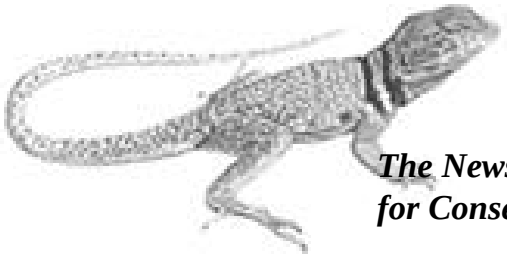

The Glade

The Newsletter of the Missouri Chapter of the Society for Conservation Biology

Volume 5, Number 1 **April 2002**

Contents

The Corner

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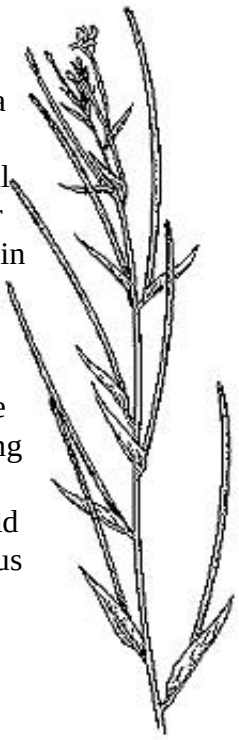

This issue of *The Glade* marks the fifth year in which our young chapter has published a statewide newsletter addressing the activities, concerns, and needs of conservation biology (and biologists!) in Missouri. An accomplishment that proves the conservation biology ideal is alive and growing in our state. How so? It takes the dedication of many people, from our editor, and the contributors of the articles, to our multi-faceted membership/readers, to sustain production and support for this avenue of communication amongst conservation-minded individuals. There truly is an interest and a need for the information *The Glade* provides.

At MOSCB's annual meeting, held in January, attendees brainstormed on topics for future issues of *The Glade*. There was overwhelming enthusiasm for articles on the invasive species issue, so much so that we are contemplating a special edition of *The Glade* addressing this topic. A suggestion was also made that we begin reporting not only conservation work being done in Missouri, but that we highlight conservation work being done around the world by researchers based in Missouri. With so many MO-based institutions with worldwide focus (and impact), it is an idea whose time has come. Finally, we learned last summer, while attending the annual SCB meeting in Hawaii, that Missouri has the only local chapter of the Society for Conservation Biology in the country that produces a science based newsletter. We've done a lot in five years, and look forward to serving our membership for many more.

The Fall of Missouri's Giant Salamanders: Decline of Hellbender Populations

Alicia Mathis, Dept. of Biology, Southwest Missouri State University, Springfield,MO; sam477f@smsu.edu

In any geographic region, there are a handful of species that seem to symbolize the area. In the Ozarks region of Missouri, one of those species is the hellbender. As you might guess from its name, the hellbender is not what anyone would call beautiful, but even the most unkind critic would have to admit that its appearance is distinctive. Hellbenders are the largest salamanders in North America and the second largest in the world. Adults can reach up to about 74 cm in length, with robust bodies and wrinkled skin.

Hellbenders are found only in clear, rocky-bottomed streams with rapidly flowing water, habitats that are abundant in the Ozarks. They spend most of their time under medium-sized to large rocks, but can be active at night. Their color tends to range from greenish gray to brown, so they blend in well with the rocky substrate. Like most amphibians, hellbenders have lungs, but they also rely heavily on cutaneous respiration. The wrinkled skin maximizes the surface area so that a large amount of oxygen can be diffused from the water into capillaries near the skin's surface. This mode of respiration explains why hellbenders require well-oxygenated, fast-flowing waters.

Two subspecies of hellbenders are found in the Appalachian and Ozark Mountains of the eastern United States. The eastern hellbender (*Crytobranchus alleganiensis alleganiensis*) is widely distributed across this range. The distribution of the Ozark hellbender (*C. a. bishopi*) is much more narrow, including the Spring River in Arkansas and the south-flowing North Fork, Current, and Eleven Point Rivers in Missouri.

In Missouri, hellbenders have been studied for decades by a number of researchers, including Robert Wilkinson, Chris Peterson, and Max Nickerson. These studies included extensive population surveys from the 1970's and 1980's when populations seemed large and relatively stable. For example, between 1971 and 1973, Taber and his colleagues (Copeia 1975:633-639) marked over 1000 hellbenders in the Niangua River.

By the early-mid 1990's alarming anecdotal reports were accumulating indicating that hellbenders in Missouri and Arkansas were becoming difficult to find. At the same time, similar subjective reports of apparent population declines were surfacing concerning amphibian species all over the world. One problem with assessing the validity of these anecdotal reports is that quantitative historical population data are limited for most species. Because of the extensive work of researchers in Missouri, solid historical data were available for populations of hellbenders for almost every river in the state.

Robert Wilkinson (SMSU) recognized that the availability of these historical data presented an excellent opportunity to assess population trends for hellbenders in Missouri and to determine whether the anecdotal reports were indicative of a real problem. The Missouri Department of Conservation agreed to provide funding for an in depth survey of hellbenders in Missouri rivers, and Wilkinson invited me to participate in the project. We identified two graduate students (Ethan Prosen and Ben Wheeler) who were interested in spending lots of time in the water, and began the survey.

Wilkinson dusted off his field records from the 1970's and 1980's, and Chris Peterson generously donated his data from the same period. We resampled five rivers from their previous studies (Big Piney, Eleven Point, Gasconade, North Fork, Niangua), including the range of both subspecies. Where possible, we resampled the same sites from the previous studies, although habitat changes sometimes made this impossible.

The results were dramatic, disturbing, and consistent for all rivers and for both subspecies. Our estimates of population densities indicated a decrease in numbers that ranged from 70 - 85% for each river. Work by Stanley Trauth and others in Arkansas has indicated that hellbenders in the Spring River are experiencing similar declines in numbers. For most rivers, our historical data sets were from the early to mid 1980's, so it is difficult to pinpoint when the declines began. We have a clearer picture of changes that have occurred in the Niangua River population because historical records for this population dated from the early 1970's. The

Niangua River population decline was evident by the 1980's.

Even in historical samples, hellbender populations are characterized by a preponderance of older, mature individuals. However, we found that the age structure has shifted over time so that this concentration of older animals is even more pronounced. For the populations in our 1998-1999 survey, young individuals made up a significantly smaller proportion of the population than had been the case in the historical samples. Like changes in population numbers, the change in age structure also was consistent across all rivers and for both subspecies. These data indicate that either the adults are failing to reproduce or that the young are experiencing decreased survival.

The Missouri Department of Conservation continues to be concerned about the future of this spectacular animal. Jeff Briggler, Missouri State Herpetologist, has helped facilitate our continuing study (with graduate student Shem Unger) of reproduction in Missouri hellbender populations. The restricted range of the Ozark hellbender makes the severe decline of this subspecies particularly disturbing. The US Fish and Wildlife Service (USFWS) is greatly concerned about the conservation status of this subspecies, and has provided funding for our ongoing study. Susan Rogers and Amy Salveter of the USFWS have established a hellbender working group, including interested researchers across Missouri and Arkansas. The Arkansas State Herpetologist, Kelly Irwin, is cooperating with Briggler in Missouri to facilitate communication among researchers in the two states.

At this time, we can only speculate about the cause of the rapid and dramatic decline of Missouri's hellbender populations. Humans are naturally attracted to the beauty of Missouri's rivers, and the presence of humans almost inevitably leads to increased disturbance and development. Increased siltation and habitat degradation unquestionably are a problem in some areas, but other areas that appear less degraded also have experienced population declines. Toxicity due to chemical runoff is a possibility, but specific cause-and-effect relationships may be difficult to identify. Globally, a number of amphibian populations recently have been shown to be negatively affected by a chytrid fungus, and disease or parasites also could be affecting hellbenders.

Clearly, identifying and correcting the cause of the problem may take time. Time may be a more critical problem for hellbenders than for most other species because hellbenders are long-lived, reaching over 30 years of age. It takes about 5-8 years before hellbenders reach sexual maturity, so populations naturally will be slow to rebound from disturbance events. Captive breeding programs may provide an important stop-gap measure to ensure survival of the species while more long-term conservation measures are developed. Immediate and concentrated efforts may be necessary if we are to save this symbol of Missouri and the Ozarks.

Announcements:

- Nominations for the MOSCB executive board for August 2002-August 2003 are presently welcomed. If you would be willing to serve, or wish to nominate someone else, please send your nominations to Neal Sullivan at sullivann@missouri.edu. Descriptions of officers duties can be found at http://www.snr.missouri.edu/moscb/exec_brd_pg.html.
- We are presently looking for articles for *The Glade*'s August 2002 issue. If you are doing research in the field of conservation biology and are willing to write an article, please contact Michelle Boone at michelle_boone@usgs.gov. Articles can pertain to any topic related to conservation biology, and may include a discussion of your research, philosophical considerations, or local efforts to promote conservation through education in schools or public outreach.

Growth, Removal, and Consumption of Forest Products in the North Central Region

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We depend on forests for a myriad of benefits. These include values such as wood products, wildlife, recreation, aesthetics, and clean water as well as biological services such as conserving biodiversity and moderating global climate change. In the coming decades the demand for wood, fiber, and other forest products and amenities will increase as our population grows.

Two years ago, the Forest Service's North Central Research Station initiated a Forest Productivity Integrated Research Program. This program combines the efforts of scientists from across the station's 13 research work units to examine the current condition of forests in the North Central Region (NCR) and their prospects for producing wood and fiber (Fig. 1). The program is designed to:

- characterize current patterns of forest productivity and forest product consumption within the NCR;
- assess and evaluate environmental and social consequences of forest production practices and opportunities in the NCR; and,
- implement research and develop new technologies to increase forest productivity.

Figure 1. Forest Cover and the seven states in the North Central Region.

To begin this process, we have compiled an assessment using available data that begins to address these issues and, more importantly, to frame future lines of inquiry. This synopsis will be printed as a special publication of the North Central Station in 2002. Some of our findings and observations are presented below.

In the NCR, the cubic foot volume of growing stock (that is, from trees traditionally deemed suitable for forest products) has more than doubled since 1953 (Fig. 2). This is due, in part, to better management as well as the maturing of the forests that were cutover at the beginning of the last century.

When we first began this project, we were invited to attend a workshop in support of "The Intelligent Consumption Project" (ICP) sponsored by the Wisconsin Academy of Sciences, Arts, and Letters. This workshop included representatives of environmental groups, theologians, philosophers, academics, as well as members of government agencies. The workshop identified many actions that would improve our ability to make environmentally responsive decisions. Two of these are: 1) conveying the complex implications of wasteful consumption to the public, and 2) considering "lifetime" analysis of materials. For the former, for example, wasteful consumption may shift demand for wood products to regions outside of the U.S., thereby threatening the environment in places where environmental regulations are lax or nonexistent. For the latter, "lifetime" analysis refers to considering all of the costs associated with the materials we consume. For example, while the harvest of wood has impacts on land, the impacts are relatively benign when compared

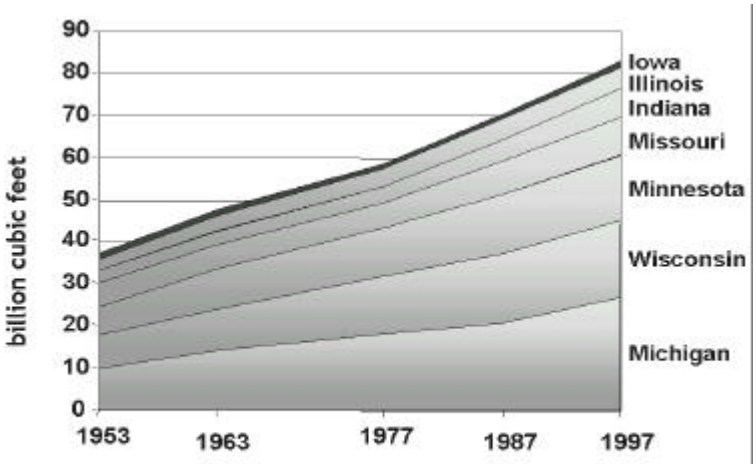

Figure 2. Total cubic foot volume of growing stock by state between 1953 and 1997.

to those associated with the production of steel (e.g. environmental impacts of mining and manufacturing and the energy consumed in the process). The ICP report can be found at: http://www.wisconsinacademy.org/programs/intelligentconsumption.html

The people who live in the NCR, annually consume a far greater volume of wood than is harvested and processed within the region (Fig. 3). Consequently, the environmental and economic impacts of that consumption (both positive and negative) are shifted to other wood producing regions of the U.S. and to other nations. The impact of major metropolitan areas is shown conceptually in Fig. 4. All of the forest growth within the shaded areas would be required to offset the amount of wood annually consumed by these cities (a function of the population of these cities and the amount of forested land surrounding area).

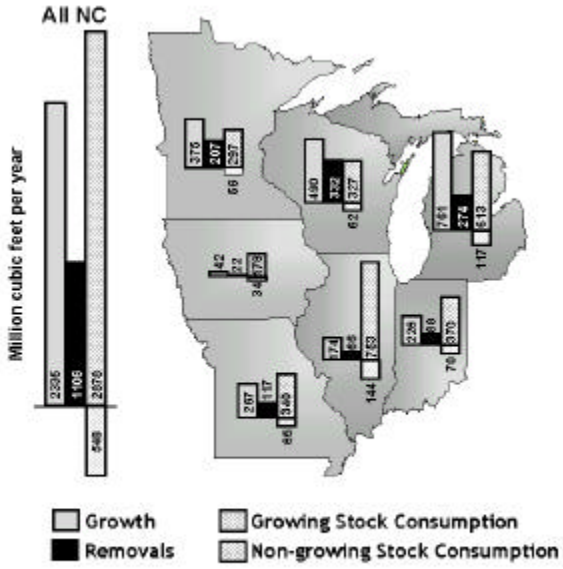

Figure 3. Growth, removals, and consumption of wood products (cubic feet) in the North Central Region.

The assessment will help frame forest productivity issues in the NCR, and help identify opportunities for new research aimed at increasing forest productivity for wood and fiber in balance with other desired forest commodities and amenities. At the same time, changes in land use patterns and social preferences will affect the area of lands managed for forest products and will affect methods of management. Given the current conditions, how much wood can the forests in the region produce sustainably? The next phase of the assessment will attempt to address that question from an ecological and biological perspective. We may be able to close the gap between overall consumption of forest products and forest growth through informed decisions. Consumers can consume less, recycle more, and increase or decrease consumption of wood relative to alternative products and commodities. Resource managers and owners can increase forest growth per acre through better management of natural forests, increase forest growth per acre through intensive plantation culture, and increase the number of forested acres in production through reforestation and agro-forestry. Millers and manufacturers can increase the efficiency of converting of wood into products and engineer products that extend the utility of a given amount of harvested timber. We all can devote our efforts to formulating and discussing the issues.

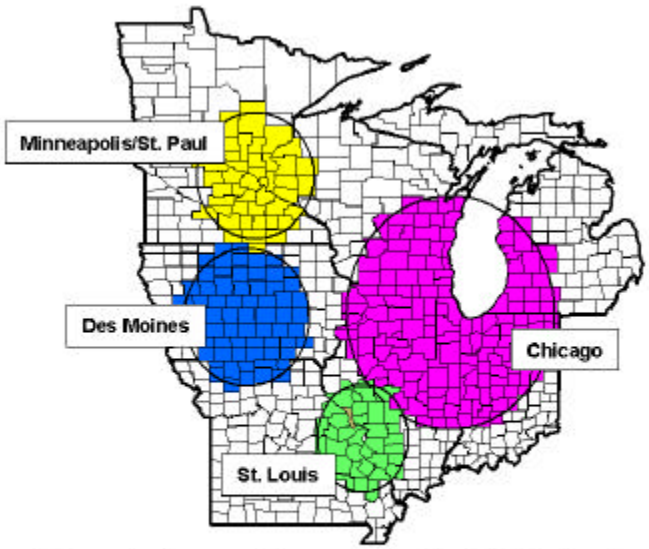

Figure 4. Consumption ecological footprint of major metropolitan areas. Based on estimates of growth by county, 1998 population, 75 ft³ per capita consumption and no consumption in outlying counties.

"The long and short of the matter is that forest conservation depends in part on intelligent consumption, as well as intelligent production of lumber." Aldo Leopold, "The Home Builder Conserves" (1928)

Movement and Terrestrial Habitat Use in Adult Green Frogs, *Rana clamitans*, in Central Missouri

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Habitat fragmentation is one of the most challenging problems facing conservation biologists. As suitable habitat becomes increasingly isolated, colonization and migration between habitats becomes more difficult. In North America the landscape surrounding many smaller wetlands, particularly those that fall under the lower size threshold for federal protection, is becoming increasingly fragmented. Pond-breeding amphibians require aquatic areas for breeding and larval development, but spend most of their juvenile and adult life in terrestrial habitats. The migration between aquatic and terrestrial habitats can be a significant source of mortality. Reproductive failure is a common occurrence in pond-breeding amphibians and populations are often characterized by episodic recruitment. Given their reliance on both aquatic and terrestrial habitats, the variable nature of amphibian reproduction, and recent reports of global amphibian declines, it is critical to investigate how amphibian population dynamics are affected by habitat fragmentation. Because information about average dispersal distance is lacking for most species, it is uncertain to what extent amphibians utilize the surrounding habitat. Little is known about amphibian habitat use during the terrestrial phase of the life cycle, and basic data on movement patterns are not available for many species, although a few investigators have conducted tracking studies of amphibian dispersal to and from breeding sites (e.g., Kusano et al. 1995, Madison 1997, Madison & Farrand 1998).

My research involves tracking adult green frogs, *Rana clamitans*, in fragmented habitat in central Missouri to understand their movement behavior and terrestrial habitat use. Green frogs are a common, widely-distributed species likely to use permanent ponds throughout the eastern U.S. and Canada. As a larger ranid frog with a prolonged breeding season, they are of suitable size to conduct telemetry work and they can be captured at ponds for an extended period of time. They typically breed in permanent ponds in late spring through summer and reside at creeks or streams the remainder of the year. While males tend to reside at ponds throughout the breeding season, females often leave soon after breeding. In Missouri, larvae overwinter in ponds and metamorphose the following summer. Green frog migration has only been investigated in recent years (Lamoureux & Madison 1999, Birchfield 2002) with radio-telemetry used to track adults from breeding ponds. I have also used powdered fluorescent pigments to examine how green frogs use habitat in an experimental context.

The main population I study breeds in a man-made pond at the A. L. Gustin golf course on the University of Missouri campus in Columbia. The golf course is a relevant landscape for studying habitat fragmentation, particularly because of the distinct contrast between habitat types. The course comprises three main habitat types: woods, short grass (ca. 8 cm, primarily *Zoysia*), and taller grasses and herbaceous vegetation (ca. 34 cm, unmown, low maintenance areas). The distinct mowline separating short grass and taller grasses makes studies of habitat choice and edge behavior possible. The course is a good representation of fragmented landscapes common to our region.

I followed adults to two creeks bordering the north and south sides of the golf course, Flatbranch Creek and Hinkson Creek. The average maximum distance adults travel from the pond is 560 m (n = 9, Birchfield 2002). At Flatbranch Creek, three tracked adults that migrated had

survived until they initiated overwintering in November. They overwintered in two areas where water was deeper (1-1.5m) than most areas of the creek. One frog overwintered in a root tangle partially submerged in a bend and two others overwintered underneath large rocks near the edge of the creek. Both areas likely had trapped air above the surface of the water and remained well-oxygenated during winter. Neither area experienced significant freezing throughout winter. Although transmitter batteries died before spring, one female was captured in good condition close to her overwintering site the following May.

In one study, Joe Deters and I selected areas on the golf course where three major habitat types converged as release points for habitat choice experiments conducted at night. Each night frogs were collected, toe-clipped, and their hindquarters dipped in fluorescent powder. Frogs were placed underneath a bucket suspended to a wooden tripod so that the bucket could be raised remotely with string. After releasing frogs and leaving the area for about an hour, my field assistant and I returned with a portable ultraviolet lamp to follow the pigment trail. Frogs were often recaptured and used in multiple trials in a single evening. Adult frogs exhibited a significant preference for short grass in these trials, and almost always avoided wooded areas. Several frogs showed a tendency to follow the edge of tall grass habitat while traveling through the short grass, entering the tall grass apparently only when disturbed. Rate of movement was significantly higher in short grass as opposed to taller grasses, so frogs may travel more easily and quietly through short grass, but prefer to remain close to sheltered habitat, in case of predator approach. On numerous occasions, frogs were observed hopping into the taller grass on our approach. In a similar study of green frog response to habitat edges, I found that some frogs tended to travel around patches of taller grass to reach the breeding pond, rather than move more directly through tall grass. Of seven frogs released above the breeding pond on the opposite side of a large patch of taller vegetation, four moved around the patch to reach the pond, while only one moved directly toward the pond.

Adult green frogs may choose the least resistant habitat available for dispersal, especially when adjacent to sheltering habitat. If green frogs follow habitat edges, strips of sheltering habitat may serve as corridors beside which frogs might travel through less-sheltering terrain. Information on local amphibian populations and their terrestrial activity and overwintering areas could be gathered prior to development, perhaps by radio-tracking adults from nearby ponds. Constructed ponds on golf courses would be more accessible to amphibians if there were strips of sheltered habitat within a short distance (ca. 10-20 m) of the pond, rather than mowing up to the edge of ponds. This would lessen the risk of exposure to predators as frogs travel between isolated breeding ponds. Similar landscape configurations could be utilized in suburban/residential areas where ponds are isolated after construction or built as part of development.

My research indicates that green frogs use the terrestrial landscape surrounding ponds to a great extent. It is critical to protect upland aquatic areas as well as breeding areas when managing this species. For most amphibian species, there is inadequate information on suitable habitat for seasonal migration, or on mortality rates during migration. If inflated mortality due to desiccation or predation in unsuitable terrestrial habitat is superimposed on already-variable population sizes, many amphibian populations with adequate *breeding* habitat may be endangered. Thus, information about terrestrial habitat use during seasonal migrations is critical and should be considered in urban land use and conservation planning.

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"There is nothing in which the birds differ more from man than the way in which they can build and yet leave a landscape as it was before." Robert Lynd

The Glade

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When one tugs at a single thing in nature, he finds it attached to the rest of the world. --John Muir

Membership Information

The goal of MOSCB is to promote communication among conservation biologists throughout the state of Missouri. Membership in MOSCB is free. To become a member send your name, address, phone number, and email address to: moscb@showme.missouri.edu or write to the address listed above. Membership must be renewed annually. Membership expires on August 1st of each year. Please visit our MOSCB web page for more detailed information (http://www.snr.missouri.edu/moscb).

The Glade Vol. 5, No. 1 was edited by Michelle Boone. Special thanks to the authors in this issue for their time and thought in writing their articles.