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Introduction: A Perspective on Midwest Amphibian Declines

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On March 21, 1998, approximately 300 scientists and students gathered at the Milwaukee Public Museum for two days of scientific presentations and intense discussion on amphibian declines and malformities. Never before had so many persons come together to address amphibian conservation in the Midwestern United States (Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Iowa, and Missouri).

Amphibians have had a long history in the Midwest, and the modern species assemblage dates back 10–18,000 years ago, when much of the region was buried under massive sheets of ice. The very crust of the earth is, to this day, rebounding from the compression caused by the weight of these ice sheets. As the glaciers receded, the region underwent drastic ecological change. Climatic warming, rising carbon dioxide levels, and melting glaciers (with the formation of many meltwater lakes and rivers) made for a very different environment and climate than we see today. Winds blowing off the glaciers are thought to have kept adjacent regions constantly misted and cool, factors that favor most temperate amphibians. Over hundreds of years, lands liberated from the ice underwent changes from tundra-like conditions, to spruce forests, to mixed conifer-hardwood forests. Some regions then became grassland or savanna, other regions remained forested. During this period of successive ecological change, amphibians marched steadily northward with the receding ice front. Periods of glacial advance and retreat, coupled with climate fluctuations, often isolated or divided populations, and new species evolved (witness the *Ambystoma laterale-jeffersonianum* complex). As climate change continued, some species once widespread in cool, moist, glacier-influenced forests, became isolated in pockets of moist habitat, resulting in scattered populations of “glacial relics” (i.e. *Hemidactylium scutatum*).

Then European settlement began. About a century ago almost all forests were rapidly clearcut, then burned. Over the next few decades, most savanna and prairie regions were converted to agriculture, and 50–90% of wetlands were drained (with considerable geographic variation in losses). The impact on amphibians must have been profound. Perhaps entire species were lost. Soil moisture, soil pH, cover object availability, and light intensity all significantly affect salamander distribution (Wyman 1988a; Wyman 1988b, Frisbie and Wyman 1992, Sugalski and Claussen 1997, Grover 1998). Studies suggest that salamander populations may require 30 to 60 years to recover from clearcutting (Pough et al. 1987, deMaynadier and Hunter 1995). Since this initial abuse, second-growth forests have returned, but few wetlands have been effectively restored, and agriculture has intensified. After a brief period of environmental concern in the 1970s, recent political trends have been to reverse and weaken environmental protection overall; as rapid development and road building continues unabated, giant corporate agribusinesses replace family farms, and hundreds of synthetic chemicals now permeate air,

water, and soil throughout the region. Recent trends in forestry (continued clearcutting and short stand rotation), and aquaculture (conversion of wetlands to fish farms and winter drawdowns), have also been harsh on amphibians. A recent research emphasis on landscape analyses and meta-population dynamics (see Ball, Knutson et al., this proceedings) has revealed the problems many amphibians face as landscape fragmentation proceeds, the most significant being isolation of small populations, which may not remain viable. This problem will be compounded as global warming proceeds, and amphibians are unable to migrate across barriers, losing migration corridors.

Midwest amphibian declines were first noted in the 1960s, when the Blanchard's cricket frog (*Acris crepitans blanchardi*) began to disappear from the north. In the 1970s, northern leopard frog (*Rana pipiens*) populations crashed. Currently, approximately 16 amphibian species are listed as threatened or endangered in the Midwest region, mostly because of habitat losses. In the mid-1980s Wisconsin began the nation's first frog and toad survey, and research into amphibian conservation began to increase.

Then in 1995, Minnesota school children discovered grossly malformed frogs. Pictures of these monstrous anurans captured the public eye, and sparked a rapid media, political, and research response. An excellent summary of this investigation (still ongoing) can be had in William Souder's recent book *A Plague of Frogs: The Horrifying True Story* (Hyperion Press, 2000), and several papers herein continue the saga. Largely lacking in this debate has been an acknowledgment that malformed wildlife in the Midwest is nothing new, with synthetic chemicals implicated for past outbreaks of bird and fish malformities, and fish contamination and cancer rates remaining unacceptably high. As of this writing, the causative agent in Midwestern frog malformities has not been determined. However, at least three things have now been shown to be capable of causing these malformities: chemical contaminants, parasite infestations, and UV-B light. Interplay of these and other factors is also suspected in both malformity and decline issues (see Britson and Threlkeld, Jofre et al., this proceedings).

The Midwest Declining Amphibians Conference was a joint meeting of the Great Lakes and Central Division Working Groups, of the United States Declining Amphibian Populations Task Force, which organizations are chaired by myself, Christopher A. Phillips, and Michael J. Lannoo, respectively. While the focus of the conference was on Midwestern amphibian decline issues, interest grew beyond this geographic constraint, with attendees coming from as far away as Maryland, California and Guatemala. The conference became somewhat dominated by the malformed frog issue, then a hot topic in the press, but still considered a minor issue in amphibian decline by most scientists. Consequently, the new research being presented by scientists investigating potential causes of frog malformities attracted national attention, resulting in coverage by NBC Nightly

News (Chicago), ABC (New York), Wisconsin Public Radio (WUWM), Outdoor Wisconsin, Minnesota Public Radio, the Minneapolis Star Tribune, the Milwaukee Journal Sentinel, and the Washington Post (among others). Participating agencies included seven state Natural Resources Departments, the United States Environmental Protection Agency, the Minnesota Pollution Control Agency, the Illinois Natural History Survey, the U.S. Geological Survey, many universities and colleges, the Nature Conservancy, the National Wildlife Health Center, the United States Fish and Wildlife Service, the Pacific Northwest National Laboratory, the Patuxent Wildlife Research Center, the National Institute of Environmental Health Sciences, and the Northern Prairie Wildlife Research Center.

This proceedings was conceived shortly after the conference, as a means of uniting papers on a common theme into one publication. The manuscripts were prepared and finalized in 1998 and 1999. Some authors could not meet publication deadlines, and others chose to publish elsewhere. Of the 45 papers presented at the conference, 25 are published here. They fall into two general areas: malformity investigations, and decline and natural history investigations. The content and length of papers is variable, with some contributions being extended abstracts. However, an important body of work is collected here, well representing the spirit of the conference. There remains much work to be done if we wish to reverse amphibian declines in the Midwest. Continuing natural history and monitoring studies are paramount to this goal. Basic distribution, habitat, demographic, and reproductive data are still lacking for many species (Redmer, Mauger et al., this proceedings). However, the major reasons for amphibian declines are well known (habitat loss and degradation). They are simply not being effectively addressed in the political arena. Relatively minor changes in forestry, fishery, agricultural, and development practices could have large impacts on reversing amphibian declines (see Merovich and Howard, Mierzwa, Nyberg and Lerner, this proceedings). Reaching these communities is challenging, however, and the development of effective management practices and communication and implementation of these strategies remains the most important issue in amphibian conservation in the Midwest (and perhaps everywhere). It is important that such strategies be based on sound science, towards which I believe this proceedings contributes.

Abstracts from the conference are available online at www.mpm.edu/collect/vertzo/herp/Dapftf/MWabst.html. Papers presented at the conference, but not included here, were: Effects of methoprene and UV light on survival and development of *Rana pipiens* (G.T. Ankley, J.E. Tietge, D.L. DeFoe, K.M. Jensen, G.W. Holcombe, E.J. Durhan, S.A. Diamond, and P.K. Schoff); Field and laboratory evidence for the role of retinoids in producing frog malformities (B. Blumberg, D.M. Gardiner, D. Hoppe and R.M. Evans); Iowa's declining amphibians (J.L. Christiansen and C. Van Gorp); Examination of a long-term monitoring technique and the effects of fire management on the herpetofauna of Chilton Creek Preserve, Shannon and Carter counties, Missouri (B.M. Churchwell and K.S. Mierzwa); Deformed frogs: developmental and molecular mechanisms (D.M. Gardiner and D. Hoppe); Wisconsin's amphibian malformations: 1960–1997 (H. Gilbertson, R. DuBois and R. Hay); The

North American Amphibian Monitoring Program (J. Griffin); Blanchard's cricket frog (*Acris crepitans blanchardi*) in Wisconsin: A vanishing species (R. Hay); A methodology to assess exposure to organophosphate insecticides in amphibian species (R. Hirsch and S. Temple); Exposure of northern leopard frogs in the Green Bay ecosystem to polychlorinated hydrocarbons as measured by direct chemistry and hepatic P450 activity (Y. Huang, W.H. Karasov, K.A. Patnode and C.R. Jefcoate); Amphibian malformities in Missouri (T.R. Johnson); Ephemeral Pools in Missouri: Their Value, Status, and Restoration (T.R. Johnson); Predicting amphibian occurrence using landscape-level attributes (M.B. Kolozsvary and R. K Swihart); Recent surveys of Blanchard's cricket frogs (*Acris crepitans blanchardi*) in southern Michigan (Y.M. Lee); Minnesota frog and toad survey: changes and status (J.J. Moriarty); The Wisconsin Frog and Toad Survey: update and 1984–97 trends (M.J. Mossman, L. Hartman, J. Sauer, R. Hay, and B. Dhuey); Differential distribution of terrestrial salamanders in southern Indiana forests (N. Murphy); Gonadal intersex in cricket frogs (*Acris crepitans*): a retrospective study before, during, and after the era of organochlorine insecticide use (A.L. Reeder, A. Pessier, L. Brown, R. Warner, M.B. Wheeler, and V.R. Beasley); Forest succession and the distributional dynamics of an amphibian assemblage (D.K. Skelly, E.E. Werner, and S.A. Cortwright); and Photo-enhanced toxicity of a carbamate insecticide on early life stage amphibians (A. Zaga, E.E. Little, C.F. Rabeni and M.R. Ellersieck).

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