Development of a Herptile Monitoring Program for the Lake Superior Basin

Results of a workshop held in Association with the 17th Annual Meeting of the Society for Conservation Biology

Duluth, Minnesota
June 30, 2003

Compiled By Lisa David
October 2003

Introduction

The Terrestrial Wildlife Community Committee of the Binational Program to Restore and Protect Lake Superior organized a herptile monitoring workshop held in conjunction with the 2003 *Society for Conservation Biology* annual meeting, which was held in Duluth, Minnesota. The goal of the one-day workshop was to bring together reptile and amphibian experts from around the Lake Superior Basin to initiate discussion for the implementation of a basin-wide herptile monitoring program. Specific workshop objectives were:

- to identify species which warrant monitoring,
- to identify which species can be effectively monitored, and
- to begin discussing appropriate monitoring methods or techniques for the species identified.

Funding for this workshop was provided by the Environmental Protection Agency, grant number GL96502301-2.

Background

The Lake Superior Lake-wide Management Plan (LaMP 2000) has identified reptiles and amphibians as a critical group to be monitored, since they are sensitive to both anthropogenic perturbations and to chemical contaminants. It is believed that since Lake Superior is at the northern edge of the natural range of many herptile species declines in their abundance within the basin may be indicative of pending declines elsewhere. Herptiles may also be particularly useful for monitoring in the Areas of Concern (as defined in the Great Lakes Water Quality Agreement) to document progress in remediation and restoration at those sites.

Lake Superior Basin Herptile Species

Thirty-seven amphibian and reptile species occur in and are considered ecologically significant components of the Lake Superior watershed (Table 1). The following species list was taken from "*A Review of the Amphibians and Reptiles of the Lake Superior Watershed, Technical Report provided to the Terrestrial Wildlife Community Committee, for the Lake Superior Lakewide Management Plan*," submitted by G. Casper, 2002. (The entire report can be accessed at http://www.mpm.edu/collect/vertzo/herp/Casper/casper.html Note: this URL is case sensitive)

Table 1. Herptile species in the Lake Superior basin.

Caudata: Salamanders	
Family Proteidae: Mudpuppies	
Common Mudpuppy	*Necturus maculosus maculosus*
Family Salamandridae: Newts	
Eastern Newt	*Notophthalmus viridescens*
Family Ambystomatidae: Mole Salamanders	
Spotted Salamander	*Ambystoma maculatum*
Blue-spotted Salamander	*Ambystoma tigrinum tigrinum*
	Ambystoma laterale
Family Plethodontidae: Lungless Salamanders	
Four-toed Salamander	*Hemidactylium scutatum*
	Plethodon cinereus
Anura: Frogs and Toads	
Family Bufonidae: True Toads	
Eastern American Toad	*Bufo americanus americanus*
Family Hylidae: Treefrogs and Relatives	
Western Chorus Frog	*Pseudacris triseriata*
Northern Spring Peeper	*Pseudacris maculata*
Eastern Gray Tree frog	*Pseudacris crucifer crucifer*
Cope’s Gray Treefrog	*Hyla versicolor*
	Hyla chrysoscelis
Family Ranidae: Typical Frogs	
American Bullfrog	*Rana catesbeiana*
Mink Frog	*Rana clamitans melanota*
Wood Frog	*Rana septentrionalis*
Northern Leopard Frog	*Rana sylvatica*
	Rana pipiens
	Rana palustris
Testudines: Turtles	
Family Chelydridae: Snapping Turtles	
Eastern Snapping Turtle	*Chelydra serpentina serpentina*
Family Emydidae: Pond and Box Turtles	
Wood Turtle	*Clemmys insculpta*
Painted Turtle	*Emydoidea blandingii*
Northern Map Turtle	*Chrysemys picta*
	Graptemys geographica
Family Trionychidae: Softshell Turtles	
Eastern Spiny Softshell	*Apalone spinifera spinifera*

Table 1. Continued.

Squamata, Lacertilia: Lizards	
Family Scincidae: Skinks	
Common Five-lined Skink	*Eumeces fasciatus*
	Eumeces septentrionalis septentrionalis
Squamata, Serpentes: Snakes	
Family Colubridae: Typical Snakes	
Northern Ring-necked Snake	*Diadophis punctatus edwardsii*
Western Foxsnake	*Opheodrys vernalis*
Eastern Milksnake	*Elaphe vulpina vulpina*
Eastern Hog-nosed Snake	*Lampropeltis triangulum triangulum*
Bullsnake	*Heterodon platirhinos*
Dekay's Brownsnake	*Pituophis catenifersayi*
Northern Red-bellied Snake	*Storeria dekayi*
Common Gartersnake	*Storeria occipitom aculata occipitom aculata*
Northern Watersnake	*Thamnophis sirtalis*
	Nerodia sipedon sipedon

Workshop Synopsis

Nine 20-minute presentations were given during the afternoon session of the workshop (complete presentation abstracts are located in Appendix I). The session opened with a presentation outlining the range and status of each herptile species found in the basin. Synopses of statewide or range-wide monitoring surveys were given for Michigan, Minnesota, and the Upper Mississippi; along with synopses of comparative survey techniques and the various considerations or approaches to monitoring studies. Other presentations highlighted research studies recently conducted on the five-lined skink, snapping turtles and mudpuppies.

A moderated, round-table discussion aimed at establishing herptile monitoring priorities in the Lake Superior basin was the focus of the workshop's evening session (participant list follows in Appendix II). Initial discussions concentrated on determining the most acceptable means of identifying those herptile species that warranted monitoring. The need for statistical rigor in data collection was stressed, as was the appropriateness of monitoring species at the edge of their ranges. The group decided that of the 37 species found in the Lake Superior basin a subset should be identified through a vote-tallying process by all those present. Considerations for vote casting were whether a species could be monitored reliably (i.e. with statistical rigor), and whether a species was common or rare.

Votes were cast via a show of hands for each species that workshop participants (n=38) thought merited monitoring. Each participant was entitled to vote for as many species as he or she wanted.

Species were then ranked in descending order based upon the number of votes they received. The voting results are shown in Table 2. After ranking the 37 species participants agreed to eliminate those seven species which scored fewer than five votes. The species removed from further discussion were the prairie skink, milk snake, bull snake, brown snake, tiger salamander, map turtle, and spiny softshell turtle.

The pros and cons of grouping the remaining herptile species into different assemblages for monitoring purposes was debated. There was a desire to group species together in a <u>habitat approach</u> or in a similar or effective survey <u>method approach</u>. In the end, the remaining 30 species were individually categorized into what the group decided were the 10 most effective herptile monitoring methods. Monitoring methods selected were:

- calling surveys
- aquatic cover objects
- general cover objects
- aquatic funnel traps
- hoop net traps
- basking traps
- visual encounters
- egg mass surveys
- drift fences with traps
- dip net surveys

Although standardized protocol for all herptile surveys in the Lake Superior basin will be established in the future, the following loosely describes the monitoring methods selected. <u>Calling surveys</u> require the establishment of a survey route encompassing a variety of habitats where auditory assessments are performed to determine the abundance or presence/absence of herptile species. <u>Aquatic and general cover object surveys</u> involve the placement of natural or artificial objects in suitable environments which may attract herptiles seeking protective cover; these sites are later revisited to record species found beneath them. <u>Aquatic funnel traps, hoop net traps, basking traps and drift fences with traps</u> all involve the temporary placement of traps or fencing which act as impediments to the movement of herptiles, directing them into traps for subsequent identification. The intended survey area and the species targeted will dictate the most suitable type of trap method. <u>Visual encounters</u> involve documenting the sightings of herptiles (both species and numbers) whenever encountered in the wild. <u>Egg mass surveys</u> are performed during the breeding season to detect and identify herptile egg mass structures. <u>Dip net surveys</u> require hand-held nets which are randomly or systematically dipped into the water in an effort to ensnare herptiles for identification.

Through a group effort the species were categorized among the 10 survey methods as to which species was detected (either effectively or questionably) by each method. The results of this categorization process are shown in Table 3 (by survey method) and Table 4 (by species). Table 5 summarizes the number of herptile species potentially surveyed for each of the 10 monitoring methods chosen.

Other highlights of the methods discussions included:

- the effectiveness of egg versus larval versus adult amphibian surveys
- the benefits of varying the time of day surveys are conducted
- the benefits of repeat visits to a survey site
- the desire for more information on rare and/or endangered plant communities within the Lake Superior Basin

- the fact that true abundance cannot be deduced from the methods suggested and that additional surveying will be needed to extrapolate results to estimate true abundance
- observer experience will affect survey results, although observer detection can be incorporated into the statistical analysis
- presence / absence surveys can give appropriate resolution and trends over time.

Table 2. Results of voting / ranking herptile species in the Lake Superior basin.

Species	Votes received	Rank
snapping turtle	25	1
spotted salamander	24	2
leopard frog	24	2
red-bellied snake	24	2
wood turtle	23	3
red-backed salamander	23	3
wood frog	22	4
blue-spotted salamander	22	4
spring peeper	21	5
green frog	21	5
mink frog	21	5
painted turtle	21	5
chorus frog	20	6
mudpuppy	19	7
four-toed salamander	19	7
bullfrog	19	7
garter snake	19	7
water snake	17	8
ring-necked snake	17	8
eastern treefrog	14	9
American toad	13	10
smooth green snake	13	10
Eastern newt	12	11
five-lined skink	10	12
blanding's turtle	9	13
pickerel frog	8	14
cope's treefrog	7	15
hog-nosed snake	7	15
fox snake	6	16
prairie skink	3	17
milk snake	2	18
bull snake	1	19
brown snake	0	20
tiger salamander	0	20
map turtle	0	20
spiny softshell turtle	0	20

Table 3. Amphibian and reptile species detected by 10 common survey methods - sorted by survey method.

Survey method	Species effectively surveyed	Species questionably surveyed
Calling Surveys	green frog	wood frog
	spring peeper	mink frog
	eastern gray treefrog	pickerel frog
	bullfrog	
	leopard frog	
	cope's gray treefrog	
	American toad	
	chorus frog	
Aquatic Cover Objects	mudpuppy	water snake
General Cover Objects	red-backed salamander	newt
	garter snake	spotted salamander
	red-bellied snake	blue-spotted salamander
	ring-necked snake	
	green snake	
	five-lined skink	
Aquatic Funnel Traps	newt	
	mudpuppy	
	spotted salamander	
	blue-spotted salamander	
	water snake	
	wood frog	
	larval amphibians (most)	
Hoop Net Traps	snapping turtle	
	blanding's turtle	
	painted turtle	
Basking Traps	painted turtle	
	blanding's turtle	

Table 3. Continued

Survey method	Species effectively surveyed	Species questionably surveyed
Visual Encounters	wood turtle	
	four-toed salamander	
	water snake	
	blanding's turtle	
	spotted salamander	
	mudpuppy	
	red-backed salamander	
	fox snake	
	hog-nosed snake	
	pickerel frog	
	mink frog	
	leopard frog	
Egg Mass Surveys	wood frog	
	spotted salamander	
	leopard frog	
	blue-spotted salamander	
Drift Fences with Traps	red-backed salamander	
	frogs	
	snakes	
	skinks	
	pond breeding salamanders	
Dip Net Surveys	newt	
	mudpuppy	
	larval amphibians	

Table 4. Amphibian and reptile species detected by 10 common survey methods - sorted by species. **?** = denotes species which are questionably or less effectively detected by the corresponding survey method.

	Calling	Aquatic Cover	General Cover	Funnel	Hoop	Basking	Visual	Egg Mass	Drift Fence	Dip Nets
Salamanders										
mudpuppy		X		X			X			X
Eastern newt			?	X					X	X
spotted salamander			?	X			X	X	X	
blue-spotted salamander			?	X				X	X	
four-toed salamander							X			
red-backed salamander			X				X		X	
Frogs and Toads										
American toad	**X**								**X**	
chorus frog	**X**								**X**	
spring peeper	**X**								**X**	
cope's treefrog	**X**								**X**	
eastern treefrog	**X**								**X**	
bullfrog	**X**								**X**	
green frog	**X**								**X**	
mink frog	**?**						**X**		**X**	
wood frog	**?**			**X**				**X**	**X**	
leopard frog	**X**						**X**	**X**	**X**	
pickerel frog	**?**						**X**		**X**	
Turtles										
snapping turtle					**X**					
wood turtle							**X**			
blanding's turtle					**X**	**X**	**X**			
painted turtle					**X**	**X**				
Lizards										
five-lined skink			**X**						**X**	
Snakes										
ring-necked snake			**X**						**X**	
smooth green snake			**X**						**X**	
fox snake							**X**		**X**	
hog-nosed snake							**X**		**X**	
red-bellied snake			**X**						**X**	
garter snake			**X**						**X**	
water snake		**?**		**X**			**X**		**X**	
Larval Amphibians				**X**						**X**

Table 5. Number of selected Lake Superior herptiles effectively or questionably monitored by 10 common survey techniques in descending order of number of species effectively surveyed.

Survey method type	Number of species effectively surveyed	Number of species questionably surveyed	Total number of species detected
Drift Fences with Traps	25	0	25
Visual Encounters	12	0	12
Calling Surveys	8	3	11
Aquatic Funnel Traps	7	0	7
General Cover Objects	6	3	9
Egg Mass Surveys	4	0	4
Hoop Net Traps	3	0	3
Dip Net Surveys	3	0	3
Basking Traps	2	0	2
Aquatic Cover Objects	1	1	2

No single monitoring method was effective in detecting all the herptile species present in the basin. Drift fences with traps had the highest species detection rate of 25 species. However, this survey method was not effective for detecting turtles, which are better monitored with hoop net traps, basking and visual encounter surveys. Calling surveys are traditionally used for frogs and toads but three species (mink, wood, and pickerel frogs) are frequently missed in these surveys since these species tend to call either early in the season or in the very late hours of the night after surveys have typically concluded. From this review it was obvious that a varied monitoring program would have to be devised in order to maximize herptile species detection within the basin.

Concluding Remarks

Workshop participants decided that the Terrestrial Wildlife Community Committee should solicit comments and a peer review of any follow-up decisions from the workshop. A summary document and accompanying questionnaire should be sent to those present as well as other key individuals or organizations which did not attend the workshop. A starting point may be to rank the 10 survey methods by effectiveness, cost, practicality and feasibility.

It was recognized that two parallel programs may result - one based on intensive monitoring and the other based on extensive monitoring.

Objectives for a second phase of the Lake Superior basin herptile monitoring program were also discussed. Key issues for this phase include:

1) deciding who will perform the surveys
2) what funding sources are available
3) where the data repository will be and
4) the selection of reference sites.

APPENDIX I

Presentation Abstracts

Page Presenter	Title
Baker, Richard	Amphibian and Reptile Surveys in Minnesota
Bailey, Larissa	Designing Wildlife Monitoring Studies: General Considerations
Casper, Gary	Assessing Amphibian and Reptile Status in the Lake Superior Watershed
Fernie, Kim	Contaminants and the Health of Snapping Turtles in Canadian Areas of Concern
Genet, Kristen	The Michigan Frog and Toad Survey: Population Trends Analyses (1996-2002) and Observer Evaluation
Hall, Carol	Amphibian and Reptile Surveys in Minnesota
Hecnar, Steve	Monitoring Five-Lined Skinks in Ontario
Pauley, Thomas	Search and Capture Techniques for Mudpuppies (*NECTURUS sp.*)
Sadinski, Walt	The Current Approach of the Amphibian Research and Monitoring Initiative to Surveying in the Upper Mississippi Region
Sargent, Lori	The Michigan Frog and Toad Survey: Population Trends Analyses (1996-2002) and Observer Evaluation
Truant, Shana	Comparative Assessment of Techniques for Sampling Native Amphibians in the Boreal-Mixed Wood Forests in Northern Ontario

Amphibian and Reptile Surveys in Minnesota

Richard Baker and Yvette Anderson

Natural Heritage and Nongame Research Program, MN DNR, 500 Lafayette Road, St. Paul, MN 55155; rich.baker@dnr.state.mn.us

The Minnesota Frog and Toad Calling Survey (MFTCS) was developed in 1993 in response to concerns about the potential for population declines in Minnesota's 14 frog and toad species, and is designed to detect population-level trends in these species. Based upon USGS's North American Amphibian Monitoring Program, the MFTCS uses volunteers to collect data on the presence and call-intensity of vocalizing anurans along roadside routes. Volunteers are either assigned to predetermined routes, or are invited to develop new routes. Each route consists of ten stops located at least ½ mile apart. To encompass the calling periods of all species present, data are gathered on each route during three survey periods throughout the spring and summer. As of 2002, a maximum of 70 routes had been reported on in any year, with many portions of the state remaining unsurveyed. Analysis of the resulting data reveals that 13 of 14 species have been reported by observers, but no statewide population trends are evident. Few routes have been run with sufficient consistency to allow for within-route trend analysis in either presence/absence or in call-intensity. In 2003, an intensive volunteer recruiting effort will result in data being reported on at least 280 routes distributed throughout the state. In the meantime, useful distributional information is being collected, and the public relations and educational benefits of the MFTCS are considerable.

Designing Wildlife Monitoring Studies: General Considerations

Larissa Bailey

Recently perceived herptile declines have highlighted a need for more extensive and rigorous monitoring programs to document species occurrence and detect population change. To be successful, monitoring programs must have well-defined goals and use sampling methods that provide information adequate to meet those goals. Investigators should choose a state variable to sample based on the program's information needs, spatial sampling scale, and financial constraints. All methods should incorporate 2 essential sources of variation: detectability estimation and spatial variation.

In this presentation, I discuss estimation-based methods for three possible state variables: abundance, species richness, and patch (site) occupancy. Abundance estimation methods, such as mark-recapture, are appropriate for small-scale or detailed investigation of population dynamics, but they are often expensive and impractical for large-scale or long-term monitoring programs. I discuss relatively new methods to estimate species richness and proportion of area (sites) occupied when species detection probabilities are <1 and vary among species, sampling methods, or observers. Few herptile species are likely to be so evident that they are always be detected at a site when present. This imperfect detection probability can cause bias and confound comparisons of species richness or occupancy rates over time and space. The estimators I discuss explicitly accommodate imperfect detection and enables relationships between occupancy and site covariates (e.g. wetland size, habitat variables) to be modeled within a statistically rigorous framework. The methods only require detection/non-detection (presence/absence) data, but multiple visits must be made to at least a proportion of the sites within a given sampling season.

Assessing Amphibian and Reptile Status in the Lake Superior Watershed

Gary S. Casper

Milwaukee Public Museum, 800 W Wells St, Milwaukee, WI 53233; gsc@mpm.edu

A review of the state of knowledge of the amphibians and reptiles in the Lake Superior Watershed was recently commissioned by the Terrestrial Wildlife Community Committee of the Lake Superior Binational Program. The review identified gaps in information and conservation needs, and developed recommendations for meeting these needs. Over 12,000 distribution records were reviewed and a pilot Geographic Information System was developed. Bibliographies and species lists were compiled, and existing inventory and monitoring programs were summarized. Recommendations included addressing inventory and monitoring gaps and standardizing methods, achieving more cooperation among programs, establishing reference sites, and beginning some conservation initiatives. Conservation issues included addressing reptile and amphibian decline, developing best management practices for forestry, and concerns over contaminants, disease, malformations, urbanization, global warming, harvesting, and aquaculture. Information on reptile ecology, distribution, status, and conservation lags far behind that for amphibians in the region. Based on the review, a workshop framework for choosing indicator species and implementing inventory and monitoring programs will be presented.

Contaminants and the Health of Snapping Turtles in Canadian Areas of Concern

Kim J. Fernie - Canadian Wildlife Service
Shane R. de Solla - Canadian Wildlife Service

The Canadian Wildlife Service (CWS) is currently using snapping turtles as one of three species to monitor wildlife health and contaminants in Canadian Areas of Concern (AOCs) in the lower Great Lakes basin. Since the early 1980s, snapping turtle eggs have been used by the CWS to monitor chemical concentrations at multiple sites in the basin. In addition, this work has shown that some physiological endpoints measured in juveniles were altered by exposure to the contaminants. Results from the current monitoring efforts in the AOCs have shown alterations in reproduction, development and thyroid function, as well as numerous other biomarkers, in adult and juvenile snapping turtles. While egg size differed among sites, egg composition was similar and so unlikely to have contributed to differences in hatchling size or subsequent growth. Despite hatching from larger eggs, hatchlings from near the Wheatley Harbour AOC had more deformities, were smaller and continued to be smaller for the next 70 days. Clutch sizes and deformity rates were related to specific organochlorine compounds. Results relating to chemical concentrations and selected biomarkers will be presented from this current study as well as from previous historical work of the CWS in AOCs.

Amphibian and Reptile Surveys in Minnesota

Carol Hall, MCBS Herpetologist

Since 1987 the Minnesota County Biological Survey (MCBS) has completed surveys in 57 counties with surveys currently underway in 8 additional counties. MCBS amphibian and reptile surveys target state-listed species tracked in the Natural Heritage Information System's Rare Features Database. Potential border entrants and species poorly documented in Minnesota are also targeted. Two species of salamanders previously undocumented in Minnesota were collected during MCBS surveys during the past decade. Locations of rare species documented during MCBS surveys provide support for the identification and prioritization of ecologically significant sites at local and statewide levels. MCBS techniques include anuran breeding call surveys, turtle trapping, drift fences, and aquatic and terrestrial searches. Amphibian and reptile surveys are typically conducted for a single field season (April through Sept) and are not intended for long-term monitoring, however MCBS amphibian and reptile surveys provide valuable baseline information from which long-term monitoring can be initiated.

Monitoring Five-lined Skinks in Ontario

Stephen Hecnar
Darlene Hecnar

Department of Biology, Lakehead University, 955 Oliver Road, Thunder Bay, Ontario, P7B 5E1, Canada; Stephen.Hecnar@lakeheadu.ca

The common five-lined skink (*Eumeces fasciatus*) is one of three skink species occurring in the Great Lakes basin, and one of two species in the Lake Superior basin. Because of their secretive behavior, skinks can be locally common in open habitats such as stabilized dunes, savannas, and forest edges and openings, but remain inconspicuous. Considering their low dispersal capabilities and their disjunct distribution fringing the Great Lakes, suggests that skinks are sensitive to habitat loss and degradation in the basin. We have studied and monitored a large isolated population of skinks in Point Pelee National Park, on the shores of Lake Erie, continuously since 1990. After determining an activity profile for the population, we conducted annual surveys to track population status. Surveys of habitat by checking under woody debris provides rapid information on abundance, population structure, and nesting. Skinks show preferential use of large moderately decayed woody debris as refuge and nesting sites. Our monitoring revealed a nearly monotonic decline in abundance which appeared to be related to human removal and degradation of woody debris and illegal collection. Habitat restoration by debris augmentation and increased enforcement have resulted in population recovery. Visual monitoring provides an effective, low-disturbance method for determining skink population status which in turn reveals valuable information on microhabitat quality in stabilized dune environments.

Search and Capture Techniques for Mudpuppies (*NECTURUS sp.*)

Thomas K. Pauley
Mizuki Takahashi and Mark B. Watson

Department of Biological Sciences, Marshall University, Huntington, WV 25755;
pauley@marshall.edu
Department of Biology, University of Memphis, TN 38152
Allegheny Institute of Natural History, University of Pittsburgh at Bradford, Bradford, PA 16701

Over the last 50 years, many species of amphibians throughout the world have declined markedly in numbers. Concerns about these declines have alerted biologists to realize the need to establish long-term studies using standardized methods and protocols for sampling natural populations of amphibians. However, monitoring methods for many species considered to be common have not been well established. Monitoring populations of permanently aquatic species of salamanders such as mudpuppies is especially difficult and there are no standardized monitoring methods available at present. Examination of known searching and capturing techniques is the first step for the establishment of monitoring methods. We will present advantages and disadvantages of 10 methods reported in the literature including hook and line, dip nets, seines, trawls, capturing by hand, electro-shocking, snorkeling, scuba diving, traps, spotlighting, and spearing. Effectiveness of methods may vary depending on habitats, densities, or purposes of the research, thus it may be necessary to try several searching methods. We will also provide information about equipment, time consumption, economical costs, and permits. Complete results of our literature search are available at:
http://testweb-pwrc.er.usgs.gov/monmanual/techniques/mudpuppieswaterdogsvarious.htm

The Current Approach of the Amphibian Research and Monitoring Initiative to Surveying in the Upper Mississippi Region

Walt Sadinski

U. S. Geological Survey, Upper Midwest Environmental Sciences Center, 2630 Fanta Reed Road, La Crosse, WI 54603; wsadinski@usgs.gov

We began inventorying and monitoring amphibians in the Upper Mississippi National Wildlife and Fish Refuge Complex, the St. Croix National Scenic Riverway, and Voyageurs National Park during 2002. Our approach is intermediate in scale between fine and coarse. We sampled all potential breeding sites within 25-ha blocks of habitat selected randomly in each management unit. We used standardized visual and call surveys during at least three daytime visits to each block throughout the breeding season and measured environmental conditions during each survey. We also conducted call surveys at night three times in each management unit over the course of the breeding season. We sampled 20 - 30 blocks of habitat and 70 - 80 potential breeding sites per management unit and located 9 – 12 species. We mostly are surveying the same blocks of habitat in 2003. All of our data will be analyzed via procedures standardized across ARMI regions and will be deposited in the national ARMI database.

The Michigan Frog and Toad Survey: Population Trends Analyses (1996-2002) and Observer Evaluation

Lori G. Sargent, Michian DNR Wildlife Division
Kristen S. Genet, Dept. of Zoology, Michigan State University

A volunteer-based monitoring project for frog and toad populations in Michigan was initiated in 1996. The survey protocols developed by the North American Amphibian Monitoring Program (NAAMP) were used and modified to suit the needs of the Michigan project and to accommodate the highly variable spring weather in the state. These modifications specific to Michigan include route establishment, recommended dates during which surveys are conducted, and a more specific definition of population indices. We evaluated quality and consistency of volunteer-collected data using questionnaires and an audio CD with a simulated anuran survey route, which were mailed to all active volunteers. Volunteers were reasonably reliable in their abilities to identify species, but there was extensive variability in abundance estimation. Some species were characteristically confused by volunteers, and additional species were frequently recorded even when absent from a site. There are 262 active routes in Michigan, 51 of which are within the Lake Superior Basin. Simple trend analyses were performed on all 11 species of frogs found in the Lake Superior basin, and more detailed analyses using multiple statistical methods were performed on route in southern lower Michigan, where the highest density of routes is found. Trend analyses of the first seven years of data indicate no significant declines. However, in southern Michigan, significant trends in site occupancy, annual call index values, frequency and abundance that emerged from statistical analyses for Rana palustris, Rana catesbeiana, Pseudacris crucifer, Bufo americanus, Hyla versicolor/chrysoscelis, and Rana clamitans need to be further investigated. Two species, Rana palustris and Acris crepitans blanchardi, were too rare to be thoroughly evaluated with statistical methods, and deserve detailed study at sites where they do occur. The results of this study indicate that anuran abundance and distribution are highly variable through time, and call surveys provide a record that can be used to track population trends and identify potential declines in time to implement appropriate conservation measures.

Comparative Assessment of Techniques for Sampling Native Amphibians in the Boreal-Mixed Wood Forest in Northern Ontario

Shana Truant - M.Sc. Candidate, University of Guelph
Dr. D.G. Thompson - Canadian Forest Service
Dr. G.R. Stephenson - University of Guelph

Amphibians and particularly salamanders are widely considered as sensitive indicators of anthropogenic or natural disturbances in forests. Monitoring changes in salamander populations requires efficient, unbiased and reproducible sampling as well as mark/recapture techniques. Optimal sampling techniques may vary with species, site and climate, and comparative information pertinent to salamander population monitoring in boreal mixed-wood forests is generally lacking.

To address these needs, six methods for sampling salamanders were employed, including the use of drift fences and pitfall traps, solitary pitfall traps, night encounter surveys and three types of cover objects (modified, plywood and patio stone) and assessed in White River, Ontario. Captured individuals were uniquely marked using a subcutaneous injection of visible implant elastomer dyes (Northwest Marine Technologies). The effectiveness of each of the sampling methods was determined by comparing the number and species of salamanders captured. Four species of salamander, the blue-spotted salamander (*Ambystoma laterale*), spotted salamander (*Ambystoma maculatum*), eastern newt (*Notophthalmus viridescens*), and redback salamander (*Plethodon cinereus*) were captured in the 2002 field season. Other amphibians were included in the study strictly as an examination of the population densities and dynamics in this area, which has not been studied to date. The anurans that have been captured to date are the American toad (*Bufo americanus*), spring peeper (*Pseudacris crucifer*), wood frog (*Rana sylvatica*), and green frog (*Rana clamatins*).

Results from the 2002 and 2003 field seasons will be discussed. However preliminary observations were obtained from a small sample size (N=95) in 2002, therefore more data is required from the 2003 field season to support any results. Results of this experiment will provide pre-treatment data for a four-year study designed to investigate the effect of differential harvesting in riparian zones on amphibian populations.

APPENDIX II. Workshop Participants

Name	Agency / Affiliation	E-mail Address
Anderson, Yvette	Minnesota Department of Natural Resources	yvette.anderson@dnr.state.mn.us
Austen, Madeline	Environment Canada - Ontario Region	madeline.austen@ec.gc.ca
Bailey, Larissa	Patuxent Wildlife Research Center	lbailey@usga.gov
Baker, Rich	Minnesota Department of Natural Resources	rich.baker@dnr.state.mn.us
Burghardt, Gordon	University of Tennessee	gburghar@UTK.edu
Casper, Gary	Milwaukee Public Museum	gsc@mpm.edu
Coleman, John	Great Lakes Indian Fish & Wildlife Commission	
Dawson, Neil	Ontario Ministry of Natural Resources	neil.dawson@mnr.gov.on.ca
de Solla, Shane	Canadian Wildlife Service	shane.desolla@cciw.ca
DonnerWright, Deahn	USFS North Central Research	ddonnerwright@fs.fed.us
Edblom, Tara	Wisconsin Department of Natural Resources	tara.edblom@dnr.state.wi.us
Fernie, Kim	Canadian Wildlife Service	kim.fernie@ec.gc.ca
Genet, Kristen	Michigan State University	ksgenet@msu.edu
Gilbert, Jonathan	Great Lakes Indian Fish & Wildlife Commission	jgilbert@glifwc.org
Goodstine, Amy	Frogwatch USA, National Wildlife Federation	goodstine@nwf.org
Grundel, Ralph	US Geological Survey	ralph_grundel@usgs.gov
Hall, Carol	Minnesota Department of Natural Resources	carol.hall@dnr.state.mn.us
Hanowski, JoAnn	NRRI University of Minnesota - Duluth	jhanowski@nrri.umn.edu
Hecnar, Darlene	Lakehead University	drhecnar@lakeheadu.ca
Hecnar, Steve	Lakehead University, Biology Department	stephen.hecnar@lakeheadu.ca
Johnson, Wendell	University of Wisconsin - Mariniette	wjohnson@uwc.edu
Johnson, Lucinda	NRRI University of Minnesota, Duluth	ljohnson@nrri.umn.edu
Koehler, Ted	USFWS-Ashland FRO	ted_koehler@fws.gov
Lee, Yu Man	Michigan Natural Features Inventory	leeyu@michigan.gov
Licht, Dan	National Park Service	dan_licht@nps.gov
Lindquist, Ed	Superior National Forest	elindquist@fs.fed.us
McCammon-Soltis, Ann	Great Lakes Indian Fish & Wildlife Commission	amsoltis@glifwc.org
Moriarty, John	Ramsey County Parks	john.moriarty@co.ramsey.mn.us
Paloski, Rori	University of Wisconsin - Stevens Point	paloskra@hotmail.com
Pauley, Thomas	Marshall University, Biology Department	pauley@marshall.edu
Price, Steve	University of Wisconsin - Green Bay	prices@uwgb.edu

Name	Agency / Affiliation	E-mail Address
Radke, Lissa		
Route, Bill	National Park Service	bill_route@nps.gov
Sadinski, Walt	US Geological Survey	wsadinski@usgs.gov
Sargent, Lori	Michigan Department of Natural Resources	sargenL2@michigan.gov
Seibel, Rich	Towson University	rseibel@towson.edu
Truant, Shana	University of Guelph	shana_truant@hotmail.com
Van Stappen, Julie	National Park Service	julie_van_stappen@nps.gov
Weir, Linda	US Geological Survey	linda_weir@usgs.gov