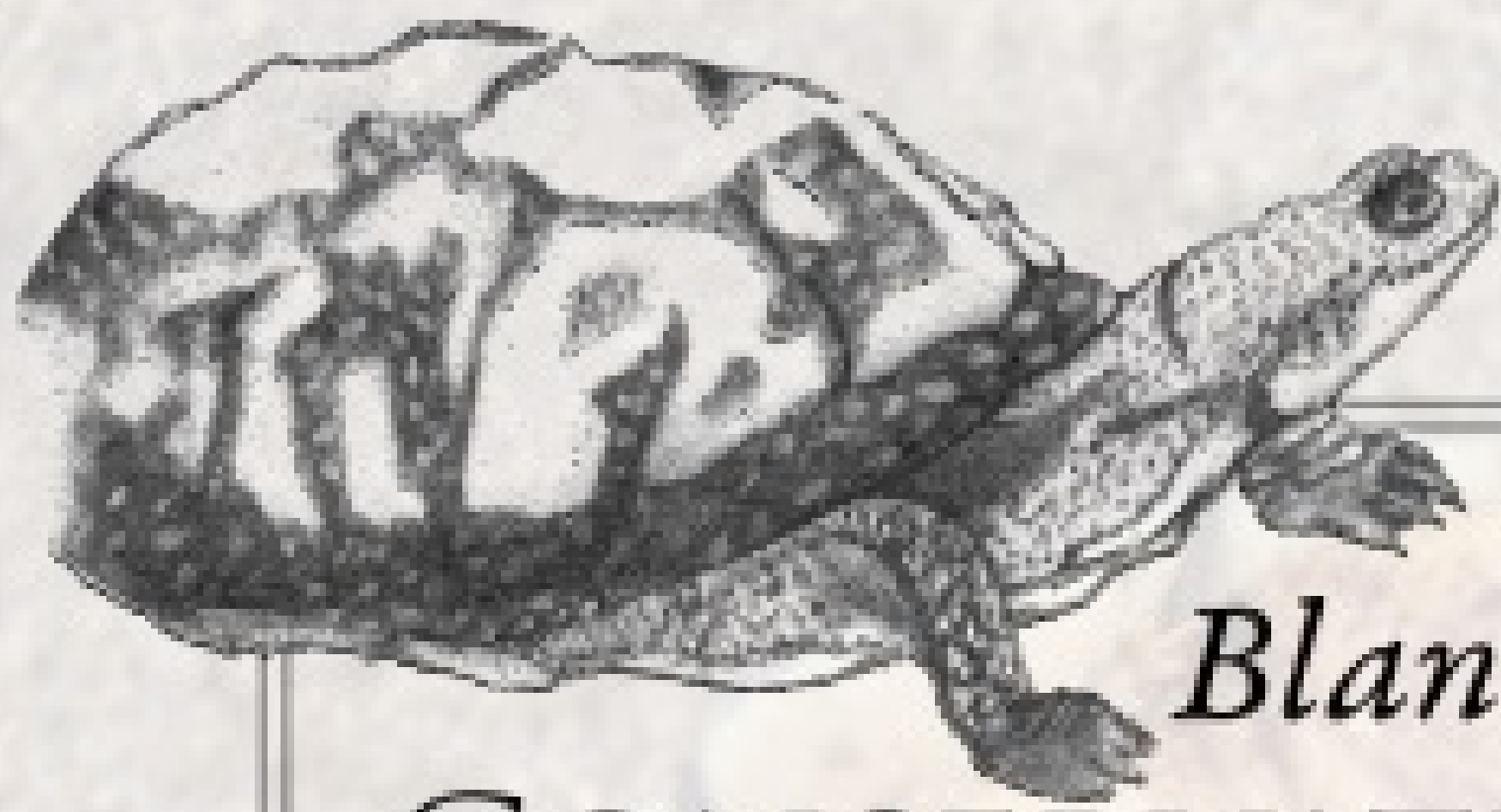




Blanding's & Wood Turtle
CONSERVATION SYMPOSIUM

October 2016 • Westborough, Massachusetts





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October 2016 • Westborough, Massachusetts



October 3–4, 2016 / Massachusetts Division of Fisheries and Wildlife

The Blanding's & Wood Turtle Conservation Symposium is supported by the *Competitive State Wildlife Grants* program (administered by the U.S. Fish and Wildlife Service) through an award to the Massachusetts Division of Fisheries & Wildlife and their partners.

Planning committee:

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- Glenn Johnson, State University of New York at Potsdam
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Agenda

Monday, October 3 (Morning)

7:00-8:00 Breakfast & Check-in

SESSION 1: Symposium Overview

8:00-8:05 Welcome to Massachusetts & MassWildlife
Mark Tisa, Deputy Director, MassWildlife

8:05-8:10 Conference Overview
Mike Jones, MassWildlife

8:10-8:25 Diversity Technical Committee
John Kanter, NH Fish & Game

8:25-8:40 USFWS Overview
Tony Tur, New England, U.S. Fish & Wildlife Service

8:40-8:45 USFWS SSA Update
Wende Mahaney, U.S. Fish & Wildlife Service

8:45-9:00 AFWA / PARC Overview
Priya Nanjappa, Association of Fish & Wildlife Agencies

9:00-9:45 Participant Introductions

SESSION 2: Regional Coordination/Status for Wood Turtles

9:45-9:55 Regional Coordination and Conservation Area Design in the NE
Mike Jones, Massachusetts Division of Fisheries and Wildlife

9:55-10:05 Regional Efforts in Canada
Maureen Toner, New Brunswick

10:05-10:15 Collaborative Research and Management of Wood Turtles in the Upper Midwest
Donald Brown, West Virginia University / USFS

10:15-10:30 **BREAK**

SESSION 3: Techniques for Wood Turtle Population Assessment

10:30-10:40 Standardized Wood Turtle Population Assessments in the NE USA
Mike Jones, Massachusetts Division of Fisheries & Wildlife

10:40-10:50 Survey and Analysis Design for Wood Turtle Abundance Monitoring Programs in the Upper Midwest
Donald Brown, West Virginia University / U.S. Forest Service

10:50-11:00 Use of eDNA for the Detection of Freshwater Turtles: Lessons from a Wood Turtle Study
Tom Akre, Smithsonian Conservation Biology Institute

11:00-11:10 Wood Turtle Survey Protocols in New Brunswick
Connie Browne and Maureen Toner, New Brunswick

11:10-11:20 Wood Turtle Mass Mortalities in New Brunswick
Deanna McCullum and Maureen Toner, New Brunswick

11:20-12:00 **Breakout Session: Inter-region collaboration on sampling and population assessment**
Facilitators: Tom Akre, Donald Brown, Priya Nanjappa

12:00-12:55 **Group photo and LUNCH**

Agenda

Monday, October 3 (Afternoon)

SESSION 4: Management

12:55-1:05 Recovery of a Wood Turtle
Population: Headstarting and Habitat Management Kurt Buhlmann, University of Georgia

1:05-1:15 Conservation of a Wood Turtle
Population Over 46 Years in Northern Michigan: Assessment of Population Augmentation Dave Mifsud, Michigan Herp Atlas

1:15-1:25 Recovery and Habitat Management
for Wood Turtles in an Agricultural Landscape Rachel White, Huron Stewardship Council, Ontario

1:25-1:35 Freshwater Turtle Poaching Jim Dowd, U.S. Fish & Wildlife Service

1:35-2:30 **Breakout Session: Effectively minimizing poaching pressure**
Facilitators: Mike Jones, Derek Yorks

2:30-2:45 BREAK

SESSION 5: Genetics

2:45-2:55 Rangewide Wood Turtle Genetics Dana Sheedy, University of Montana

2:55-3:00 Blanding's Turtle Genetics in the
Northeastern United States Mike Marchand, New Hampshire Fish and Game

3:00-3:10 Range-wide Mitochondrial and
Nuclear DNA Sequence Analysis of Blanding's Turtle Mark Jordan, Indiana University-Purdue University

3:10-4:00 **Breakout Session: Genetics Techniques and Priorities**
Facilitators: Liz Willey, Dana Sheedy, Lori Erb

4:00-4:30 Day 1 Wrap-up

4:30-5:30 Keynote Presentation Dr. Justin Congdon

6:00-8:00 DINNER: Medusa in Hudson, MA

Agenda

Tuesday, October 4 (Morning)

7:15-8:00 Breakfast & Check-in

8:00-8:05 Morning Intro / Announcements Mike Jones, Massachusetts Division of Fisheries & Wildlife

SESSION 6: Regional Coordination / Status of Blanding's Turtle

8:05-8:15 Blanding's Turtle Coordination in the Northeast Mike Marchand, NH Fish and Game Department

8:15-8:25 Blanding's Turtle Status in the Midwest Greg Lipps, Ohio Biodiversity Conservation Partnership

8:25-8:35 Status and Conservation of Blanding's Turtle in Ontario Joe Crowley, Ontario Ministry of Natural Resources

8:35-8:45 Conserving Blanding's Turtles in Nova Scotia Tom Herman, Mersey Tobeatic Research Institute and Acadia University

8:45-9:00 **BREAK**

SESSION 7: Blanding's Turtle Population Assessment and Conservation Efforts

9:00-9:10 Coordinated Regional Monitoring Strategy for Blanding's Turtles in the NE USA Liz Willey, Antioch University/American Turtle Observatory

9:10-9:20 Translating Blanding's Turtle Conservation Needs in the Context of Legal Challenges Fred Beaudry, Alfred University

9:20-9:30 Land Conservation through NRCS Programs Brooke Smart, Natural Resource Conservation Service

9:30-10:15 **Breakout Discussion: Effective Land Conservation for Blanding's & Wood Turtles**
Facilitators: Mike Jones, Derek Yorks, Michael Marchand

10:15-10:30 **BREAK**

SESSION 8: Blanding's Turtle Management I

10:30-10:40 Regional Bog Turtle Conservation: Applications for EMBL and GLIN Lori Erb, Mid-Atlantic Center for Herpetology and Conservation

10:40-10:50 Blanding's Turtle Conservation Efforts in Minnesota Carol Hall, MN DNR - Minnesota Biological Survey

10:50-11:00 25 Years of Blanding's Turtle Research at the Three Rivers Park District, MN Madeleine Linck, Three Rivers Park District, Minnesota

11:00-11:10 Blanding's Turtle Conservation and Management in Illinois Mike Dreslik, Illinois Natural History Survey

11:10-11:20 Conservation and management of Blanding's Turtles in Lake County, IL Gary Glowacki, Lake County Forest Preserve District, IL

11:20-11:30 Conservation and Management in the Forest Preserve District of DuPage County, IL Dan Thompson, Forest Preserve District of DuPage County, IL

11:30-11:40 Blanding's Turtle Recovery in the Future Rouge National Urban Park, Toronto Andrew M. Lentini, Toronto Zoo

11:45-12:45 **Group photo and LUNCH**

Agenda

Tuesday, October 4 (Afternoon)

SESSION 9: Blanding's Turtle Management II

12:45-12:55	Using PVA to Model Conservation Actions for Blanding's Turtles in New York	Angelena Ross, New York State Department of Environmental Conservation
12:55-1:05	Conservation Efforts for Blanding's Turtles in Northern New York	Glenn Johnson, State University of New York Potsdam
1:05-1:15	Conservation and Management of Blanding's Turtles in Dutchess County, NY	Lisa Masi, New York State Department of Environmental Conservation
1:15-1:25	Blanding's Turtle Habitat Use in a Changing Landscape in Saratoga County, New York: Conservation and Management Implications	Andrea Chaloux, New York Natural Heritage Program
1:25-1:35	Long-term Monitoring of a Massachusetts Population of Blanding's Turtles	Brian Butler, Oxbow Associates
1:35-1:45	Restoring a Regionally Significant Blanding's Turtle Population in Eastern Massachusetts	Bryan Windmiller, Grassroots Wildlife Conservation
1:45-1:55	Effectiveness of Headstarting as a Management Tool for Establishing a Population of Blanding's Turtles	Jared Green, U.S. Fish & Wildlife Service
1:55-2:45	Breakout Discussion: Managing Habitats and Populations Facilitators: Glenn Johnson, Kurt Buhlmann, Mike Dreslik	
2:45-3:00	BREAK	
3:00-4:00	Breakout Discussion: Where From Here? Wood and Blanding's Turtle Conservation <i>next steps</i> Facilitators: Mike Marchand and Ellery Ruther; Mike Jones and Liz Willey	

An electronic questionnaire will be provided to participants following the symposium as a means of ranking and prioritizing identified conservation actions and opportunities. The proceedings of this symposium, and the results from the prioritization questionnaire, will be published. Thank you to all participants and presenters!

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The Use of Environmental DNA for Detection of Freshwater Turtles: Lessons Learned from an Occupancy Study of the North American Wood Turtle (*Glyptemys insculpta*)

Thomas Akre* and Ellery Ruther, Smithsonian Conservation Biology Institute, Front Royal, VA 22630; akret@si.edu; ruthere@si.edu; Lorien Lemmon, National Ecological Observatory Network, Front Royal, VA 22630; Lillian Parker, Smithsonian Conservation Biology Institute, Front Royal, VA 22630; Nancy McInerney and Jesus Maldonado, Smithsonian Conservation Biology Institute, Front Royal, VA 22630

The detection of environmental DNA (eDNA; defined as short DNA fragments released by an organism into the environment through skin, urine, feces, mucus, or dead cells) has been used to record the presence of many different types of organisms in several different aquatic environments. These include invertebrates, fish, amphibians, reptiles and mammals, both exotic and native species, in marine and freshwater environments, including rivers, streams and ponds. Although the basic technology has been around for 30 years, the new application appeared to be a silver bullet because it offered the promise of improving detection of rare, cryptic, and difficult-to-sample species while reducing sampling costs at the same time. However, the eDNA approach is subject to the same considerations that limit the interpretation of results from traditional survey techniques (e.g. detection variables, their interaction and magnitude and their relationship to occupancy), and because the technology is fairly new, most of these limitations are relatively unknown and poorly quantified. The wood turtle is a cryptic semi-aquatic species that is declining across its range and, like so many chelonian species, is in-need of a rapid and effective method for monitoring distribution and abundance. To meet this need, we used an eDNA approach to sample for wood turtle presence in northern Virginia streams. At the same time, we used repeat visual encounter surveys in an occupancy-modelling framework to validate our eDNA results and reveal the relationship of detection and occupancy for both methods. We sampled 56 streams of varying size within and beyond the known distribution of the wood turtle across northern Virginia. Wood turtle eDNA was recovered in as many as 86% of the samples from sites with confirmed presence. Our results suggest that eDNA technology holds promise for sampling aquatic chelonians in some systems, even when discharge is high and biomass is relatively low, when the approach is validated and sampling error is quantified. Results from this study will be presented, and the utility of eDNA for sampling aquatic chelonians will be discussed.

Lessons in a Hostile Environment: Translating Blanding's Turtle Conservation Needs in the Context of Legal Challenges

Frederic Beaudry*, Division of Environmental Studies & Geology, Alfred University, Alfred, NY 14802; beaudry@alfred.edu

An important series of court cases have recently been heard in Ontario, challenging the provincial government's land use decisions and their effects on at-risk species, most notably Blanding's turtles. Generous provincial energy policy directives have been encouraging the rapid development of utility-scale renewable energy projects. In the rush to stake areas with abundant wind resources, shortcuts have been taken in selecting environmentally appropriate wind project sites. As a result, many wind projects have been approved at locations along the Lake Ontario shoreline, some among wetlands where Blanding's turtles are found. The resulting conflict with Blanding's turtle habitat has led to a series of court challenges aimed at revoking the development permits awarded by the provincial government. I will briefly discuss my involvement in these proceedings, with emphasis on 1) the issues encountered when communicating turtle conservation concepts in a legal environment, and 2) the research needed to answer questions from stakeholders, especially in terms of risk mitigation.

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Collaborative Research and Management of Wood Turtles in the Upper Midwest

Donald J. Brown*, School of Natural Resources, West Virginia University, Morgantown, WV 26506 / Northern Research Station, U.S. Forest Service, Parsons, WV 26287; donald.brown1@mail.wvu.edu

The wood turtle (*Glyptemys insculpta*) is a species of conservation concern in the Upper Midwest states of Michigan, Wisconsin, Minnesota, and Iowa. However, with a few notable exceptions, wood turtles have not historically been major focal species for active management and research in the region. In recent years, all states have increased wood turtle management and research activities through funding from the Competitive State Wildlife Grants (CSWG) program. Major recent management actions include construction of road barriers to reduce road mortality, creation and restoration of nesting sites, and protection of nests from predators. Major recent research activities include investigations of individual responses to road barriers, assessments of reproductive success at control and managed nest sites, nesting site flood risk mapping, and development of a survey and analysis protocol for a long-term abundance monitoring program. The CSWG projects have enhanced our understanding of wood turtle populations in the region, and have led to collaborative research among states.

A Survey and Analysis Design for Wood Turtle Abundance Monitoring Programs in the Upper Midwest

Donald J. Brown*, School of Natural Resources, West Virginia University, Morgantown, WV 26506 / Northern Research Station, U.S. Forest Service, Parsons, WV 26287; donald.brown1@mail.wvu.edu; Madaline M. Cochrane, Natural Resources Research Institute, University of Minnesota-Duluth, Duluth, MN 55811; cochr081@umn.edu; Ron A. Moen, Natural Resources Research Institute, University of Minnesota-Duluth, Duluth, MN 55811; rmoen@d.umn.edu

The wood turtle (*Glyptemys insculpta*) is a species of conservation concern in the Upper Midwest states of Michigan, Wisconsin, Minnesota, and Iowa. State agencies in this region are interested in implementing long-term monitoring programs to track changes in abundance of wood turtles at management and control sites. In spring of 2015, we completed a pilot field study in northern Minnesota to assist with development of a survey protocol. In spring of 2016, we implemented the survey protocol, completing 8 survey replications at 8 potential long-term monitoring sites. The major characteristics of the protocol included active searches of aquatic, riparian, and terrestrial habitat by foot, using 4 transects spaced 15 m apart on each side of the river. We detected 313 wood turtles, including 174 unique individuals, during the 64 surveys. Using these data, we compared the performance of 3 hierarchical models for estimating site-level abundance, delineated important survey covariates, and identified the minimum distance from river and minimum number of survey replications necessary in order to obtain precise abundance estimates. We found that a generalized binomial N -mixture model that included a temporary emigration state process resulted in higher precision of abundance estimates than a standard binomial N -mixture model and a multinomial N -mixture model that included a removal sampling observation process. Air temperature was an important covariate for estimating availability to be detected, and leaf-out was an important covariate affecting detection probability when 4 transects were included. We considered 2 transects (visual survey distance up to ca. 25 m from the river) to represent the optimal survey distance, and 7 surveys to represent the optimal number of replications. The wood turtle survey and analysis design we developed and tested was effective for estimating abundance of wood turtle populations in northern Minnesota, and could serve as a template for wood turtle abundance monitoring programs in the Upper Midwest.

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Open Standards Planning for Wood Turtle Recovery in New Brunswick

Constance L. Browne*, New Brunswick Museum, 277 Douglas Avenue, Saint John, NB, E2K IE5, Canada; cbrowne@unb.ca; Maureen Toner, New Brunswick Department of Energy and Resource Development, Hugh John Flemming Forestry Centre, P.O. Box 6000, Fredericton, NB, E3B 5H1, Canada; Maureen.Toner@gnb.ca

Conservation planning for Wood Turtle (*Glyptemys insculpta*) in New Brunswick has been initiated within the framework of *Open Standards for the Practice of Conservation*. We present results from the initial planning steps (*scope, targets, key ecological attributes and indicators*) and describe challenges and potential pathways forward. The scope of the project is the conservation of Wood Turtles in New Brunswick. Four targets have been identified, based on input from experts. The first is a population target, where the *population unit* has been defined as all turtles occurring within a watershed, as mapped within the New Brunswick Hydrographic Network. The finest scale of watershed delineation has been selected for these purposes; that is, watersheds with at least one 4th order stream. Watersheds in this layer varied in size, up to 630 km². Three habitat targets have also been identified: the watershed, the watercourse and a 200 m riparian buffer on both sides of the watercourse. This last target corresponds to the critical habitat definition in the proposed national recovery strategy for Wood Turtle in Canada. For each conservation target, key ecological attributes (KEAs) have been identified. These are *the aspects of a target's biology or ecology that, if missing or altered, would lead to the loss of that target over time*. In the case of the Wood Turtle population units, the KEAs are abundance of adults, reproductive success and adult survivorship. KEAs for the three habitat targets include features such as forest cover at the scale of the watershed, early successional features within the watercourse and diversity of successional types in the 200m buffer. Identifying measurable indicators to track changes has proven to be challenging for some of these key ecological attributes. Overlapping or redundant indicators have thus been retained as candidates, as additional information is required to test their usefulness. Identifying thresholds that separate poor conditions from good, or very good, conditions has been attempted through reference to the literature and through GIS analyses. Case studies of a selection of watersheds with large Wood Turtle populations may provide clearer indicators and thresholds.

Recovery of a Wood Turtle Population: Head-starting and Habitat Management

Kurt A. Buhlmann*, Savannah River Ecology Laboratory, University of Georgia, Aiken, South Carolina 29809; kbuhlmann@earthlink.net; Colin P. Osborn, Great Swamp National Wildlife Refuge, U.S. Fish and Wildlife Service, Basking Ridge, New Jersey 07920; colin_osborn@fws.gov; Brian A. Bastarache, Natural Resource Management Department, Bristol County Agricultural High School, Dighton, Massachusetts, 02715; bbastarache@bcahs.com

A small relict population of Wood Turtles (*Glyptemys insculpta*) was discovered on the Great Swamp National Wildlife Refuge in 2006. Over the 10-yr period, 2006-2016, we encountered 19 different females and 8 males. We know that as of 2016, 4 of the females are deceased. At the beginning of the study, we determined that nesting habitat had become limited due to forest succession of riparian habitat once in active dairy farming, as well as encroachment by invasive vegetation, including Mugwort (*Artemisia vulgaris*) and Multiflora Rose (*Rosa multiflora*). We have begun restoration of historic nesting areas and engaged adjacent landowners in mitigating land management impacts to Wood Turtles. We constructed an elevated nesting mound of soil which female Wood Turtles have readily used each year, 2007-2016, and we have protected all observed nests. From these nests, each Autumn 2007-2015, we have released varied percentages (18%-100%) of the produced hatchlings, totaling 227. Recaptures of these "direct-release" hatchlings has been low, (N=3), presumably due to natural low hatchling survivorship, small size

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and secretive behavior, but perhaps due to predation by raccoons. We have head-started five cohorts (2011-2015; N=103), reared indoors by high school students for approximately 9 months (Sept-May), and then released into the exact habitat where the small adult population exists on the Refuge. Radio-tracking of each head-started cohort has informed us of first year survivorship (May to May) of 55% (2011 cohort), 83% (2012 cohort), 50% (2013 cohort), 83% (2014 cohort) with representatives from all cohorts known alive as of September 2016. Cumulative survivorship of the 2011 head-started cohort (N=22) was 36% at 4 yrs post-release. Known mortalities of head-started wood turtles are most frequently attributed to raccoons, with lawnmower interactions a lesser, but yet frustrating cause. Terrestrial movement of radio-tracked individuals is greatest in the first summer post-release. Home ranges decrease in size as turtles acquire greater site fidelity, with increasing time on the landscape. Head-started turtles successfully return to the stream and often hibernate under the same undercut banks as the adults. We believe that the combination of nesting habitat creation, nest protection, invasive plant removal, head-starting of multiple cohorts, raccoon management, and positive human interactions with adjacent landowners can recover and result in a viable wood turtle population.

Blanding's Turtle Habitat Use in a Changing Landscape in Saratoga County, New York: Conservation and Management Implications

Andrea M. Chaloux*, New York Natural Heritage Program, 625 Broadway, 5th Floor, Albany, NY 12233-4757; andrea.chaloux@dec.ny.gov; Glenn Johnson, Department of Biological Sciences, University at Potsdam, Potsdam, NY; johnsong@potsdam.edu; Alvin Breisch (retired), New York State Department of Environmental Conservation, Albany, NY; Michael Kallaji (retired), New York State Department of Environmental Conservation, Albany, NY

In 2003, a small, isolated population of the Blanding's turtle (*Emydoidea blandingii*) was documented in Saratoga County, New York, between the Midwestern range and eastern range of the species, approximately 120 km from the nearest known population. Its occupancy of wetlands in an area experiencing heavy development pressure called for immediate conservation-focused research. Building upon work of New York State Department of Environmental Conservation (NYSDEC) staff from 2003-2006, we conducted a trapping (2007-2008) and radio-telemetry (2007-2009) study to determine the status and distribution of the population and its conservation and management needs. Additional surveys were conducted in 2012-2013, using the standardized Blanding's turtle Trapping Rapid Assessment protocol. A total of 14 Blanding's turtles (7 females, 5 males, and 2 juveniles) and one dead-on-the-road juvenile were documented. While the population occurs in a mostly unfragmented, high-quality habitat complex centered in a preserve, individuals are nesting and overwintering on several private parcels outside the preserve. The movements and habitat use of individuals following development (~2000-2002), logging (~2006), and habitat restoration activities (2007-2008) indicate the turtles are using the landscape opportunistically, responding to activities that open the canopy. Road mortality, loss and degradation of habitat, and drought are threats. To date, five conservation or management actions have been implemented: 1) translocation and protection of nests (89 hatchlings released from 10 protected nests, including 6 translocated nests, 2004-2009), 2) purchase of land (occupied parcels purchased by The Nature Conservancy in 2006 and 2007, and parcel adjacent to occupied habitat purchased by a local land trust in 2010), 3) creation of suitable nesting habitats (in 2008 and 2009, 60% [3/5] of located nests were in habitat created the year before), 4) installation of turtle crossing road signs at an identified road crossing hotspot (2013-2015), and 5) addition of ~113 ha of wetlands to the NYSDEC regulated wetland map, based on documented occupancy by Blanding's turtles (2015). Since the turtles are using critical habitats on private parcels around the preserve, conservation of the population depends on conservation practitioners establishing relationships with private landowners around the preserve. Continuing efforts to protect high-priority parcels

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and install turtle crossing road signs seasonally will benefit the population. In addition, the data indicate that creation and maintenance of suitable nesting areas within the unfragmented habitat of the preserve and conservation of drought-refuge/over-wintering ponds are priorities. We also recommend further inventory of suitable habitats capable of supporting viable populations in Saratoga County.

Status and Conservation of the Blanding's Turtle in Ontario

Joe Crowley, Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario, Canada, K9J 8M5, Joe.Crowley@ontario.ca

The Blanding's Turtle (*Emydoidea blandingii*) has a widespread distribution throughout southern and central Ontario with isolated populations in parts of northern Ontario. Although there have been no systematic Ontario-wide surveys for Blanding's Turtle, local projects and citizen science programs (e.g., Ontario Reptile and Amphibian Atlas) have provided extensive occurrence data over the past decade. Research and monitoring projects have also produced population estimates for several sites, and long-term mark-recapture studies have occurred at a few sites in southern Ontario. The Blanding's Turtle is listed as threatened under both the federal Species at Risk Act (SARA) and the Ontario Endangered Species Act, 2007 (ESA). Both Acts provide protection for threatened and endangered species and their habitat; SARA habitat protection generally only applies on federal land while the ESA applies on provincial and private land. An authorization under Ontario's ESA is required for any activity that would kill or harm individuals or damage or destroy the species' habitat. Authorizations for development projects typically require mitigation and additional activities that will result in an "overall benefit" for the species. For example, an authorization for road construction through Blanding's Turtle habitat would usually include mitigation approaches for that road (e.g., fencing + culverts) as well as additional beneficial activities (e.g. additional road mitigation or habitat restoration elsewhere). In addition to providing protection for species at risk, the ESA also sets out requirements for recovery planning and promotes species at risk stewardship within Ontario. Ontario's Species at Risk Stewardship Fund (SARSF) provides up to five million dollars each year for projects that contribute to the protection and recovery of Ontario's species at risk. Since 2007, this program has funded over 100 projects that contribute to Blanding's Turtle recovery in Ontario, including surveys, education, habitat creation, threat mitigation, and applied conservation research. For example, the Saving Turtles at Risk Today (START) project, which has been supported by SARSF since 2014, has carried out extensive surveys, applied conservation initiatives and public education for Blanding's Turtles throughout much of central Ontario.

Current Conservation Efforts for the Blanding's Turtle in Illinois

Michael Dreslik*; Illinois Natural History Survey; dreslik@illinois.edu.

Once occupying a broader range in Illinois, the Blanding's Turtle has suffered declines primarily to habitat loss (urbanization and cultivation) resulting in its listing as endangered in the state. The Illinois Department of Natural Resources is developing a species conservation plan aimed at stabilizing the decline and securing long-term persistence of populations in several key regions of its former range. In the Chicago region, several populations remain, but their stability is challenged by continued habitat loss (degradation), small population sizes, and anthropogenic mortality. Chicago Wilderness (a consortium of land management agencies in the region) has identified the Blanding's Turtle as a priority species for conservation. The goal of the priority species campaign is to provide a unified and long-term approach to species conservation within the

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Chicago region. In this presentation, I will cover the current state of knowledge and conservation efforts for the Blanding's Turtle in Illinois.

Regional Bog Turtle Conservation: Applications for Blanding's Turtles and Wood Turtles

Lori Erb*, Mid-Atlantic Center for Herpetology and Conservation, Monkton, MD, 21111; The Northeast State and Federal Bog Turtle Partners Working Group

Bog Turtle (*Glyptemys [Clemmys] muhlenbergii*) is a federally listed species in the northeastern U.S. Major threats include habitat loss or alteration due to human activities, vegetative succession, and disease (USFWS 2001). To assist with recovery efforts the Northeastern Bog Turtle State and Federal Partners Working Group has begun work on several conservation initiatives funded through a Competitive State Wildlife Grant. A regional conservation plan will be developed, including a population and habitat corridor prioritization analysis and setting benchmarks for recovery implementation. Inventory surveys will be performed to clarify the species range. All seven northeastern states will implement a standardized monitoring program to track population and habitat trends in light of recovery actions. A regional database will be developed to house monitoring data collected as well as much of the state's legacy data for this species. QPCR Assays will be developed and tested for the detection of bog turtle DNA in water samples collected in the fields. Habitat management projects are being planned, to restore and enlarge existing nesting and basking sites in occupied wetlands. Site-specific habitat management plans will be developed. In addition, sites where recent mortality events occurred (>5 dead bog turtles) will be monitored and disease screening tests performed to determine the cause of these mortalities.

Conservation of the Blanding's Turtle within the Chiwaukee Illinois Beach Lake Plain

Gary A. Glowacki*, Lake County Forest Preserve District, Natural Resource Division, Libertyville, IL 60048; gglowacki@lcfpd.org; Andrew R. Kuhns, Illinois Natural History Survey, Prairie Research Institute, University of Illinois, Champaign, IL 61820; arkuhns@illinois.edu

The Lake County Forest Preserve District (District) and partners have been monitoring the Blanding's Turtle population within a 530 acre unit of the Chiwaukee Illinois Beach Lake Plain (Lake Plain) since 2004. This macrosite, which encompasses over 4,200 acres of protected habitat managed through a partnership of 9 public land management agencies in Illinois and Wisconsin, contains one of the largest known populations of Blanding's Turtles in the region. However, despite the seemingly sizable population and availability of habitat, modeling done in 2010 indicated that the population is in decline due to lack of recruitment and unsustainable levels of annual adult survivorship (88%). In an effort to arrest the decline, the District formally instituted a recovery program in 2010 aimed at increasing recruitment and adult survivorship through head-starting and meso-predator control, combined with continued habitat restoration, management and monitoring. The District's head-starting efforts have resulted in the release of 736 individual turtles of which 29.5% of marked individuals (157 of 532) have been re-encountered at least once following successful brumation. Meso-predator control, conducted immediately prior to nesting season (2013-2016), effectively removed >80% of Northern Raccoons annually (Leslie catch per-unit effort removal model; N=132). During this time, nest success increased from 7.7% to 65.2%, suggesting removal efforts had a positive influence on nest success. Since initiation of the recovery program, the number of juvenile (< 250 g) and sub-adult (250 to 749 g) turtles encountered has increased substantially from 160 individuals through 2010 to 305 by 2016. This largely explains the increase of Blanding's Turtle captures per trap night from 0.049 to 0.123 experienced during the same time period as juvenile and sub-adult turtles were responsible for 0.072 captures per trap night alone. Population estimates have also shown a slight increase from an

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estimated 99 adults in 2010 to 119 adults in 2016 (Schnabel) with estimates of adult survivorship increasing to 91.2% (Cormack-Jolly-Seber)–97.1 (Known Fates). This, combined with the increasing number of juvenile and sub-adult turtles as a result of head-starting and meso-predator control, suggest the adult population is likely to continue to grow as more juveniles and sub-adult turtles reach maturity. Although preliminary results suggest that recovery efforts have been successful in increasing recruitment and adult survivorship, the fate of the species within the larger Lake Plain macrosite remains uncertain and is likely dependent upon continued interventional management.

Effectiveness of Headstarting as a Management Tool for Establishing a Population of Blanding's Turtles

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Blanding's turtles (*Emydoidea blandingii*) are facing various threats throughout their range, particularly in the northeastern United States and eastern Canada. To counteract shrinking populations, a Blanding's turtle repatriation project has been underway at Assabet River National Wildlife Refuge (NWR) in eastern Massachusetts since 2007. The initial environmental assessment evaluated the relative benefits and risks of using various life stages of Blanding's turtles collected from a donor population within the same watershed, including direct-release hatchlings (released shortly after hatching), head-started hatchlings (raised in captivity for nine months), subadults (9-11 years old), and adults. The results of population modeling suggested that annual releases consisting largely of head-started hatchlings was the release strategy most likely to result in a stable population at Assabet River NWR (recipient site) while minimizing negative impacts to the donor site. Therefore, annual releases at Assabet River NWR resulted in the release of 401 direct-released hatchlings and 440 head-started hatchlings from 2007-2014. Direct-released hatchlings had an average carapace length of 35.3 millimeters (mm) at time of release, while head-started hatchlings had an average carapace length of 66.2 mm at time of release. We conducted mark-recapture efforts from 2011-2014 and used a Cormack-Jolly-Seber (CJS) analysis to estimate apparent survival of direct-released and head-started hatchlings. This resulted in the recapture of 180 unique individuals, over 87% of whom had been head-started. We found from the CJS analysis that head-started hatchlings' first year post-release apparent survival was nearly six times higher than direct-released hatchlings. The results of our research should aid biologists in evaluating the effectiveness of their own freshwater turtle reintroductions and highlight the potential for head-starting as a management technique.

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Blanding's Turtle Conservation Efforts in Minnesota

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The Blanding's Turtle is listed as a Threatened species in Minnesota due to several stressors that impact life stages from egg to adult. It is widespread with vouchered records from over 50 of Minnesota's 87 counties, though it is rarely common. Over 2,500 Blanding's Turtle records are in Minnesota's Natural Heritage Information System, although many records consist of turtles found DOR, acknowledging one of the major threats to the species (road mortality). This species is adaptable, utilizing rivers, streams and adjacent wetlands in Minnesota's three major ecoregions (Prairie Parkland, Broadleaf Forest, and Laurentian Mixed Forest). Threats to Blanding's Turtle populations occur throughout the state, however differences in land-uses result in somewhat unique conservation challenges in each ecoregion. Several targeted efforts have increased our knowledge of the distribution, abundance, and habitat use of this species in Minnesota. Examples include sighting requests, surveys, and focused research projects. Blanding's Turtle population ranking, threats, and management efforts within the three ecoregions will be presented.

Conserving Blanding's Turtles in Nova Scotia: The Evolution of Evidence-based Stewardship

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In Nova Scotia Blanding's turtles occur as a structured population complex at the northeastern limit of the species range, with at least 3 genetically distinguishable units. Our evolving understanding of distribution, nesting, recruitment, movements and population structure has been primarily powered by a student and volunteer engine. That same engine is at the heart of the recovery effort, which has engaged students, volunteers, landowners, educators, First Nations, ENGO's and government in developing and executing monitoring protocols, assisting in data management and recovery planning, and most recently discovering a fourth population in the province. Standardized protocols and data processing ensure that high quality data are shared among members of the team, facilitating analysis and allowing volunteers to see how the results of their work tie into a larger context for this long-lived species. Stewardship efforts have employed an iterative, evidence-based approach, which tries to match ecological and management scales to identify solutions that are both biologically effective and socially sensible.

Edge of the Range: Conservation Efforts for Blanding's Turtles in Northern New York

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Populations of the New York State Threatened Blanding's turtle (*Emydoidea blandingii*) were investigated at multiple locations in St. Lawrence and Jefferson counties in northern New York over the period 1999-2016. Although disjunct populations occur elsewhere in New York and in

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New England and eastern Canada, this region represents the edge of the contiguous range of this semi-aquatic specialist of scrub/shrub wetlands. Here we summarize initial attempts to understand the fine-scale regional distribution, identify hotspots of movements among wetlands and between wetlands and upland nesting habitat in relation to roads, as well as to estimate population density at several key occupied sites. Results of these efforts were used to inform the nascent draft New York State Recovery Plan and identify and guide potential site-specific conservation activity across the region. Finally, we describe and summarize our initial findings of these efforts. Warning signs and installation of barriers and culverts were used in several locations that were hotspots of road crossing to potentially mitigate adult mortality with mixed results. Road signs did not significantly reduce driver speed or reduce mortality however they may have value as long-term public outreach. Ecopassages and barriers may not be effective for a species such as Blanding's turtles that can wander widely across the landscape. Nest site creation with careful site selection has potential to not only reduce road mortality, but can increase nest success in some agricultural landscapes where cultivated fields may act as ecological traps. Nest protection can be very effective in increasing nest success. However, installation of individual nest predator guards can be labor intensive. We are beginning the evaluation of electric fencing around known nesting areas and report some preliminary results.

Regional Coordination for Wood Turtles in the Northeastern States

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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. 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, which found evidence of widespread decline and a lack of effective regulation to protect habitat and curtail poaching. A subset of eight NE states and partners from adjacent states are in the final year of a Competitive SWG-funded effort to develop a Conservation Plan; the Plan should be complete by June 2017, and it will include a Conservation Area Network of prioritizes for conservation and management. The Wood Turtle Working Group is co-hosting (with the Blanding's Turtle Working Group, NHFG, MassWildlife, ATO, and the USFWS) this conservation symposium in October 2016, held at the Massachusetts Division of Fisheries and Wildlife. 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 populations from Maine to Virginia/West Virginia. The CAN is based on a hydrologic unit code (HUC)-based stratification, habitat suitability models, empirical survey results and population estimates, and evidence of population structure. 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 governance body (Northeast Wood Turtle Working Group or "Wood Turtle Council").

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Standardized Wood Turtle Population Assessments in the Northeastern United States

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Thirteen northeastern state agencies and partners collaborated to develop a flexible survey protocol designed to: 1) work in a variety of habitat conditions; 2) fit easily within existing research programs; and 3) use nested sampling periods for multiple levels of assessment. The standard spatial sampling unit is one kilometer of stream and adjacent riparian habitats. This segment is surveyed by one or more experienced observers in one hour. A “lead” observer is designated for each survey regardless of total number of observers. Three surveys are undertaken in a single season (spring and/or autumn). Air and water temperature and weather observations were recorded. Surveys were conducted at a network of survey sites across the Northeast Region, and sites were designated either Long-Term Reference (LTR) or Rapid Assessment (RA) sites. We added a random site selection component by surveying sites randomly selected from the output of a model of potentially suitable habitat. During the Status Assessment from 2012-2013, 825 surveys (383 in the spring, 71 during nesting, and 371 in the fall) were conducted on 196 stream segments. Each stream segment was surveyed between 1 and 15 times (mean=4.2), and a total of 1,567 wood turtle sightings occurred on 73 of 96 streams (with segments on the same stream pooled). Fewer than half of the surveys (43.9%) yielded no turtles, and the average survey yielded 1.9 turtles (sd=3.17), 1.33 (sd=2.03) of those were seen by the lead observer. Using zero inflated poisson mixture models, the individual probability of detection was estimated to be 0.06 when evaluating all sites with three or more surveys and 0.07 when evaluating only spring surveys, and site abundance decreased significantly with impervious surface cover at 3 km around the site. The total abundance across all 78 sites sampled at least three times in the spring was estimated to be 1461 (95% CI=1003–2074), though this may be an underestimate of the total number of turtles present in a given year, based on total captures and results from capture-mark-recapture models. Total survey success improved with number of observers, as expected. Survey success varied by observer, and surveys conducted by experienced surveyors yielded significantly more turtles. Survey success was significantly higher when air temperature increased rapidly from the starting temperature during a survey (i.e., cool starting temperature and warm ending temperature). Spring surveys produced significantly more turtles (about twice the detection rate) than fall surveys, though fall surveys were still effective at detecting turtles. Surveys conducted at air temperatures less than 12 °C were rarely productive. Estimates of adult and subadult population size from CMR estimates at long-term 17 sites ranged from 6.4 to 198.4 turtles / km (mean=66 turtles for open population models and 63 for closed population models). Average survey results were significantly correlated with CMR population estimates and explained 66% of the variation, suggesting that for sites with at least nine surveys, average survey returns are a good indicator population size. CMR models indicated that detection rate per survey for individual turtles averages 0.03, less than that estimated with the mixture models, suggesting regional population sizes for the mixture models may be an underestimate. This framework is currently the basis for ongoing population assessment across the Northeast region.

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Range-wide Mitochondrial and Nuclear DNA Sequence Analysis of Blanding's Turtle (*Emys blandingii*)

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Disentangling genetic lineages in Blanding's Turtle (*Emys blandingii*) is a challenge due to the species' current distribution in formerly glaciated regions and its status as threatened and endangered throughout most of its range. In addition to an apparent signature of range expansion, previous studies using microsatellite markers have suggested that there is population structure between eastern and western populations, and also within these regions. To date there has been no range-wide analysis of the species using mitochondrial and nuclear DNA sequences. We analyzed variation in two mitochondrial (1706 bp from control region and cytochrome B) and three nuclear loci (1638 bp in AMY1A, NB10005, and NB17367) from up to 68 turtles sampled at 32 localities. Nine mitochondrial and 23 nuclear haplotypes were recovered, but nucleotide and haplotype diversities were low relative to its congeners, *E. orbicularis* and *E. marmorata*. Haplotypes were widely distributed across the geographic range with no structure found west of the Appalachians. Demographic analyses based on coalescent theory were consistent with the hypothesis of post-glacial range expansion. Although slow rates of molecular evolution are an important consideration in detecting lineages within turtle species, recent range expansion and shallow diversification across the geographic range is suggested by this analysis.

Collaborating to Conserve Wildlife in the Northeast United States

John Kanter, NH Fish and Game Department on behalf of the Northeast Wildlife Diversity Technical Committee and Terwilliger Consulting Inc.

Fish and wildlife agencies in the Northeast United States (the Virginias north to Maine) have worked together as the Northeast Association of Fish & Wildlife Agencies (NEAFWA) for more than fifty years to protect and conserve the region's vulnerable fish, wildlife and habitats. NEAFWA's Fish and Wildlife Diversity Technical Committee and its key partners have created a regional conservation planning framework enabling the systematic development of common terrestrial and aquatic habitat classifications, identification of Regional Species of Greatest Conservation Need, integrated monitoring framework for species and their habitats, and regional assessments of species and habitat condition. Key Regional Species of Greatest Conservation Need conservation efforts (i.e. New England cottontail and Blanding's turtle) highlight how the states are applying this regional conservation planning framework across state lines to preempt federal listing and develop on the ground conservation

Blanding's Turtle Recovery in the Future Rouge National Urban Park, Toronto, Ontario

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Blanding's turtles (*Emydoidea blandingii*) are a globally threatened species at risk of extinction in many parts of their historic Canadian range. Blanding's turtle populations once thrived in the

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Greater Toronto Area's Rouge Valley but they have suffered declines over the past four decades due to a variety of threats. Since 2005, Blanding's turtles have been monitored in the Rouge Valley by Toronto Zoo's Adopt-A-Pond Programme. Important ecological data has been collected and analyzed to determine suitable habitat for the species. Using this information, Toronto Zoo, in partnership with Rouge National Urban Park (RNUP) and the Toronto and Region Conservation Authority, has initiated a headstarting program for the species. A population viability assessment was conducted in 2013 and indicated that 40 headstart hatchlings with a 60% female-to-male ratio will be required for release every year for 20 years to reach a stable target of 150 adults with at least 12 breeding pairs. In partnership with Ontario Ministry of Natural Resources and Forestry, eggs are collected from at-risk nest sites and transferred to the Toronto Zoo for incubation. Hatchling turtles are reared in a secure zoo environment for just under two years until they reach a critical size where they are less likely to be consumed by predators. These juvenile turtles are released into restored wetland areas in the wilds of RNUP and monitored by zoo staff and University of Toronto Scarborough researchers to track their survival, movements and habitat use. In 2014 the first group of 10 headstart turtles was released. In 2015 21 headstart turtles were released. In 2016 36 headstart turtles were released. We plan to release 50 per year from 2017 onwards. In addition to raising and releasing turtles for the recovery of populations across a diverse and complex landscape, this program is also about public engagement and habitat restoration to ensure the sustainability of populations into the future. We will continue to restore wetland habitat for turtles creating new wetlands, turtle nesting sites, basking habitats and safe hibernation zones. Toronto Zoo works with all of our partners and several local community groups to lead shoreline clean up events, wetland hikes, turtle conservation events, landowner stewardship workshops and appreciation days for volunteers who contribute to citizen science projects in RNUP and across Canada.

Highlights from Monitoring the Blanding's Turtle at Three Rivers Park District, Minnesota

Madeleine Linck, Natural Resources Technician, Retired

Three Rivers Park District is a natural-resources based park district covering 27,000 acres of parkland within the 7-county Minneapolis metro area. The District includes 7 Park Reserves where an 80/20 policy allows only 20% be developed. The remaining 80% is managed to protect natural resources and restore wildlife habitat. From 1992-2015, 146 Blanding's Turtles from 3 Park Reserves (ranging from 2,397 - 5,300 acres) were captured and marked. Radio telemetry was begun in 1993 to identify habitat use and protect nests. Size, sex, capture/recapture and nesting activity data has been compiled. In 2004, supported by a SWG grant, 36 turtles were tracked in one season. Volunteers and Park neighbors have been valuable in finding and observing turtles. While many turtles moved several miles during a year, often faithful to overwintering, basking, and nesting sites, two individuals moved > 10 miles. Also, in 2001, a female found nesting along a high-traffic road was relocated twice approximately 1 mile away into excellent nesting habitat within a park reserve. Both times she returned to her exact digging location within 2 days. Despite the large acreage, turtles routinely leave the park reserves, crossing roads to private property. Public education about turtles on roads is done through road signage and press releases, although loss to road mortality continues. Males generally measured at greater carapace lengths (270–275 mm, 9 individuals) than females. Nesting locations and clutch size are known for a number of females that have been followed for 10-15 years. One female with 11 known nestings, always in the same location, produced the largest known clutch, 26 eggs. It was not unusual for marked turtles to turn up after an interval of 10-12 years, suggesting good adult survival within the park reserves. Documenting recruitment after years of nest protection and the release of 725 hatchlings incubated from eggs salvaged from roads (1994-2005) has been challenging, but some subadults

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have been caught. Smaller projects included headstarting and radio tracking hatchlings. In 2005–2006, 33 hatchlings were headstarted and released. The hatchlings were raised to ~ size of 3-year old turtles. Seven were fitted with transmitters, but were found predated or disappeared. One non-radioed headstart was found healthy 4 years later. Fourteen hatchlings from field nests were fitted with transmitters. Seven tracked to terrestrial overwintering sites were caged until the following April. Two were confirmed alive despite minimal snow cover.

Blanding's Turtle Status in the Midwest

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The majority of the Blanding's Turtle's range occurs in the Midwest, with occurrences documented in 10 states. A species ranking matrix developed by The Midwest Regional Working Group of PARC (Partners in Amphibian and Reptile Conservation) placed the Blanding's Turtle in the top tier of the 164 Midwestern amphibian and reptile species based on regional responsibility and concern. A survey of Midwestern states was conducted in 2010 to coincide with a MWPARC conference focused on Blanding's Turtle conservation. Completed surveys were received from all 10 states and included information on the historic and current status, threats, population monitoring and research, and conservation and management. Eight of the 10 states reported declines of 8% - 100% in the number of extant populations. The most commonly cited threats included habitat destruction, predation (especially of nests), inadequate nesting areas, and road mortality. Most states are monitoring only a few populations and with varying intensity. Research has mostly focused on natural history, ecology, and collecting occurrence records. The most commonly cited conservation needs included habitat management and restoration and surveys and monitoring. A summary of the survey is available at the MWPARC website: <http://mwparc.org/products/blandings/>

Blanding's Turtle Coordination in the Northeast

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The Northeast Blanding's Turtle Working Group has been working since 2004 to conserve the Blanding's Turtle (*Emydoidea blandingii*) throughout its range in the Northeast Region. The group initially collaborated on the development of a regional status assessment, completed in 2007 (Compton 2007). Representatives of wildlife agencies, universities, and NGOs, and individual researchers from five northeastern states, with funds from the U.S. Fish and Wildlife Service Competitive State Wildlife Program, in 2011 began a comprehensive planning process and long-term standardized monitoring effort to assess distribution, prioritize sites, evaluate genetic structure and diversity, and develop a baseline to evaluate change over time and assess the effectiveness of conservation actions. We developed site specific management plans for the highest priority sites in the region, and have reached out to land managing agencies, organizations, landowners, and interested individuals for feedback and to begin to implement the conservation

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strategy. The Working Group was recently awarded a Competitive State Wildlife Grant to continue implementation of the regional conservation plan from 2017-2019. This regional, collaborative effort has served as a model for a parallel wood turtle (*Glyptemys insculpta*) effort (Jones et al. 2014), and could serve as a model for other rare reptile and amphibian species in the Northeast region. We will give a brief overview of the Northeast Blanding's Turtle Conservation Plan, describe the process and lessons learned, and outline our implementation framework and future directions.

Conservation and Management of Blanding's Turtle in Dutchess County, NY

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Dutchess County currently accounts for 44 of the New York State's 69 element occurrence records for Blanding's turtle (*Emydoidea blandingii*). While still harboring this state listed threatened species, the county continues to experience land use change pushed by commercial and residential development, infrastructure improvements, and utility projects. The Department of Environmental Conservation's (the Department's) current predominant role in conservation and management of this species in Dutchess County is through the use of the State's Environmental Conservation Laws and associated regulations protecting endangered and threatened species and their habitats from take. These regulations come into play during the review of the Department's jurisdictions and issuance of discretionary permits. While this is not a comprehensive way to manage all impacts to the species, nonetheless, many projects have been required to implement both habitat and species take avoidance measures through the project review process. The Department recently undertook a project to evaluate how well permanent take avoidance and mitigation measures have worked for Blanding's turtle. The case study focused on a town in central Dutchess County with a well-studied population of Blanding's turtles, and a number of recent and old development projects that have been required to implement various mitigation measures to avoid impacts to the species. The initial results point to mixed effectiveness of the required measures based on the design, maintenance, follow up, and initial requirements agreed upon through the project review process. The results of this investigation will be used to improve the project review process and take avoidance and mitigation measures used in future projects. In addition to the Department's role, New York State Parks, Hudsonia, Arlington High School, Wetlands Trust, and other private researchers have continued to conduct research and habitat management at key sites in Dutchess County adding to the overall understanding of the Blanding's turtle populations and have been instrumental in maintaining and improving the species' habitats in this area. The Department and this group of cooperators attempts to meet annually to discuss issues related conservation and management of the species.

Wood Turtle Mass Mortalities in New Brunswick, Canada

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High mortality of Wood Turtles has been reported on three New Brunswick rivers since 2011. The most thoroughly investigated case has been the events at 5th Canadian Division Support Base Gagetown, where 14 dead wood turtles (*Glyptemys insculpta*) were found in an area of approximately one square kilometer of live fire training. All turtles were found with shells intact on their backs on training roads. A few of the specimens were suitable for necropsy, which

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rendered no definitive explanation. In investigation we have considered; training schedules, munition composition, munition use patterns, concussion, contamination, toxicology, herbicide (chemical make-up and use), mechanical brush cutting, prescribed fire, wildfires, overwintering mortality, extreme weather events, and predation. To date we have identified 48 dead wood turtles from this one area and attribute this death to predation by ravens. The shells were all collected and are held at NB Museum. In 2014 in a separate watershed, off of DND property, it was reported that there had been 30 dead wood turtles over a three-year time span. This includes two sites roughly one kilometer apart; the bank of the watercourse and along a forestry road. In 2015 in a third watershed approximately 15 dead wood turtles were reported near two salmon pools in close proximity to each other. Further investigation in 2016 yields an additional 12 carcasses at this site. The three sites are approximately 100 kilometers apart with differing levels of information and investigation effort for each site; the limited information available is not inconsistent with evidence of predation. There are approximately 110 dead wood turtles cumulatively from the three known locations.

Conservation of a Wood Turtle *Glyptemys insculpta* Population Over 46 Years in Northern Michigan: Assessment of Population Augmentation

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In 1969 a study was established to evaluate the demography, spatial distribution, and overall population viability in a northern Michigan population of *Glyptemys insculpta*. During the duration of this study (and particularly the late 1980s- early 1990s) the population was significantly reduced by poaching, presumably for the illegal pet trade. Substantial and increasing nest and direct mortality from over-populated raccoons, and perhaps other subsidized meso-predators, have exacerbated the turtle's decline and prevented any potential recovery. Efforts began in the mid-1990s to test the possibility of augmenting recruitment through artificial incubation of eggs for immediate hatchling release, and by headstarting of young for one season prior to release. We will discuss detection and overall comments on what has been learned over 46 years of observations, along with practical conservation recommendations to help conserve this declining species.

Using PVA to Model Conservation Actions for Blanding's Turtles in New York

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The Blanding's turtle (*Emydoidea blandingii*) is threatened in New York, with four disjunct populations occurring in the state: northern New York (NNY), Saratoga County, Dutchess County, and western New York (WNY). We conducted a population viability analysis (PVA) and sensitivity testing to identify and prioritize conservation actions and research priorities for the species in the NNY, Dutchess, and Saratoga populations to guide recovery of the species. As a result, we drafted a recovery plan for the species in the state. Populations were sensitive to hatchling survivorship, mortality from roads, and headstarting at regular intervals. Through this effort, we determined that a reduction in road mortality of 20%, the addition of 5 nest guards per year, and the headstarting of 20 individuals every 10 years will allow the NNY and Dutchess population to remain extant over the next 300 years with 95% confidence. We determined that a 10% reduction of juvenile mortality, protection of 10% of nests, and headstarting 10 young female

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turtles at 10-year intervals will permit the Saratoga population to remain extant over the same time frame. Work has begun to manage for nest predation and to protect nests. Nesting areas have been created in opportune areas to reduce mortality of adult females crossing roads to nest.

Conservation Genetics of the Wood Turtle

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The Conservation Genetics portion of the Northeast Competitive State Wildlife Grant conservation planning project is examining over 1,000 tissue samples collected from Wood Turtles (*Glyptemys insculpata*) across 13 eastern states to provide analyses to support conservation planning efforts. Additionally, the project will include samples collected in coordination with the US Forest Service from the Midwestern states expanding the analysis to include most of the current range of this species. Seventeen microsatellite markers will be used to examine genetic diversity, population differentiation, gene flow, landscape connectivity and population assignments of confiscated turtles from illegal trade. Tissue collected includes blood, tail tips, shell shavings and toe nails. Blood resulted in the highest proportion of samples with scored data. Data from 400 individuals from 25 sites have statistically significant allele frequencies except for a few site pairs in the Potomac Basin. Genetic diversity and population differentiation (heterozygosity, allelic richness and F_{ST}) were similar to other published studies for this species.

Blanding's Turtle Land Protection and Habitat Management Strategy for the Agricultural Conservation Easement Program (ACEP) Wetland Reserve Easements (WRE)

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The Northeast Blanding's Turtle Working Group compiled many years of field survey data to develop Blanding's Turtle Habitat Focal Areas. These areas provide a basis for prioritizing conservation easement acquisition and conservation planning for the species. The purpose of ACEP-WRE is to restore, protect and enhance wetlands and wildlife habitat on eligible lands. ACEP-WRE policy states that riparian areas along streams or other waterways are eligible, provided that the offered riparian area directly links wetlands less than 1 mile apart and that those wetlands are currently protected or will be protected under the same ACEP-WRE easement transaction. Riparian areas are considered to be a part of the eligible acres to which additional adjacent lands may be added. Adjacent lands are primarily upland buffer areas that contribute significantly to the wetland functions and values and overall wetland protection, restoration and enhancement objectives of the program. USDA-NRCS in NH prioritize Riparian Areas for enrollment into ACEP-WRE through ranking criteria. Lands offered for enrollment that fall within the Blanding's Turtle Focal Areas are prioritized for ACEP-WRE funding using the following FY2016 ranking considerations: 1) Direct riparian connection to protected lands; 2) Occurrences of either State or Federally listed endangered, threatened, species of concern or monitored species; 3) Habitat restoration measures are identified for endangered, threatened, or at-risk species; 4) Being located within the Blanding's Turtle Focal Area and 5) Located directly adjacent to an existing WRP or ACEP-WRE easement. Once enrolled, NH WRE lands enrolled for Blanding's Turtle within habitat areas are restored and managed using restoration measures such as Early Successional Habitat Management (NRCS Practice Code 647) for nesting habitat management, Conservation Cover (NRCS Practice Code 327) - establishment of warm season grasses and sweet fern (*Comptonia* sp.), and Access Control (NRCS Practice Code 472). *Possible next steps to further protection and recovery includes* increasing outreach to landowners for land protection

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within turtle habitat focal areas in order to improve travel corridors and riparian connectivity. Strengthening partnerships between State and Federal agencies, NGO's, and private landowners is also needed to address challenging issues such as correcting "problem" roads with stream crossing improvements or access control measures. Also increased trapping of turtle predators within turtle habitat focus areas could be considered as a means to improve turtle populations.

Twenty One Years Of Head-starting Efforts in DuPage County, Illinois

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In response to declining Blanding's turtle populations the Forest Preserve District of DuPage County initiated a head-starting program in 1996. Over the past twenty-one years of hatching and rearing the District has released over 2,800 turtles. Hatching success has improved over time as we continually learn and improve our techniques. Time is a significant factor to see results for a long lived species. 2014 was a significant year for our program, three of our head-started turtles were gravid and produced a third generation. Each subsequent trapping year has yielded more adult head-start turtles as well as juvenile capture numbers. Partnerships are key when undertaking such a large recovery effort, this effort has been greatly enhanced and able to accomplish much more through strong partnerships.

Recovery and Habitat Management for Wood Turtles (*Glyptemys insculpta*) in an Agricultural Landscape

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The available habitat for Wood Turtles (*Glyptemys insculpta*) is declining throughout most of its range in Canada. In a primarily agricultural landscape in southern Ontario, Wood Turtles face several threats including poaching, habitat loss, unsustainable farming practices and direct mortality by farm equipment, and predation by subsidized predators. A mass poaching event in the mid-1990s, where approximately 70% of the population was removed, prompted a recovery effort to prevent the extirpation of this southern Ontario population. We conducted head-starting (the collection and incubation of eggs and rearing of young in captivity) to attempt to restore and maintain a viable, self-sustaining population. To ensure that the local Wood Turtle population could continue to reproduce in the wild, several habitat management projects were undertaken to expand or enhance Wood Turtle habitat. Artificial nest sites were installed to increase the number of suitable nesting locations, and increase the likelihood of recovering the eggs. Nesting habitat was improved by clearing vegetation from suitable sites and installing electrified fencing to deter predators. Clutches have been collected from 7 of 24 artificial nest sites. Over 13 years, 480 turtles have been head-started and released into their maternal streams. Population estimates indicate that the wild population is declining, and the head-started turtles are more abundant than wild turtles. Change in land ownership has resulted in additional pressure on Wood Turtle habitat, and the destruction of some habitat improvement projects. Maintaining strong landowner relationships and a strong field presence, promoting stewardship, and raising awareness of threats to reptiles are crucial tools for mitigating threats to Wood Turtles in a primarily agricultural landscape.

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A Coordinated Regional Monitoring Strategy for Blanding's Turtle in the Northeastern U.S.

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To quantify the current status of Blanding's turtles at multiple scales and to direct conservation planning efforts, we developed and implemented a standardized monitoring protocol and coordinated monitoring strategy for Blanding's turtle (*Emydoidea blandingii*) populations throughout the Northeast Region. Goals of the strategy were to 1.) establish a present-day baseline of Blanding's turtles distribution and abundance in the Northeast that could be used to track change over time; 2.) rank and prioritize sites for conservation action and site-specific management plans; and 3.) evaluate the influence of habitat and landscape characteristics on population size and structure. The monitoring strategy has two, nested tiers: 1.) a network of long-term (LT) reference sites that were intensively sampled using 20 traps for least 36 nights to provide site-specific density estimates using open, closed, or spatially explicit mark-recapture population models; and 2.) a network of rapid assessment (RA) sites that were analyzed using mixture models. Rapid assessment sites were sampled using either: a series of three, standardized visual surveys (VRA), or a four-night trapping event (TRA) using 20 traps. Across the Northeast Region in 2012 and 2013, we sampled a total of 156 sites: 13 LT intensive sites, 71 TRA sites, 22 VRA sites, 22 sites using both methodologies, and 28 randomly selected plots. At these sites, we visually surveyed a total of 1,345 vantages and deployed a total of 2,938 traps over 20,342 trap nights. This resulted in visual observations of 378 Blanding's turtles, 89 spotted turtles, and 8,067 painted turtles and trap captures (including recaptures) of 1,178 Blanding's turtles, 9,162 painted turtles, 1,585 snapping turtles, and 110 spotted turtles. Of the 10,171 times traps were checked, Blanding's turtles were only caught 7.4% of the time, and the highest yielding trap caught nine Blanding's turtles at one time. We evaluated how relative trap success varied throughout the season, under different weather conditions, after various lengths of trap deployment, and using traps of various sizes. We also evaluated at effects of landscape characteristics (wetland abundance and diversity and anthropogenic disturbance) on trap success. Results were used to build GLMMs to help prioritize sites for conservation in the 2014 Northeast Blanding's Turtle Conservation Plan. The monitoring program will continue to be utilized across the region to evaluate the change in occupancy and abundance across the region and to assess demographic change and the effectiveness of conservation actions at priority sites.

Restoring a Regionally Significant Blanding's Turtle Population In Eastern Massachusetts

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The Great Meadows population of Blanding's turtle (*Emydoidea blandingii*) was studied by others in the 1970's to early 1980's. By 2003, when we began to study this population, the number of

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adult Blanding's turtles at Great Meadows had declined from its 1973 estimate of 115 by more than 55% to a current adult population of about 50. Contrary to initial expectations, given the urbanized surrounding of Great Meadows NWR, we have learned that adult survival rates are very high, with a mean annual survival probability of 0.965 with still higher survival rates among relatively young adults. We also discovered that the age distribution was highly skewed to older individuals with few juveniles and younger adults. To aid in the restoration of the Great Meadows Blanding's turtle population, we have helped greatly boost egg and juvenile survival rates by screening nests and headstarting up to 70 hatchlings annually for a period of 9 months. Radiotelemetry of 86 headstarted turtles for up to 5+ years post release demonstrated very high annual survival rates of 0.86 for the first year post-release and 0.97 for the second year post-release. We estimate that at least 170 of the 314 headstarted turtles that we have released since 2008 are likely to live to 17 years of age. Additionally, we have sought out clues to the underlying causes of past low recruitment rates. Together with USFWS and MDFW, we are experimenting with methods to enhance aquatic habitat quality for young Blanding's turtles by planting patches of wetland shrubs and we are working to improve and manage a nesting area. Far from detracting from efforts to identify and remedy underlying causes of population decline, our headstarting efforts, most of which we have carried out in schools and have involved thousands of school children to date, have helped us build a strong local constituency to support Blanding's turtle conservation locally. Local residents welcome Blanding's turtles nesting in their yards, report sightings, and have helped us in efforts to restore both nesting and aquatic habitat.

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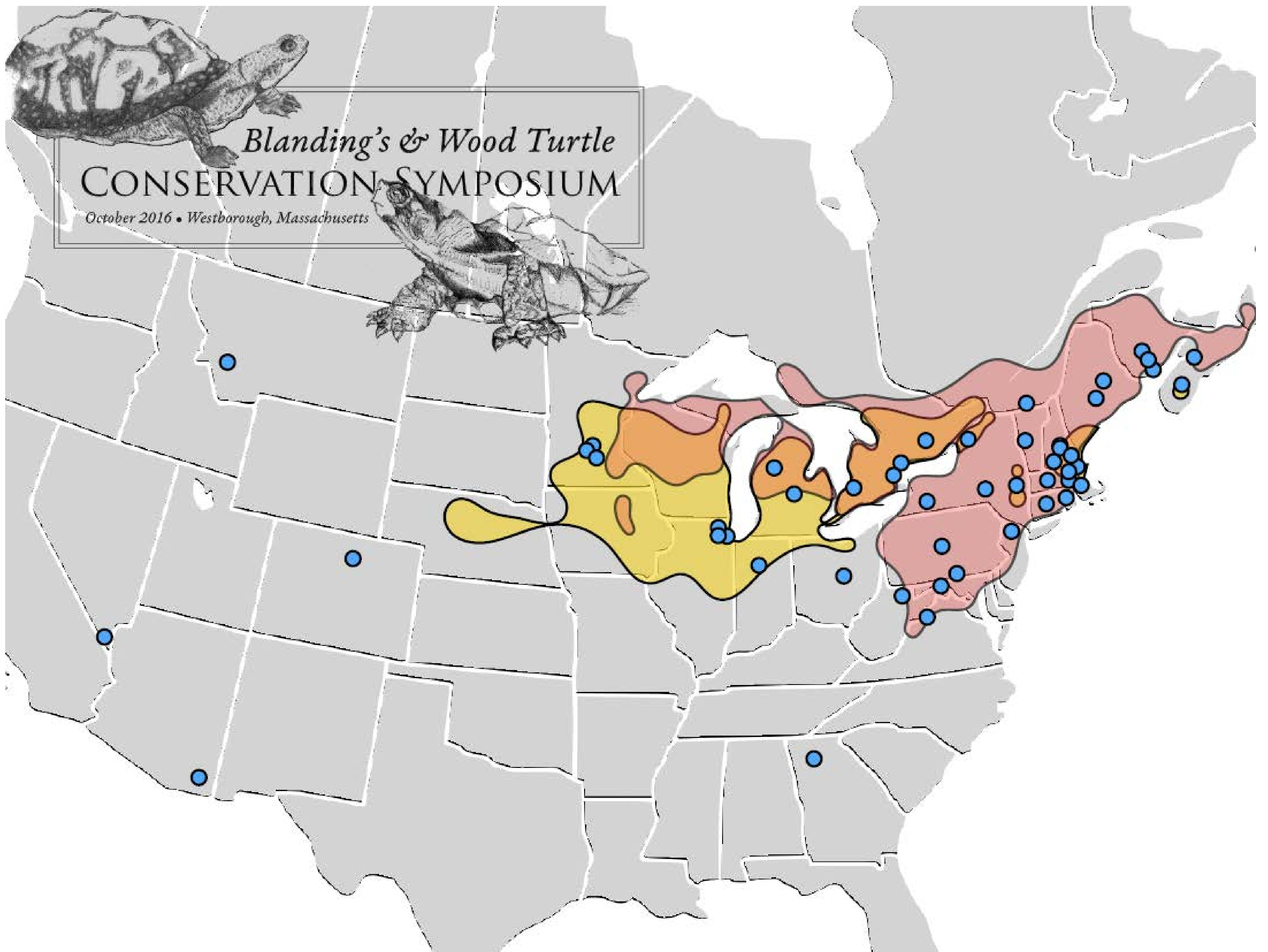
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Approximate range of Blanding's turtle is shown in yellow; the range of the wood turtle is shown in red. Symposium participants (represented by blue dots) represented 19 states and four provinces.

Participants



