

The Glade

The Newsletter of the Missouri Chapter of the Society
for Conservation Biology <http://www6.semo.edu/MOSCB/>

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News and Notes

Student Poster Contest Winner: Congratulations to Michael Pillow of Missouri State University. His poster submission to the Missouri Natural Resources Conference was selected as the winner of the 2009 student poster contest sponsored by MOSCB. Michael's poster was titled "Acute toxicity of copper to glochidia larvae in- and outside of conglutinates." He will receive a one-year membership in SCB and a subscription to *Conservation Biology*. An article written by Michael about his work appears in this issue.

News and Notes (continued)

Become a voting member of MOSCB: SCB membership dues have been restructured and, in order to be a voting member of the Missouri Chapter of the Society for Conservation Biology, one must join SCB. One can apply online for membership in the society at <https://www.conbio.org/join/>.

New Bylaws adopted: View our newly adopted by-laws, our new Chapter Charter, and the SCB Chapter Handbook on our webpage: <http://www6.semo.edu/MOSCB/>

Society for Conservation Biology makes recommendations to President Obama's Transition Team: The Society for Conservation Biology presented recommendations for advancing the scientific foundation for conserving biological diversity. Read the recommendations here:
<http://conbio.org/Activities/Policy/docs/SCB2008TransitionTeamRecommendations.pdf>

MOSCB Silent Auction at MONRC 2009

Esther Stroh

Our silent auction at Missouri Natural Resources Conference was another success. We raised \$288 through the auction of a wide variety of quality items. We wish to extend heartfelt thanks to the following individuals and organizations for their support and generous donations:

Dennis Figg: Stratigraphic Succession in Missouri, a Woods Prairie handmade mug, small handmade ceramic pot and vase

Alan Journet: four photographs: paw-paw, shooting star, tiger lily, and bald eagle

Nadia Navarrete-Tindall: Salvadoran treasures: two table runners, two nested baskets and a decorative wooden tray

Nels Holmberg: potentially magic wand, hand carved from black walnut, with a black ram hair core

Missouri Botanical Garden: two books, Biology 8th Edition, and Missouri Botanical Garden each signed by Peter Raven

River Ridge Winery: a magnum of Cynthiana wine

Bethany Williams: American toad pen and ink drawing

Uria Gingerich: handmade Amish basket

Meet the New Board

Esther D. Stroh, President:

Esther earned a B.S. in Education at National College of Education in Evanston, IL; M.S. in Biology and M.S. in Environmental Science from Indiana University; and Ph.D. in Evolutionary Biology and Ecology from University of Missouri. Esther has worked for the National Biological Survey/US Geological Survey as an ecologist for 15 years. From 1993-1995, she worked in Washington, D.C. and coordinated national programs for climate change and invasive species research. She moved to Missouri in 1995; her research focuses on ecology and genetics of relict and disjunct plant populations, plant-climate interactions, and vegetation community dynamics. Esther is especially interested in Ozark ecosystems and biodiversity.



Outgoing president Alan Journet, passes the gavel to incoming president Esther Stroh, at the MOSCB meeting in February 2009.

Photo by MOSCB member Jill DeWitt

Andy West, Vice President: (More in the next newsletter)

Amy Buechler, Treasurer:

Amy earned her B.S. Biology, at Truman State University; M.S. Environmental Studies, at Antioch University New England. Amy serves as Teaming With Wildlife Coordinator for the Conservation Federation of Missouri in Jefferson City. She works with conservation partners around the state to advocate for increased conservation funding and to help implement Missouri's Comprehensive Wildlife Strategy. Amy has a great love for the Missouri outdoors and is rediscovering a sense of wonder through her 14-month old son.

Stephanie Manka, Secretary:

Stephanie is currently a Ph.D. Student at the University of Missouri-Columbia in the department of Biological Sciences. She studies social structure of African forest elephants (*Loxodonta cyclotis*) in two national parks in Gabon using non-invasive genetics, satellite telemetry, and behavioral observations.

Stephanie Manka, Secretary (continued):

Her past experiences include working for the Bureau of Land Management, the Wildlife Tracking Center in Disney's Animal Kingdom, and the School for Field Studies in Kenya. She plans to pursue a career in conservation science.

James C. Trager, Conservation Committee Chair and Glade Editor: See "The Editor's Corner", p. 5.

The President's Corner: Changes "in the air"

Esther Stroh

Change seems to be in the air and water everywhere. A change in U.S. Administration, changes in global financial markets, and changes in our little organization. Our Chapter has several new Board members, new governing documents, and new operating guidelines.

Changes in the Board: The Missouri Chapter of the Society for Conservation Biology (MOSCB) held its annual meeting February 5, 2009 at the Missouri Natural Resources Conference (MNRC). I would like to thank Alan Journet, our President since 2007, for all his hard work and dedication, especially his efforts to organize and facilitate two very successful workshops at MNRC. His passionate leadership will be missed; I hope he will still be an active MOSCB member and mentor. Todd Jones-Farrand retired as Chair of the Conservation Committee and editor of *The Glade*. I would like to thank Todd for his excellent job of getting out two issues of *The Glade* for the past several years. I want to welcome our new Conservation Chair James Trager; this is his first issue as Editor of *The Glade*. Nadia Navarrete-Tindall stepped down from the Vice-president position after two years; she worked hard to make the silent auction, our primary fundraiser, a success each year. Andy West was elected as Vice President, and has already become an active officer by attending monthly conference calls for SCB Chapters. Andy will be an excellent liaison between our chapter and the Society. Stephanie Manka was re-elected to the position of Secretary for the third year; she has done an excellent job keeping track of our meeting minutes, decisions and membership lists. Amy Buechler was elected to the Treasurer position; she has been an active MOSCB member, and is well qualified for her new position. I have served as both Secretary and as Treasurer in the past, and as the newly elected Chapter President, I look forward to working with the new Board and with all interested members.

Changes in our membership guidelines: The SCB required all Chapters to renew their charters and adopt a consistent set of bylaws. We accomplished both of these tasks at our annual membership meeting. I received word on April 8th that our charter and by-laws had been ratified by the SCB Board of Governors. The biggest change in our by-laws requires a person to be a member of SCB in order to be a voting member of MOSCB. In the past, any one who subscribed to *The Glade* was essentially considered a member of our Chapter, and MOSCB Chapter dues were optional. Payment of optional dues in the past few years has been about 15% of *The Glade* readership. The biggest drawback to the new arrangement is that it

has reduced our “membership” from about 200 to about 30. We will still continue to send *The Glade* to all interested parties, but please consider joining SCB: http://www.conbio.org/membership_conversion.cfm. Currently, regular SCB membership is \$20, (this membership includes the SCB newsletter; dues are more if you subscribe to a journal). For membership in a large global network of conservation biology scientists and practitioners, \$20 is not an unreasonable amount. Please consider joining SCB and MOSCB. Dues for our chapter are \$5.00 per year). And of course, we still accept donations from individuals who want to support MOSCB but not join SCB. Contact our Treasurer, Amy Buechler: abuechler@confedmo.org.

Changes in our operations: Another requirement under the new by-laws is for each Chapter to file an Annual Organizational Plan, which includes proposed events and activities for the coming year. Because we adopted the new by-laws at the end of our annual meeting, we are (technically) not required to do this for 2009, but it is a good idea that I want to pursue. The MOSCB Board will meet this spring to discuss our plans for the remainder of this year. Our meeting date has not been set, but if you have suggestions for activities you would like our Chapter to undertake, or if you would like to attend the meeting (probably in Rolla, which is centrally-located for current Board members), send an email to me at estroh@usgs.gov, and I will make sure you are included in meeting communications. I am especially interested in ideas for partnering with other groups and organizations that have a conservation focus.

The Editor’s Corner: Meet the new editor

James C. Trager

I developed an interest in the natural world at an early age, around 5. Summers spent in rural New Mexico solidified this interest, especially for ants. Later, I completed a Bachelors in Biology at Northern Illinois University. There, botanist Paul Sorensen first introduced me to Midwestern native plants and to the concepts and practice of habitat management (especially with fire) for conservation of biological diversity. In quest of opportunities to do research on ant systematics, I went on to do masters and doctoral degrees in entomology at the Universities of Kansas and Florida. Along with these formal degrees, my transcripts would reveal that I have *de facto* minors in Plant Taxonomy, Portuguese and Spanish, which facilitated travel and post-doctoral research in Brazil, Argentina and Bolivia on the systematics and geographic distribution of fire ants, a New World group of 20+ species, of which two have invaded southeastern US from South America, and one of these two, plus a third one have become pests in much of the tropical world. I came to Missouri in 1988, and after two and a half years in “Adjunctdom”, joined the Missouri Botanical Garden in 1991 as biologist at Shaw Nature Reserve in Franklin Co. At the reserve, I am a restoration biologist and naturalist, and serve on the faculty of a collaborative summer program with Washington University ecologists to train high school students in field biology. Time permitting, I still occasionally squeeze in and publish research on the systematics of various ant genera.

The role of conglomerates in the survival of glochidia larvae (Unionidae) exposed to dissolved copper

Michael J. Pillow, Missouri State University, Department of Biology

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The allowable limits of water pollution recommended by government agencies are often based on the most sensitive aquatic species. Freshwater mussels are potentially important in this regard, because they are highly sensitive to certain pollutants. Mussels spend their relatively sedentary lives in one localized area of the stream bed. They are partly buried in the substrate and filter the water to ingest fine particulates, so they are exposed to both sediment and water pollution. The larvae of mussels, called glochidia, are easily obtained in large numbers. These larvae are tiny bivalves that can close their shell in response to chemical stimuli, which allows easy assessment of their viability.



Figure 1. Ouachita kidneyshell conglomerates (*Ptychobranthus occidentalis*) have adhesive, membranous tails that can attach to rocks or other substrate and mimic fish or insect larvae, tasty food for hungry darters.

Glochidia pollution tolerance has been studied extensively, and several studies have shown that glochidia are especially sensitive to dissolved copper, a common water pollutant in mining and industrial areas. However, little attention has been given to the ecological relevance of the test conditions. In order that toxicity tests on glochidia be ecologically relevant, the tests should mimic the duration and route of exposure that occurs in nature.

Glochidia are parasites of fish. The time they normally spend in the water prior to reaching a host fish is not documented, but is thought to depend on the species' method of larval dispersal. Some species expel the microscopic larvae to drift in the water. In other species, the larvae are contained in membranous packets, called conglomerates, that attract host fish. Either way, they must come into contact with the proper fish host to complete their life-cycle. The time that glochidia are normally exposed to water, and the possible protective effects of conglomerates are of interest. In this study we investigated the role of the conglomerate structure as a shield prolonging the survival of glochidia exposed to dissolved

copper in water. We tested glochidia viability inside and outside of conglomerates at two temperatures in the presence and absence of dissolved copper. Our goal was to measure any differences in copper toxicity to glochidia inside conglomerates compared to those free in the water at each test condition.



Figure 2. Ouachita kidneyshell adult and conglomerate (inset, magnified). Each conglomerate contains 300-500 glochidia larvae.

The Ouachita kidneyshell (*Ptychobranthus occidentalis*) and the round pigtoe (*Pleurobema sintoxia*) are common freshwater mussels that use conglomerates. Kidneyshell conglomerates are complex, membrane-bound packets that resemble fish or insect larvae, while round pigtoe conglomerates are simply cohesive groups of eggs containing glochidia, held together by the egg membranes. For this study, conglomerates and glochidia were obtained from six brooding kidneyshell mussels from the

St. Francis River in Wayne County, Missouri and seven brooding round pigtoe mussels from the Meramec River in Jefferson and St. Louis Counties, Missouri. Both whole conglomerates and glochidia freed from conglomerates were exposed to the test conditions. Freeing the glochidia involved careful dissection of conglomerates and gentle agitation in water using a pipette to disrupt the egg membranes, which are quite fragile. Viability of subsets of glochidia was assessed at timed intervals before and during the exposures.

Glochidia exhibit a distinct response to environmental stressors: valve closure.

Valve closure is also the means for attachment to a host, by clamping on the gill filaments of the fish. Therefore, a glochidium that is either unable to close, or closed prematurely, will no longer be able to attach to a host. We tested viability by quantifying open and closed glochidia prior to and following the addition of a concentrated saline solution.

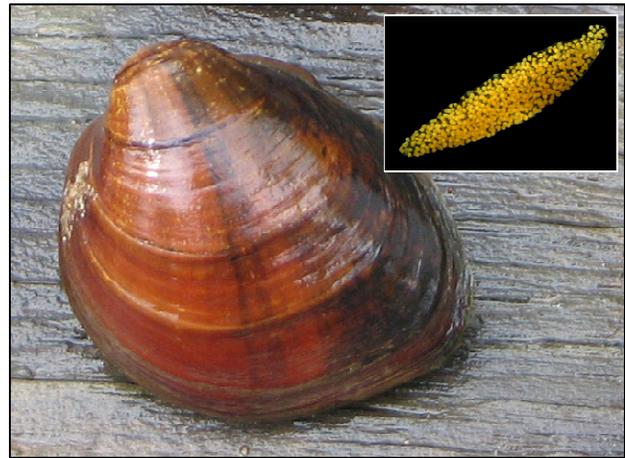


Figure 3. Round pigtoe (*Pleurobema sintoxia*) and conglomerate (inset, magnified). Round pigtoe conglomerates can contain over 1,000 glochidia larvae.

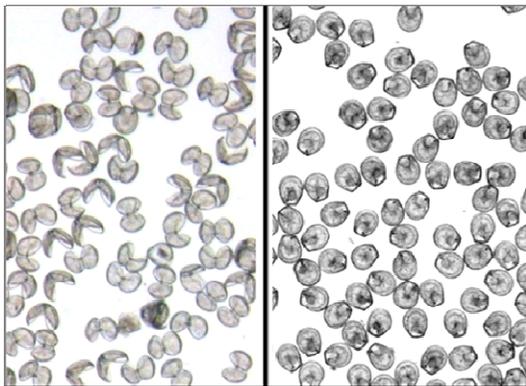


Figure 4. Kidneyshell glochidia before (A) and after (B) adding NaCl solution to quantify viability. Viable glochidia will respond to NaCl by closing their valves.

Viable glochidia were those that were open before adding saline and closed afterward.

We compared the time to 50% loss of viability (ET50) of glochidia in conglomerates and free in water when exposed to dissolved copper. Tests were made with both species at 10 and 20 C. Groups of glochidia or conglomerates were placed in 250mL Erlenmeyer flasks, with 3 replicate flasks for each treatment group. Target copper concentration was 50µg Cu/L (CuO4S, Acros Organics) in 200mL of water. Water was changed periodically with fresh copper-spiked water mixed from a stock solution. Every 1-2 days, one conglomerate and approximately 100 glochidia were sampled from each flask for viability assessment, and copper concentrations

were checked using inductively coupled plasma mass spectrometry (ICP-MS). Results were analyzed using a modified probit analysis to estimate median time to 50% loss in viability (ET50). ET50s were calculated for treatment and control groups of both species, at two temperatures, and for glochidia in conglomerates and glochidia free in the water. ANOVA was used to test differences between ET50s.

Results & Discussion

ET50s for freed glochidia treated with copper were significantly lower than those in the controls, indicating copper toxicity. Temperature was also important, and ET50s at 20°C were significantly lower than those at 10°C for all treatments and both species.

Species	Temperature (°C)	Treatment	Specimen	ET50 (95% CI) (h)
Ouachita kidneyshell	10	Control	Freed glochidia	163.8 (158.6-169.0)
			Conglutarinate	219.1 (213.0-225.1)
		Copper	Freed glochidia	61.5 (58.0-65.0)
			Conglutarinate	347.0 (336.8-357.1)
	20	Control	Freed glochidia	84.3 (80.9-87.6)
			Conglutarinate	145.1 (139.4-150.8)
		Copper	Freed glochidia	55.6 (52.9,58.4)
			Conglutarinate	130.5 (125.4-135.5)
Round pigtoe	10	Control	Freed glochidia	81.2 (79.5-82.9)
			Conglutarinate	142.8 (139.7-146.0)*
		Copper	Freed glochidia	28.7 (27.1-30.2)
			Conglutarinate	108.1 (106.2-110.0)
	20	Control	Freed glochidia	37.8 (36.6-39.0)
			Conglutarinate	62.9 (61.3-64.5)
		Copper	Freed glochidia	25.4 (24.3-26.4)
			Conglutarinate	71.5 (70.1-72.9)

In contrast to freed glochidia, we found that glochidia in conglutinates exposed to copper did not die sooner than those in conglutinate controls, for both species. This observation showed that conglutinates can protect glochidia against dissolved copper. All glochidia in conglutinates were dead by day 9 at 21°C, and by day 32 at 10 °C. Survival may have been limited by a fungus, probably *Saprolegnia*, which appeared by day 5 at 21°C. The fungus appeared on day 11 at 10°C on control conglutinates, but not until day 21 at 10°C groups in copper exposures, when survival began to drop. For glochidia in conglutinates, pathogens such as *Saprolegnia* might also limit survival in the wild. Paradoxically, the glochidia in conglutinates exposed to copper at 10°C survived longer than even the 10°C control group. Although the difference was not quite statistically significant, copper might extend the life of glochidia in conglutinates by discouraging the growth of the fungus.



Figure 6. A fungus, probably *Saprolegnia*, was visible on conglutinates by day five at 21°C and by day 11 at 10°C. Conglutinates with fungal infections also exhibited weakened conglutinate membranes and elevated glochidia mortality.

Photo: MJ Pillow

Conglutinates are clearly an adaptation to facilitate glochidia dispersal to host fish (Barnhart et al. 2008). The present study shows that conglutinates also prolong the life and viability of larval freshwater mussels after release from the female. For species that release conglutinates, toxicologists might choose to test intact conglutinates rather than free glochidia, thus making longer test exposure periods relevant. Conglutinates can also protect the glochidia from exposure to copper, potentially raising the tolerable concentration. Both effects are important to consider if water quality standards are to be developed based on the sensitivity of the larval life stage of freshwater mussels.

Literature Cited:

Barnhart, M.C., W.R. Haag, and W.N. Roston. 2008. Adaptations to host infection and larval parasitism in Unionoida. *J. N. Benthol. Soc.* 27:370-394.

Managing Resources in the Face of Climate Change: A synopsis of the MOSCB Climate Change Workshop 2009

D. Todd Jones-Farrand, FarrandD@missouri.edu

I will admit it up front – like most Americans I get my information about climate change from the media. I'd like to think that I am informed by objective, scientifically-accurate sources, but in reality it's still second hand news. It still comes as "sound bites." Several sound bites that have dominated my understanding are things like, "Missouri's climate will become more like Arkansas," "We will lose our oak-hickory forests as communities shift to the northeast," and "ecological timing (phenology) will get more and more out of whack causing populations to crash."

Sound bites are easily digestible and easy to remember because they make some intuitive sense. Thus, they are passed on until they achieve the status of urban legend. While they may be true to some extent, they are also a bit of fantasy. As such, they do us a disservice by promoting misconceptions and masking the complexity and subtle nuances of the issue.

So I was very happy to attend the recent workshop MOSCB held as part of the 2009 Missouri Natural Resources Conference. It was an illuminating morning as I sat with about 80 others listening to those on the front lines of protecting and enhancing Missouri's natural resources. Titled "Managing Biological Resources in a State Undergoing Climate Change," the workshop complimented the climate change theme of the conference and served as a follow-up to last year's workshop on the expected impact of climate change on Missouri's biodiversity.

This year's workshop featured 6 invited speakers and ended with an hour of spirited discussion. Outgoing MOSCB President, Alan Journet, got the session rolling with a synopsis the climactic changes Missouri can expect. Presentations by the panel followed. Paul Nelson (US Forest Service) discussed the management of natural communities; Ken McCarty (MO State Parks) discussed management of their lands; Mike Leahy (MDC) discussed management implications for the state's Natural Areas; Matt Albrecht (Missouri Botanical Garden) discussed the use of ex situ conservation techniques to preserve plant diversity; Brad Jacobs (MDC) discussed how we might use vulnerability assessments for birds to guide management; and, Tim Smith (MDC) discussed the management of Native and Exotic plants.

What Are The Likely Effects of Climate Change?

Although there are no climate models specifically for Missouri, Journet reviewed what we can infer from climate models that encompass the eastern U.S. In Missouri, we will likely see continued increases in carbon dioxide (from 375 ppm up to 540-850 ppm) and temperatures (another 1.5-3.5°C or 3-7°F). That's quite a bit hotter when you consider that the last ice age was only about 5°C cooler. The potential changes in precipitation are much less certain, but levels are not expected to change much. However, these general predictions refer only to annual averages. The frequency of extreme events is expected to increase, so the pattern of

temperature and precipitation within years is really where climate change will have its greatest impacts on Missouri, ecologically and economically. Smith noted that a 2-week heat wave could have devastating consequences on agriculture.

Although it is true that the projected temperatures for Missouri approximate those currently experienced in parts of Arkansas, this only refers to summer temperatures in the near term. Journet noted that by 2036 Missouri is expected to experience temperatures like northern Arkansas in the summer and northern Alabama in the winter. By 2095, that may shift to the temperatures currently experienced by northern and southern Texas.

The arrangement of biomes and communities we see today is the product of past and current temperature and precipitation regimes (i.e., climate). So, as temperature and precipitation change we should expect changes in communities. However, it is an oversimplification to expect that the communities of Arkansas and Texas will “move to” Missouri. Several presenters stressed that communities do not move. Species may shift their distributions, but they do so at different rates. There is also the problem of significant barriers, like the Corn Belt. A better way to think about these changes was given in an example by Leahy. In the Dust Bowl era, prairies in eastern Nebraska shifted from tall grass to mixed grass. This change occurred not because the species composition changed, but because the species in that community that were more tolerant of drier conditions became dominant. It is this type of resorting that Missouri natural communities are likely to experience.

One of the most evident ways that the climate change is already producing impacts is in phenology. Several speakers showed examples of this, including the famous example of 400 years of records in Japan showing ever earlier dates for cherry blossoms. Such changes can cause economic and ecological problems. For example, tourism revenues would be hard hit if the Cherry Blossom Festival in Washington DC or the fall colors of the northeast are not accurately predicted. Similarly, nest success has been shown to decline in areas of the Appalachians where peak insect abundance occurs prior to the arrival of migratory birds. However, Smith pointed out phenology has never been perfectly synchronized. Inherent variability in timing opens the door to adaptation and the ability to adapt to changing phenology may be a driver in the resorting of communities.

How Should We Respond?

The speakers were unanimous in identifying current stressors as the greatest problems managers face. These stressors include urbanization, fragmentation, pollution, invasive species, and the loss of functional processes. That is not to say that climate change isn't important. Leahy noted that it may compound the effects of current stressors, and may be the “final straw” for many species. However, we can't ignore these current stressors in our attempts to deal with climate change.

So what is the proper focus of conservation professionals in the face climate change on top of all the current threats we deal with? First, we must remember that anthropogenic forces are among the greatest determinants of ecological functioning. Although we have been homogenizing the

species composition of our continent for at least the last century through the spread of exotic and “weedy” native species (some refer to this as the Homogenocene Era), we can play a positive role. Nelson reminded the audience that our historical climate would not have maintained savannas and woodlands without Native Americans applying fire. Our future climate may support the return of these vegetation types to Missouri, but only if we ensure that the process of fire also returns.

McCarty reminded the audience that natural systems possess the qualities of diversity, integrity, complexity, and resiliency. It is still our job to restore these qualities to communities by restoring functional processes to landscapes where we can. This is especially true of short-term repetitive disturbance processes like fire, flooding, and herbivory. Alluding perhaps to G. Evelyn Hutchinson’s book “The Ecological Theater and the Evolutionary Play,” Leahy referred to this philosophy as a “save the stage, not the actors” approach. While we may be able to undertake heroic efforts like assisted migration and ex situ conservation, Albrecht pointed out that these measures are costly, can only work for a limited number of species, and even then only in compliment to in situ conservation. To “save the stage,” McCarty pointed out that we needed to do a better job of protecting natural areas, valuing biodiversity, emphasizing viability of populations, reinstating natural processes, and restoring ecosystems. If we can do these things as we move forward, we can achieve landscapes designed for resiliency. While this approach might not save every species, it does provide the most efficient way to save the greatest number.

Leahy noted that we do not need new management tools to address climate change. All the things we are trying to do are the things we need to do to deal with it, we just need to do them better. This “same tools, sharper blades” mentality was reflected in all the presentations. During the presentations and in the discussion that followed, some general blade-sharpening techniques were discussed. First and foremost was cooperation – across disciplines and agencies, and across the lines of public and private. We all need to get involved and help each other out. Monitoring is another area of significant need, and we need to expand our focus beyond terrestrial systems to aquatic systems and caves, and beyond birds to include all taxa. In addition, the development of more focused regional climate models may give us better predictions on expected changes in precipitation.

Final Thoughts

Attending the workshop was enlightening. Climate change adds to our professional burdens, but hopefully the current sense of urgency will generate policies that reduce the root causes and properly fund our response. There is a lot of information out there, but not all of it is

good or pertinent to Missouri. Certainly, there was much more presented at the workshop than could be included here. If you are interested in learning more about climate change and it's impact on Missouri, I encourage you to go to the MOSCB website and review the presentations from the workshops in 2008 (http://www6.semo.edu/MOSCB/MONRC_2008.html) and 2009 (http://www6.semo.edu/MOSCB/MONRC_2009.html). There is also a very informative article summarizing the IPCC report in the Fall 2007 issue of The Glade [The Future Is Now by Esther Stroh (<http://www6.semo.edu/MOSCB/glade/Glade%20Vol10%20No2.pdf>)].



Society for Conservation Biology

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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 \$5.00 (esther_stroh@usgs.gov). Please contact one of the Board members for more information – and bear with us as we transfer web site locations.

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