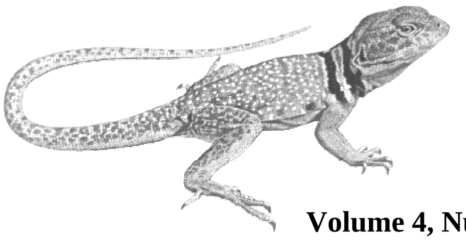

The Glade

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

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The Corner

Michelle D. Boone, 4200 New Haven Road, USGS Columbia Environmental Research Center, Columbia, MO 65201; michelle_boone@usgs.gov

Kathleen Norris says in *The Cloister Walk* (1996) that "Maybe monks and poets know, as Jesus did when a friend, in an extravagant, loving gesture, bathed his feet in nard, an expensive fragrant oil, and wiped them with her hair, that the symbolic act *matters*; that those who know the exact price of things, as Judas did, often don't know the true cost or value of anything." And I would add conservation biologists to the list of those in the know. Although many have demonstrated that there are economic benefits to preserving nature, faced with the selection of the *spotted owl* or *me*, it is understandable that people often choose *me*. These issues are often presented as discrete options, when it is conceivable that both choices are congruous. Certainly we must use every reasonable, ethical, and responsible means to support wildlife and natural resources, but economics will never be enough. A lot of people will have to care and participate in the struggle to conserve nature and meet the basic needs for humans if our efforts as conservationists are to succeed. In the wake of a growing human population and the problems associated with urbanization, however, we may often feel that our efforts are more symbolic than substantive. Conveying information about environmental problems and solutions to the public, our families, and the media (as well as other researchers and managers) are acts that will increase awareness, and are a means of inspiring one another. As you receive this edition of *The Glade*, many students across Missouri are beginning a new school year; they are likely being encouraged to try new things, and undoubtedly they are already doing homework. We would like to encourage everyone to do a little more this year and to find a new way to raise awareness about your favorite taxonomic group, because there is no limit to the potential of six billion symbolic acts.

Visualization of Flow Alternatives, Lower Missouri River

Robert B. Jacobson, U.S. Geological Survey, Columbia, Missouri; robert_jacobson@usgs.gov

Review of the Missouri River Master Water Control Manual (Master Manual) has resulted in consideration of many flow alternatives for managing the water in the river (USACE 1998a). The Missouri River system is large and complex, including many reservoirs, control structures, and free-flowing reaches extending over a broad region. Evaluation of future effects of system management requires complex computational models that attempt to integrate physical, chemical, biological, and economic effects. The complexity of the modeling process, the large number of alternatives that have been under consideration, and the many different ways of analyzing results present challenges to understanding the flow alternatives. This article introduces a USGS on-line report (Jacobson 2001) that presents a statistical visualization of modeled flows. The visualization is intended to improve public understanding of the differences and similarities among alternatives.

The visualization report presents analyses of six modeled flow alternatives and two reference alternatives, for four selected sites on the Lower Missouri River (Fig. 1). Water-control alternatives presented in the visualization report are those under active consideration in early 2001, and two reference alternatives, the current water-control plan (CWCP) and a run-of-the-river scenario (EVQ2). Evaluation of alternatives is an ongoing process; additional alternatives will be analyzed and added to the report as they are proposed and modeled.

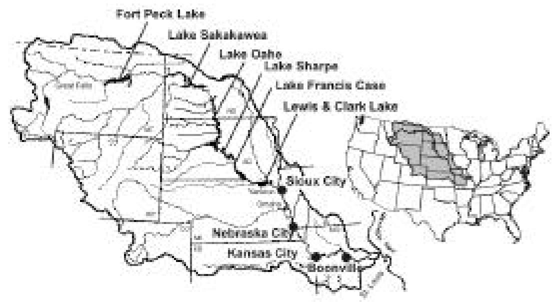

Figure 1. Missouri River basin and the Lower Missouri River. Modeled alternative flows are presented for Sioux City, Iowa, Nebraska City, Nebraska, Kansas City, Kansas, and Boonville, Missouri.

Daily Routing Model

Flow alternatives have been modeled by the U.S. Army Corps of Engineers using the Daily Routing Model (USACE 1998b). The modeled flows are synthesized from historical data on tributary inflows, calculations of streamflow depletions due to evapotranspiration and consumptive use of water, and modifications of outflows according to water-control rules. The model reproduces how reservoirs would be managed under a set of water control rules, given the actual historical inflows. Historical data are available, or have been estimated, for the period 1898-1998. The Daily Routing Model uses these data to generate 100 years of daily flows for each of 14 sites for each management alternative. The 14 sites consist of nine streamflow gaging stations on the Lower Missouri River and five streamflow gaging sites in inter-reservoir river segments. Model runs show the result of highly variable streamflow routed through the reservoir system according to water-control rules of varying complexity. Additional information on the Daily Routing Model can be found in USACE (1998b).

Methods

Modeled flow data for the alternatives were obtained from the USACE; four streamflow gaging station sites were selected to represent the range of effects on the Lower Missouri River (Fig. 1). The data were analyzed for daily flow duration (Flynn et al. 1994) and output data were extracted for flows that equaled or exceeded 90, 75, 25, and 10 percent of the time. The data were then plotted

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Visualizations of flow alternatives (continued from page 2)

as shaded bands by day of the year to illustrate variations in flow during the year and over the 100 years of modeled record (Fig. 2). Overlays of reference alternatives present opportunities for visual comparisons. Each of the new alternatives is compared to the run-of-the-river scenario, the 90th and 10th percentile flows of the current water control plan, and navigation target flows.

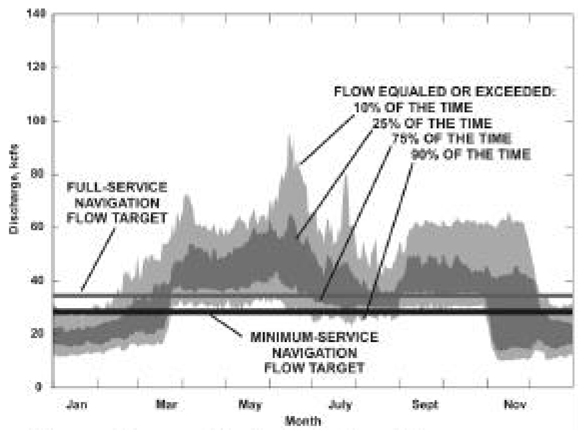

Figure 2. Elements of flow-duration hydrograph figures.

Modeled Alternatives

The following alternatives are analyzed and presented in the online report. Except for EVQ2, all the alternatives include drought conservation measures, reservoir unbalancing, and tern and plover mitigation rules (see USACE 1998a). The alternatives are identified by the codes shown in bold:

Reference Alternatives:

• **EVQ2**. The run-of-the-river alternative where streamflow is modeled for the conditions of constantly full reservoirs. Except for some evaporation from the reservoirs, it provides a realistic depiction of flows in the absence of regulation, that is, a natural-river alternative.

• **CWCP**. The current water-control plan for the MRMRS.

Management Alternatives:

• **FW22**. Prescribed by the USFWS in the Missouri River Biological Opinion (USFWS 2000), this alternative includes a 17,500 cubic feet per second (17.5 kcfs) spring rise above full-service navigation releases from Gavins Point dam, when conditions permit (to be achieved on average once every three years), and a split navigation season with two low-flow periods during the summer of 21 and 25 kcfs.

• **FW32**. This alternative was run to evaluate the relative effects of a 30 kcfs spring rise above full-service navigation releases from Gavins Point dam (to be achieved on average once every three years), and the split navigation season as specified in FW22.

• **FWMS00**. This alternative was formulated to evaluate the effects of a 17.5 kcfs spring rise (to be achieved on average once every three years) coupled with release of 28.5 kcfs at Gavins Point throughout the navigation season.

• **FWMS16**. This alternative is identical to FWMS00, but includes the effects of 1.6 million acre feet (MAF) depletion from the basin.

• **MODC00**. This alternative is similar to CWCP, but delays fall evacuation of the reservoirs (when possible) until after September 15 at Kansas City.

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Flynn, K. M., P. R. Hummel, A. M. Lumb, J. L. Kittle, Jr. 1995. User's manual for ANNIE, version 2, a computer program for interactive hydrologic data management, WRI 95-4085, p. 211.

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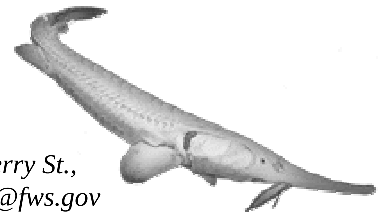
Searching for the Elusive Pallid Sturgeon in the Missouri River



Joanne Grady and Louise Mauldin
U.S. Fish & Wildlife Service, Columbia Fishery Resources Office, 608 E. Cherry St., Room 200, Columbia, MO 65201; joanne_grady@fws.gov & louise_mauldin@fws.gov

The pallid sturgeon (*Scaphirhynchus albus*) was first recognized as a species by Forbes and Richardson in 1905 and was listed as an endangered species in 1990. The pallid sturgeon is an ancient fish species that evolved in turbid, free-flowing large rivers with braided channels, sandbars and extensive backwater habitats. The Missouri and Mississippi Rivers historically provided these habitats. Threats to the species include habitat alteration, modifications to the rivers' natural hydrograph, and hybridization with the shovelnose sturgeon (*S. platorynchus*).

The Columbia Fishery Resources Office (CFRO) has been working for the last five years to document the occurrence and habitat preferences of pallid sturgeon in the lower Missouri River. Our work has included a large-scale multi-state project to identify pallid sturgeon habitats and gear selectivity, a smaller site-specific project to identify seasonal habitat use and potential project impacts, and ongoing monitoring to document benefits of restored riverine habitats to pallid sturgeon.

CFRO worked with Nebraska Game and Parks Commission, Iowa Department of Natural Resources, Missouri Department of Conservation, and Southern Illinois University on a large-scale cooperative effort to sample pallid sturgeon in the Lower Missouri and Middle Mississippi Rivers from 1996 through 2000. Sturgeon were last extensively sampled in the lower Missouri and middle Mississippi Rivers in the late 1970s (Carlson et al. 1985). In the recently completed study, sampling crews targeted river reaches in which historic pallid sturgeon catches were noted, or in which juvenile pallid sturgeon stocked by Missouri Department of Conservation's Blind Pony Hatchery were recaptured. Efforts were made to standardize sampling gear across habitats. The majority of sturgeon species were caught in gill nets or trammel nets. Seven presumed wild origin and two recaptured hatchery pallid sturgeon were collected in the Lower Missouri River. Eleven hatchery reared pallid sturgeon and two presumed wild origin fish were collected in the Middle Mississippi River. The ratio of wild pallid sturgeon to all river sturgeon collected dropped from 1 in 398 (0.25%) collected by Carlson et al (1985) to 1 in 647 (0.15%). Seven pallid-shovelnose hybrids were collected in the Middle Mississippi River while 15 were collected in the Lower Missouri River. The rate of hybridization increased from 1 in 365 (0.27%) in the late 1970s (Carlson et al. 1985) to 1 in 235 (0.42%) in the 1990s. The documented decline in pallid sturgeon numbers coupled with the increased hybridization rate indicate a need to step up efforts to benefit the species.

CFRO conducted extensive sturgeon monitoring work for the Missouri Department of Transportation (MoDOT) near Hermann, Missouri. MoDOT is preparing to replace the current narrow Highway 19 bridge that crosses the Missouri River. As part of the planning process, MoDOT must conduct an environmental species review to determine if their actions will have an impact on threatened or endangered species. Because CFRO had previously found pallid sturgeon within the project vicinity, MoDOT was required to determine if their actions would impact the pallid sturgeon. We monitored the Missouri River two miles above and below the current bridge alignment for 14 months. We collected 3,017 fish in 8,525 hours of sampling effort. Three of these were pallid sturgeon and 14 were pallid sturgeon-shovelnose sturgeon hybrids. Both the pallid sturgeon and their hybrids were collected in cooler temperatures between November and May. They were located in deeper water behind or between wing dikes; the only areas providing a diversity of habitat in this river reach. Initial recommendations were made to MoDOT to minimize potential impacts to the pallid sturgeon. CFRO will continue to work with MoDOT throughout the bridge construction process.

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Searching for the Elusive Pallid Sturgeon (continued from page 4)

The first documented evidence of natural reproduction of the species in the lower Missouri River was collected in August 1998. We collected three larval pallid sturgeon in an ongoing monitoring study of the Lisbon Bottoms Unit of the Big Muddy National Fish & Wildlife Refuge on the lower Missouri River. A total of 44 larval sturgeon were collected from 1997-2000 in a 7-mile stretch (RM 213-219) of the Missouri River. Three larval sturgeon were identified as pallid sturgeon, three as shovelnose sturgeon, 31 as *Scaphirhynchus* spp., and seven were tentatively identified as pallid sturgeon. The pallid sturgeon were caught in Lisbon Chute (RM217), a 2-mile naturally formed side channel of the lower Missouri River. The Lisbon Chute possesses a diversity of backwater habitats, including point and mid-channel sandbars. Two of the larval pallid sturgeon were collected over a soft detritus substrate while the third was collected over a sand/gravel substrate. The pallid sturgeon were caught at depths ranging from 0.92 m-3.97 m. with bottom velocities of 0.30-0.43 m/s.

Most of our pallid sturgeon sampling has been paired with detailed bathymetric survey work conducted by the USGS—Columbia Environmental Research Center. Large volumes of depth, velocity, and substrate data were collected within the vicinity of our sampling gear. CFRO and USGS will be working jointly to determine if any trends in habitat use can be identified through a spatial analysis of this data.

Our staff will continue our efforts to provide the information about pallid sturgeon populations needed by Missouri River managers and policy makers over the next several years. We have just begun long-term monitoring of several sites within the Lower Missouri River to document impacts and benefits of Missouri River operations for the U.S. Army Corps of Engineers. This work is being conducted in partnership with the Nebraska Game and Parks Commission, Iowa Department of Natural Resources, and Missouri Department of Conservation. This data is an important component of the decision making process regarding modifications to Missouri River operations, mitigation site development, habitat restoration, and land acquisition.

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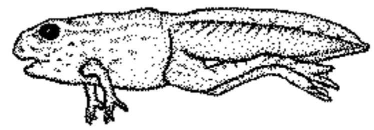
Announcements

❖ There will be a Systematics Symposium at the Missouri Botanical Garden on Oct. 14-15 focusing on **Invasive Exotics**. The list of speakers, and registration information can be found at: http://www.mobot.org/MOBOT/symposium/welcome.html.

❖ MOSCB's new web site has just been launched. If you have pictures or information to post on our site, please contact the new site manager, Neal Sullivan, at moscb@mizzou.edu or sullivann@missouri.edu. The new web address is http://www.snr.missouri.edu/moscb.

❖The 5th annual "Conservation Forum" will be held at the St. Louis Zoo on October 4 (5-10 pm). Speakers include Jan Salick (Curator of Economic Botany, MoBOT) and Barry Chernoff (Associate Curator and Head, Fishes, Field Museum-Chicago, IL). Registration is free. Box dinners may be purchased for $11. To register or for more information, contact: Patrick Osborne (UMSL) at 314-516-5219 or icte@umsl.edu.

Evaluating the Risk of Chemical Contamination to Amphibian Communities



Michelle D. Boone[1], Christine M. Bridges[1], and Nathan E. Mills[2]
[1]USGS Columbia Environmental Research Center, Columbia, MO; [2]Division of Biological Sciences, University of Missouri, Columbia, MO; mboone@usgs.gov, christine_bridges@usgs.gov, nemee9@mizzou.edu

The traditional saying, "One for the rook, one for the crow, one for to rot, and one for to grow" epitomizes the primal struggle of humans cultivating crops over the last 10,000 years. Insects are a major agricultural nuisance with one out of 70 *officially* recognized as pests for their destruction of over 30% of the food grown for human consumption. Records from 1500 B.C. verify recipes to kill insects, so the attempt of humans to overcome these pests is likely ancient. In agricultural areas like the Midwest, pesticide application is a normal procedure. Many of the pesticides used today are considered relatively benign because they are short-lived, they do not bioaccumulate, and they are believed a minimal threat to wildlife. However, pesticide application typically overlaps with the breeding season of many fall-, spring-, and summer-breeding amphibian species. Amphibians in the Midwest that breed opportunistically in temporary wetlands, roadside ditches, or agricultural floodplains may be especially vulnerable to pesticides. Additionally, amphibians that live and breed along the floodplains may be exposed to contaminants from river-flooding.

At the University of Missouri, we have conducted research on the effects of a single insecticide on amphibian life hisotry traits in the lab, field, and semi-natural ponds. We have used the chemical carbaryl (the active ingredient in *Sevin*), a short-lived carbamate insecticide, that may serve as a model contaminant in understanding the effects of field-levels of chemicals in nature, and allow us to make predictions about the effects of other neurotoxins.

Laboratory Studies: All pesticides are federally required to be tested to assess their risk to nontarget wildlife. Most of these tests are conducted in the lab, and certainly lab studies are a necessary starting point to understand how contaminant effects, manifested at the community level, begin. Basic toxicological data like LC50s (lethal concentration of 50% of the population) indicate that concentrations that induce mortality in larval amphibians are often greater than found in the environment, and suggests that amphibians may be less sensitive than fish species. Vulnerability to lethal levels of carbaryl, however, varies widely among species and populations, and tadpoles most sensitive to high levels of carbaryl appear to be less fit under natural field conditions. Because expected environmental concentrations (EECs) are normally much lower, the effects of sublethal concentrations may be more relevant to amphibians. For example, tadpoles show reduced swimming abilities and activity levels at sublethal exposures to carbaryl. This study suggested that tadpoles may be less able to escape predators and may be smaller when they metamorphose because of reduced feeding during part of their development. Other studies have shown that carbaryl-exposed tadpoles also exhibit non-adaptive predator avoidance responses, which can alter predator-prey dynamics. Additionally, when tadpoles are chronically exposed to concentrations of carbaryl that are an order of magnitude lower than EECs, there is still a dramatic increase in mortality and a high incidence in deformities. Results from many laboratory studies indicate that even short-term chemical exposure early in development could lead to effects that outlive the chemical and negatively impact responses beyond the larval stage or metamorphosis.

Field Studies in Cattle Tank Ponds and Experimental Wetlands: Because amphibians in more complex systems may be affected by contaminants differently than individuals reared in controlled laboratory conditions, it is necessary to determine if predicted effects in the laboratory transpire to the field. Outdoor cattle tank studies demonstrate that short-lived contaminants at EECs can impact mass, time, and survival to metamorphosis, although sometimes in unexpected ways. For instance, the biotic environment can influence the potency of carbaryl; carbaryl's effect changes with the predator environment and initial larval density.

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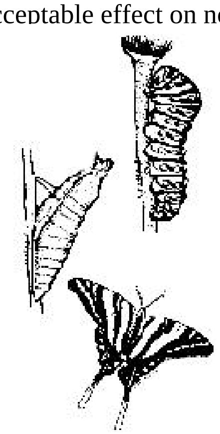
Evaluating the Risk of Chemical Contamination (continued from page 7)

In one case, more Woodhouse's toads (*Bufo woodhousii*) survived to metamorphosis at high density when exposed to carbaryl, than in low density or control environments. In a study considering the effects of multiple doses of carbaryl, exposure to carbaryl three times enhanced survival and size at metamorphosis under high density conditions; these results suggested that carbaryl may affect metamorphosis by stimulating stress hormones, as well as acting through the food chain. Even in large experimental wetlands, which include a range of factors typically excluded in cattle tank studies, a short-lived contaminant can alter amphibian abundance and mass at metamorphosis; effects in the field were similar to those in cattle tank studies. While laboratory studies predicted reduced mass or survival from EECs of carbaryl, field studies often indicate that carbaryl has stimulatory effects on these responses. Therefore, laboratory work was not necessarily predictive of the response of amphibians in the field.

In a community, carbaryl can directly alter a species' behavior/physiology or indirectly alter the biotic community (which could account for "positive" chemical effects). Studies designed to distinguish indirect and direct effects of carbaryl indicate that, in the field, the direct effects of carbaryl on metamorphosis were small to nonexistent. Effects on metamorphosis in response to carbaryl-induced changes in the aquatic community (i.e., indirect effects) were much greater. For example, even when tadpoles were not exposed to carbaryl, spring peeper (*Pseudacris crucificer*) and southern leopard frog (*Rana sphenocephala*) tadpoles grew faster and were larger at metamorphosis when raised in communities previously exposed to carbaryl, even though survival did not vary. Indirect effects (via effects on phytoplankton and zooplankton) were far more important in influencing responses of anurans at metamorphosis, and this outcome emphasizes the significance of understanding the effects of a contaminant in more realistic and complex conditions.

In conclusion, by studying the effects of carbaryl on amphibians in the laboratory, field, and semi-natural ponds, we are developing a good understanding of how this broad-spectrum insecticide could affect amphibian communities in nature. Our results suggest that despite its short half-life (hours to days in our studies), carbaryl can directly affect behavior at EECs, and carbaryl can alter the food web of the community resulting in changes in species abundance, and size and time to metamorphosis. Our studies demonstrate the importance of incorporating genetic variation, biological realism, and realistic exposures in discerning how contaminants affect community processes. This our work illustrates even a short-lived contaminant may alter the structure of amphibian communities by direct or indirect effects on individual species at environmentally relevant levels. When a chemical affects community processes, by altering abundance in an apparent positive way, we must ask ourselves if this is something to be concerned about, particularly in light of potential reduction in fitness. The ecological answer to this conundrum may be that a no effect level is the only acceptable effect on non-target populations.



"….A clean environment is human right like any other. It is therefore part of our responsibility towards others to ensure that the world we pass on is as healthy, if not healthier, than when we found it. This is not is not quite such a difficult proposition as it might sound. For although there is a limit to what we as individuals can do, there is no limit to what a universal response might achieve. It is up to us as individuals to do what we can, however little that may be. Just because switching off the light on leaving the room seems inconsequential, it does not mean that we should not do it." The Dalai Lama, Freedom in Exile 1990

The Glade
attn: Michelle Boone
4200 New Haven Road
Columbia, MO 65201

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 **new** MOSCB web page for more detailed information (http://www.snr.missouri.edu/moscb).

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