



The Glade

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

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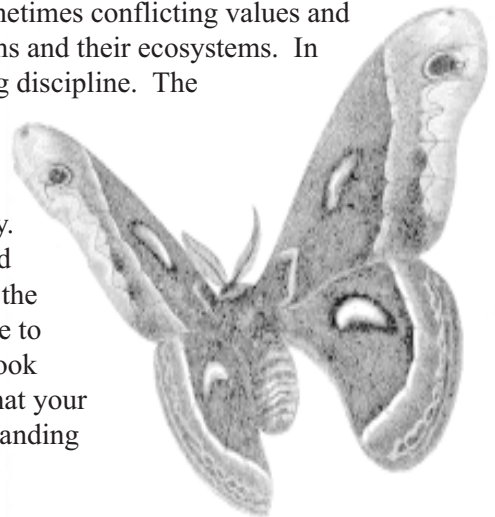
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President's Corner

By Mary Ratnaswamy, Fisheries and Wildlife Program, University of Missouri-Columbia, Columbia, MO 65211 - ratnaswamym@missouri.edu

Conservation biology is a discipline that has arisen from increasing concern for maintaining and restoring our biological heritage. This idea became relevant to me at an early age, when I realized it was important to me whether future generations would have the opportunity to share the biosphere with the same species and habitats that are here today. Conservation biologists address these problems by integrating available knowledge, extrapolating risks, accommodating stakeholders with diverse and sometimes conflicting values and goals, and attempting to unravel the complexity of biological organisms and their ecosystems. In short, conservation biology is a difficult, but fascinating and rewarding discipline. The multifaceted nature of conservation problems calls for interdisciplinary collaborations to work on these issues, and this kind of cooperation and communication is one of the great contributions that can be made by the Missouri Chapter of the Society for Conservation Biology. It is with great pleasure that I notice that this new Chapter has attracted members from a wide variety of institutions and organizations around the state. Your expertise, energy and enthusiasm are fundamental if we are to address the important conservation issues that face us in Missouri. I look forward to meeting all of you at our first Chapter meeting and know that your efforts will allow us to make significant contributions towards understanding and conserving our natural treasures.



Announcements and Notes

◆ The first annual MOSCB General Meeting will be held at 1:30 PM on Monday, February 1, 1999 in conjunction with the Missouri Natural Resources Conference at Tan-Tar-A Resort, Lake of the Ozarks. The meeting will take place in Rooms 76 and 77. Agenda will be as follows:

- ◆ 1:30 - 1:50 PM Refreshments/socializing
- ◆ 1:50 - 2:00 PM Message from the President
- ◆ 2:00 - 2:10 PM Executive Board reports
- ◆ 2:10 - 3:30 PM Group discussion outlining the direction of the chapter

Visit the MOSCB website (<http://www.missouri.edu/~moscb/index.html>) and the MNRC website (<http://www.conservation.state.mo.us/mnrc/mnrc99.html>) for more information.



◆ A sustainable forestry conference entitled, "Towards a Vision for Missouri's Private Forests", will be held March 4-5, 1999 at the University of Missouri-Columbia. Eighty-five percent of the 14 million acres of forest in Missouri are privately owned. This forest (most in tracts less than 1000 acres) is divided among 200,000 owners. The conference will explore the intersection of science, economics, human behavior, and public policy with respect to these private forests. The conference is intended for forest landowners, scholars, students, forestry professionals, resource management agency officials, and interested citizens. Registration is \$15 (free for students). Paul Ellefson from the University of Minnesota will present the Keynote Address entitled, "State level policies and programs for private forestry." This address will take place at 7:30pm on Thursday, March 4 in Conservation Hall, Natural Resources Building. The Keynote Address is free and open to the public. Registration requests and questions should be directed to Jan Weaver, 220 Gentry Hall, University of Missouri-Columbia, Columbia, MO 65211, or call (573) 882-7116.

◆ A Symposium on the Ecology and Management of Bottomland Hardwood Systems will be held March 10-13, 1999 in Memphis, Tennessee. The goals of the symposium are to synthesize basic and applied information on bottomland hardwood systems and to identify conservation and management practices that will sustain productivity and ecological, biological, and physical functions of these systems within the current socio-economic framework. For more information, contact Annette Wiseman, Gaylord Memorial Laboratory, Puxico, Missouri - (573) 222-3531.

◆ The XVI International Botanical Congress (IBC) will be held August 1-7, 1999 at the America's Center in St. Louis, Missouri. For information, visit the IBC website (<http://www.ibc99.org>).

◆ A major scientific analysis by the American Institute of Biological Sciences and the National Center for Ecological Analysis and Synthesis of Habitat Conservation Plans (HCPs) confirms conservationists concerns about HCPs and highlights the need for improved protection for endangered species. In Using Science in Habitat Conservation Plans, a group of 119 independent scientists examined 43 HCPs in detail and another 208 more generally. The report concludes that critical scientific information about endangered species often is not available for HCPs. It also highlights a major lack of biological monitoring to determine what effect each HCP has on endangered species. For a copy of the report see <http://www.nceas.ucsb.edu/>

◆ The Columbia Day With Wildlife will be held on Sunday, April 11 from 12pm-5pm in Columbia, Missouri. For more information, contact Alan Buchanan ((573) 882-9880, ext. 3257).

◆ December 28, 1998 marked the 25th anniversary of the Endangered Species Act. MDC plans to hold events and activities across the state which will carry on throughout 1999 to commemorate this landmark piece of legislation. For more information, contact Carol Davit (573-751-4115, x874).

Linking Environmental Contaminants and Amphibian Population Declines

By Christine M. Bridges and Raymond D. Semlitsch, Division of Biological Sciences, University of Missouri-Columbia, Columbia, Missouri 65211 - tbridges@biosci.mbp.missouri.edu

Rachel Carson's Silent Spring, published in 1963, was an impassioned plea to reduce or eliminate production and release of contaminants into the environment. Carson painted a grim portrait of earth so polluted with chemicals that no birds or frogs were left to sing during the spring. Despite recent efforts to reduce pollutants by several agencies, our environment is becoming increasingly contaminated. Indeed, her book seems rather prophetic as each passing spring seems to be more silent than the last as global reports of declining songbird and amphibian populations are increasing.

While ecotoxicological studies involving amphibians have been conspicuously few, more studies are beginning to focus on the effects environmental contaminants have on amphibians, an interest stimulated by widespread reports of amphibian declines (Wake, 1998). It has been speculated that chemical contamination may be to blame by disrupting growth, reproduction, and behavior (Bishop, 1992). However, xenobiotics have not been directly implicated in population declines because concentrations found in the environment typically are not great enough to generate direct mortality.



LC50s (i.e., lethal concentration that kills 50% of a test population) for larval amphibians indicate that amphibians are often less sensitive than a large proportion of other aquatic test species examined, both vertebrate and invertebrate (Mayer and Ellerseick, 1986). Therefore, because most environmentally safe concentrations of various chemicals are based on values obtained from organisms that are considerably more sensitive, fortuitously amphibians will be, in theory, protected from harm using values generated using these other organisms. However, the growth and development, and ultimately the metamorphosis, of larval amphibians is highly dependent on environmental conditions. For example, tadpoles reduce their activity when exposed to various contaminants. A reduction in activity also can diminish feeding and lead to decreased growth and development, which can lengthen the larval period and reduce the size at metamorphosis. The length of the larval period as well as mass at metamorphosis are traits critical in determining an individual's fitness (e.g., survival and future reproductive success). Tadpoles that metamorphose at larger sizes and earlier in the season have a greater chance of surviving overwinter and will reproduce at younger ages (Smith, 1987; Semlitsch et al., 1988). Furthermore, a short larval period is especially important to amphibian species breeding in temporary ponds, where any factor that lengthens the time to metamorphosis, such as the presence of an environmental contaminant, can lead to indirect mortality. Consequently, low levels of contaminants in the environment can disrupt these vital growth and developmental processes and cause a population to decline over time. While at first researchers searched for obvious causes of amphibian population declines, the focus has recently shifted toward examining more subtle factors, such as these.

Much of our research has focused on the effects sublethal concentrations of the chemical carbaryl have on tadpoles. This insecticide is widely used throughout the U.S. and Canada. Carbaryl is used agriculturally and is found on the shelves of gardening centers under the trade name Sevin, where it is the active ingredient in many common garden insecticides and flea powders. Aquatic habitats can become contaminated with carbaryl directly from drift from aerial spraying as well as indirectly through run-off from gardens or agricultural fields. Tadpoles have 96-hour LC50s (10 - 20 mg/L; C.M. Bridges, unpublished data) that fall well above concentrations found in

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Applying Conservation Biology in Missouri

By Carol Davit, Natural History Special Projects Coordinator, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65101 - davitc@mail.conservations.state.mo.us

Caving headlamps, butterfly nets, seines, small mammal traps and plant presses are some of the "tools of the trade" for Natural History staff at the Missouri Department of Conservation. To an outsider, using this field equipment on the job might seem more like fun than work. "Well," says Natural History Chief Rick Thom, "a lot of our work is fun. We catalyze the conservation of biodiversity, and our field work is an important step in this process." The Natural History Section's mission is to work with all other Conservation Department units to protect, conserve and enhance nongame wildlife, native plants and natural ecosystems, and to enhance public understanding, appreciation and enjoyment of all natural resources. "We focus interest in natural history in its broadest sense," says Rick. "We are a clearinghouse of Missouri's biodiversity information, both for the Conservation Department and for all Missourians." The compilers of this information are the Natural History staff, which has grown from two people in 1977 to more than 26 full-time employees. The staff includes an endangered species coordinator, an ornithologist, wildlife ecologists, botanists, a cave biologist, a natural areas coordinator, a natural community ecologist, database coordinators, a recreation specialist and ten regional biologists. To carry out their mission, the Natural History staff often have to simply learn what is out there, and that's where the fun field equipment comes in. In documenting Missouri's biodiversity, Natural History staff fly over bald eagle nests, crawl through caves, wade through prairie grass and conduct systematic natural features inventories. "Ever since Europeans first visited what is now Missouri," says Rick, "people have been interested in documenting our flora



and fauna. But such observations were seldom systematic and comprehensive for either a region or a feature. The Natural History Section systematically documents Missouri's biodiversity." Natural features inventories have been completed for every county; they document plant, animal, natural community and geologic features, in addition to sensitive or imperiled species. They also guide acquisition and management of public land, endangered species recovery efforts, and also help private landowners practice wise conservation.

"We started the inventories by looking for high quality natural communities and rare species," says Rick. "Now we are conducting new inventories to identify less pristine sites with restoration potential." Such an inventory is currently underway in northeastern Missouri. Natural History also spearheads long-term, specialized surveys and monitoring projects to track individual species. Such projects include surveys of toads and frogs, alligator snapping turtles, breeding birds, marsh birds, winter raptors, nocturnal birds and several federally listed plants, including Mead's milkweed, eastern prairie fringed orchid, and pondberry. Often, volunteers from groups like the Audubon Society and the Missouri Native Plant

Society collect much of the data. For example, almost 400 expert birders volunteered to complete the ambitious Missouri Breeding Bird Atlas project. In addition, the Natural History Section sponsors research and wildlife diversity surveys through its small grants program. A checklist of Missouri spiders, a survey of Orthoptera and a study of threatened freshwater mussel fertilization are examples of recent Natural History grants.

To ensure the survival of federally and state listed species in Missouri, Natural History coordinates the Conservation Department's rare and endangered species program. Through research, management, surveys, monitoring, protection, landowner participation, species reintroduction and education, all units of the Conservation Department work together to improve the status of species of conservation concern. Through careful management, populations of Missouri bladderpod - a federally endangered plant that grows on glades and grazed

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Amphibian Declines (Continued from page 3)

the field (< 4.8 mg/L). Many other organisms also have LC50s for carbaryl that are above field concentrations (Mayer and Ellerseick, 1986). Therefore, it may seem that carbaryl would be relatively harmless when found in natural environments. However, tadpole behavior is affected after only 24 hours of exposure at concentrations of as low as 1.25 and 2.50 mg/L, which could alter the behavioral interactions between tadpoles and their prey. For example, tadpole swimming (Bridges, 1997) as well as predator avoidance behavior (Bridges, 1999) is altered, potentially increasing susceptibility to predation.

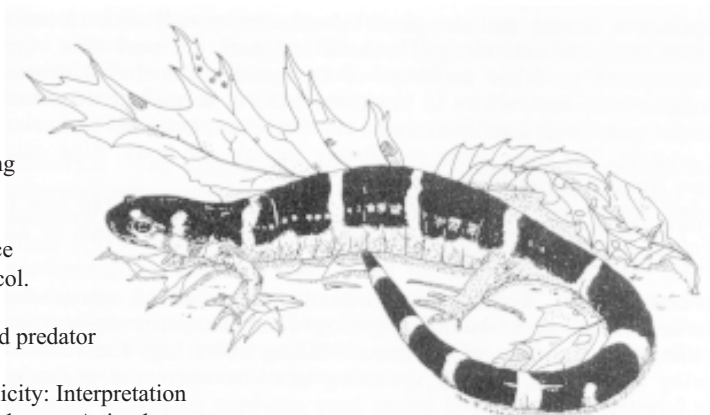
Chronic exposure to carbaryl concentrations as low as 0.16 mg/L can cause tadpoles to develop bent tails (C.M. Bridges, unpublished manuscript), which decreases swimming speed and may lead to increased predation. Additionally, exposure to this low concentration at any time during development increases the rate of lethal and non-lethal deformities, including visceral malformations and missing or extra limbs. When exposed to carbaryl concentrations between 0.16 and 1.0 mg/L throughout development, there is a significant increase in mortality that is concentration dependent. Additionally, when exposed during the egg stage, these tadpoles have a reduced mass at metamorphosis. So, whether tadpoles are exposed to low levels of carbaryl, well below standard LC50s, either for a short or long period of time, they display negative behavioral, developmental, and morphological effects that will ultimately affect individual fitness.

Research to determine the effects of environmental contaminants on larval amphibians is necessary, as it may be in the larval phase of the amphibian life cycle that population regulation occurs (Wilbur, 1980). Additionally, amphibian larvae may be at higher risk of exposure than adults, for a number of reasons. First, a large number of amphibian species, especially frogs, migrate to aquatic habitats to breed. In many cases, breeding seasons coincide with application of agricultural chemicals and with spring rains or runoff from snow melt. In cases of acid pollution, spring breeding is often associated with episodic decreased environmental pH due to snow melt. Second, amphibian larvae are not only more sensitive to environmental contaminants than adults, they may be exposed to greater concentrations because they are constrained to the aquatic environment, while adults are more mobile. Finally, larval amphibians may be more at risk because aquatic habitats not only receive chemical from direct application, but also runoff containing chemicals from nearby agricultural lands, and so may be exposed to higher concentrations of a contaminant than terrestrial adults.

Amphibian ecotoxicological research is especially vital in light of growing concerns of amphibian population declines (Wake, 1998). Levels of environmental contaminants are increasing annually, and have been shown to increase mortality, vary behavior, and alter critical life-history characteristics of larval amphibians. In combination, these alterations can significantly disrupt natural population and community regulatory processes which can lead to localized declines over time and ultimately dictate the persistence of a species.

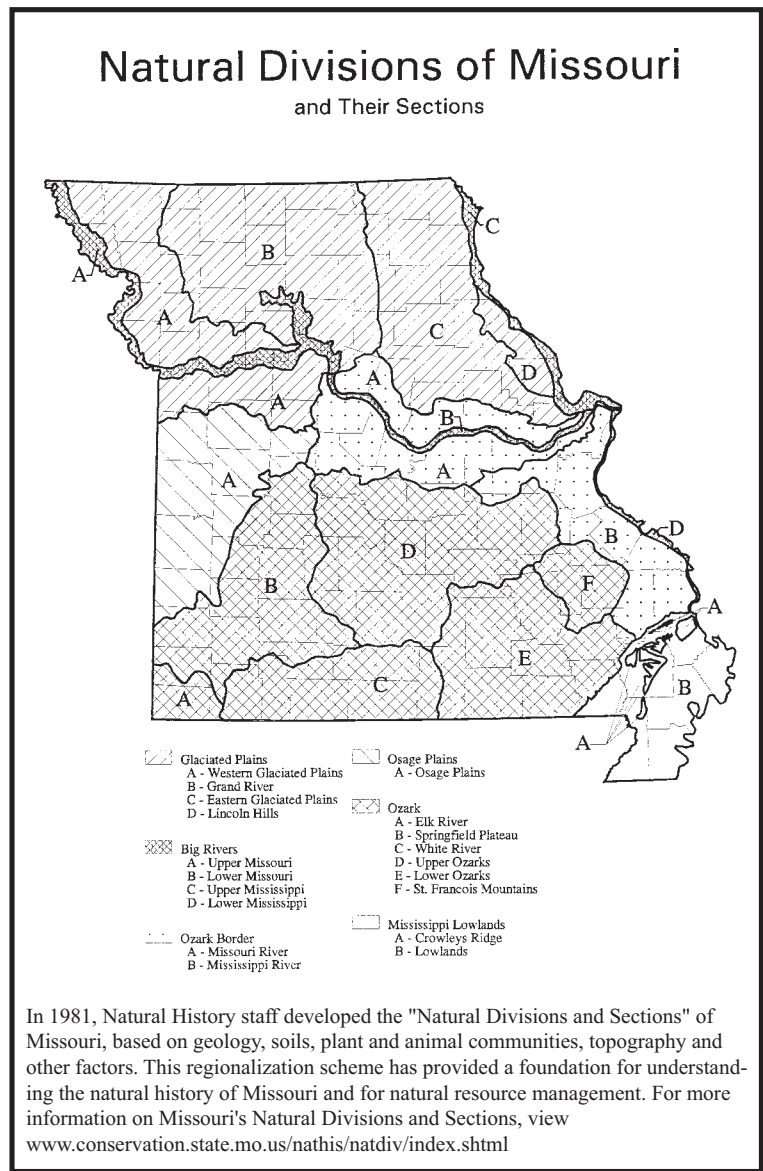
Literature Cited:

- Bishop, C.A. 1992. The effects of pesticides on amphibians and the implications for determining causes of declines in amphibian populations. *In Declines in Canadian amphibian populations: designing a national monitoring strategy*, C.A. Bishop and K.E. Pettit, eds. Can. Wildl. Serv., Occasional Paper 76.
- Bridges, C.M. 1997. Tadpole activity and swimming performance affected by sublethal levels of carbaryl. *Environ. Toxicol. Chem.* 16:1935-1939.
- Bridges, C.M. 1999. Effects of a pesticide on tadpole activity and predator avoidance behavior. *J. Herpetol.* In press.
- Mayer, F.L. Jr. and M.R. Ellerseick. 1986. *Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemical and 66 Species of Freshwater Animals*. U.S.F.W.S. Resource Publication #160.
- Semlitsch, R.D., D.E. Scott and J.H.K. Pechmann. 1988. Time and size at metamorphosis related to adult fitness in *Ambystoma talpoideum*. *Ecology* 69:184-192.
- Smith, D.C. 1987. Adult recruitment in chorus frogs: effects of size and date at metamorphosis. *Ecology* 68: 344-350.
- Wake, D.B. 1998. Action on amphibians. *Trends Ecol. Evol.* 13: 379-380.
- Wilbur, H.M. 1980. Complex life cycle. *Ann. Rev. Ecol. Syst.* 11:67-93.



Conservation Biology in Missouri (Continued from page 4)

pastures - have dramatically increased on public land. This success has prompted the Conservation Department to propose to the U.S. Fish and Wildlife Service that Missouri bladderpod be upgraded to federally Threatened. In addition to tracking individual species, Natural History, along with other partners, coordinates the protection of the best examples of Missouri's natural communities in the Missouri Natural Areas System. High quality dry chert prairies, igneous glades, deep muck fens and bottomland forests are just a few of the natural community "crown jewels" in the natural areas system. Missouri's 169 natural areas contain more than 46,000 acres; natural areas harbor many species of conservation concern as well as geologic wonders. What does Natural History do with all this information? The biodiversity data amassed is used to drive wildlife diversity protection and management within the Conservation Department and to provide all Missourians with information about their natural heritage. The data powerhouses within Natural History are the Missouri Natural Heritage Database (MONHD) and the Missouri Fish and Wildlife Information System (MOFWIS). The MONHD contains more than 12,000 records of occurrences of more than 800 sensitive species and natural communities, including abundance, distribution and conservation needs. The MONHD provides data for conservation and urban planning, environmental reviews of development and scientific research. The MOFWIS contains information about the habitat, life history, management and distribution of Missouri's wildlife species. Currently the database contains records for 739 vertebrate and 6 federally endangered invertebrate species. The MOFWIS is consulted by Conservation Department employees, university, elementary and secondary students and teachers, The Nature Conservancy and various federal agencies. Both databases can be viewed at www.conservation.state.mo.us/. Natural History data is also used for many Conservation Department publications, both technical and popular. In 1996, Missouri claimed 1.6 million wildlife watchers, according to a U.S. Fish and Wildlife Service's National Survey. In both stimulating and satisfying the great interest Missourians have in wildlife diversity resources, Natural History staff have contributed hundreds of articles for the Missouri Conservationist and have written or edited scores of publications such as the revision of Steyermark's Flora of Missouri, Missouri Wildflowers (1998), Amphibians and Reptiles of Missouri, Shrubs and Woody Vines of Missouri, and free literature on Missouri's snakes, birds, lizards, turtles, toads and frogs, natural areas, spiders, and others. "Interpretation and education have been our objectives from the very beginning," says Rick. In addition to producing publications, Natural History staff initiated the development of our Conservation Nature Centers. Natural History staff also began the popular "Prairie Days" and



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Conservation Biology in Missouri (Continued from page 6)

"Eagle Days" around the state. These programs and activities are now coordinated by other Conservation Department units. "One of Natural History's most important contributions to wildlife diversity," says Rick, "is that many of our staff are now working in other states as biologists and program specialists for state and federal agencies and organizations like The Nature Conservancy. The Natural History Section was their training ground."

For more information about the Conservation Department's wildlife diversity programs, please contact: Carol Davit, Natural History Special Projects Coordinator, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65101, or view www.conservation.state.mo.us/

Partners in Flight Update

By Jane Fitzgerald, Midwest Regional Coordinator, Partners in Flight, Missouri Department of Conservation, P.O. Box 180, Jefferson City, MO 65102 - fitzgj@mail.conservation.state.mo.us



For those of you interested in bird conservation, I want to provide an update about Partners in Flight (PIF), an international, cooperative bird conservation initiative. PIF was fledged in 1991 with an initial focus on neotropical migrants, but since has broadened its purview to include all landbirds exclusive of game species. In 1995, PIF undertook a national planning effort. Four regional and one national coordinator were hired to oversee the development of Bird Conservation Plans (BCPs) for states or physiographic areas across the United States. (Missouri, for example, overlaps portions of five physiographic areas, the Dissected Till Plains in the northwest, Prairie Peninsula in the northeast, Osage Plains in the southwest, Mississippi Alluvial Valley in the Bootheel and the Ozark/Ouachitas.) The PIF physiographic area BCPs for each of those regions provide a general historical/ecological overview of the planning unit, identify species of priority for the area in question, and identify habitat needs and make conservation recommendations at both a local and landscape scale. The plans draw heavily upon science. Interested parties in the research community have been and will continue to be important participants in the development and review of the documents.

Similar planning efforts are now underway nationally for both shorebirds and colonial waterbirds, and along with PIF and the North American Waterfowl Management Plan, will provide a sound base for conservation action in the coming years. An integrated delivery mechanism for the various plans is now under development in the U.S. Steps also are being taken to coordinate bird conservation efforts among Canada, the United States, and Mexico, via the Commission for Environmental Cooperation, an offshoot of the North American Free Trade Agreement. It's an exciting time; goodwill and opportunities abound. Perhaps within the next decade we'll see the kind of results on the ground that will lead to a healthy and secure North American avifauna.

To learn more about PIF and these ongoing efforts, you can subscribe to the PIF Midwestern Working Group newsletter by sending your name and address to: Jane Fitzgerald, c/o Natural History Section, MO Dept. of Conservation, P.O. Box 180, Jefferson City, MO 65102 or E-mail: fitzgj@mail.conservation.state.mo.us



U of MO-Columbia Conservation Biology Seminar Series

Mar. 11 - **Dr. Mary E. Power**, Department of Integrative Biology, University of California-Berkeley "Flood effects on food webs in a river and its watershed"

May 6 - **Dr. Malcolm L. Hunter, Jr.**, Department of Wildlife Ecology, University of Maine, Orono "Lessons from nature: Using ecosystem processes as models for managing natural resources"

All seminars take place at 4pm in 100 Stewart Hall on the U of MO-C campus

Membership Information

The goal of MOSCB is to promote communication among conservation biologists throughout the state of Missouri. Membership in MOSCB is free. Send your name, address, phone number and email address to:

moscb@showme.missouri.edu

or write to the address listed below. Membership must be renewed annually. Membership expires on August 1 of each year. Please visit the MOSCB web page for more detailed information (<http://www.missouri.edu/~moscb/index.html>).

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