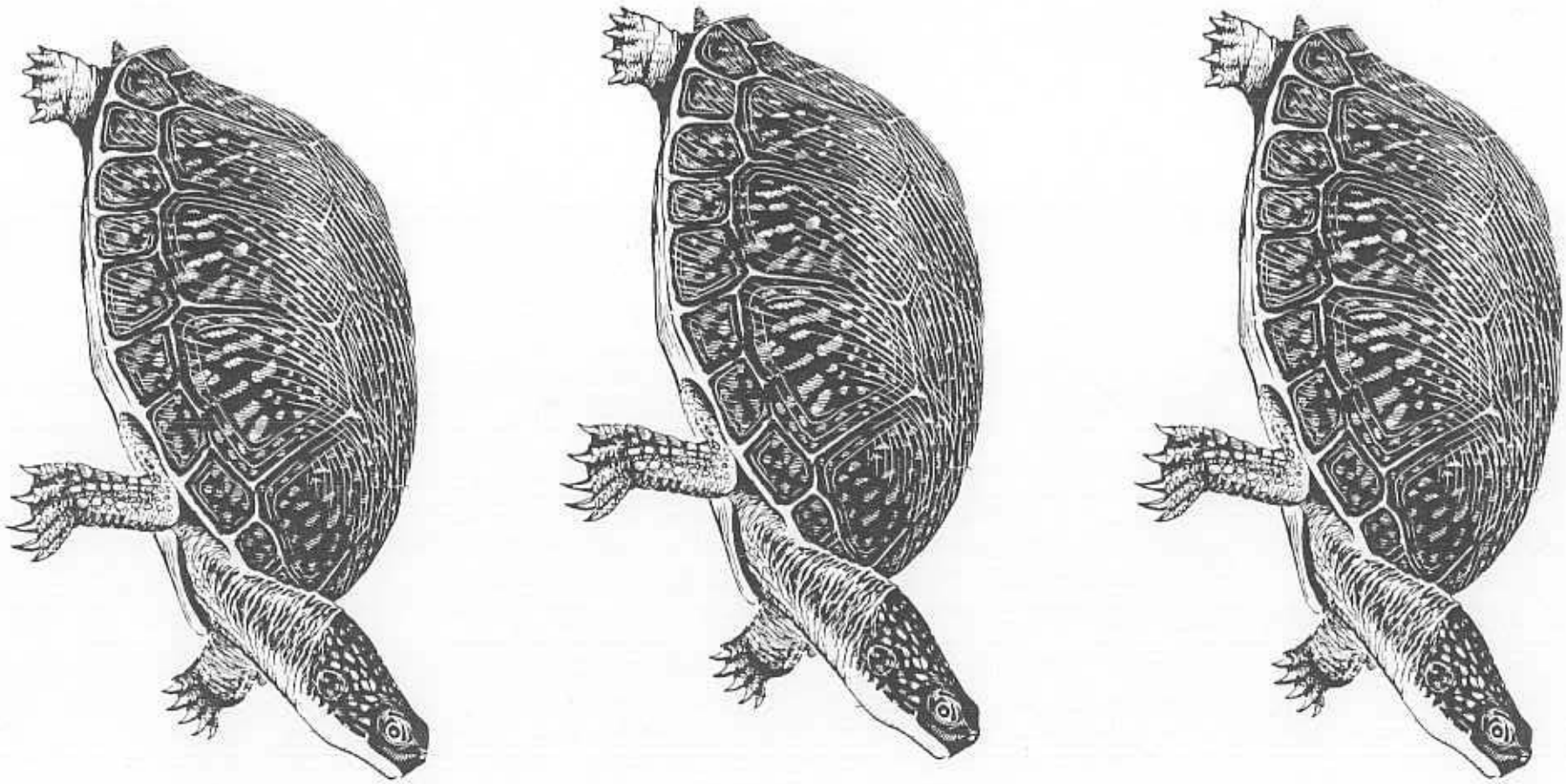
Blanding's Turtle Workshop



Blanding's Turtle Workshop

organized by

John J. Moriarty

May 7 and 8, 1998

held at

J.F. Bell Museum of Natural History

Minneapolis, MN

Workshop Sponsors

J.F. Bell Museum of Natural History
Chelonian Research Foundation
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WORKSHOP SCHEDULE

Presenters and Titles

Wednesday – May 6

8:00 Field Trip to Camp Ripley – Morrison County

Thursday - May 7

9:00 Introductions

9:15 **Justin Congdon**
Conservation and Management of Long-Lived Organisms: Lessons from Blanding's Turtle Demographics

9:50 State updates

10:10 **Michael Oldham**
Distribution, Status, and Conservation of the Blanding's Turtle in Ontario

10:30 Break

10:50 **Suzie Fowle**
Status and Conservation of Blanding's Turtles in Massachusetts

11:10 **Tom Johnson**
Blanding's Turtle in Missouri

11:30 **Dan Ludwig**
Urban Blanding's Turtle Populations in Northeastern Illinois

11:50 **John Levell**
Commercial Exploitation of Blanding's Turtles for the Live Animal Trade

12:10 Discussion

12:30 Lunch

1:40 **Jeff Lang**
Reproductive and other life history features of a central Minnesota population of Blanding's Turtles

2:00 **Todd Sajwaj**
Seasonal and Daily Patterns of Body Temperature and Thermal Behavior in Blanding's Turtles

2:20 **Steve Piepgras**
Seasonal movements, home ranges and wetland habitats of a MN population of Blanding's Turtles

2:40 **Jason Tanck**
Blanding's Turtle Population Studies - Sandhill Wildlife Area, Wood Co., Wisconsin

3:00 **Gary Casper**
Movement patterns, habitat use, and conservation strategies in Blanding's turtle in southern Wisconsin

3:20 Break

3:40 **Carol Hall**
Impacts of Controlled Wetland Drawdowns on Blanding's Turtles

4:00 **Chris Harmon** CH
Conservation of Blanding's Turtles at a Nature Conservancy Preserve in Dutchess County, New York

4:20 **Erik Kiviat**
Restoration of Wetland and Upland Habitat for Blanding's Turtles

4:40 Discussion

Friday - May 8

9:00 Announcements

9:10 **Cory Rubin**
Conservation genetics of Blanding's turtle: geog. isolation, small pop. size, and genetic diversity.

9:30 **Steve Mockford**
A Molecular Approach to the Study of Blanding's Turtle in Nova Scotia

9:50 **Tom Herman**
Recovery of a threatened Blanding's turtle population: Is headstarting a viable conservation tool?

10:10 **Lorraine Standing**
Reproduction and nest success in Blanding's Turtles in N. S.: an evaluation of the nest screening

10:30 Break

10:50 **Nat McMaster**
Movements and habitat selection of juvenile Blanding's turtles in Kejimkujik National Park, Nova Scotia.

11:10 **Ian Morrison**
Movements and habitat Selection of headstarted hatchlings in a population of Blanding's turtles

11:50 **Jeffie McNeil**
Movement of hatchling Blanding's turtles in response to varying proximities to water

12:10 **Brian Butler**
Nesting Site Subsidy and Population Structure of a Blanding's Turtle Population in Massachusetts.

12:30 Lunch

1:50 Discussion

2:10 **Christine Barlow**
Habitat Use and Home Range of Juvenile and Adult Blanding's Turtles in Northeast Indiana

2:30 **John Moriarty**
Site Fidelity and the Lack there of in Blanding's Turtles:Results of a five-year telemetry study

2:50 **Madeleine Linck**
Blanding's Turtle use of a Restored Prairie and Wetland Complex in Crow-Hassan Park Reserve, MN

3:10 Break

3:30 **Jim Harding**
Population Structure and Movements in a Suburban Blanding's Turtle Population

3:50 **Mike Pappas**
The Blanding's Turtles of Weaver Dunes, Minnesota

4:10 Discussion

4:30 **Whit Gibbons** – Blanding's Turtles – Where do We go from Here

7:00 **Minnesota Herpetological Society meeting** - Turtles and roads (panel discussion)
Suzie Fowle, Brad Kovach, John Moriarty, and others

Saturday – May 9

7:00 Field Trip to Weaver Dunes – Wabasha County

HABITAT USE AND HOME RANGE OF JUVENILE AND ADULT BLANDING'S TURTLES IN NORTHEAST INDIANA

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We are using radio telemetry to study the habitat use and patterns of movement by Blanding's Turtles in a wetland in northeastern Indiana. During the summers of 1996 and 1997, 26 Blanding's Turtles were tracked, including 11 adults, 9 juveniles and 6 hatchlings. Home range analysis revealed that the hatchlings used much smaller areas than adults and juveniles, and that older juveniles used larger areas than younger juveniles. Distinct differences in habitat use among age classes were also observed. Although younger turtles were generally associated with shallower water, dominant vegetation type appeared to be more important than water depth in describing the aquatic microhabitats of the different age groups. Movement between wetlands was observed in both the adult and juvenile age classes. Among the juveniles, it was the older individuals that moved between wetlands. Our findings suggest that a complex of wetlands containing diverse vegetation patches is necessary to support a viable population of Blanding's Turtles in the study area.

NESTING SITE SUBSIDY AND POPULATION STRUCTURE OF A BLANDING'S TURTLE POPULATION IN MASSACHUSETTS.

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MOVEMENT PATTERNS, HABITAT USE, AND CONSERVATION STRATEGIES IN A SMALL POPULATION OF BLANDING'S TURTLE (*EMYDOIDEA BLANDINGII*) IN SOUTHERN WISCONSIN.

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The presence of Blanding's Turtles was discovered during the permitting process for expansion of a landfill operation in Walworth County, Wisconsin. Blanding's turtles are a state threatened species. As part of the permit approval for landfill expansion, the applicant agreed to a number of recommendations for habitat improvement and turtle monitoring in 1992. These included savanna, prairie and wetland restoration, construction of experimental nesting mounds, placement of turtle exclusion fencing around work areas, maintenance of turtle movement corridors and nesting habitat, and annual turtle surveys with assessment of habitat use and movement. Turtle surveys have utilized visual reconnaissance supplemented with artificial basking perches, and hoop net trapping. Radio tracking was begun in 1996, and expanded yearly. The success of hoop net trapping declined dramatically after year one, possibly through avoidance learning. Basking perches were not utilized by Blanding's Turtles and discontinued after 3 years, although they were highly successful at increasing the visibility of Painted Turtles. Visual reconnaissance was effective at locating Blanding's Turtles, especially in spring. Radio tracking proved to be the most time

Gary S. Casper (continued)

and cost effective method for assessing movement and habitat use. Results to date indicate a small population (N<15), utilizing a complex of wetlands spanning approximately 1 square mile, in a former savanna landscape dominated by a mix of agriculture, overgrown woods, and a landfill operation. Movements of up to a mile between wetlands are commonplace. Reproduction is occurring, with some females nesting annually. Nesting has been observed only in active agricultural fields, with questionable nest success. No evidence of recruitment has been forthcoming to date, with the youngest turtle observed estimated to be 11 years old. Landowner interaction and cooperation have evolved from skepticism to full and enthusiastic cooperation, with a strong element of proud stewardship now evident. Accumulated data on movement and habitat use will be presented. A head starting experiment is scheduled for 1998.

CONSERVATION AND MANAGEMENT OF LONG-LIVED ORGANISMS: LESSONS FROM BLANDING'S TURTLE DEMOGRAPHICS

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A study of Blanding's Turtles conducted during 33 of the last 44 years provided demographic data sufficient to examine how life history characteristics may constrain population responses of long-lived organisms. Eight independent estimates of annual survivorship of adults of females exceeded 93%. We also examine whether long-term survivorships of males and females are different. Nest survivorship was variable and ranged from 0.0 to 63% annually, with a mean of 44% from 1976-1984 and 3.3% from 1985-1991 (results on nesting observations from 1992 to 1997 will be also summarized). Major nest predators include raccoons, foxes, skunks, and burrowing mammals. Recruitment of juveniles and adults was sufficient to replace losses due to death and emigration. A life table for the population resulted in a cohort generation time of 37 years, and required 72% annual survivorship of juveniles between 1-13 years of age to maintain a stable population. Population stability was most sensitive to changes in adult or juvenile survival and less sensitive to changes in changes in age at sexual maturity, nest survival or fecundity. The results from the present study indicate that life history traits of long-lived organisms consist of co-evolved traits that result in severe constraints on the ability of populations to respond to chronic disturbances. Successful management and conservation programs for long-lived organisms will be those that recognize that protection of all life stages are necessary. Programs such as headstarting or protection only of nesting sites may be less than adequate to save long lived organisms such as sea turtles and some tortoises.

STATUS AND CONSERVATION OF BLANDING'S TURTLES IN MASSACHUSETTS

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A substantial portion of the Blanding's turtle's (*Emydoidea blandingii*) disjunct eastern range occurs in Massachusetts. The Blanding's turtle is listed as Threatened by Massachusetts' Division of Fisheries and Wildlife because of its rarity, restricted distribution, and exposure to threats such as roads and urbanization. However, conservation efforts are hampered by lack of data on population sizes, habitat requirements, and movements between habitat patches. Massachusetts' Natural Heritage Database contains records of Blanding's turtle occurrences at 57 sites in 37 towns, reported since 1972. Only 2 of these records are based on a sustained or systematic survey effort yielding >10 individuals. Forty-three (75%) of the records are based on observations of

only 1-2 individuals, and evidence of breeding was reported at only 9 sites (16%). Ten (18%) of the records consist entirely (9%) or partially (9%) of road-killed animals, and 39 (68%) of all occurrences are 0.5 km from paved roads. Fourteen (25%) of the records occur partly or wholly on protected lands. Regulations pursuant to Massachusetts' Endangered Species Act and Wetlands Protection Act provide strong protection for Blanding's Turtles and their habitats. However, effective protection and land acquisition efforts depend on detailed, site-specific information on turtle distribution and habitat use. The Division is embarking upon a rapid assessment program to identify and map habitats that may support viable populations -- and metapopulations -- of this species.

GROWTH AND DEMOGRAPHICS OF A POPULATION OF *EMYDOIDEA BLANDINGII* FROM WESTERN NEBRASKA

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We studied a population of Blanding's Turtles (Emydoidea blandingii) in 1991 at Valentine National Wildlife Refuge, Nebraska. We trapped 70 turtles (20 females, 21 males, and 29 turtles that were juveniles or which we could not sex) and skeletal remains of 10 individuals. We determined the age of these turtles using scute annuli, where possible. Ages of live turtles were from 1-16+ yr; most (75.7%) were $\leq$ 16 yr. The mean carapace length (CL) of adult males was 203.7 mm (range = 174-232 mm) and of adult females, 184.8 mm (range = 160-213 mm). Mean mass of adult males was 1174 g (range = 750-1680 g) and of adult females, 888 g (range = 590-1380 g). Mass of all turtles was highly correlated to CL ($R^2 = 0.985$); Mass = 0.000428 $CL^{2.79}$. Also, the length of the last scute ring on the second costal scute (L) was highly correlated to CL ($R^2 = 0.933$) and was used to determine past sizes of turtles. Growth curves of males and females were not different. Turtles grew fastest in their first and second years of life than in years 3-12. We found many juveniles (47% < 10 yr old) but few very small turtles, which is a pattern in most turtle populations.

IMPACTS OF A CONTROLLED WETLAND DRAWDOWN ON BLANDING'S TURTLES

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Movements, productivity, and mortality of Blanding's Turtles (Emydoidea blandingii) were studied following a wetland drawdown at a wildlife management area (WMA) in east-central Minnesota. Adult radio-tagged turtles were monitored at the WMA and at a control site between April and September 1990. Turtles that traveled 0.8 km or less from each site returned to the original wetland to overwinter. A small proportion of the radio-tagged turtles emigrated from both sites and did not return to overwinter. Oviducal eggs were detected in females at both sites but nesting success was not determined. No mortality was observed in control site turtles, however mortality at the WMA was high; 5 of 10 radio-tagged turtles died and 20 additional carcasses were found at the site. Death resulted from predation, road mortality, and winterkill. The drawdown concentrated turtles into a diminished lakebed, forced them to cross terrestrial habitats and placed them in vulnerable situations. High adult mortality following drawdowns may have a significant impact on the survival of local turtle populations that rely on long-lived adults to compensate for low recruitment of young.

POPULATION STRUCTURE AND MOVEMENTS IN A SUBURBAN BLANDING'S TURTLE POPULATION

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A population of Blanding's Turtles in Ingham County, Michigan, is being gradually engulfed by residential development, leading to diminished habitat and increasingly perilous overland migration routes between feeding, hibernating, and nesting areas. A preliminary attempt to mark the population using hand-capture and trapping may be followed up with telemetry studies in the future. Early results suggest a declining population dominated by old adults. Cooperation of sympathetic neighbors and local residents and township officials is critical to the success of such urban studies. The suitability of wetland habitats bordered directly by suburban yards will be assessed; road mortality, coupled with attacks by overly-numerous raccoons and free-running dogs, may be the greatest immediate threats.

CONSERVATION OF BLANDING'S TURTLES AT A NATURE CONSERVANCY PRESERVE IN DUTCHESS COUNTY, NEW YORK

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Overlook Wetland, located in the town of LaGrange, Dutchess County, New York, became a Nature Conservancy preserve after the discovery of Blanding's Turtles (*Emydoidea blandingii)* there in 1985. Studies have since been conducted to determine the habitat preferences, nesting migrations, and population structure of this turtle population. A joint project of The Nature Conservancy, the NYS DEC Endangered Species Unit, and Cornell University College of Veterinary Medicine was initiated to "head-start" hatchling turtles to diversify the age structure and increase the size of the population.

Since 1990, attempts have been made to improve nesting habitat, monitor nesting activities and trap and radio-track adult females to discover new nesting areas. The study objectives include: mark-release-recapture efforts to estimate the population size; determining age and sex structure of the population; searching for juvenile turtles; monitoring known or potential nesting areas and gravid females to find and protect nests; developing new areas on the preserve that are conducive to nesting by Blanding's Turtles; reintroducing head-started hatchlings to the population and monitoring their movements.

We will discuss our information to date, including our success in monitoring gravid females, finding and protecting nesting sites, establishing new nesting areas favorable for the Blanding's, and enhancing recruitment by reintroduction of head-started juveniles.

RECOVERY OF A THREATENED BLANDING'S TURTLE POPULATION: IS HEADSTARTING A VIABLE CONSERVATION TOOL?

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To assess the appropriateness of headstarting hatchling turtles as a conservation tool for the recovery of the Threatened (Committee on the Status of Endangered Wildlife in Canada) population of *E. blandingii* in Nova Scotia, we compared behavior, habitat selection, movement patterns, and over wintering sites between headstarted and wild juveniles. Head started turtles were released and wild turtles were captured by visual sampling and hoop trapping in presumptive juvenile habitats in Kejimkujik National Park between 1993 and 1996.

Fifteen headstarted hatchlings and ten wild juvenile turtles of varying size and age were radio tracked. Behaviors of headstarted hatchlings were similar to those of wild juveniles of the same size; smaller turtles were more secretive, spending the majority of time hidden beneath vegetation while larger juveniles were most frequently observed basking on vegetation or floating with the head at the surface. Movement distances increased with increasing size and varied between the seasons. During the active season, both headstarted and wild juveniles concentrated their activities in areas characterised by slow flowing, steeply banked, darkly coloured streams, and sheltered bays at the outflow of these streams in habitats dominated by *Sphagnum* sp., *Utricularia* sp. and *Carex* sp. Turtles moved up stream in late September to aquatic hibernacula.

Headstarted and wild juveniles used similar hibernacula, and in some instances members of each group used the same site. Over wintering sites were within the areas used during the active season, but did not include lake habitat. Hibernacula appear to have unique features such as reduced flow rates and more emergent vegetation cover (*Chamaedaphne calyculata*, Myrica Gale). Winter activity was minimal although movements were made in response to fluctuating water levels.

Headstarted and wild subadult Blanding's Turtles occupy similar habitat and have similar seasonal behaviour patterns. Our concern that headstarted turtles behave differently than wild juveniles is not supported, and we conclude that headstarting could be an appropriate method of enhancing recruitment in this population if survivorship is not compromised.

BLANDING'S TURTLE IN MISSOURI

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The Blanding's turtle was first discovered in Missouri in 1950 in the extreme northeastern corner of the state. Several sightings were made during the 1980's in other parts of the state, but populations in those locations have not been verified. Wetland habitat of one small colony in the northeast corner was purchased by the Missouri Department of Conservation in 1982. Several surveys were made of the two known populations in northeastern Missouri. This paper will discuss the locations, habitats and status of Blanding's Turtles in Missouri.

RESTORATION OF WETLAND AND UPLAND HABITAT FOR BLANDING'S TURTLE

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The habitats of the Blanding's turtle (*Emydoidea blandingii*, Threatened in New York) are being altered by suburbanization in Dutchess County. We designed a project to mitigate the loss of wetland and upland habitat caused by a public school expansion. Limited experiments with artificial nesting areas and inadvertent creation of wetland habitat provided models. Our goal was to create: 1. Mature shrubby wetlands with groundwater discharge, organic soils, sunny pools, and basking logs, totalling 1.4 ha; 2. Upland nesting areas with well drained, coarse textured, sparsely vegetated soils; and 3. A dredged pool for refuge during droughts. The 0.7 ha wetland to be filled for the school was on an outwash plain at the edge of a complex of Blanding's turtle habitats. Following drift fence and pitfall trapping, the "donor" wetland was drained. Intact organic sods 1.2 x 3 x 0.4 m, from the donor wetland, with vegetation including trees to 10+ cm dbh, were moved 200-700 m to excavated basins. Organic soil was salvaged to fill between sods. Non-sod wetland and upland areas were planted. Habitats were built and planted October 1996 to June 1997. A 1.5 km long fence, with ramps and curbs to allow one-way passage of turtles, was built to separate school facilities from the turtle habitat complex. We monitored Blanding's turtle activity by trapping and radiotelemetry before and after construction. During the 1997 nesting season, all 11 telemetered females used the new wetlands for rehydration, and all nested on the new uplands, producing 104 live hatchlings. One to three adults simultaneously used the new wetlands throughout summer and fall. After one season, the development of the habitats and their use by Blanding's Turtles look promising, but turtle use could increase or decrease over time, and long-term monitoring is essential. Because of the uncertainties associated with the replacement of existing wetlands, wetland construction should be used to increase habitat for rare species rather than to mitigate the planned destruction of wetlands.

REPRODUCTIVE AND OTHER LIFE HISTORY FEATURES OF A CENTRAL MINNESOTA POPULATION OF BLANDING'S TURTLES

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During 1996-97, we conducted a two year field study of Blanding's Turtles (*Emydoidea blandingii*) inhabiting a military reservation, Camp Ripley, in central Minnesota. Using aquatic trapping and road collecting during the nesting season, we marked and studied 23 males, 35 females, and 13 juveniles living in three areas of wetlands inside and outside base boundaries. Estimated densities were typically lower than those determined in other populations, and ranged from 0.95 to 0.48 turtles/ha. We estimated about 300-500 turtles occupy suitable habitat on base and in adjacent wetlands. Some turtles spent the summer on base, but overwintered off base, necessitating joint management with nearby private landowners. Reproduction is seasonal, and most females that we monitored nested in open, disturbed areas once each year. Mean clutch size was 17.7 eggs (n=31 nests), laid in mid June and hatched in September, about 83 days. Hatchlings that we observed did not overwinter in nests, but emerged before October, and presumably moved to adjacent wetlands. Large females produced larger clutches of larger eggs that resulted in larger hatchlings, in comparison with small females. Adult males were larger than females; compared to populations elsewhere, both sexes in this population reach maturity at large body sizes at an early age. Thus, Blanding's Turtles at the northwest limit of the species' range show rapid growth, large body size, and accelerated maturation relative to other populations. In this population, reproduction is characterized by large clutch size, large clutch mass, large egg size, and annual clutch production by individual turtles. Taken together, these reproductive and life history features distinguish the turtles we studied from those investigated elsewhere.

COMMERCIAL EXPLOITATION OF BLANDING'S TURTLES, *EMYDOIDEA BLANDINGII*, FOR THE LIVE ANIMAL TRADE

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The "Pet" or "Live Animal" trade is often implicated as a contributing factor in the continued long-term decline in wild populations of a wide variety of chelonian species including *Emydoidea blandingii*. Unfortunately, such statements are rarely accompanied by corroborating information of any kind and usually provide little more than purely anecdotal "assessments" of the actual impact of the animals trade on each of the various species involved. As is true of virtually all aspects of conservation biology, such unsubstantiated comments are of little value and should be viewed with some degree of skepticism. Accurate, more realistic evaluations of the effect of commercialization are only possible via the collection and analysis of pertinent data. To begin examining the extent of commercial activities involving Blanding's Turtles, preliminary data regarding the species has been gathered from a variety of sources associated the live animal marketplace. These information resources include the stock/price lists of animal dealers (both within and outside the United States), classified advertisements in regional, national, and international herpetological and animal trading periodicals, personal communications, and a variety of "first-hand" experiences at amphibian and reptile stores, "swap-meets" and expositions. A summarization of the encouraging results of this investigation, as well as additional relevant comments and recommendations are provided in this report.

BLANDING'S TURTLE USE OF A RESTORED PRAIRIE AND WETLAND COMPLEX IN CROW-HASSAN PARK RESERVE, MINNESOTA

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Hennepin Parks' Crow-Hassan Park Reserve is a 2,500 acre park with an 800 acre recreated prairie and wetland complex. The recreated prairie is between 15 and 25 years old. Most of the small wetlands were excavated or had tiles broken during the prairie planting. Prior to prairie planting, the park was mainly row crop and pasture. Between 1992 and 1995 eighteen Blanding's Turtles were marked. Most of these turtles were old (25+ years) and predate the prairie restoration.

The Blanding's Turtles used a variety of the wetlands within the prairie, including 4 created and 2 "improved" wetlands. Most nesting attempts were within the planted prairie. Out of 14 known nesting attempts half were in prairie units that were burned earlier the same spring as the nesting. These nestings show that recently burned prairies are important in attracting nesting females.

Blanding's Turtles appear to have adapted well to the restored habitat, which is of adequate size and complexity.

URBAN BLANDING'S TURTLE POPULATIONS IN NORTHEASTERN ILLINOIS

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This presentation will review inventory work (1994 - 1995); assessment of population characteristics and turtle movements (1995 - 1997); and head-starting (1996 - 1997) and population management. Two populations (23 and 42 turtles) restricted to small isolated wetlands (306 and 575 acres) will be highlighted.

MOVEMENTS AND HABITAT SELECTION OF JUVENILE BLANDING'S TURTLES (*EMYDOIDEA BLANDINGII*) IN KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA.

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The overall objective was to determine habitat selection and movement patterns of juvenile Blanding's Turtles in Kejimkujik National Park, Nova Scotia, by use of trapping and radio-tracking. Seventeen new unmarked juvenile Blanding's Turtles were found in Kejimkujik National Park in summer 1995. Juvenile density correlated with adult and nesting density in each area of concentration. Juveniles and adults occupied similar habitat; however, juveniles tended to concentrate their activities in areas with a medium to high density of sphagnum overlain by sweet gale, leather leaf and/or grass. Seasonal ranges and displacements between successive captures increased with age, and depend on the amount of suitable habitat in an area.

MOVEMENT OF HATCHLING BLANDING'S TURTLES (*EMYDOIDEA BLANDINGII*) IN RESPONSE TO VARYING PROXIMITIES TO WATER

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A manipulative experiment was conducted to determine the response of Blanding's turtle hatchlings to water. Thirty-six newly emerged hatchlings from four nests were dusted with fluorescent powder and released at 3 different locations along the beach: 1) 25cm from water; 2) 25cm from the shrub border at the top of the beach; and 3) average distance of the nests from water (~20m).

The trails left behind by the powder were flagged at night using a hand held UV light and mapped during the day. The trails from the first day after release were analyzed for directionality using descriptive circular statistics. The length of the mean vector was calculated from trails from each release site and was used as a measure of directedness to determine if hatchling movements from each group were directed toward water.

Trails varied considerably in length and tortuosity. Eight turtles entered water over the study. Seven of these entered water on the first day of release and one on the third day. None of the groups displayed directed movement. Only 4 of 12 turtles released at the water's edge entered the water and one of these remained in the water only 1.25 hours before returning to the beach.

A MOLECULAR APPROACH TO THE STUDY OF BLANDING'S TURTLE IN NOVA SCOTIA

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[2] Biology Department, Acadia University, Wolfville, Nova Scotia
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Since 1995 we have been employing DNA typing techniques in the study of Blanding's turtle in Nova Scotia. Initial research using random amplified polymorphic DNA (RAPD) suggested that the Nova Scotia population differed significantly from populations in the species' main range. In addition, this research suggested that genetic variability within the Nova Scotia population is higher than might be expected in a small isolated population; higher than some populations tested from within the species' main range. This initial genetic investigation using RAPD was limited by small sample sizes but none the less proved interesting enough to justify both, expanding sample sizes and moving to a more sensitive technique.

We are currently developing a suite of microsatellite primers for use with Blanding's turtle. Microsatellites assays are done using the polymerase chain reaction (PCR) which allows for the nondestructive collection of very small tissue or blood samples. In addition, microsatellites exhibit codominant Mendelian inheritance which allows identification of both alleles per locus per individual. These properties make microsatellites an appropriate choice for the study of mating systems and population structure. We will use these markers to: look for incidence of multiple paternity in individual clutches of Blanding's turtle eggs; look for genetic structure within the Nova Scotia population of Blanding's turtle; and compare the Nova Scotia population to populations from within the species' main range.

SITE FIDELITY AND THE LACK THERE OF IN BLANDING'S TURTLES: RESULTS OF A FIVE-YEAR TELEMETRY STUDY

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Since 1992, Hennepin Parks has conducted a radio-telemetry study on a population of Blanding's Turtles in Crow-Hassan Park Reserve in Hennepin County, Minnesota. A total of nine turtles, 8 female and 1 male, have been radioed with varying lengths of time ranging from 2 to 60 months. The site fidelity varied from year to year and individual to individual. The strongest fidelity was a female who used the same basking log for the entire 5-year time period and hibernated in the same location one km north in a different wetland. Another female over wintered in different wetlands and summered in a series wetlands. The one radioed male turtle spent a full year in one wetland then the following spring and summer went on a grand tour and overwintered in the same wetland.

Nesting fidelity was just as variable. The female with strong summer and winter fidelity nested in four different areas. Several females nested at least twice in the same location.

MOVEMENTS AND HABITAT SELECTION OF HEADSTARTED HATCHLINGS IN A THREATENED POPULATION OF BLANDING'S TURTLES (EMYDOIDEA BLANDINGII) IN KEJIMKUJIK NATIONAL PARK, NOVA SCOTIA.

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The Nova Scotia population of Blanding's turtle, like those elsewhere, appears to have an uneven age structure, with low recruitment into the breeding population. Between 1969, when regular monitoring of the population began, and 1992 only six subadults had been located. The apparent low recruitment in this threatened population (COSEWIC) led us to investigate whether the scarcity of juveniles was real. We followed headstarted turtles in an attempt to identify critical juvenile habitats, to locate wild juvenile turtles and to determine their abundance.

In 1993 and 1994, fifteen neonate Blanding's Turtles were collected upon emergence from natural nests and raised in captivity over winter. Headstarted turtles were released in spring 1994 and 1995, and radio tracked until early winter 1996. Turtles were released in Kejimkujik National Park in habitat known to support adult Blanding's Turtles, and their behaviour and movements were recorded throughout all seasons.

Four different aquatic habitats were used during the active season (May - August): an isolated roadside swamp, sheltered bays, and small inflow brooks and adjacent floodplains. All habitats are characterized by darkly coloured water and *Sphagnum* sp. mats. Turtles remained in the same habitat throughout the active season and concentrated activity in areas of heavy sphagnum and herbaceous shrubs. In 70.5% of field observations, turtles were hidden in aquatic mats of sphagnum. Overland movements (max. 270 m) occurred through deciduous (hardwood) forest and floodplains, and turtles remained in terrestrial habitat for up to 14 days.

In late August and early September, prior to hibernation, turtles migrated upstream. Turtles hibernated in stream channels, floodplains and a swamp, but did not use lake or terrestrial habitat. Among years, individuals used similar sites. Hibernation (periods of minimal movements (< 1m)) began in November; turtles left hibernacula in early May.

Headstarted turtles in this study used the same habitats as adults and led us to natural wild juvenile turtles. Though we have identified numerous wild juveniles, their relative scarcity in this population is still a concern.

DISTRIBUTION, STATUS, AND CONSERVATION OF THE BLANDING'S TURTLE IN ONTARIO

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The Blanding's Turtle (Emydoidea blandingii) may have a greater portion of its global range and more populations in Ontario than in any other jurisdiction. Ontario is one of only three North American jurisdictions where the species is ranked S4 ("uncommon to common", generally on the order of 101 to 1,000 extant occurrences) by state and provincial conservation data centres (CDC's); the others are Michigan and Nebraska. Four CDC's (IL, IA, NH, WI) consider Blanding's Turtle an S3 species ("rare", generally in the order of 21 to 100 extant occurrences), seven CDC's (IN, MA, ME, MN, NY, OH, QC) consider it S2 ("imperiled", generally in the order of 6 to 20 extant occurrences), while four CDC's (MO, NS, PA, SD) rank it S1 ("critically imperiled", generally in the order of 1 to 5 extant occurrences). The species is reported (SR) from Rhode Island, without compelling evidence for acceptance or rejection of the report, and has been reported falsely (SRF) from Wyoming. An analysis of the 1,640 Ontario Blanding's Turtle records contained in the Ontario Herpetofaunal Summary (a province-wide amphibian and reptile

Michael J. Oldham (continued)

atlas project initiated in 1984) database indicates that most Ontario populations are apparently rather small and located primarily around Georgian Bay and the southern edge of the Precambrian Shield in south-central Ontario. Fewer, but larger, populations are located in shoreline marshes along Lakes Erie and St. Clair. Populations in southwestern Ontario have probably declined more than those elsewhere in the province due to extensive habitat loss in this region. Blanding's Turtles have been little studied to date in Ontario, but range-wide concern for the species coupled with the fact that Ontario comprises a significant portion of the global distribution, indicates that the species should be closely monitored in the province.

THE BLANDING'S TURTLES OF WEAVER DUNES, MINNESOTA

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SEASONAL MOVEMENTS, HOME RANGES AND WETLAND HABITATS OF A CENTRAL MINNESOTA POPULATION OF BLANDING'S TURTLES

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Seasonal and daily movements in free ranging Blanding's Turtles (*Emydoidea blandingii*) were studied at Camp Ripley, a military reservation in central Minnesota at the northern limit of the species' range. The movements of 46 turtles (15 males, 24 females, and 7 juveniles) were monitored from 10 to 16 months, including two summers and an intervening winter. Data from 25 representatives were analyzed to determine temporal and spatial patterns, as well as activity centers, home ranges and preferred wetland habitats. Turtles typically moved overland long distances from summer wetlands to overwintering sites in shrub swamps; then they returned to the same summer wetlands the next season. Others remained in the same few marshes throughout the year. During mid-April to mid-November, males moved among various wetlands more often, but over shorter distances relative to females and juveniles. Males also had more activity centers, but these were smaller in area relative to those of females and juveniles. Home ranges of males and females were similar in area, but larger than those of juveniles. A terrestrial buffer zone of 300 meters around complex of 15 wetlands inhabited by 16 monitored turtles would protect all known nest sites and travel corridors for this concentration of turtles. Our results highlight the need to reconsider existing wetland protection guidelines at state and federal levels. At Camp Ripley, it will be necessary to designate and protect an intact area of wetlands and uplands, both on and off the base, to protect critical habitats and to insure the continued survival of Blanding's Turtles.

CONSERVATION GENETICS OF BLANDING'S TURTLE POPULATIONS: GEOGRAPHIC ISOLATION, SMALL POPULATION SIZE, AND GENETIC DIVERSITY.

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As a result of habitat fragmentation the Blanding's turtle (*Emydoidea blandingii*) is experiencing population declines distribution-wide. Among other things, an understanding of population genetic structure is essential to the

development of any reliable conservation plan. Theory predicts that small populations lose genetic variation through genetic drift and inbreeding, resulting in an increased risk of extinction. To determine whether small isolated populations of Blanding's Turtles are genetically depauperate, genetic comparisons were made among six populations of varying size and geographic distance using randomly amplified polymorphic DNA (RAPD) markers. These comparisons show that a decline in population size parallels a decline in genetic diversity (Shannon's Diversity Index, percent bandsharing, and polymorphic marker frequency), indicative of a higher degree of inbreeding. Furthermore, geographically distant populations (Fst =3D 0.333) show greater population subdivision than local populations (Fst =3D 0.078). However, a cluster analysis based on genetic distance does not completely reflect geographic isolation, suggestive of low mutation rates. These results affirm that Blanding's turtle populations lose genetic diversity as populations decline, enhancing the probability of extinction. Hence, the persistence of the Blanding's turtle over ecological and evolutionary time may be dependent upon maintaining an appropriate amount of genetic diversity.

SEASONAL AND DAILY PATTERNS OF BODY TEMPERATURE AND THERMAL BEHAVIOR IN A CENTRAL MINNESOTA POPULATION OF BLANDING'S TURTLES.

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Seasonal and daily patterns of body temperature (Tb) in free-ranging Blanding's Turtles (*Emydoidea blandingii*) were studied at Camp Ripley, a military reservation in central Minnesota at the northern limit of the species' range. Internal body temperatures of 29 individuals were recorded continuously for intervals of 2 to 16 months, including two summers and an intervening winter via surgically implanted data loggers. External shell temperature and activity were monitored via sensors in carapace mounted radio transmitters. Operative temperatures (Te) were estimated with fiberglass models to demonstrate the range of possible body temperatures in the field. Using this information, we examined how external and internal factors affected Tb patterns in individual males and females inhabiting marsh wetlands. Seasonal environments had major effects on turtle Tbs. In winter (November thru April), Tbs were <2C, at ambient water temperatures (< 1 m depths). During May through October, three distinct daily Tb patterns were evident: thermoregulation (Tb max. û min. 11C), thermoconformity (Tb max. û min. 6C), and an intermediate pattern (11 > Tb max. û min. > 6C). The dominant daily pattern on clear, sunny days changes seasonally. In May, about 90% of the monitored turtles thermoregulated daily; by July to September, the overall percentage had declined to about 45%. Continuous records provide an estimate of activity, previously unavailable for such secretive species. The activity, behavior, and energetics of this predominantly aquatic turtle are largely dependent on water temperature and available solar radiation. Wetland management practices that adversely affect water temperature regimes (e.g., draw downs or damming or fragmentation of existing wetlands) would likely threaten the continued survival of Blanding's Turtles in such altered habitats.

REPRODUCTION AND NEST SUCCESS IN A THREATENED POPULATION OF BLANDING'S TURTLE IN NOVA SCOTIA: AN EVALUATION OF THE NEST SCREENING PROGRAMME.

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As part of the annual Blanding's Turtle monitoring programme in Kejimkujik National Park, Nova Scotia, nests are screened against depredation on the night of oviposition. While the screens are effective in guarding against predators such as skunks and racoons, clutch and egg failure remain high in this population. The effects of non-predatory mortality factors appear important to annual hatching success and recruitment. Flooding and cool temperatures can substantially reduce nest success in some years, thereby reducing the effectiveness of the nest protection programme. We report on egg and hatchling success between 1987 and 1997 and evaluate the effectiveness of nest screening in bolstering recruitment in a threatened Nova Scotia population of Blanding's Turtle.

BLANDING'S TURTLE POPULATION STUDIES - SANDHILL WILDLIFE AREA, WOOD COUNTY, WISCONSIN

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Blanding's Turtles (*Emydoidea blandingii*) have been monitored at the 4,159 hectare Sandhill Wildlife Area, Wood County, Wisconsin,as part of an educational program designed to provide 4th through 12th grade students with an understanding of and appreciation for wetlands. Blanding's Turtles have been captured opportunistically since 1990, and in hoop nets since 1995, marked and released, and some individuals have been radioed and their movements followed. Nearly one-third of the 107 turtles captured through 1997 were juveniles (<15 rings/years). Survival rates, estimated using the Fuller-Heisey radio-days method, were estimated at 70 percent for males (n=9); 62 percent for females (n=9); 66 percent for adults (n=18). Turtles move extensively; home ranges of 3 males followed for 5 summers averaged 19 hectares, ranging from 4.5-33 hectares (19 acres; 10-72 acres), whereas 2 females followed in 1 summer averaged 12 hectares, ranging from 11-13 hectares (26 acres; 24-28 acres). One marked turtle moved > 6km between April and September. Jolly-Seber population estimates in the intensive southeast study site ranged from 14 to 31 individuals in 91 hectares of suitable marsh habitat; densities were therefore between 1.5 and 3.4 turtles per 10 hectares. Population estimates for the entire facility range from 220-661 using Lincoln's Index, to 163-431 using unbiased Jolly-Seber method. Blanding's Turtles on Sandhill seem to be secure.

POPULATION STRUCTURE AND REPRODUCTIVE ECOLOGY OF THE BLANDING'S TURTLE (*EMYDOIDEA BLANDINGII*) IN SOUTHERN MAINE

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ABSTRACT

We investigated the population structure and reproductive ecology of a small population of Blanding's turtles at the northeastern periphery of their range using mark-recapture methods and radio-telemetry. During 1992 and 1993, thirty-four turtles were captured on two 9 km^2 study sites and nine of the turtles were radio-tagged. The sex ratio was not significantly different from 1:1, and we did not detect any differences in body size between males and females. The age structure of the population was uneven, with an apparent scarcity of juveniles. Although the turtles occupied several discrete wetlands, the population seemed to be panmictic.

Six nests were located and monitored from oviposition to hatchling emergence. Nesting dates ranged from 13-20 June. Four of the six nests were in human-altered sites, and two were in soil-filled cracks in bedrock. Nests were located 70-410 m (mean = 242) from the nearest water. Clutch size ranged from 5-11 (mean = 8.50) eggs. Emergence took place 68-118 days (Aug 25-Oct 10) after egg deposition. Twenty-four hatchlings emerged from 51 eggs (47%). Egg failure was due to infertility or arrested development (24%), or invertebrate predation (27%).

CONSERVING WETLANDS AT A LANDSCAPE SCALE: A CASE STUDY OF SPOTTED AND BLANDING'S TURTLES IN SOUTHERN MAINE

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ABSTRACT

The spotted (Clemmys guttata) and Blanding's (Emydoidea blandingii) turtles are listed as threatened in the state of Maine, where they are near the northern periphery of their ranges. We investigated seasonal movements and habitat use of both species using mark-recapture (84 spotted, 34 Blanding's marked), wetland surveys, and radio-telemetry (16 spotted, 9 Blanding's, radio-tagged for 1-3 seasons).

Both species used the upland/wetland matrix similarly. Upland areas were used for nesting, estivating, and traveling between wetlands. Most spotted turtles followed a seasonal pattern of emergence from hibernation, travel overland to an activity pool(s), nesting excursion and return to pool (for females), overland travel to estivation site, and overland travel to hibernation site. Seasonal patterns in Blanding's turtle movements were not as apparent. Total distance traveled overland throughout a season ranged from 0-1.68 km (mean = 0.80) for radio-tagged spotted turtles and 0-6.76 km (mean = 2.90) for radio-tagged Blanding's turtles. Spotted and Blanding's turtles used multiple wetlands throughout the season.

Habitat use was significantly different between 1992 and 1993, with both species spending more time upland during 1993. Warmer and drier weather during 1993 caused seasonal wetlands to dry up earlier in the year. Wetlands occupied by spotted and Blanding's turtles were larger, had a longer hydroperiod, received more sun-hours, and were less isolated than unoccupied wetlands. Nesting and estivation sites were located in upland areas, wet meadows, or forested or scrub-shrub swamps. Nests were 1-120 m (spotted) and 70-410 m (Blanding's) from the nearest wetland. Upland estivation sites were 12-80 m (spotted) and 30-110 m (Blanding's) from the nearest wetland boundary. Spotted and Blanding's turtles estivated for 15-89+ days and 3-22 days at a time, respectively. Both species hibernated in forested or scrub-shrub swamps, or pools. Spotted turtles also hibernated in streams. Four of 16 radio-tagged spotted turtles hibernated communally. This study suggests the importance of maintaining buffers around wetlands for nesting, estivation and upland movements, and the importance of conserving wetlands in groups.

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