

# **BLANDING'S TURTLE BIOLOGY, CONSERVATION & MANAGEMENT**



**13-15 August 2010**

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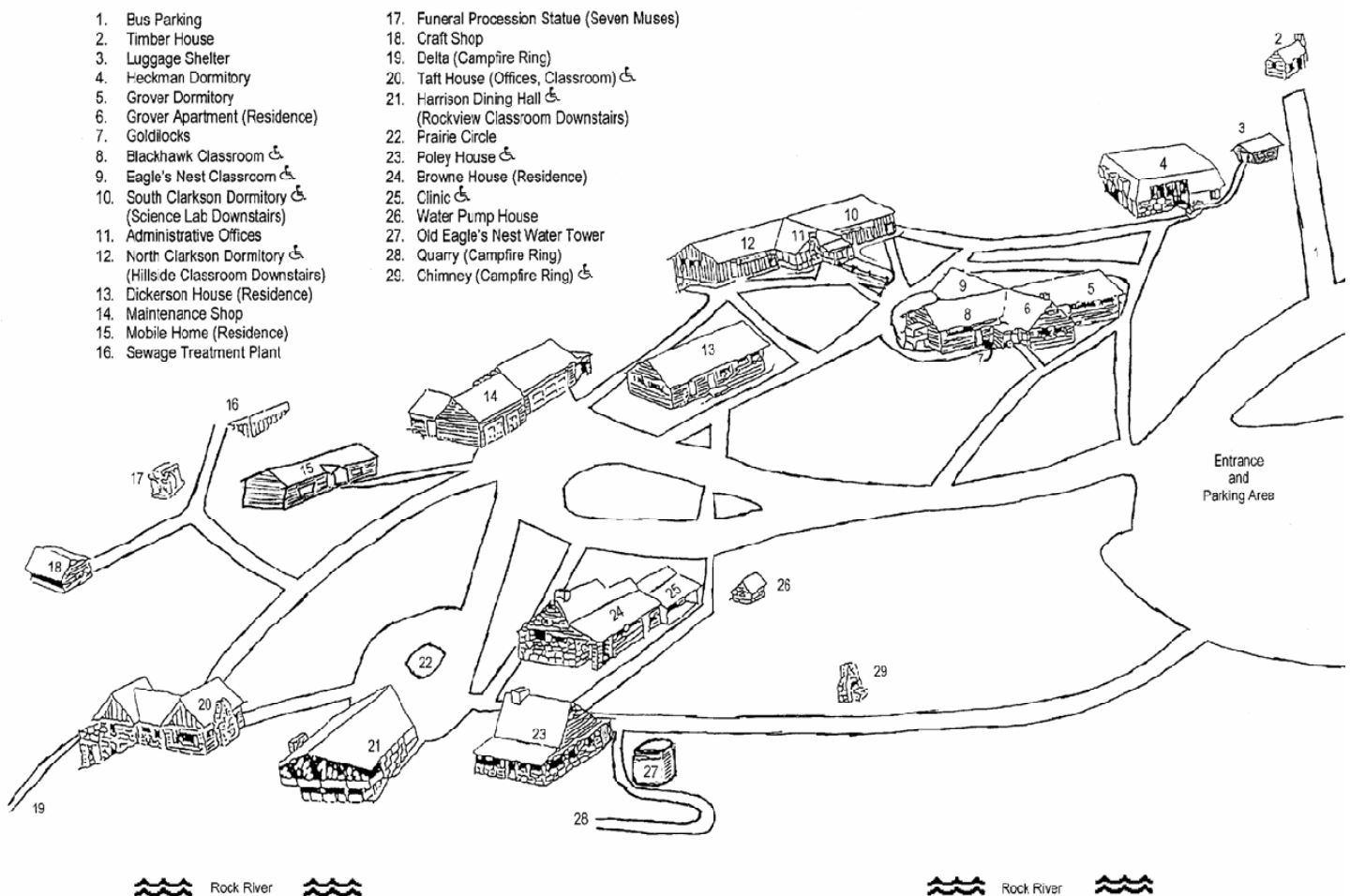
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**Partners in Amphibian and Reptile Conservation (PARC)** is an inclusive partnership dedicated to the conservation of herpetofauna--reptiles and amphibians--and their habitats. Our membership comes from all walks of life and includes individuals from state and federal agencies, conservation organizations, museums, pet trade industry, nature centers, zoos, energy industry, universities, herpetological organizations, research laboratories, forest industries, and environmental consultants.

**Midwest Partners in Amphibian and Reptile Conservation (MWPARC)** is a regional working group of Partners in Amphibian and Reptile Conservation (PARC). Both the regional group (MWPARC) and national group (PARC) are dedicated to the conservation of native herpetofauna (reptiles and amphibians) and their habitats. The Midwest region includes: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. MWPARC is managed by two co-chair positions, each serving a two-year term. The current co-chairs are Kent Bekker and Karen Kinkead. MWPARC also has an advisory board and task teams to address issues important to PARC and amphibian and reptile conservation in the Midwest. The advisory board assists co-chairs with strategic planning and communicating with working groups. The advisory board is composed of members representing the various partners (state and federal agencies, academia, and other organizations). The current advisory board members are: Jeff Briggler (Missouri Department of Conservation), Bob Brodman (Saint Joseph's College, IN), Gary Casper (University of Wisconsin-Milwaukee Field Station), Jason Daniels (US Environmental Protection Agency), Rich King (Northern Illinois University), Bruce Kingsbury (Indiana University-Purdue University Fort Wayne), Greg Lipps (Gregory Lipps LLC), David Mifsud (Herpetological Resource and Management, LLC), Steve Mullin (Eastern Illinois University), Mike Redmer (US Fish & Wildlife Service), Marcy Sieggreen (Detroit Zoological Society), Kristin Stanford (OSU's Stone Laboratory and Northern Illinois University).





# BLANDING'S TURTLE BIOLOGY, CONSERVATION & MANAGEMENT

Northern Illinois University Lorado Taft Field Campus  
13-15 August 2010

## Friday, 13 August

		Location
12:00 pm	Check-in (field trip participants)	Poley House
1:00 pm	Field trip participants depart for Richardson Wildlife Foundation/Nachusa Grasslands	Entrance & Parking Area
5:00 pm	Check-in	Poley House
6:00 pm	Dinner (buffet style)	Harrison Dining Hall
7:30 pm	Opening Reception	Poley House/Campfire Ring

## Saturday, 14 August

7:30 am	Breakfast (buffet style)	Harrison Dining Hall
8:30 am	Morning Session – Kent Bekker, moderator <b>Welcome and Introductions</b> – Rich King <b>Election of Co-chair and Advisory Board Members</b> – Kent Bekker	Poley House
8:50 am	Dan Thompson and R. Augustine: <b>"Fifteen years of Blanding's Turtle (Emydoidea blandingii) Head-starting in DuPage County, IL"</b>	Poley House
9:10 am	James Spetz and R. Spence: <b>"Investigation of Blanding's Turtle Ecology in Ohio and Results of Captive Head-start Efforts at the Cleveland Metroparks"</b>	Poley House
9:30 am	David Mifsud and S. Kahl: <b>"Head-starting Blanding's Turtles: Stabilizing Populations Impacted by Subsidized Predation, Road Mortality and Subsequent Population Decline"</b>	Poley House
9:50 am	Steve Harvey: <b>"When Habitat Management Isn't Enough: Raccoon Management on a Turtle Nesting Beach"</b>	Poley House
10:10 am	Break/Silent Auction Bidding	Rockview Classroom
10:30 am	Arun Sethuraman, R. Paitz, J. Christiansen, T. VanDeWalle, A. LeClere, C. Chandler, S. McGaugh, E. Myers, J. Refsnider, J. Monson-Miller, S Hayden and F. Janzen: <b>"Population Genetics and Phylogeographic History of Emydoidea blandingii across the Midwestern states of Iowa, Illinois, Nebraska and Minnesota"</b>	Poley House
10:50 am	Jeanine Refsnider and M. Linck: <b>"Reproductive Ecology of Blanding's Turtles in Minnesota"</b>	Poley House
11:10 am	Madeleine Linck and N. Gillette: <b>"Overwintering Sites and Survival of Hatchling Emydoidea blandingii in Crow-Hassan Park Reserve in East Central Minnesota"</b>	Poley House
11:30 am	Whitney Banning, M. J. Dreslik, M.R. Douglas, N.K. Marioni and C.A. Phillips: <b>"Mating Systems and Determinants of Reproductive Success in Male Blanding's Turtles"</b>	Poley House
12:00 pm	Lunch (family style)	Harrison Dining Hall
1:00 pm	Poster Session/Silent Auction Bidding	Rockview Classroom
1:30 pm	Afternoon Session – Karen Kinkead, moderator	
1:30 pm	Lee Walston, K. LaGory and S. Najjar: <b>"Ecology and Conservation of Blanding's Turtles (Emydoidea blandingii) in Southern New Hampshire"</b>	Poley House
1:50 pm	Kent Bekker: <b>"Blanding's Turtles of the Oak Savannah Habitat of Northwest Ohio"</b>	Poley House
2:10 pm	Andrew Kuhns: <b>"Monitoring and Management of the Blanding's Turtle, Emydoidea blandingii, in Lake County, Illinois"</b>	Poley House

2:30 pm	Michael Pappas and J. Congdon: <b><i>“Conservation and management Concerns Related to Patterns of Nesting and Hatchling Orientation During Nest Dispersal of Emydoidea blandingii, Chelydra serpentina and Chrysemys picta belli”</i></b>	Poley House
2:50 pm	Jeffrey W. Lang: <b><i>“Blanding’s Turtles on the Valentine NWR in the Nebraska Sandhills: Ecology, Management, and Conservation of a Megapopulation”</i></b>	Poley House
3:10 pm	Break/Poster Session/Silent Auction Bidding - Rockview Classroom	Rockview Classroom
3:30 pm	Dan Ludwig: <b><i>“Steps towards a Blanding’s Turtle Recovery Plan in Illinois: Status Assessment and Management”</i></b>	Poley House
3:50 pm	Jennifer Anderson-Cruz: <b><i>“Natural Resources Conservation Service Blanding’s Turtle Conservation Efforts in Iowa”</i></b>	Poley House
4:10 pm	<b>Keynote Address</b> – Dr. Justin Congdon: <b><i>“Ecological and Demographic Issues Related to Conservation and Management of the Long-lived Blanding’s Turtle”</i></b> (with O.M. Kinney and R.D. Nagle)	Poley House
5:10 pm	Silent Auction Final Bidding (‘till 5:30) and Winners Announced – Kristin Stanford	Rockview Classroom
6:00 pm	Dinner (family style)	Harrison Dining Hall
7:30 pm	Ravenwood Films screening/Mixer	Poley House/Campfire Ring

### Sunday, 15 August

7:30 am	Breakfast (buffet style)	Harrison Dining Hall
8:30 am	<b>Introduction to morning session</b> – Greg Lipps, Moderator	Poley House
8:40 am	Karen Kinkead: <b><i>National PARC Update/Important Herp Areas – a National PARC Initiative</i></b>	Poley House
9:10 am	John Curnutt, USDA Forest Service Eastern Region: <b><i>Blanding’s Turtle Conservation Assessment: Process and Need for Contributions</i></b>	Poley House
9:30 am	Greg Lipps: <b><i>Synthesis of Blanding’s Turtle Status in MW PARC States</i></b>	Poley House
10:00 am	Laura Ragan: <b><i>Blanding’s Turtles: View from the USFWS</i></b>	Poley House
10:20 am	Breakout Sessions - Blanding’s Turtle Status Synthesis, Working Groups	Poley House
11:20 am	Working Group Reports/State Updates/Michigan PARC Report	Poley House
11:50 am	Announcement of Election Results/2011 Meeting –K. Bekker/K. Kinkead	Poley House
12:00 pm	Lunch	Harrison Dining Hall
1:00 pm	Field trip participants depart for Nachusa Grasslands/ Richardson Wildlife Foundation	Entrance & Parking Area

### Posters

Rockview Classroom

Jeffrey T. Behr: <b><i>“20 Plus Years’ Experience of Captive Blanding’s Turtle Breeding and Husbandry”</i></b>
Bob Brodman and Katy Greenwald: <b><i>“Conservation of the Taxonomically Challenged: How Should we Protect Unisexual Ambystoma Salamanders?”</i></b>
Bob Brodman and Matt Harmon: <b><i>“Do Frogs Believe in Climate Change?”</i></b>
Abel Castañeda and Mark A. Jordan: <b><i>“The Effects of Water and Habitat Quality on Amphibian Assemblages in Two Midwest Watersheds”</i></b>
Matt Farmer and Bruce A. Kingsbury: <b><i>“Copper-bellied Watersnakes: Coping in a Man’s World”</i></b>
Michael R. Frank, John H. Roe, and Bruce A. Kingsbury: <b><i>“If You Build It and They Don’t Come: Tools for the Repatriation of Extirpated Snake Populations”</i></b>
Peter C. Jones, Richard B. King and the Massasauga Radiotelemetry Group: <b><i>“Rangewide Analysis of Eastern Massasauga Rattlesnake Survivorship”</i></b>
Bruce A. Kingsbury: <b><i>“Spatial Ecology and Habitat Use of Blanding’s and Spotted Turtles in Indiana”</i></b>
Carrie Morjan and Kelly Huschart: <b><i>“Eastern Newt (Notophthalmus viridescens) Documented in Kane County, Illinois”</i></b>
Brendan N. Reid, M. Zachariah Peery and Richard P. Thiel: <b><i>Keeping Tabs on Turtles: Ongoing Mark-Recapture Studies of the Turtle Community at Sandhill Wildlife Area (Central Wisconsin)”</i></b>
Allison Sacerdote: <b><i>“Assessment of Amphibian Community Structure Following Flatwoods Wetland Habitat Restoration”</i></b>

**General Information:**

**Arrival/Departure Times** – Friday field trip participants should plan to arrive between 12 and 1:00 pm on Friday, August 13. Other attendees can check in after 5:00 pm on Friday, August 13. Dormitory rooms must be vacated by 9:00 am on Sunday, August 15.

**Meals** – Dinner on Friday, August 13 will be served buffet style from 6:00 – 7:00 pm, buffet style; breakfast on Saturday, August 14 and Sunday August 15 will be served buffet style from 7:30 – 8:30 am. Lunch on August 14 and August 15 and dinner on August 14 will be served family style promptly at 12:00 pm (lunch) and 6:00 pm (dinner). This style of service requires a participant from each table to obtain food platters from a central counter and to clear the table at the end of the meal. It is important to be punctual for meals.

**Internet** – WiFi is NOT available at the Lorado Taft Field Campus. However, there are internet jacks in several locations – just bring your cable.

**Alcohol** – With adult groups such as ours, alcohol is permitted but only in meeting rooms. Under no circumstances are persons under 21 years of age permitted to consume or possess alcoholic beverages.

**Disabilities** – The dining hall, bathrooms, dormitory space, and most classrooms are accessible for individuals with physical disabilities. Many natural areas, however, are not.

**Hiking** – Several hiking trails are located on the Lorado Taft Field Campus (ca. 1 mi) and the adjacent Lowden State Park (ca. 4 mi).

**Field Trips:**

Optional field trips to Richardson Wildlife Foundation and Nachusa Grasslands will depart from the Lorado Taft Field Campus at 1 pm on Friday, August 13 and Sunday August 15. Coach and mini-bus transportation will be provided for Friday afternoon field trips. Personal vehicles will be used for Sunday afternoon field trips (carpooling is encouraged).

Richardson Wildlife Foundation is located at 2315 Shaw Road near West Brooklyn, IL. MapQuest directions from the Lorado Taft Field Campus to Richardson Wildlife Foundation can be found at [http://www.mapquest.com/mq/9-YzaCS8fPQBY5A\\*Uj](http://www.mapquest.com/mq/9-YzaCS8fPQBY5A*Uj).

Nachusa Grasslands is located at 8772 S. Lowden Road near Franklin Grove, IL. MapQuest directions from the Lorado Taft Field Campus to Nachusa Grasslands can be found at <http://www.mapquest.com/mq/5-AcCfhYjB>.

**Poster Presentations:**

Poster presentations will be held in Rockview Classroom and may be on display all day Saturday, August 14. Please plan to attend your poster from 1-1:30 on Saturday, August 14. Poster viewing will also occur during Saturday morning and afternoon breaks.

**Silent Auction:**

Silent auction items will be on display for bidding in Rockview Classroom throughout the day on Saturday, August 14. Bidding will end at 5:30 pm with winners announced shortly thereafter. Winners should plan to pay in cash or by check.

## INVITED TALKS

### **Fifteen years of Blanding's Turtle (*Emydoidea blandingii*) Head-starting in DuPage County, IL**

Dan Thompson<sup>1</sup> and Rose Augustine<sup>2</sup>

<sup>1</sup>Natural Resources, Forest Preserve District of DuPage County, IL 60189; <sup>2</sup>Willowbrook Wildlife Center, Forest Preserve District of DuPage County Wheaton, IL 60189

Head-starting can be a valuable tool to help fill gaps in populations such as the Blanding's turtle (*Emydoidea blandingii*). Head-starting requires a tremendous amount of time and effort and should not be taken lightly. Fifteen years of effort has provided valuable insight into rearing methods. It has also left us with many questions that need to be explored further. We will look at successes, failures, and plans for the future. While head-starting can be a valuable tool, it must be stressed that the future lies in habitat and adult population preservation, without this head-starting has no future.

### **Investigation of Blanding's Turtle Ecology in Ohio and Results of Captive Head-start Efforts at the Cleveland Metroparks**

James C. Spetz and Richard Spence

Natural Resources Division, Medina County Park District, Medina, OH 44256

With a limited range in Ohio, restricted primarily to the Lake Plains region of the state, Blanding's Turtle (*Emydoidea blandingii*) is currently listed as a Species of Concern. Its discovery in a Cleveland Metroparks reservation in 1999, led to the initiation of a small scale head-start program and radio telemetry study aimed at conservation of the species. In order to better understand the ecology of this species in the Ohio Lake Plains region, a population west of Cleveland was chosen for an investigation focused on habitat use, diet, and reproduction. Habitat use varied seasonally, with palustrine emergent marsh (PEM) being the dominant habitat utilized in all seasons, but particularly during the active feeding period. Feeding activity occurred from April through September, with peak feeding from May through July. Diet was comprised of approximately 75% snails with decreasing contributions from insects, crayfish, leeches, and fish. Nests were shallow (mean = 11.3cm) and the nesting process was observed to take approximately 8 hours (range = 6.5 - 13.5) from construction to completion. Radio telemetry revealed a wide dispersal pattern for hatchlings toward both aquatic and upland habitats. Trapping data coupled with characteristics of nest site availability and suitability suggested that recruitment in this population may be extremely low, with the population at risk of eventual extirpation. A decade after the initiation of a small head-start program, recapture of captive reared individuals suggests a relatively high rate of survival and eventual growth for individuals surviving their initial release and subsequent acclimation period.

### **Head-starting Blanding's Turtles: Stabilizing Populations Impacted by Subsidized Predation, Road Mortality and Subsequent Population Decline**

David A. Mifsud<sup>1</sup> and Steven Kahl<sup>2</sup>

<sup>1</sup>Herpetological Resource and Management, LLC, Grass Lake, MI 49240; <sup>2</sup>Shiawassee National Wildlife Refuge, Saginaw, MI 48601

It is believed that over time the natural and artificial attrition and suppressed recruitment of Blanding's Turtles at Shiawassee National Wildlife Refuge has led to a much smaller population relative to the likely historic density in the habitat available. In 2007, the Refuge initiated an effort to determine the number of Blanding's Turtles, a species of Special Concern in Michigan, present within the 9,620 acre refuge. In the first two years, 8 turtles were marked and tracked to assess habitat use and nesting area selection. Early surveys identified that most Blanding's Turtles selected to nest on gravel roads and roadside areas frequented by raccoons. Their choice in nesting areas, in combination with high mesopredator density, lead to significant nest predation. Efforts were made in 2009 to collect eggs and incubate artificially with 33 eggs collected and hatchlings released. Building on this effort, in 2010 a collaborative effort between the USFWS, Binder Park Zoo, Saginaw Children Zoo, and Herpetological Resource and Management, LLC to collect eggs, incubate, and headstart hatchlings in order to reduce post hatching predation. Females that contained sufficiently calcified eggs were injected with a combination of calcium, oxytocin, and prostaglandin to release eggs and prevent phantom nesting. Eggs were incubated to produce 70% females and 30% males. Further effort will include raising the hatchlings for 1-2 seasons to optimize the size of released turtles, and continued track both adult and headstarted turtles.

## **When Habitat Protection Isn't Enough: Raccoon Management on a Turtle Nesting Beach**

Steve Harvey

*Ohio Division of Wildlife, Columbus OH 43215*

Blanding's turtles, like many other reptiles, have seen a significant decline in population numbers. Habitat loss, habitat fragmentation, and collection for the pet trade have all lead to the decline. However, even in areas of good protected habitat we are finding Blanding's turtle numbers are decreasing due to predation on turtle nests by raccoons. Raccoons have long been a predator on turtle nests but the raccoon population in Ohio has exploded with estimates of an increase of 800% in the last 20 years (Ohio Division of Wildlife). With this increase of predators and the decrease of turtle numbers, we are seeing very little if any turtle recruitment. At Sheldon Marsh State Nature Preserve, we observed virtually 100% predation on turtle nests. Since 1990, only one neonate Blanding's turtle has been observed and the number of adult turtles seen has declined. In 2006, the Ohio Division of Natural Areas and Preserves along with the Ohio Division of Wildlife decided to implement a raccoon trapping program to help protect the state listed Blanding's turtle. Preliminary results have proven very effective with 17 neonate Blanding's turtles observed in 2008.

## **Population Genetics and Phylogeographic History of *Emydoidea blandingii* across the Midwestern States of Iowa, Illinois, Nebraska and Minnesota**

Arun Sethuraman<sup>1</sup>, Christopher H. Chandler<sup>1</sup>, James L. Christiansen<sup>2</sup>, Sue Hayden<sup>3</sup>, Andrea LeClere<sup>1,5</sup>, Suzanne E. McGaugh<sup>1,6</sup>, Jennifer Monson-Miller<sup>1,7</sup>, Erin M. Myers<sup>1,8</sup>, Ryan T. Paitz<sup>1,9</sup>, Jeanine M. Refsnider<sup>1</sup>, Terry VanDeWalle<sup>4</sup> and Fredric J. Janzen<sup>1</sup>

<sup>1</sup>*Department of Ecology, Evolution, & Organismal Biology, Iowa State University, Ames, IA 50011;* <sup>2</sup>*Department of Biology, Drake University, Des Moines, IA 50311;* <sup>3</sup>*McHenry County Conservation District, Richmond, IL 60071;* <sup>4</sup>*Natural Resources Consulting, Independence, IA 50644;* <sup>5</sup>*present address: Department of Genetics, Cell Biology, and Development, University of Minnesota, Minneapolis, MN 55455;* <sup>6</sup>*present address: Department of Biology, Duke University, Durham, NC 27708;* <sup>7</sup>*present address: Genome Center, University of California, Davis, CA 95616;* <sup>8</sup>*present address: Department of Biology & Biochemistry, University of Houston, Houston, TX 77204;* <sup>9</sup>*present address: School of Biological Sciences, Illinois State University, Normal, IL 61790*

The Blanding's Turtle (*Emydoidea blandingii*) has declined substantially across the North American landscape over the last two centuries, typically attributed to anthropogenic activities, leaving populations smaller and increasingly fragmented spatially. To aid in making more informed conservation decisions, we evaluated genetic variation within and among populations of *E. blandingii* across its primary range in the midwestern United States. We performed a population genetics study using eight microsatellite markers in 212 turtles sampled from 18 localities across Illinois, Iowa, Minnesota, and Nebraska. Our analyses detected considerable genetic structure within and among the sampled localities, contrary to prior more limited studies, and reveal ancestral gene flow of *E. blandingii* in this region north and east possibly from an ancient refugium in the central Great Plains. Our phylogeographic assessments identify four or five genetic lines, largely corresponding to spatially distributed habitats (Eastern Illinois, Western Illinois-Nebraska, Northern Iowa, Southeastern Iowa-Minnesota, Central-Eastern Iowa). These findings suggest that conservation/management actions involving this imperiled species should be conducted with an eye toward preserving these unique genetic lineages.

## **Reproductive Ecology of Blanding's Turtles in Minnesota**

Jeanine M. Refsnider<sup>1</sup> and Madeleine Linck<sup>2</sup>

<sup>1</sup>*Department of Fisheries, Wildlife, and Conservation Biology, University of Minnesota, St. Paul, MN 55108; current address: Dept. of Ecology, Evolution and Organismal Biology, Iowa State University, Ames, IA 50011-1021;* <sup>2</sup>*Three Rivers Park District, Plymouth, MN 55441-1248*

We radio-tracked female Blanding's turtles in Scott County, MN during the nesting seasons in 2003 and 2004 to investigate aquatic and terrestrial habitat use on nesting forays, and to locate nest sites. Nests were either covered by predator-exclusion cages or, if constructed in at-risk locations, eggs were retrieved and incubated artificially. We collected tissue samples from all hatchlings and adults for paternity analysis. Nesting forays lasted an average of 10.2 days, females traveled 1.85 km to nest, and nests were 600 m from the female's resident wetland. Females showed high use of ephemeral and small permanent wetlands during nesting forays, with 85% of turtles using an ephemeral wetland, all turtles using ephemeral or small permanent wetlands, and half of all nesting-foray days spent in such wetlands. Half of all nests were constructed along roads and trails; burned prairie was the most frequently-used natural nesting habitat. We genotyped 16 clutches of 11 females and detected multiple paternity in 81% of those clutches. Most multiply-sired clutches had two sires, with approximately equal paternal contributions. Our results illustrate the importance of ephemeral wetlands and recently-burned prairie in nesting-related travel and nesting habitat to this

population. Additionally, the unusually high rate of multiple paternity detected here suggests a polyandrous mating system. We recommend that artificial incubation programs continue to produce hatchlings of both sexes rather than biasing sex ratios towards females, and that rates of multiple paternity may be an indicator of population density and ease of locating mates in this species.

### **Overwintering Sites and Survival of Hatchling *Emydoidea blandingii* in Crow-Hassan Park Reserve in East Central Minnesota**

Madeleine Linck and Laurence N. Gillette  
*Three Rivers Park District, Plymouth, MN 55441*

Three Rivers Park District wildlife staff has studied *Emydoidea blandingii* in Crow Hassan Park Reserve, a 2,600 acre park 30 miles northwest of Minneapolis, Minnesota, since 1992. Initial studies were limited to the capture, mark, and release of adults. Radio telemetry of females was begun in 1993 to identify nesting habitat and protect nests from predation. Through 2004, eggs were salvaged from nests in at-risk locations such as roads. Eggs were artificially incubated at 29° C and hatchlings were released into wetlands closest to nest sites. Due to concerns that incubated hatchlings emerge several weeks earlier than wild nests and that hatchlings might prefer unknown habitat, all at-risk nests were reburied and caged in the field beginning in 2005. In order to study hatchling habitat use and survival, 7 hatchlings from 2 field nests in 2005 and 7 hatchlings from 2 field nests in 2006 were radio tracked for various numbers of days to what were presumed to be overwintering sites. Hatchlings appear to move during the day through prairie grasses with little predation. Terrestrial locations of 7 hatchlings tracked for 42-48 days were protected with .6m high fine mesh cages in October when movements ceased. Cages were checked the following April to determine survival. Two of the caged hatchlings were found alive in the spring. Hatchling *Emydoidea* in Crow Hassan Park are able to survive winter on land, but seem to seek areas likely to flood in the spring or close to, but not in, wet areas.

### **Mating Systems and Determinants of Reproductive Success in Male Blanding's Turtles**

Whitney J. Banning, Michael J. Dreslik, Marlis R. Douglas, Natalie K. Marioni, and Christopher A. Phillips,  
*Illinois Natural History Survey, University of Illinois Urbana Champaign, Champaign, IL, 61820*

Mating systems of many reptile species is poorly understood because reproductive behavior is often cryptic and strategies such as sperm storage and multiple paternity are difficult to quantify in wild populations. Further, it is unknown how mating systems function when population densities are reduced by fragmentation. The Blanding's Turtle, *Emydoidea blandingii*, is of great conservation concern in Illinois because most extant populations occur in fragmented natural areas. We examined the mating system and reproductive success of two fragmented Blanding's Turtle populations in Will County, Illinois by assessing paternity using microsatellite DNA analysis. We compared our paternity results to field observations of mating behavior between individuals during radio-telemetry surveys. During 2007-2009, we monitored 36 adult Blanding's Turtles and documented 49 male-female pairings among 10 males and 16 females. Tissue samples were collected from 20 clutches of Blanding's turtles and all radio-tagged individuals for DNA analysis. We report on the number of matings observed for each individual and the number of offspring sired by each male. Additionally, we describe the relationship between these measures of reproductive success and male characteristics including, body size, home range size, and movement parameters. Using a combination of molecular genetic techniques and behavioral field observations, the results of this project will provide important insights regarding turtle mating systems and aid in conservation planning for Blanding's Turtles.

### **Ecology and Conservation of Blanding's Turtles (*Emydoidea blandingii*) in Southern New Hampshire**

Lee J. Walston<sup>1</sup>, Kirk E. LaGory<sup>1</sup> and Stephen J. Najjar<sup>2</sup>

<sup>1</sup>*Environmental Science Division, Argonne National Laboratory, Argonne, IL 60439;* <sup>2</sup>*New Boston Air Force Station, New Hampshire*

The Blanding's turtle (*Emydoidea blandingii*) is listed by the state of New Hampshire as an endangered species. The species is known to occur at New Boston Air Force Station (NBAFS), a 1,144 ha satellite tracking station located in southcentral New Hampshire. Observations of the turtle at NBAFS began in 1997 and management of the species was incorporated into the station's Integrated Natural Resource Management Plan. Between 2004 and 2009, a radio-telemetry program was initiated to monitor the seasonal habitat use and home range size of turtles on the station. Results from 25 radio-tracked turtles indicate that annual activity peaked in the month of May, which coincided with the breeding season. Female turtles appeared to be more active, had larger home range sizes, and crossed roads more frequently than males. An increasing number of road-killed turtles (hatchlings and adult females) on NBAFS and adjacent roadways has raised more urgent management questions. A variety of mitigation measures to reduce road mortality of

Blanding's turtles at NBAFS have been evaluated and include modification of curbs and road drains, an employee education and awareness program, signage, and road design modification.

### **Blanding's Turtles of the Oak Savannah Habitat of Northwest Ohio**

Kent Bekker

Toledo Zoo, Maumee, OH, [kbekker@gmail.com](mailto:kbekker@gmail.com)

Blanding's turtles, *Emydoidea blandingii*, are occasionally observed within the oak savanna habitat located west of Toledo. This habitat is a linear stretch of land created by a prehistoric beach ridge deposited on clay soil, making it an area dominated by large oaks, xeric adapted plant species, and shallow ephemeral wetlands. Within this habitat there are at least three fragmented populations of *Emydoidea* turtle utilizing the wetland complexes. Occurring within these complexes are several other species of turtle. We have employed predominantly mark-recapture methodologies over the last five years to assess two of these populations. Our sampling indicates that both populations are small (10-15 individuals) and comprised of predominantly large adult *Emydoidea*, with one population appearing to have no recruitment within the last 15 years. Within this region we have also utilized GPS backpacks to begin logging location data targeting oviposition times. The status of the populations within the oak savanna region of Ohio is precarious.

### **Monitoring and Management of the Blanding's Turtle, *Emydoidea blandingii*, in Lake County, Illinois**

Andrew R. Kuhns

Illinois Natural History Survey, University of Illinois Institute of Natural Resource Sustainability, Champaign, IL 61820

The Blanding's Turtle has been documented from twelve locations in Lake County, Illinois. However, since 1995, only two locations (Spring Bluff - Illinois Beach and Chain of Lakes) are known to have populations with documented recruitment. Since 2004, we have been studying the population at Spring Bluff - Illinois Beach and estimate the population to consist of ~ 165 individuals. Sex ratios are approximately equal and the juvenile to adult ratio is 0.68J:1.0A. In a given year, 78% of females become gravid and lay an average of 12.0 eggs. Females appear to display nest site fidelity and most nesting occurs in unprotected habitats outside of female's normal activity areas. We have experimentally head-started turtles and tracked both head-started and hatchling turtles. We have not witnessed declines to this population but potential threats include development, altered hydrologic regimes, vehicular mortality, poaching, and encroachment of invasive plants into nesting habitats.

### **Conservation and management concerns related to patterns of nesting and hatchling orientation during nest dispersal of *Emydoidea blandingii*, *Chelydra serpentina* and *Chrysemys picta belli*.**

Michael Pappas<sup>1</sup> and Justin D Congdon<sup>2</sup>

<sup>1</sup>Michaels Restaurant, Rochester, Minnesota; <sup>2</sup>Savannah River Ecology Laboratory, Drawer E, Aiken, South Carolina, 85601.

We determined patterns of hatchling dispersal associated with nesting tactics of females (nest close to or far from wetlands) of 1052 naïve and 278 experienced Blanding's turtles (*Emydoidea blandingii*), 746 naïve snapping turtles (*Chelydra serpentina*) and 76 painted turtles (*Chrysemys picta belli*). Nests of painted turtles (n = 113) and snapping turtles (n = 89) averaged 64.9 and 74.9 m from nearest wetlands, respectively, whereas Blanding's turtle nests (n = 142) were located farther away from wetlands (mean = 589 m). Orientation and dispersal of all hatchlings was primarily non-random and appeared to be based on vision; however, Blanding's hatchlings dispersed toward far dark horizons, whereas snapping and painted turtles dispersed toward near open and illuminated horizons. Despite the lack of relationships between the changing positions of the sun and the relationships between nest sites and wetlands, patterns of dispersal were different for Blanding's and snapping turtle hatchlings released in the morning and late afternoon. Comparisons of the dispersal of naïve and translocated experienced Blanding's turtle hatchlings (those with previous exposure to environmental cues) suggest that dispersing individuals developed a sun compass within 2 days of emergence from nests. Traits such as morphology, body size, mobility, desiccation rates and risk of being killed or injured by predators combine to influence the nesting tactics (distances) of females and abilities of hatchlings to survive dispersal from nests. Alteration of nesting areas can increase problems females face when selecting nest sites that provide hatchlings with appropriate cues for orientation and dispersal.

## **Blanding's Turtles in the Nebraska Sandhills: Ecology of a Megapopulation.**

Jeffrey W. Lang

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Blanding's turtles (*Emydoidea blandingii*) are common at Valentine National Wildlife Refuge (VNWR), a 71,722 acre protected area in the Nebraska Sandhills. In 2002-03, I studied turtles living in road adjacent vs. road remote areas, and used trapping and telemetry to document seasonal habitats and activities, space use, reproduction, population structure and size, and road mortality. 1247 individuals were marked, with 609 recaptures. Juveniles, adult females, and adult males were captured in nearly equivalent proportions. Space use of 66 radioed turtles over two seasons indicated limited home ranges (6-74 ha). Turtles nested  $\leq 500\text{m}$  in nearby sandhills, and overwintered  $\leq 2500\text{m}$  from summer activity areas. Turtles inhabiting larger lakes had smaller home ranges and travel distances, relative to those using seasonal wetlands. Actual densities ranged from 20 to 57 turtles/ha, and averaged 38 turtles/ha during 2002-2003. Population estimates for 8913 ha of wetland habitats at VNWR was 137,300 turtles (=juveniles + adults; not hatchlings; 95% limits=109,600 to 164,900 turtles). Blanding's turtles (total=424) were encountered on roads, including 249 alive and 175 salvaged (60% were juveniles). Road mortality was day and location-specific, and noticeably higher in the spring and late summer. Simple efforts at protection such as fencing reduced roadkill adjacent to federal NWR and state SWMA. The large size and healthy demography of the Blanding's turtle population at VNWR, is an outstanding wildlife resource, unique to the Sandhills, and provides insights for conservation/management strategies elsewhere.

## **Steps towards a Blanding's Turtle Recovery Plan in Illinois: Status Assessment and Management**

Daniel R. Ludwig

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In Illinois, the Blanding's Turtle (*Emydoidea blandingii*) has received historic and current attention from herpetologists, the staffs of land management agencies, and the Illinois Department of Natural Resources (IDNR)'s threatened and endangered species consultation group and the Office of Resource Conservation staff. Sensing a strong interest in the species' conservation, the IDNR's Division of Wildlife Resources conducted a 2006 survey to gather information about the Blanding's Turtle status in Illinois, and opinions and ongoing efforts to benefit the species in Illinois. A survey questionnaire (17 responses) determined the objectives of a variety of management activities and programs working to preserve the turtle. The questionnaire posed questions regarding the conservation biology and sustainability of the species. Biologists were contacted because they or their agencies were involved in a species management program or a field study, and/or they had a known interest in the conservation of the Blanding's Turtle. The group surveyed (turtle researchers, land managers and environmental consultants) suggested that a recovery plan should be written, and items of importance for the species' survival. The overall impression was that many/all Blanding's Turtles in Illinois were actually small groups of old individuals persisting on the rapidly changing landscape and experiencing low to no recruitment. Stabilizing populations was considered a realistic goal, but expanding development represented a suite of challenges (i.e. threats) to population sustainability. Early in 2010, 30 individuals representing agencies in northern Illinois that are actively involved in Blanding's Turtle management met to review and critique ongoing management of the species, and to provide information on the status of populations on their properties, and to build partnerships. Several agencies had already pooled resources for head-starting programs. The information obtained to date from both sources will be used to complete and submit a "species recovery tool" for the IDNR and the Illinois Endangered and Threatened Species Board. It is anticipated that the recovery tool will be approved, a formal recovery plan will be prepared by a small group of biologists, and the plan will be implemented with multi-agency cooperation and commitment.

## **Natural Resources Conservation Service Blanding's Turtle (*Emydoidea blandingii*) Conservation Efforts in Iowa**

Jennifer S. Anderson-Cruz

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The United States Department of Agriculture Farm Bill equips the Natural Resources Conservation Service (NRCS) with program and technical assistance funds to accomplish its mission of "helping people help the land". One such program is the Wetlands Reserve Program (WRP), which is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands and associated uplands on their property. In Iowa, WRP application sites that provide habitat for a state or federally protected species may be given special consideration for program enrollment. This requires the landowner to agree to restore and manage the easement to specifically meet the habitat requirements of a nearby protected species. With the majority of WRP enrolled under perpetual easement in Iowa, the ability to provide

long-term habitat protection at the landscape scale places NRCS at the forefront of at-risk species conservation. Beginning in 2003, Iowa NRCS began active restoration of habitat for the Blanding's Turtle (*Emydoidea blandingii*), a species listed as threatened in Iowa. Most of this work occurs through the aforementioned WRP special consideration process, with NRCS focusing on the enrollment of WRP easements near existing Blanding's Turtle populations. These WRP easements are restored based on site capabilities, the species life history requirements, and identified habitat needs for the respective population.

## KEYNOTE ADDRESS

### **Ecological and Demographic Issues Related to Conservation and Management of the Long-lived Blanding's Turtle**

Justin D. Congdon (with Owen M. Kinney and Roy D. Nagle)

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Blanding's turtles are noted for being long-lived and for their extensive overland movements that often make use of temporary wetlands. In many areas, the numbers of permanent and temporary wetlands have decreased as habitat corridors have become fragmented. As a result distances, durations, and risk or injury and death to adults during migrations have probably increased substantially due to exposure to agricultural activities, roads, high traffic densities and vehicle speeds. Data collected during 43 years between 1953-2007 (mark-recapture) and from 1975 – 2007 (reproduction and nesting ecology) combined with one year of radio-tracking were used to document the activities that define the core habitats of Blanding's turtles on the University of Michigan's E. S. George Reserve (ESGR) near Hell Michigan. Individuals occupied the same resident wetlands for more than 40 years and females use up to six different nesting areas, some separated by more than 1 km. Movements associated with selecting a nest site are longer in duration and distance than are return movements from nests to wetlands. On the ESGR, a 300 m buffer zone around wetlands would protect about 90% of nests; whereas protection of the same proportion of females during nesting migrations would require a 1.2 km buffer zone. The potential risks associated with activities will be discussed in relation to how life history trait values of long- vs. short lived turtles can influence population stability and persistence.

## POSTERS

### **20 Plus Years' Experience of Captive Blanding's Turtle Breeding and husbandry**

Jeffrey T. Behr M.D.

*Independent Consultant, 1631 National Avenue, Rockford IL, 61103*

This poster presents the author's 20 plus years' experience of captive Blanding's turtle breeding and husbandry. Blanding's have been shown to have significant mortality rates when released as hatchlings and juveniles. Adults on the other hand are nearly indestructible. It is the author's hope to release and track a population of healthy breeding age young Blanding's turtle adults into a protected habitat in northern Illinois with a known existing native Blanding's population. This presentation highlights the author's methods, observation, and results in pursuing his goal of releasing an adult Blanding's turtle population. Successively larger enclosures are used as the turtles mature. Males and females are kept separated during hibernation. Fertile egg production requires a minimum hibernation temperature of 45 degrees Fahrenheit or less. Gravid females stop eating 5 to 7 days before laying their eggs. These fasting females become ravenous the moment the clutch is laid. The Author will be available for questions.

### **Conservation of the Taxonomically Challenged: How Should We Protect Unisexual *Ambystoma* Salamanders?**

Bob Brodman<sup>1</sup> and Katy Greenwald<sup>2</sup>

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Unisexual (all-female) populations of ambystomatid salamanders are widely distributed across eastern North America. These salamanders are generally triploid (three sets of chromosomes), but can be diploid, tetraploid and even pentaploid (two, four or five sets, respectively). The genome may be comprised of DNA from up to five "true" (bisexual) species: the blue-spotted salamander (*Ambystoma laterale*), Jefferson's salamander (*A. jeffersonianum*), smallmouth salamander (*A. texanum*), tiger salamander (*A. tigrinum*), and infrequently the streamside salamander (*A. barbouri*). Despite the complexity of the nuclear genome, all unisexuals form a monophyletic group based on their mitochondrial DNA. The maternal ancestor of the unisexual ambystomatids was most closely related to *A. barbouri*, with the original hybridization likely occurring 2.4-3.9 million years ago. Unisexual salamanders present an interesting conservation

conundrum. They currently receive no protection despite the fact that some populations have highly restricted ranges and may therefore be vulnerable to stochastic local extinction. This lack of protection exists in part because the herpetological community does not list unisexual salamanders by a scientific or standard name, and they are therefore ignored by "species-centric" legislation such as the Endangered Species Act. Here we consider the taxonomic complexity and resulting conservation issues surrounding this unique group.

### **Do Frogs Believe in Climate Change?**

Bob Brodman and Matt Harmon

*Department of Biology, Saint Joseph's College, Rensselaer, IN 47978*

We examined 17 years of frog call data from an annual county survey in northwest Indiana to test the hypothesis that frogs are responding to climate change by breeding earlier in the season. Mean temperatures in the study area have been significantly warmer than normal during that span, and the 2001-2010 have been warmer than 1994-2000. Eight of nine species started calling significantly earlier from 2001-2010 compared to 1994-2000. On the average, these species start calling 14.5 days sooner.

### **The Effects of Water and Habitat Quality on Amphibian Assemblages in Two Midwest Watersheds**

Abel Castañeda and Mark A. Jordan

*Department of Biology, Indiana University-Purdue University Fort Wayne, Fort Wayne, IN 46805*

Amphibians have declined dramatically in the United States and many other areas of the world. Poor water quality and habitat modification are possible causes of declines and both factors are of particular concern in agricultural regions. Although the effects of water quality and habitat change have been identified in many studies, much of the focus has been on pond and wetland systems rather than the ditches and streams that receive surface water from terrestrial areas. The purpose of our study is to examine the composition of amphibian assemblages and its relationship to water and habitat quality in agricultural ditches of the St. Joseph River watershed in northeastern Indiana and the Upper Big Walnut Creek Watershed in Ohio. Both ditches and adjacent riparian zones were used for habitat characterization, and instream surveys occurred along a 125 m distance downstream of the automated samplers to measure wet width, water velocity, substrate type, habitat structure, temperature, dissolved oxygen, pH and specific conductivity. Additional water quality data included weekly measurement of a range of pesticides and nutrients. Sampling of the amphibian larvae, metamorphs and aquatic adults occurred four times during the active season over a two year period. We are using principle component analysis within the habitat and water quality datasets to describe variation among sites. Identified axes will then be used as independent variables in a multiple regression analysis of amphibian assemblages. This preliminary analysis will describe the composition of amphibian assemblages in two Midwest watersheds and identify the environmental variables likely to predict differences in species diversity among sites.

### **Copper-bellied Watersnakes: Coping in a Man's World**

Matt Farmer and Bruce A. Kingsbury

*The Center for Reptile and Amphibian Conservation and Management, Indiana University - Purdue University Fort Wayne, Fort Wayne, IN 46805*

Populations of the Copper-bellied Watersnake (*Nerodia erythrogaster neglecta*) are threatened with extirpation throughout much of their range, especially the northern populations. These declines are the result of habitat loss and degradation from agriculture, surface mining and the draining of wetlands within the large wetland complexes they need to persist. Knowing the ecosystem requirements of copperbellies and how anthropogenic alterations impact their behavior are critical for producing effective management guidelines and recovery strategies. To examine the response of copperbellies to anthropogenic impacts, we tracked individuals over two years using radio-telemetry at Muscatatuck National Wildlife Refuge. While Muscatatuck is large (several square miles), it has been extensively modified by roads, agriculture, reservoirs, levees and development, and thus provides an environment to examine anthropogenic impacts. We examine the responses of copperbellies to various potential barriers and conclude that persistence does not require pristine habitat is not required, provided that the remaining landscape contains appropriate components and is extensive.

## **If You Build It and They Don't Come: Tools for the Repatriation of Extirpated Snake Populations**

Michael R. Frank, John H. Roe, and Bruce A. Kingsbury

*Center for Amphibian and Reptile Conservation and Management, Indiana-Purdue University Fort Wayne, Fort Wayne, IN 46805*

Habitat loss and fragmentation are factors leading to declines in many faunal populations. Restoring habitats to support the rebound of local populations may help to remedy these declines, but in cases where a species has been extirpated, natural recolonization is unlikely. Translocation has proven to be a successful strategy for the repatriation of some extirpated populations, but its effectiveness is unclear and understudied in snakes. Using the Northern Watersnake (*Nerodia sipedon*) we directly translocated individuals to a recently restored nature preserve from a nearby site in 2008. We also raised neonates in simplistic laboratory enclosures ("headstarts") until they were large enough to be translocated to the same preserve. These experimental release groups were compared to resident snakes. Compared to residents, translocated snakes selected aquatic habitats with a more open canopy, moved more extensively, and used areas outside of reserve boundaries more frequently. Headstarts showed restricted movements and used habitats in ways atypical of residents. Translocated and resident snakes grew at similar rates, but headstarts failed to grow appreciably. Both experimental groups had low survivorship relative to residents. Much of the mortality in headstarts occurred during the overwintering period, while mortality in directly translocated snakes was limited to the active season. Due to the poor performance of headstarts, we also examined the alternative approaches of releasing headstarts directly into constructed hibernacula and enriching captive conditions for headstarts prior to release. We compare and contrast the outcomes for these different approaches and provide recommendations for repatriation efforts involving snakes.

## **Rangewide analysis of Eastern Massasauga Rattlesnake Survivorship.**

Peter C. Jones, Richard B. King and the Massasauga Radiotelemetry Group

*Department of Biological Sciences, Northern Illinois University, DeKalb, IL 60115*

The Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is an endangered species afforded protection in every state/province in its range, which extends from Iowa to New York and from Ontario to Missouri. Populations of massasauga are fragmented with only a few areas containing multiple, sizable populations. Research on the massasauga usually focuses on single populations or local metapopulations but suggest that demographic parameters may vary geographically. In this study, we use radiotelemetry datasets provided by massasauga researchers throughout its range to characterize geographic patterns of massasauga survival. Radiotelemetry datasets were analyzed using the known-fate model in Program MARK to determine annual survivorship. Annual adult survival estimates averaged 0.69 (range = 0.48-0.87). Five of the datasets were also used to determine whether or not there was a difference in survival rates between the sexes. There was not a significant pattern to the difference in survival rates between males and females. Further work will include an analysis of possible geographic patterns in survival rate and forecasting of demographic changes due to climate change. These analyses will provide a better understanding of the relationship between survivorship and geographic location for the Eastern massasauga rattlesnake as well as predict possible changes in massasauga survivorship and range due to climate change.

## **Spatial Ecology and Habitat Use of Blanding's and Spotted Turtles in Indiana**

Bruce A. Kingsbury

*Department of Biology, Indiana-Purdue University Fort Wayne, Fort Wayne, IN 46805*

In the mid to late 90s I did extensive work with Christine Barlow on Blanding's Turtles (*Emydoidea blandingii*) and Spotted Turtles (*Clemmys guttata*) at a series of sites in northeastern Indiana. Here I revisit that study to contribute to the meeting, using data from 23 Blanding's Turtles and 11 Spotted Turtles across seven wetland systems. There was a linear relationship between turtle size and average water depth used. Vegetative affinities were also observed in keeping with the water depth, such that smaller/younger turtles (~5cm plastron length) used water only averaging 10-20 cm in depth in areas dominated by sedges and shrubs, subadult "teenagers" (~10-15 cm long) water averaging 40 cm and in affiliation with shrubs, sedges and cattails, and adults (~20 cm long) were in deeper water averaging about 50 cm. Adults used a variety of vegetative types including those use by other sizes classes and also lilies and floating vegetation mats. Spotted turtles followed the same trend, placing along the Blanding's continuum as appropriate for their size (~8-10 cm plastron length) and using habitat like teenagers. Extent of area occupied also varied with size for Blanding's Turtles, such that the juveniles had ranges of less than 0.3 ha while adults, while variable, averaged about 4 ha. The results of this study demonstrated that areas which were to support viable populations of Blanding's turtles must have

wetlands with a variety of wetland depths and vegetative types in close proximity so as to support all size classes and promote recruitment.

### **Eastern Newt (*Notophthalmus viridescens*) Documented in Kane County, Illinois**

Carrie Morjan and Kelly Huschart

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Amphibians and reptiles have suffered declines in the Midwest due to urbanization, habitat alteration, and invasive species. Although urbanization has increased tremendously in Kane County over the past few decades, large tracts of land have also been acquired and are being restored from agricultural to prairie habitat. For the past two years, students and faculty from Aurora University have conducted surveys of amphibians and reptiles on Kane County forest preserve lands as part of the Forest Preserve District's efforts to evaluate the conservation status of these taxa. Sampling was conducted using a combination of terrestrial drift fences, snake boards, baited hoop traps, and aquatic drift fences. We document the first captures of Eastern newts (*Notophthalmus viridescens*) in Kane County in over a century. Although a single Blanding's turtle had been captured in the same suburban wetland a decade ago, none have been captured in our surveys despite extensive trapping efforts. Future surveys will continue to document changes in distribution of amphibians and reptiles in these urban wetlands.

### **Keeping Tabs on Turtles: Ongoing Mark-Recapture Studies of the Turtle Community at Sandhill Wildlife Area (Central Wisconsin).**

Brendan N. Reid<sup>1</sup>, Zachariah Peery<sup>1</sup>, and Richard P. Thiel<sup>2</sup>

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Sandhill Wildlife Area, a 9,1250 acre property in central Wisconsin managed for education and recreation, is home to a robust community of Blanding's (*Emydoidea blandingii*), painted (*Chrysemys picta*), and snapping (*Chelydra serpentina*) turtles. Individuals have been marked and recaptured over a period of twenty years by a similarly robust community of DNR employees, students, and volunteers. Analysis of this rich data repository has the potential to provide valuable information on trends in species populations, life history, and spatial and temporal nesting patterns. A preliminary analysis of these data is presented, along with plans to augment this analysis with genetic data from within the region and throughout the state.

### **Assessment of Amphibian Community Structure Following Flatwoods Wetland Habitat Restoration**

Allison Sacerdote

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Lake County Forest Preserve District implemented habitat restoration in MacArthur Woods, an Illinois State Nature Preserve. MacArthur Woods contains globally-imperiled flatwoods wetland habitat characterized by seasonal pools. MacArthur Woods was degraded by agricultural drainage tile and severe infestation of European buckthorn. Amphibian diversity was assessed in 1999, prior to restoration. Following a five-year restoration effort to disable drainage tile, remove buckthorn, and encourage regeneration of native species, I began post-restoration monitoring of MacArthur Woods amphibians in 2004. Monitoring continued through 2009, coupled with reintroduction efforts for three extirpated species: spotted salamanders (*Ambystoma maculatum*), wood frogs (*Lithobates sylvaticus*), and spring peepers (*Pseudacris crucifer*). I calculated species richness, evenness, diversity, and effective number of species for the amphibian assemblage for each year following restoration and compared amphibian community structure during the post-restoration period with pre-restoration data. I observed an increasing trend in amphibian richness, evenness, and diversity in the post-restoration years, independent of the reintroduced species. Changes in species dominance were observed for particular wetlands with dominance shifting among blue-spotted salamanders (*Ambystoma laterale*), western chorus frogs (*Pseudacris triseriata*), and American toads (*Anaxyrus americanus*). Increased presence of semi-permanent and permanent pool-breeding amphibians may indicate improved terrestrial habitat quality such that the site effectively serves as a corridor for interwetland migration. The successful recruitment of northern leopard frogs (*Lithobates pipiens*), late-breeding seasonal and semi-permanent pool breeders, in MacArthur Woods, indicated that hydrologic restoration has successfully increased pond-hydroperiod.

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